International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

Report ITU-R BT.2247-2
(06/2013)

Field measurement and analysis of compatibility between DTTB and IMT

BT Series

Broadcasting service (television)

International Telecommunication Union

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from http://www.itu.int/ITU-R/go/patents/en where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

Series of ITU-R Reports

(Also available online at http://www.itu.int/publ/R-REP/en)

Series	Title
BO	Satellite delivery
BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
BT	**Broadcasting service (television)**
F	Fixed service
M	Mobile, radiodetermination, amateur and related satellite services
P	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management

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

Electronic Publication
Geneva, 2013

© ITU 2013

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without written permission of ITU.

REPORT ITU-R BT.2247-2

Field measurement and analysis of compatibility between DTTB and IMT

(2011-2012-2013)

Within many administrations consideration is being given to the entry of mobile services into the UHF band previously allocated primarily to terrestrial analogue and digital television services.

Entry of mobile services gives rise to assessment of compatibility of globally harmonized IMT applications and DTTB.

Regulatory agencies and broadcasting organizations have been seeking guidelines from ITU-R as the basis for spectrum planning to aid with the replanning of the bands previously allocated primarily to terrestrial analogue and digital television services.

Within many administrations the planning of digital terrestrial television services has been determined in the bands allocated to broadcasting based on clearly designed spectrum planning principles largely based upon protection of a minimum median field strength for all services.

Working Party 6A has been advised planning of mobile network deployments depends on mobile network operators.

Toward establishing a series of spectrum that planning procedures for determining compatibility between broadcast service and mobile network planning, guidance is sought by broadcasting organizations on the level of interference within a geographic area.

This Report contains national case studies which cannot be generalized:

– Part A – Field study of compatibility between DVB-T and UMTS.

– Part B – Study on interference between ISDB-T and IMT in the 700 MHz band.

Part A

Field study of compatibility between DVB-T and UMTS

TABLE OF CONTENTS

Page

Chapter 1

Detailed results of field study of compatibility between DVB-T and UMTS

1 Introduction

This Report describes a field study undertaken jointly by EBU and Free TV Australia in August 2008 making use of the existing UMTS (WCDMA) network in Australia in the 850 MHz band. The study aimed to carry out real tests of compatibility between DVB T reception on one side and UMTS base station and mobile terminal transmissions on the other side.

This study considered the potential impact on European and Australian DVB T receivers from UMTS base station and mobile terminal transmissions. It provides observations on the existing protection ratios of a panel of DTTB receivers assessed using the test method described in Recommendation ITU R BT.1368-7 (Annex 6, Test methods for protection ratio measurements for wanted digital terrestrial signals).

The location chosen for the survey was within the western suburbs of Sydney, given its undulating topography, likely symmetrical geographic UMTS cell size and likelihood of network presence. Measurements were also done in the city of Sydney and on the fringe of the city across Sydney harbour in North Sydney in order to consider the case of urban environment.

The objectives of the study were:

a) to assess the protection requirements between a UMTS transmission from a base station as an adjacent or image channel to the channel used for DVB T reception employing an external TV receive antenna (10 m a.g.l) or a portable receiving antenna (1.5 m a.g.l);

b) to assess the protection requirements between a UMTS transmission from a mobile terminal as an adjacent or image to the channel used for DVB T reception employing an external TV receive antenna (10 m a.g.l) or a portable indoor receiving antenna (1.5 m a.g.l).

Intended audiences of this study are Regulators, Telcos and Broadcasters. It provides information about the possible interference between the mobile service using UMTS and the Broadcasting service using DVB-T in the context of the use of adjacent channels. The report provides also indications about the possible measures to avoid or at least reduce sufficiently the risk of interference from UMTS into DVB-T. To be noted that one of these measures is related to the channel arrangements for IMT. The normal channel arrangements are to assign the uplink in the lower frequency allocation and the downlink in the upper frequency. In Europe, the ECC took a decision to reverse these channel arrangements.

2 Findings and proposals

Objective A − to assess the protection requirements between a UMTS transmission from a base station as an adjacent or image channel to the channel used for DVB-T reception employing an external TV receive antenna (10 m a.g.l) or a portable receiving antenna (1.5 m a.g.l).

Main outcome

The field measurements on real UMTS base stations operating in the UHF band have shown that levels as high as −14 dBm of UMTS signal can be received at the DTTB set-top boxes through the roof top antenna, from base stations transmitting at 40 W e.i.r.p. These levels approach the overloading threshold of the DTTB receiver. They were measured at distances representative of real situations between UMTS base stations and DVB-T receiving antennas. Furthermore, the concerned UMTS base stations use slant polarization which excludes the use of cross-polarization to mitigate the possible interference.

The measured levels and the compatibility tests made in this study show that the adjacent channel interference is a real issue that should be considered when implementing a mobile network in an area covered by an adjacent broadcasting channel. A set of measures is proposed here in order to ensure the protection of the broadcasting service from possible interference of UMTS base station.

General measures

- To reduce the out-of-band radiated signal spectrum of the base station. A possible target for compliance to reduce the out-of-band impact is at least the spectrum mask for sensitive cases as defined in the ETSI EN 300 744 V1.6.1 (2008-09) for the 8 MHz variant and AS4599 (Australian DTTB transmission standard) for the 7 MHz variant.
- To implement a guardband of 1 to 5 MHz between the wanted DVB-T channel and the mobile service channel from the base station. Such a guardband helps reduce the number of possible interference cases. However its implementation might have an impact on, i.e. offsetting, the channelling raster of the mobile service and would have to be taken into consideration as early as possible in the process of defining the planned channel raster for the mobile service.

Particular measures as interference mitigation techniques

- Use of cross-polarization between the mobile service signal and the broadcasting signal received in fixed reception mode.
- Reduction of the e.i.r.p. of the mobile service base station. The level of the required limitation depends on the wanted broadcasting signal characteristics to be protected and on the guardband implemented in the general measures (a higher guardband allows for less restriction on e.i.r.p.).

The measurements and the corresponding analysis in this study suggest the following order of magnitude: with a reduced level of out-of-band emissions, a 5 MHz guardband and cross-polarization, the e.i.r.p of the base station could be as high as 400 W (56 dBm) in the interior of the broadcasting coverage area (wanted level at receiver input of −60 dBm) but may have to be limited to 3 W (35 dBm) at the edge of the broadcasting coverage area.

For the image channel case, i.e. mobile service downlink channel being the image frequency of the broadcasting channel (that is N+9 or N+10 depending on the channel bandwidth), there is no effect of reducing the out-of-band emission level or of implementing a guardband. However, using cross-polarization and reducing the e.i.r.p. level improve the protection.

If there are still cases of interference in the adjacent or image channel to the broadcasting service, further mitigation techniques could be used to solve the remaining cases:

- Installing rejecting filters on the fixed broadcast reception installations which are subject to interference. When relevant, this helps to avoid the possible overload of the DVB-T receiver input or any wideband broadcast antenna amplifier used in the receiving installation.
- Increasing the power of DVB-T transmitters to increase the wanted field strength. Alternatively, installing additional in-fill DVB-T transmitter(s) to cover the area concerned.

With regard to the specific case of impact of the mobile service downlink on portable DVB-T reception, further investigations and tests would be needed.

Objective B – to assess the protection requirements between a UMTS transmission from a mobile terminal as an adjacent or image to the channel used for DVB-T reception employing an external TV receive antenna (10 m a.g.l) or a portable indoor receiving antenna (1.5 m a.g.l).

Main outcome

One major parameter in this configuration is the actual transmit power of the mobile phone. The measurements made with one real UMTS mobile phone and one HSDPA data card operating in the UHF band have shown that the mobile transmit power varies considerably depending on the network configuration (density of the base stations) and the location of the mobile device in the network coverage area. The levels measured in Sydney suburbs and in the City range from −11 to −48 dBm.

In a dense network of small base stations implemented in a suburban area, the mobile phone transmit power seems to be kept at a low average level as the link budget does not require high transmit power. It was observed during the measurement that when the downlink signal at one location is weakly received, the respective uplink signal is often bursty. It is believed that the TPC is activated under a weak downlink environment. When a data/voice call is first initiated, an extremely high impulsive uplink signal can be observed. The network is then endeavoured to manipulate the TPC in order to reduce the uplink signal as the call is established. However, intermittent bursts can still be observed throughout the call. As could be expected, the average transmit power of the mobile terminal is higher in an upload session than in a download session and it can almost reach the maximum transmit power (according to specifications, i.e. 21 dBm).

Interference on portable indoor DVB-T reception from real UMTS mobile phone with insufficient guardband has been shown and recorded on video[1].

From the observed interference conditions during testing, our preliminary finding is that, taking into account the protection of both fixed and portable indoor reception of DVB-T from the UMTS uplink, a guardband[2] of 7 MHz would be suitable if the wanted DVB-T signal is at −60 dBm or higher, in all the UMTS cell coverage area. If the DVB-T signal is lower, like near the edge of the coverage area, a guardband of up to 21 MHz would be required.

The use of reversed FDD duplex (uplink in the upper part and downlink in the lower part) in the band above 790 MHz is a good measure to ensure a sufficient separation between the highest broadcasting channel below 790 MHz and the lowest uplink channel in the band above 790 MHz band.

With regard to possible image channel interference, there might be cases of interference on some types of receivers when receiving low wanted signal levels. Installation of image channel rejection filters at the victim receiver side could be the ultimate solution to solve these possible cases of interference.

Where to consider these findings?

This analysis provides insights into one case of compatibility based upon the UMTS network design, base station architectural structures and cellular service characteristics in one country.

Entry of mobile services into the band above 790 MHz is an issue being considered within many administrations and the results of studies in other administrations could give rise to assessment of compatibility of globally harmonized UMTS applications and DVB-T. The collaborators of this study would encourage ITU-R to call for more studies on this topic so that the globally harmonized compatibility can be realized not only from the theoretical studies but from actual UMTS and DTTB deployments across the regions.

---

1 These videos are available upon request to EBU.

2 Guardband: frequency separation between the upper edge of one service and the lower edge of another service to achieve frequency planning compatibility between these services.

3 Methodology

3.1 Parameters considered for the downlink

Figure 1 shows the spectral configurations between the Telstra NextG downlink signal and the Hutchison[3] downlink signal as well as the DTT channels for both the European and the Australian channel rasters.

A number of parameters and outcomes to be considered in the downlink study are outlined as follows:

a) channel configurations of the wanted and unwanted signals:
   - for the European 8 MHz channel raster: adjacent channel interference and N+9[4] image channel interference;
   - for the Australian 7 MHz channel raster: adjacent channel and N+10[2] image channel interference;

b) DTT reception mode: fixed with roof top antenna and portable;

c) distance between the base station (BS) and the study location (SL). This determines the level of the interfering field strength;

d) input level (dBm) of the UMTS signal at the DTT receiver. It was verified that the measuring equipment allows for measuring the average power in the concerned UMTS channel;

e) input level (dBm) of the DTT signal at the DTT receiver;

f) interference on the DTT received signal (observe via displayed picture) based on Recommendation ITU-R BT.1368-6 Annex 6 for subjective failure point (SFP) method for protection ratio measurements[5].

3.2 Parameters considered for the uplink

Figure 2 shows the spectral configurations between the Telstra NextG uplink signal and the Hutchison[6] uplink signal as well as the DTT channels for both the European and the Australian channel rasters.

A number of parameters and outcomes considered in the uplink study are outlined as follows:

a) channel configuration of the wanted and unwanted signals:
   - for the European 8 MHz channel raster: adjacent channel interference and N+9 image channel interference;

---

[3] While Hutchison has the spectrum licence of 870-880 MHz band, to date its 3G network does not appear to operate in this band.

[4] Image channel interference usually occurs at frequency around 70 MHz to 74 MHz above the desired carrier, therefore it can be perceived at 9 channels (9 × 8 = 72 MHz) above carrier for 8 MHz channel raster whereas at 10 channels (10 × 7 = 70 MHz) above carrier for 7 MHz channel raster.

[5] Recommendation ITU-R BT.1368-6 Annex 6 stated that "the subjective failure point method corresponds to the picture quality where no more than one error is visible in the picture for an average observation time of 20 seconds".

[6] While Hutchison has the spectrum licence of 825-835 MHz band, to date its 3G network does not appear to operate on this band.

– for the Australian 7 MHz channel raster: adjacent channel and N+10 image channel interference;

b) DTT reception mode: fixed with roof top antenna and portable indoor;

c) distance between the base station (BS) and the study location (SL). It was anticipated that TPC may work more effectively (higher dynamic range of the transmit signal variation) when the mobile phone is close to the edge of the cell coverage area;

d) mode of the mobile phone: on-call, file download and file upload;

e) distance between the mobile phone and the receiving antenna;

f) input level (dBm) of the UMTS signal at the DTT receiver. It was verified that the measuring equipment allowed for measuring the average power in the concerned UMTS channel;

g) input level (dBm) of the DTT signal at the DTT receiver;

h) interference on the DTT received signal (observe via displayed picture) based on Recommendation ITU-R BT.1368-6 Annex 6 for subjective failure point (SFP) method for protection ratio measurements[6].

3.3 Outdoor measurement procedures

This section outlines the necessary procedures to obtain the required measurements as illustrated in Fig. 3.

3.3.1 Measurements for downlink study

Based on the outcome of an initial selection, the measurements at the selected locations for downlink study required the following procedures:

a) measure the UMTS channel power received with the 10 m mast and with co-polarization between the DTT receiving antenna and the UMTS BS antenna;

b) capture the signal and store it[7];

c) measure with cross-polarization (if practical), or refer to the antenna characteristics to evaluate the cross-polarization discrimination;

d) repeat steps a) and b) with portable antenna;

e) measure the field strength with a calibrated dipole antenna;

f) capture the signal and store it.

3.3.2 Measurements for uplink study

Based on the outcome of an initial selection, the measurements at the selected locations for uplink study required the following procedures:

a) ensure that the study location perceives reasonably low downlink signal in order to emulate a location at the fringe of coverage cell where TPC is most probably be required to enhance Quality of Service;

b) activate the UMTS handset and measure the UMTS channel power with portable indoor antenna that is located at 1.5 m above ground level and at a distance between 0 m and 2.5 m away from the mobile handset;

c) capture the signal and store it[7].

[7] With the availability of a signal analyser that is capable of digitizing the captured UMTS uplink/downlink signals.

3.4 Indoor analysis procedures

With the availability of a signal analyser that is capable of digitizing the captured UMTS uplink/downlink signals and down-converting the respective signals to a nominated frequency for analyses, both downlink and uplink studies were conducted in a laboratory environment.

3.4.1 Analyses for downlink study − Frequency separation

The captured downlink signals would be regenerated at a relevant frequency for compatibility studies. The required procedures are as follows:

a) measure the total cable losses, x dB, in the configuration as illustrated in the indoor section of Fig. 3;

b) set the captured UMTS downlink signal at $-y$ dBm level such that the effective downlink level is $-(x+y) = M1$ dBm which is to be defined as a first typical level received from the base station on the basis of the outdoor measurements (see § 8.1.2);

c) set DTT signal at $-z$ dBm such that the effective DTT level is $-(x+z) = -80$ dBm, which may deem as the minimum required DTT signal perceived by any set-top boxes;

d) assess picture quality according to Recommendation ITU-R BT.1368-6, Annex 6;

e) if interference occurs as per step d), introduce an adequate guardband between UMTS and DTT by shifting the UMTS signal frequency such that the interference is completely mitigated;

f) further assess picture quality according to Recommendation ITU-R BT.1368-6, Annex 6 by residing UMTS signal frequency to image channel N+10 and N+9 for Australian and European set-top boxes, respectively;

g) repeat steps c) to f) with DTT effective level of −60 dBm;

h) repeat steps b) to g) with UMTS effective downlink signal at $M2$ dBm which is defined as a second typical level received from the base station on the basis of the outdoor measurements (see § 8.1.2).

3.4.2 Analyses for downlink study − Power restriction

The captured downlink signals would be regenerated at a relevant frequency for compatibility studies. The required procedures are as follows:

a) measure the total cable losses, x dB, in the configuration as illustrated in the indoor section of Fig. 3;

b) set DTT signal at $-y$ dBm such that the DTT effective level is $-(x+y) = -80$ dBm, which may deem as the minimum required DTT signal perceived by any set-top boxes;

c) assess picture quality according to Recommendation ITU-R BT.1368-6, Annex 6;

d) reduce UMTS downlink signal level, if interference occurs as per step c), until interference is completely mitigated;

e) repeat steps b) to d) with DTT effective level of −60 dBm;

f) repeat steps b) to e) with resided UMTS signal at:
   - a frequency such that no guardband is used;
   - centre frequencies of immediately adjacent TV channel (i.e. 1 MHz and 1.5 MHz guardband for Australian and European channel rasters);
   - 5 MHz guardband;
   - image channel N+10 and N+9 for Australian and European set-top boxes, respectively.

3.4.3 Analysis for uplink study − Frequency separation

The captured uplink signals were regenerated at a relevant frequency for compatibility studies. The procedures were as follows:

a) measure the total cable losses, x dB, in the configuration as illustrated in the indoor section of Fig. 3;

b) set the captured UMTS uplink signal at $-y$ dBm level such that the effective downlink level is $-(x+y) = M1$ dBm which is to be defined as a first typical level received from the terminal equipment on the basis of the outdoor and indoor measurements (see § 8.2.3);

c) set DTT signal at $-y$ dBm such that the DTT effective level is $-(x+y) = -80$ dBm, which may be deemed as the minimum required DTT signal perceived by any set-top boxes;

d) assess picture quality according to Recommendation ITU-R BT.1368-6, Annex 6;

e) if interference occurs as per step d), introduce an adequate guardband between UMTS and DTT by shifting the UMTS signal frequency such that the interference is completely mitigated;

f) further assess picture quality according to Recommendation ITU-R BT.1368-6, Annex 6 by shifting UMTS signal frequency to image channel N+10 and N+9 for Australian and European set-top boxes, respectively;

g) repeat steps c) to f) with DTT effective level of −60 dBm;

h) repeat steps b) to g) with UMTS effective uplink signals at other levels defined on the basis of the measurements of the uplink signal (see § 8.2.3).

3.4.4 Analysis for uplink study − Power restriction

The captured uplink signals were regenerated at a relevant frequency for compatibility studies. The procedures were as follows:

a) measure the total cable losses, x dB, in the configuration as illustrated in the indoor section of Fig. 3;

b) set DTT signal at $-y$ dBm such that the DTT effective level is $-(x+y) = -80$ dBm, which may be deemed as the minimum required DTT signal perceived by any set-top boxes;

c) assess picture quality according to Recommendation ITU-R BT.1368-6, Annex 6;

d) reduce UMTS uplink signal level, if interference occurs as per step c), until interference is completely mitigated;

e) repeat steps b) to d) with DTT effective level of −60 dBm;

f) repeat steps b) to e) with resided UMTS signal at:
   - a frequency such that no guardband is used;
   - centre frequencies of immediately adjacent TV channel (i.e. 1 MHz and 1.5 MHz guardband for Australian and European channel rasters);
   - 5 MHz guardband;
   - image channel N+10 and N+9 for Australian and European set-top boxes, respectively.

FIGURE 1

UMTS downlink channels

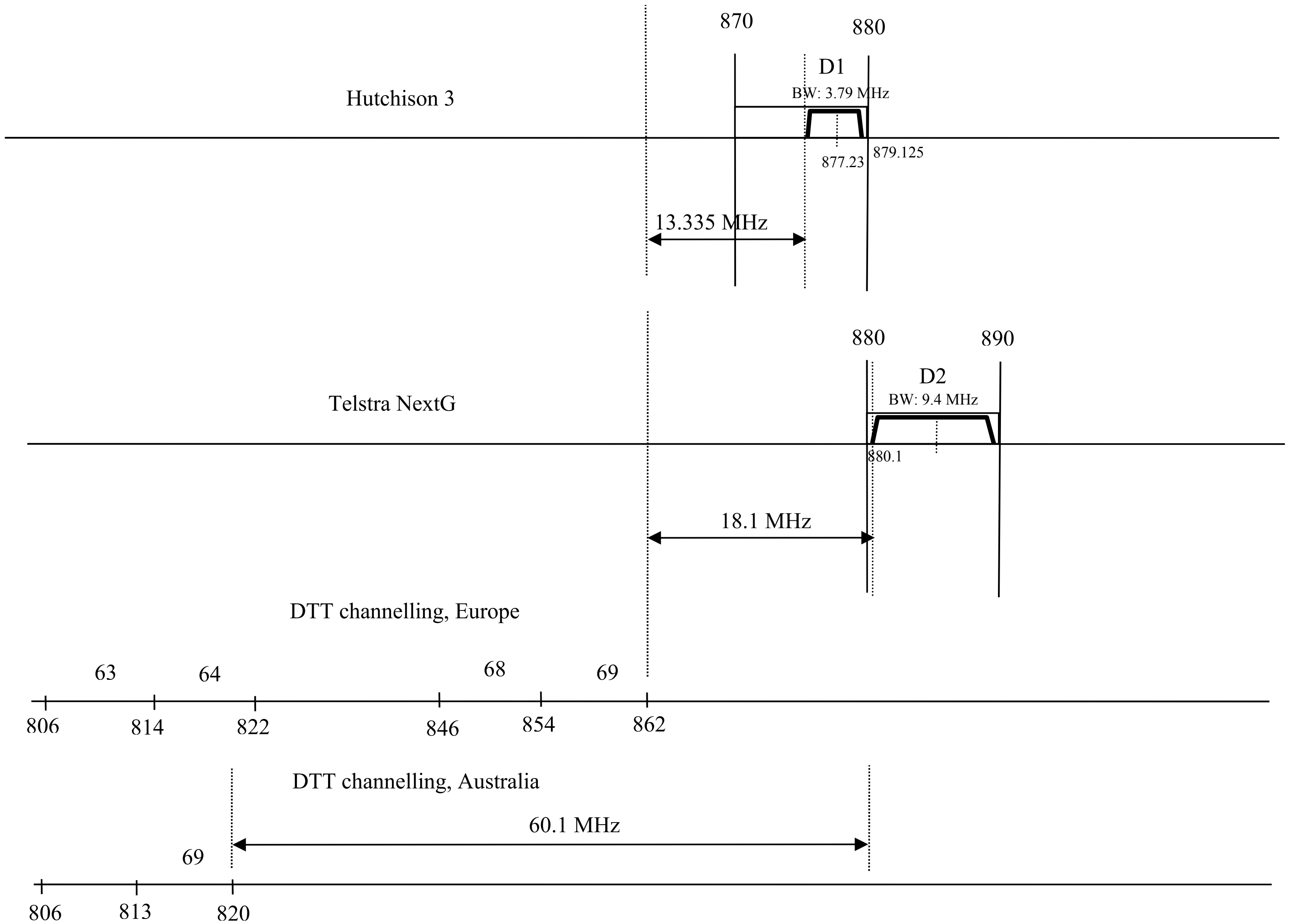


FIGURE 2

UMTS uplink channels

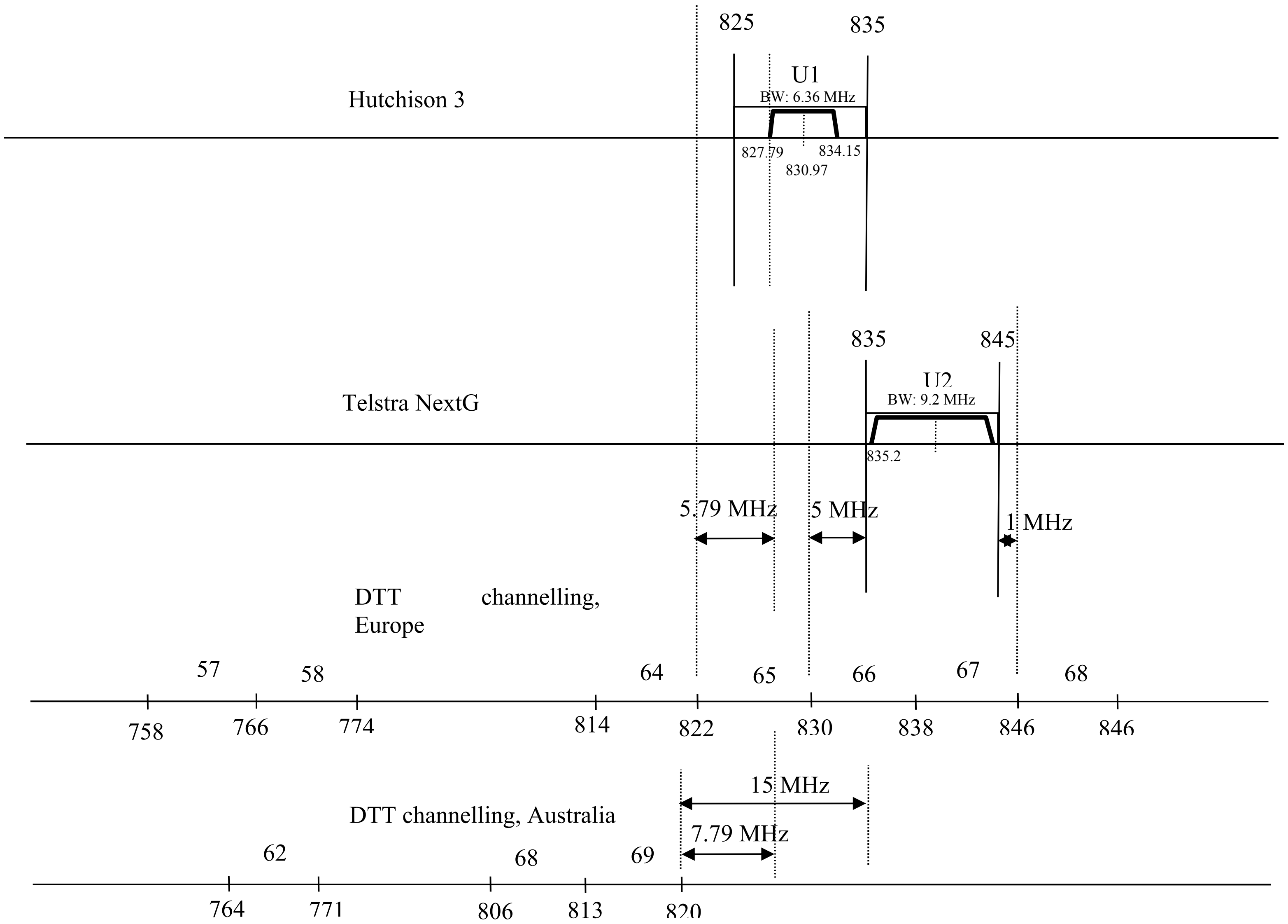
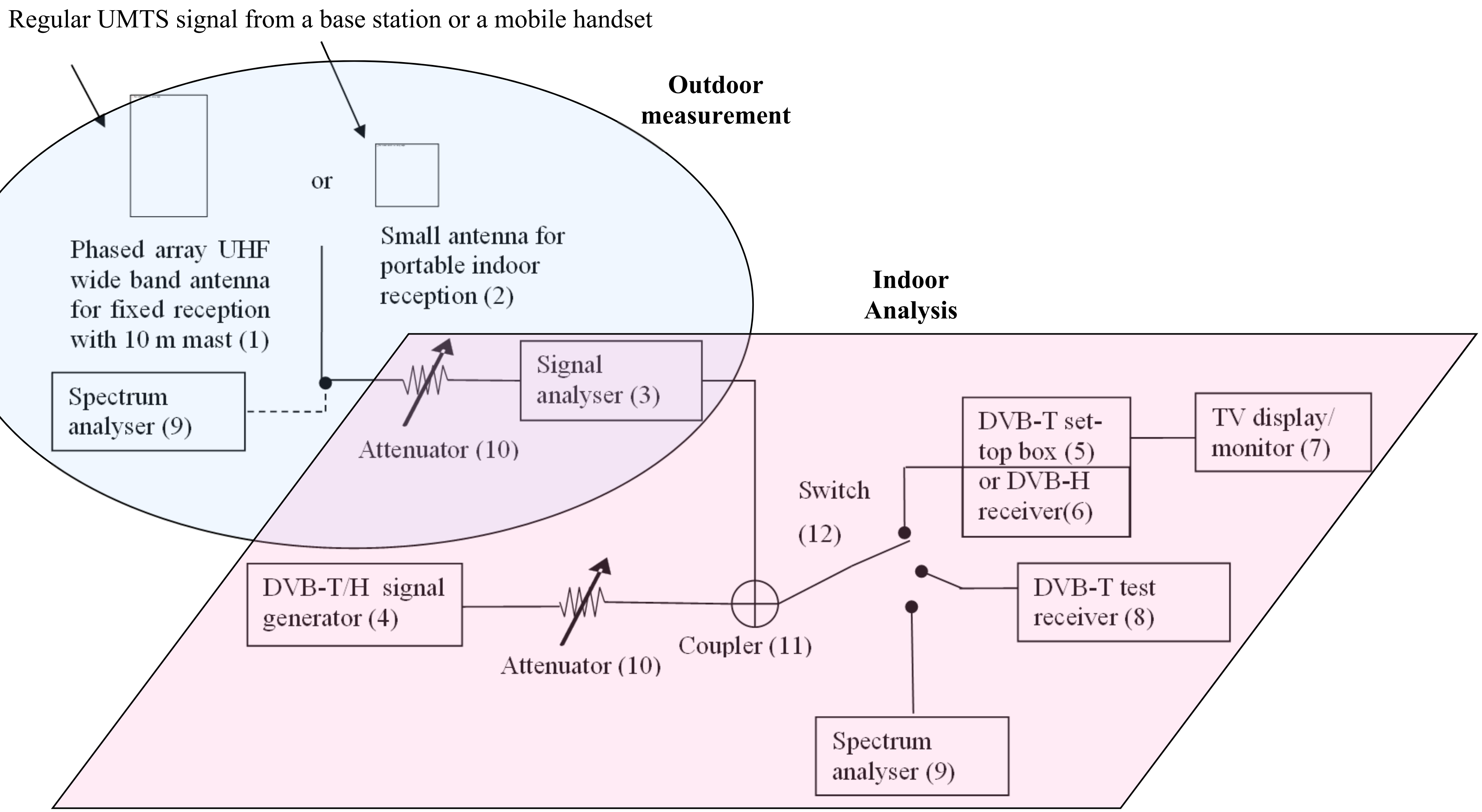


FIGURE 3

Illustration of the measurement procedures



4 Site selection and characteristics

Australia is one of the countries as of today that makes use of the 850 MHz band by one of its UMTS/3G providers, namely Telstra. This provides an implemented UMTS network to perform testing of compatibility between UMTS and DVB-T services that operate, spectrally and/or geographically, in close proximity.

A number of locations in the Sydney metropolitan were selected for this study to cover different granularity of a large population environments. This includes:

a) location within the western suburb of Sydney (see Annex 1) which has an undulating topography that is similar to some typical European low rise suburban area and within adequately good UMTS coverage, i.e.:
   - Mill Place, St Clair (33 47 24.3 S/150 47 37.2 E)
   - Fuller Place, St Clair (33 47 28.6 S/150 48 07.2 E)
   - Japura Place, St Clair (33 47 31.4 S/150 48 17.0 E)
   - Augusta Place, St Clair (33 47 34.8 S/150 48 21.7 E)
   - Mark Leece Sporting Complex, St Clair (33 47 31.5 S/150 47 22.4 E)
   - Gosse Court, St Clair (33 47 31.0 S/150 47 24.0 E)
   - Shepherd Street, Colyton (33 47 22.5 S/150 48 24.5 E)
   - Potter Field, Colyton (33 47 08.2 S/150 47 18.9 E)

b) location within Sydney CBD that emulates a busy city compacted with large number of UMTS base stations located at rooftop of skyscrapers serving a large number of concurrent users, i.e.
   - Margaret Street, Sydney (33 51 52.9 S/151 12 25.4 E)
   - Loftus Street, Sydney (33 51 46.5 S/151 12 36.9 E)
   - Martin Place, Sydney (33 52 06.6 S/151 12 30.4 E)

c) location within high rise residential area in Sydney/North Sydney that emulates the fringe area of a busy CBD but well within good UMTS coverage, i.e.
   - The Rock, Sydney (33 51 14.9 S/151 12 30.2 E)
   - Blue’s Point, North Sydney (33 50 56.9 S/151 12 15.2 E)
   - Miller Street, North Sydney (33 47 24.3 S/150 47 37.2 E)

d) potential residential/commercial location which receives very weak UMTS downlink signal, i.e.
   - Avenue Road, Mosman (33 49 54.7 S/151 14 15.2 E).

It is important to note that the sites outlined above were chosen to observe the signal level or channel power of UMTS uplink/downlink. Only a few among them were selected for the capturing of UMTS uplink or downlink signal.

5 Pre-trial spectrum plot analysis

Based on an initial investigation, the selected study locations were characterized for different tasks outlined as follows:

a) Observation of uplink/downlink signal levels − A quick snapshot of the spectrum chart as picked up by a portable Yagi antenna to observe the signal level of the downlink channels. Separate snapshots were taken when a phone/data call was established via an UMTS mobile handset to observe the signal level of the uplink channels. Sites required for this task are:
   - Margaret Street, Sydney (33 51 52.9 S/151 12 25.4 E)
   - Loftus Street, Sydney (33 51 46.5 S/151 12 36.9 E)
   - Martin Place, Sydney (33 52 06.6 S/151 12 30.4 E)
   - The Rock, Sydney (33 51 14.9 S/151 12 30.2 E)
   - Blue’s Point, North Sydney (33 50 56.9 S/151 12 15.2 E)
   - Miller Street, North Sydney (33 47 24.3 S/150 47 37.2 E)

b) Capture of downlink signals − A wideband UHF phased array antenna mounted at 10 m mast of a field survey vehicle was positioned such that the maximum signal strength from the nearest UMTS base station could be observed via a spectrum analyser. The downlink signal and its spurious emissions were captured and recorded into digitized form for further analysis. Sites selected for this task are:
   - Gosse Court, St Clair (33 47 31.0 S/150 47 24.0 E)
   - Shepherd Street, Colyton (33 47 22.5 S/150 48 24.5 E)
   - Potter Field, Colyton (33 47 08.2 S/150 47 18.9 E)

c) Capture of Uplink Signals − A portable indoor UHF Yagi antenna was positioned in close proximity to an UMTS mobile handset when a voice/data call was established such that the maximum signal strength from the handset could be observed via a spectrum analyser. The uplink signal and its spurious emissions were captured and recorded into digitized form for further analysis. Sites required for this task are:
   - Mill Place, St Clair (33 47 24.3 S/150 47 37.2 E)
   - Avenue Road, Mosman (33 49 54.7 S/151 14 15.2 E)

The plots presented in the following indicate some samples of uplink and/or downlink signal levels as perceived in the selected study locations.

Figure 4 indicates the UMTS uplink and downlink signal levels measured at Margaret Street within Sydney CBD with a portable UHF Yagi antenna. Two downlink channels, centred at 882.2 MHz and 887.2 MHz, were observed at levels approximately −23.8 dBm. The uplink signal, when the mobile broadband card was in operation, was measured at a level approximately −34.5 dBm. It is also noted that a number of GSM signals at levels equal to or higher than the UMTS signals were observed at frequencies above 890 MHz.

FIGURE 4

Spectrum chart at Margaret Street (picked up via portable Yagi antenna)

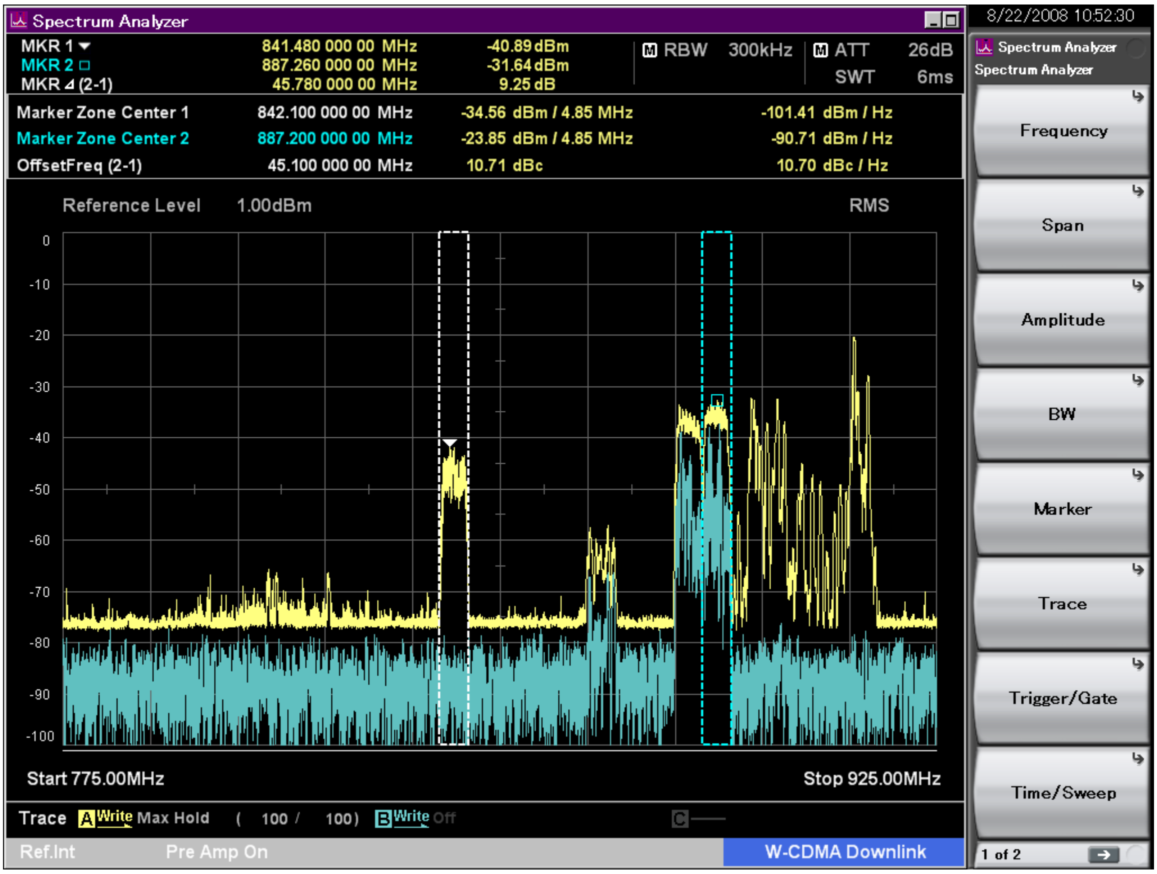


Figure 5 indicates the UMTS uplink and downlink signal levels measured at Loftus Street within Sydney CBD (in close proximity to the Australia Stock Exchange) with a portable UHF Yagi antenna. Two downlink channels, centred at 882.2 MHz and 887.2 MHz, were observed with one at level approximately −24.4 dBm whereas the other was significantly lower at −54 dBm. The uplink signal, when the mobile broadband card was in operation, was measured at a level approximately −32 dBm. It is also noted that a number of GSM signals at levels equal to or higher than the UMTS signals were observed at frequencies above 890 MHz.

FIGURE 5

Spectrum chart at Loftus Street (picked up via portable Yagi antenna)

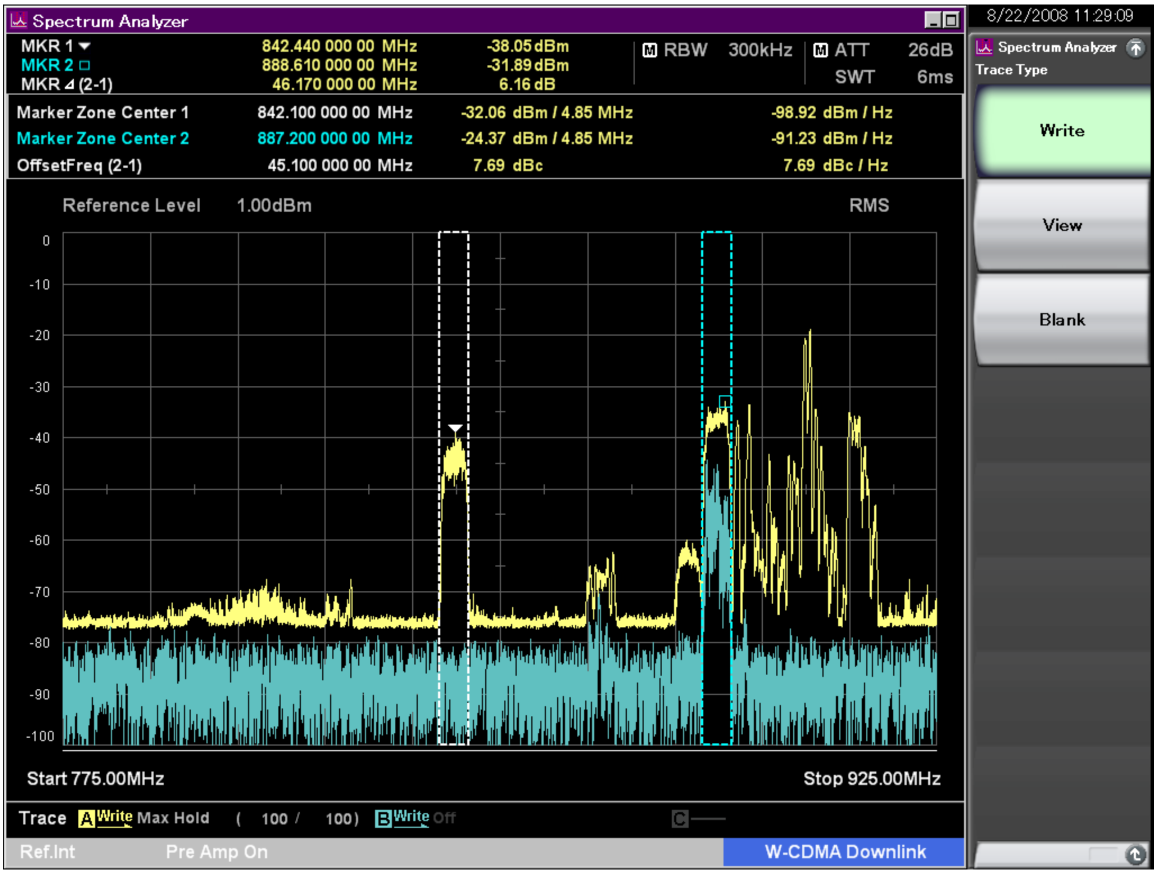


Figure 6 indicates the UMTS uplink and downlink signal levels measured at Martin Place within Sydney CBD (crowded with pedestrians) with a portable UHF Yagi antenna. Two downlink channels, centred at 882.2 MHz and 887.2 MHz, were observed with one at level approximately −38.2 dBm whereas the other was slightly lower at −55 dBm. The uplink signal, when the mobile broadband card was in operation, was measured at a level approximately −23.5 dBm. It is noted that the uplink signal comprised some spurious emissions which was not observed at other Sydney CBD locations, e.g. Margaret Street and Loftus Street. It is also noted that a number of GSM signals at levels equal to or higher than the UMTS downlink signals were observed at frequencies above 890 MHz.

FIGURE 6

Spectrum chart at Martin Place (picked up via portable Yagi antenna)

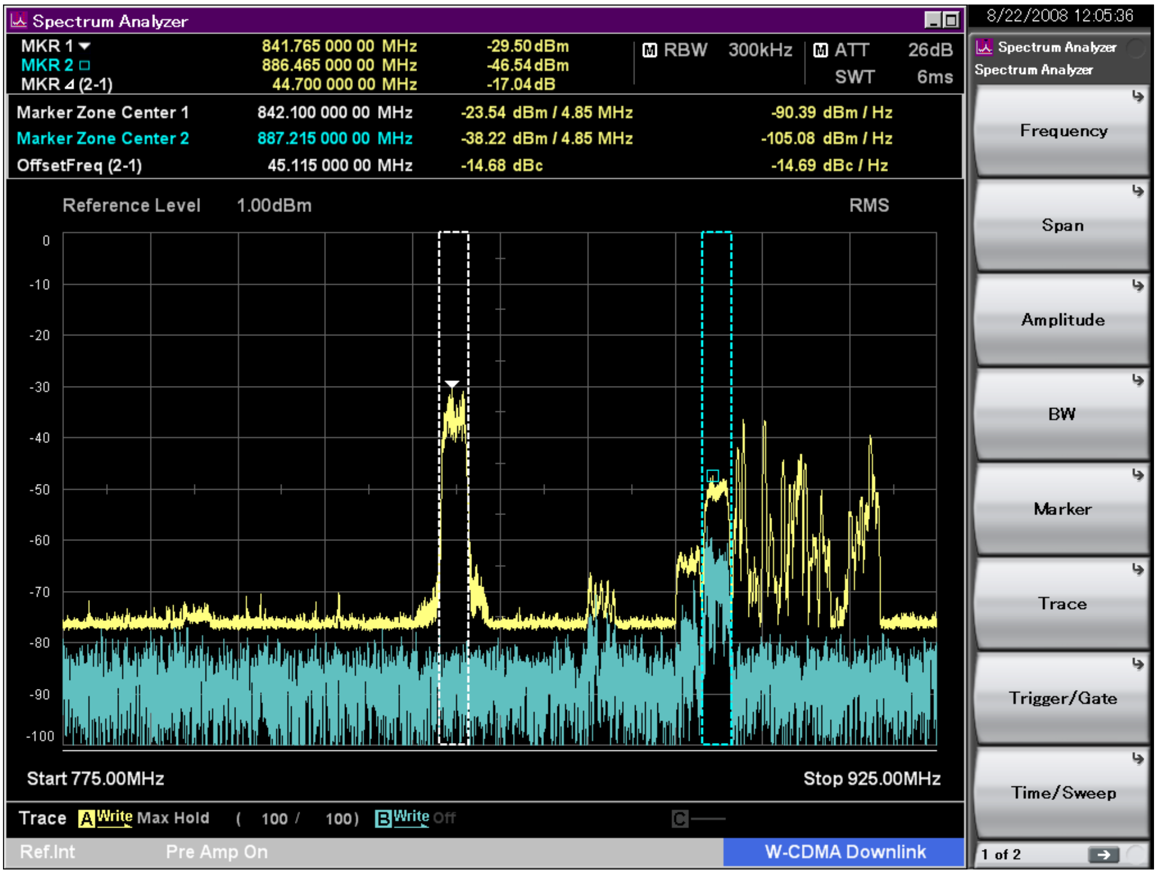


Figure 7 indicates the UMTS uplink and downlink signal levels measured at The Rock (at the fringe of Sydney CBD) with a phased array antenna at 2.5 m height above ground level. Two downlink channels, centred at 882.2 MHz and 887.2 MHz, were observed at levels approximately −60 dBm and −49.7 dBm, respectively. The uplink signal, when the mobile broadband card was in operation, was measured at a level approximately −39.5 dBm. It is noted that this location only perceived a small number of weak GSM signals at frequencies above 890 MHz.

FIGURE 7

Spectrum chart at The Rock (picked up via phased array antenna at 2.5 m height)

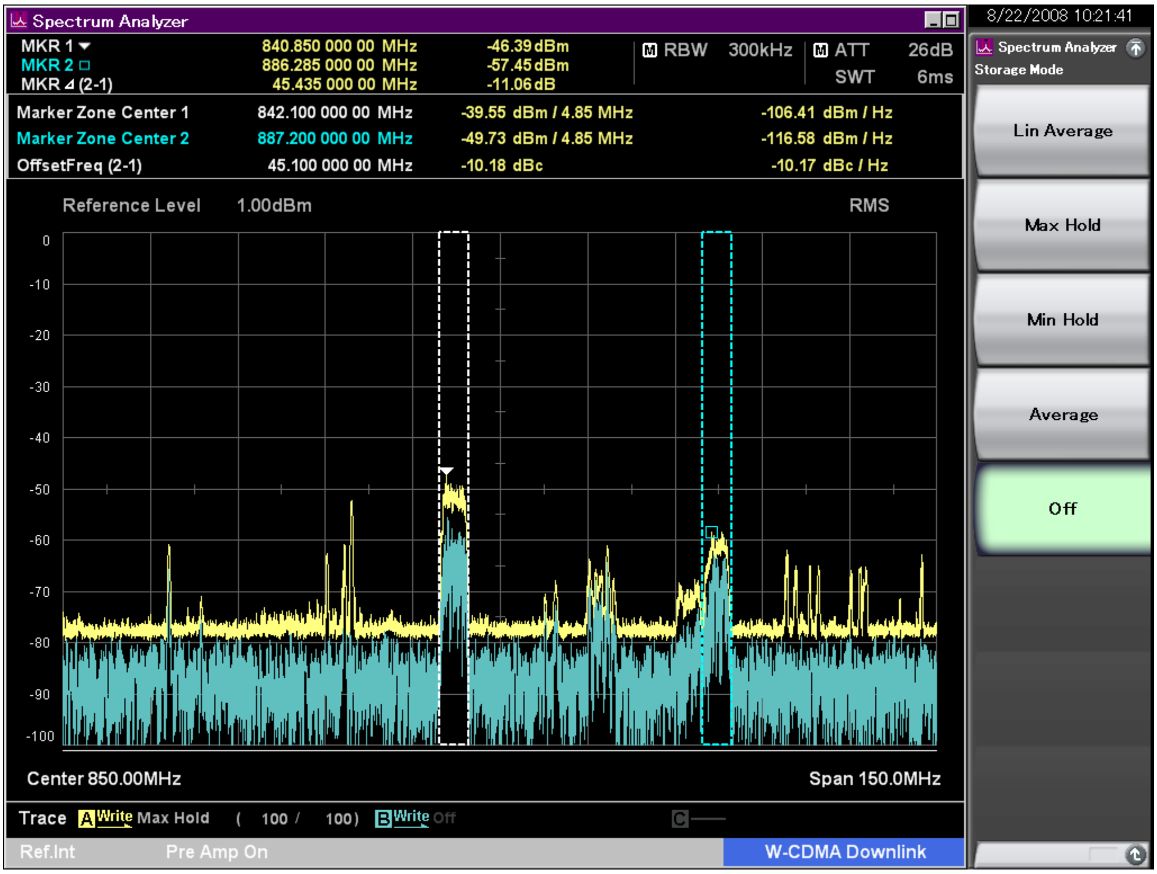


Figure 8 indicates the UMTS uplink and downlink signal levels measured at Blue's Point Reserve with a portable UHF Yagi antenna. Two downlink channels, centred at 882.2 MHz and 887.2 MHz, were observed at levels approximately −43 dBm. The uplink signal, when the mobile broadband card was in operation, was measured at a level approximately −15.7 dBm. It is noted that the uplink signal comprised some spurious emissions which were not observed at Sydney CBD locations, e.g. Margaret Street and Loftus Street. It is also noted that very few GSM signals at frequencies above 890 MHz were observed and they were at levels much higher than the UMTS downlink signals.

FIGURE 8

Spectrum chart at Blue's Point (picked up via portable Yagi antenna)

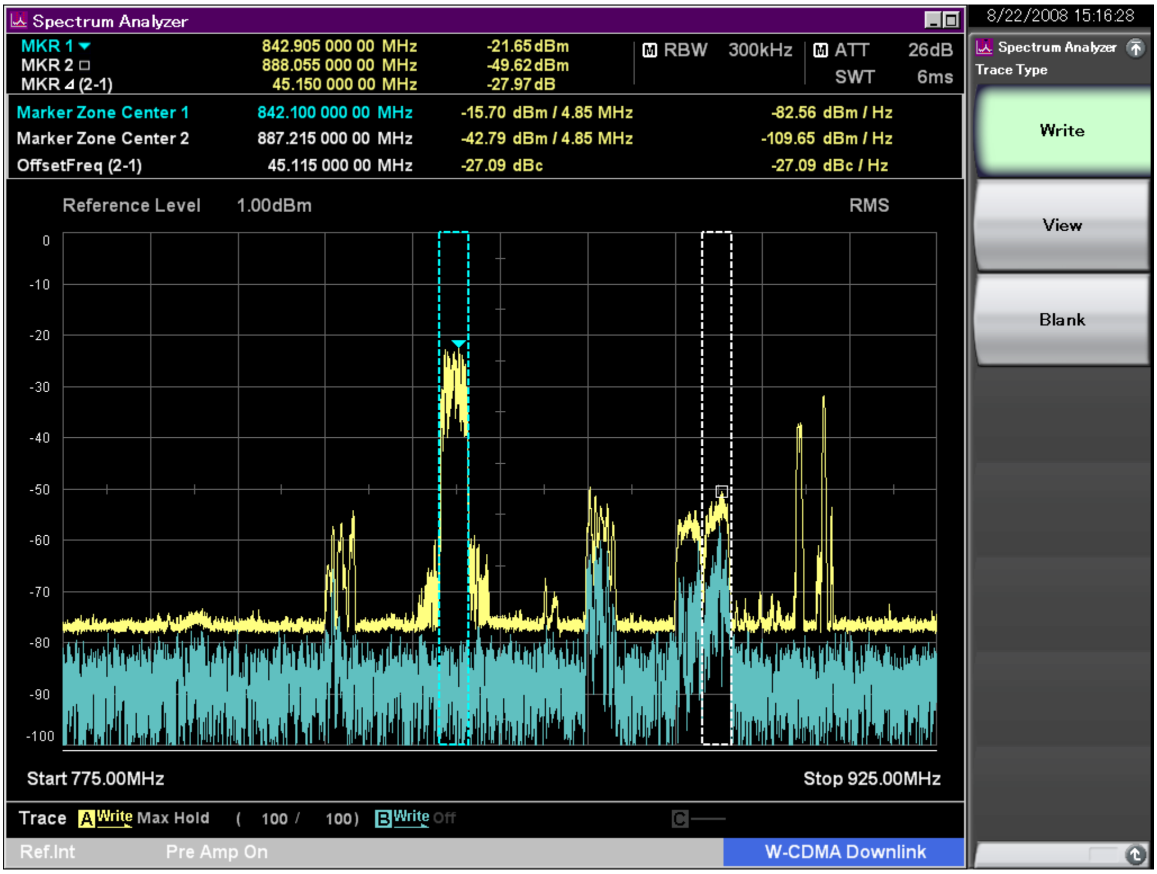


Figure 9 indicates the UMTS uplink and downlink signal levels measured at Miller Street (residential area in North Sydney) with a portable UHF Yagi antenna. One downlink channel centred at 887.2 MHz was observed at level approximately −30.8 dBm. The uplink signal, when the mobile broadband card was in operation, was measured at a level approximately −34.5 dBm. It is noted that frequencies around 790 MHz to 820 MHz were filled up with very weak signals. These signals were analogue TV transmissions at channel 66 (Manly/Mosman TEN service at 792-799 MHz) and possible wireless microphones and/or land mobiles. It is also noted that very few GSM signals at frequencies above 890 MHz were observed and some were at levels equal to or higher than the UMTS downlink signals.

FIGURE 9

Spectrum chart at Miller Street (picked up via portable Yagi antenna)

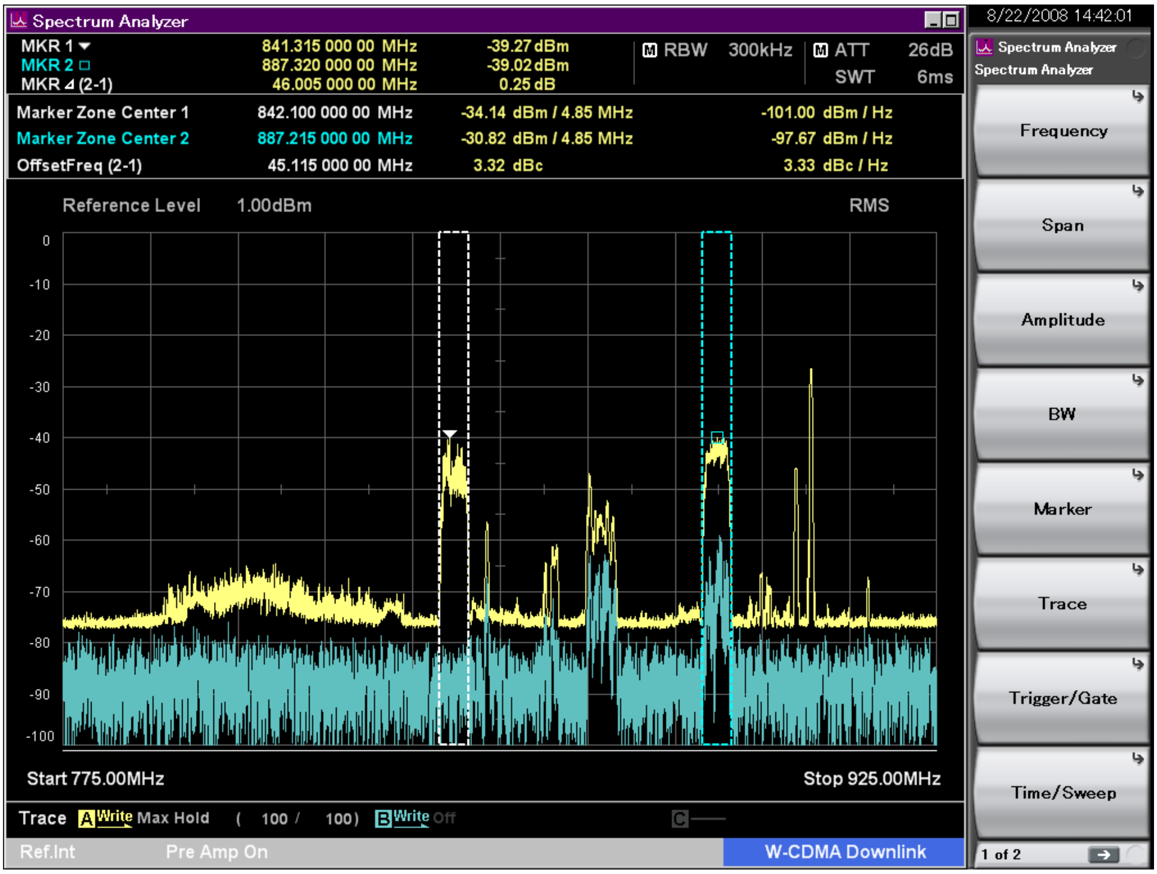


Figure 10 indicates the UMTS downlink signal received at Gosse Court with a UHF phased array antenna mounted on 10 m mast. The signal level was measured at a level approximately −13.8 dBm.

FIGURE 10

Spectrum chart at Gosse Court (picked up via a phased array antenna at 10 m height)

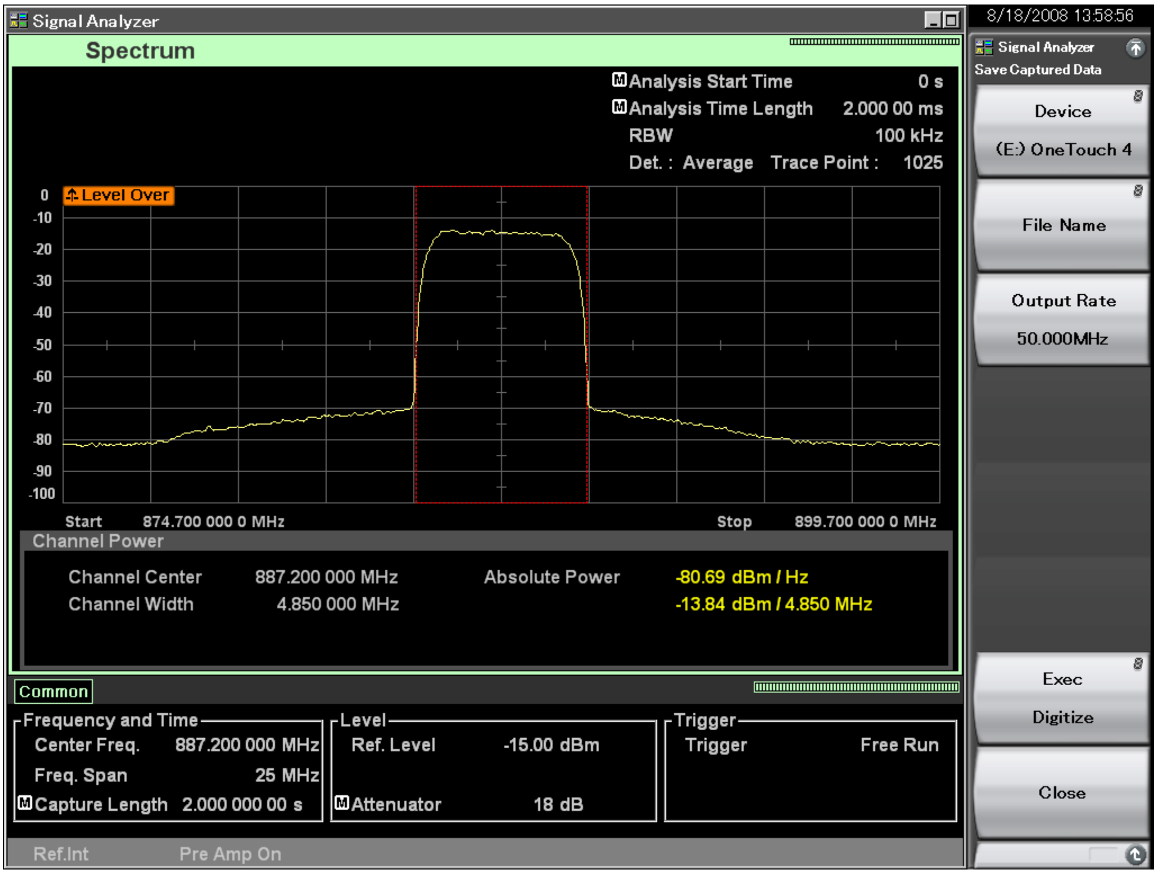


Figure 11 indicates the UMTS downlink signal received at Shepherd Street with a UHF phased array antenna mounted on 10 m mast. The signal level was measured at a level approximately −14.8 dBm.

FIGURE 11

Spectrum chart at Shepherd Street (picked up via a phased array antenna at 10 m height)

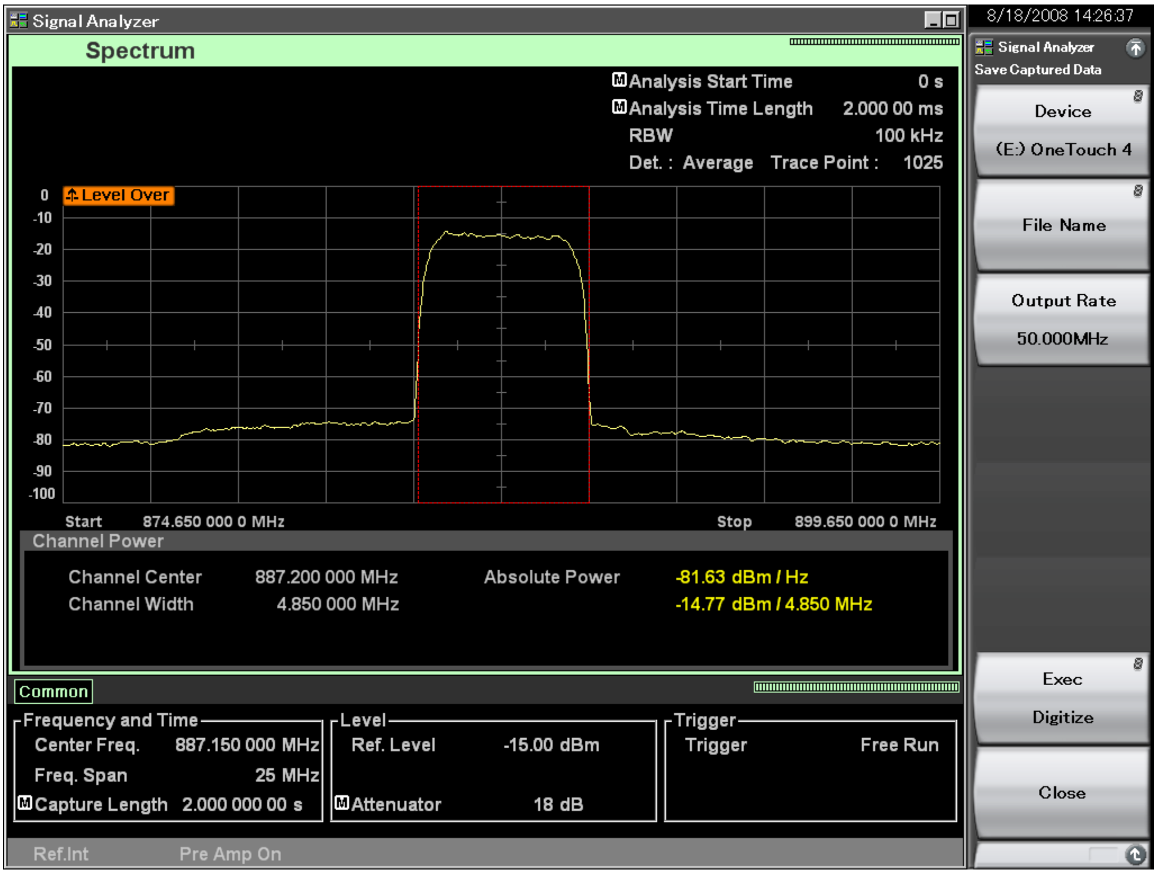


Figure 12 indicates the UMTS downlink signal received at Potter Field with a UHF phased array antenna mounted on 10 m mast. The signal level was measured at a level approximately −22.8 dBm.

FIGURE 12

Spectrum chart at Potter Field (picked up via a phased array antenna at 10 m height)

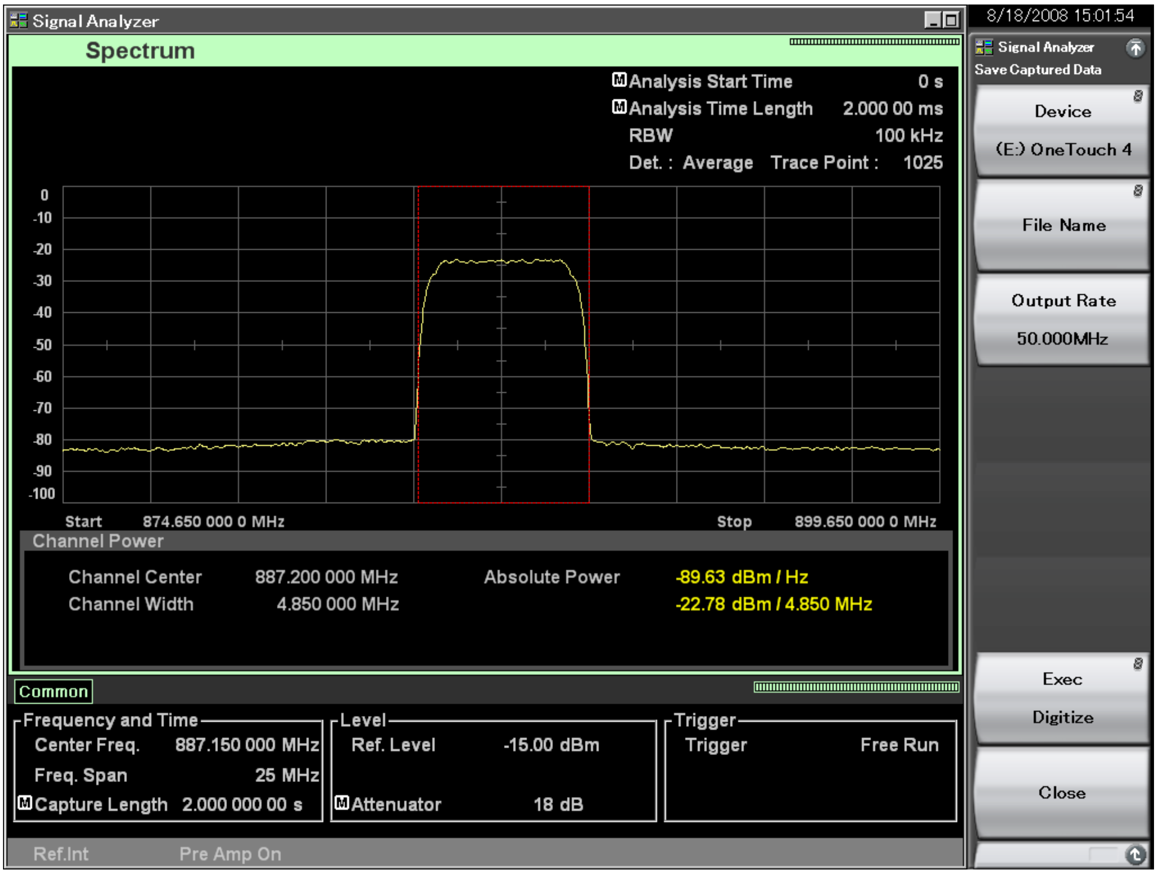


Figure 13 indicates the spectrum scan of frequencies from 545 MHz to 895 MHz at St Clair via an external rooftop antenna. The UMTS downlink signal level was measured at a level approximately −35.4 dBm. It is noted that the antenna was capable of picking up a number of television broadcasts from 547 MHz to 792 MHz, including services from Sydney (Artarmon) and Illawarra (Knights Hill).

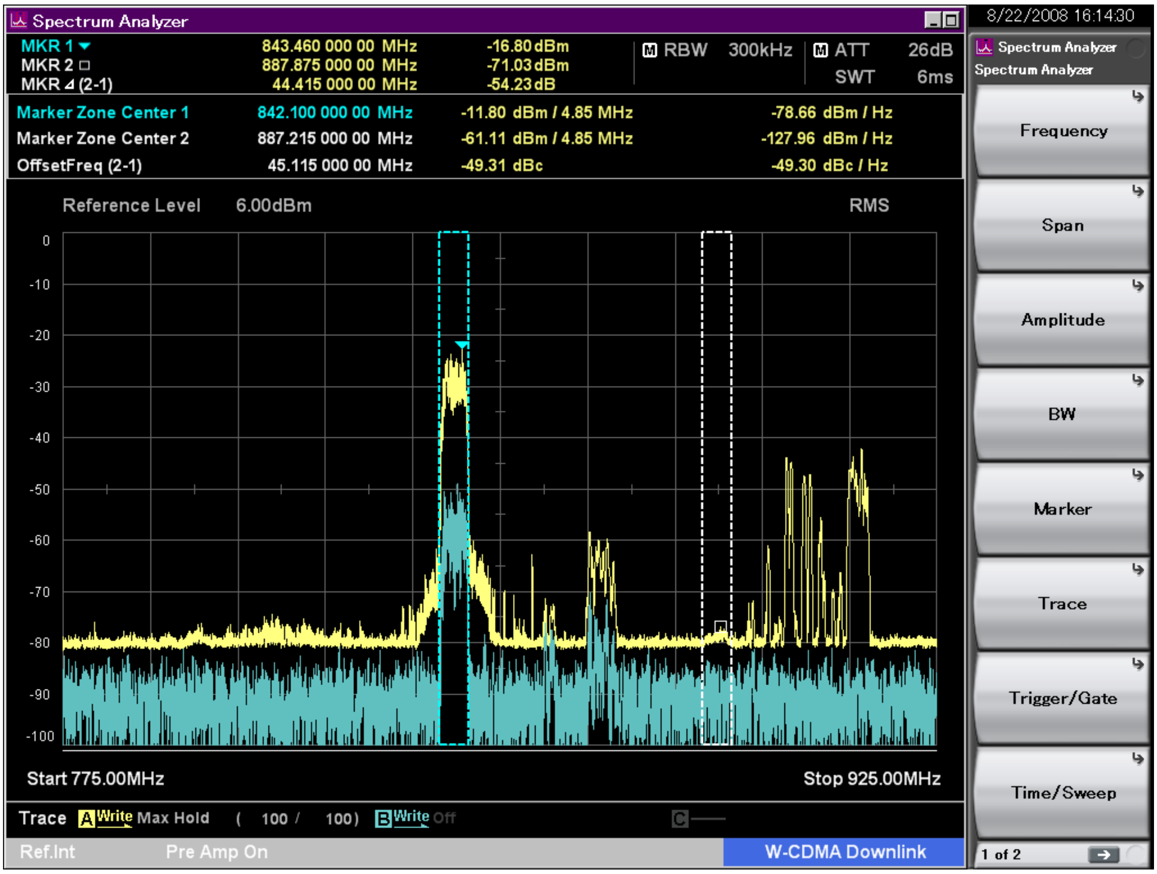
FIGURE 13

Spectrum chart at St Clair (picked up via external rooftop antenna)

Figure 14 indicates the UMTS uplink and downlink signal levels measured indoor at Avenue Road Mosman with a portable UHF Yagi antenna. One downlink channel centred at 887.2 MHz was observed at a very low level of −61 dBm (almost approaching the noise floor). The uplink signal, when the mobile broadband card was in operation, was measured at a level approximately −11.8 dBm. It is noted that the uplink signal comprised some spurious emissions which were much higher than the UMTS downlink signal itself. It is also noted that a number of GSM signals at frequencies above 890 MHz were observed and they were at levels much higher than the UMTS downlink signals.

FIGURE 14

Spectrum chart at Avenue Road (picked up via portable Yagi antenna)



6 UMTS uplink/downlink signal characteristics

The UMTS networks in Australia, as of today, are operating in 850 MHz, 1 800 MHz and 2 200 MHz bands. Among them, this study is focusing on the WCDMA system implemented in 850 MHz band occupying frequency ranges of 835-845 MHz and 880-890 MHz for uplink and downlink, respectively. This frequency arrangement is categorized as UMTS Terrestrial Radio Access Frequency Division Duplex (UTRA/FDD) Band V with a recommended transmit/receive frequency separation of 45 MHz as specified in the 3GPP specification.

6.1 Downlink signals

Two 5 MHz downlink channels constitute the 10 MHz spectrum between 880-890 MHz with the respective carrier frequencies at 882.5 MHz and 887.5 MHz, as per the 3GPP specification.

Spectrum scan results indicated that majority areas of Sydney receive only one downlink channel of bandwidth approximately 4.85 MHz at centre frequency of approximately 887.2 MHz. Sydney CBD is the only exception where at this location UMTS utilizes both downlink channels most probably due to the rise in noise levels and to meet the demand of a higher capacity of admitted users in the CBD network. It is noted that the centre frequencies of the lower and upper uplink channels are offset by approximately −0.3 MHz to 882.2 MHz and 887.2 MHz, respectively, when compared to the 3GPP specification.

An initial investigation was conducted on a number of UMTS base stations with easy access to measure signal level at clear line of sight (LoS). Table 1 outlined the parameters for the three selected base stations and the respective measurements at the study locations. Figures 15, 16 and 17 illustrated the set-up of each measurement. It is noted that a wideband UHF TV antenna is chosen for this study which was mounted on the 10 m mast of the field survey vehicle.

TABLE 1

Technical parameters for targeted base stations

		Shepherd Street	**Gosse Court**	**Potter Field**
Base station (BS)	**Lat**	33 47 25.1 S	33 47 31.8 S	33 47 12.3 S
	Long	150 48 24.9 E	150 47 21.6 E	150 47 15 E
ACMA site id		9007685	133747	133561
Licensed nominal transmission power*	**e.i.r.p.***	501 W	40.6 W	39.5 W
Licensed carrier frequencies	**Rx**	840 MHz	839.8 MHz	839.8 MHz
	Tx	885 MHz	884.8 MHz	884.8 MHz
Bandwidth	**Rx**	9.9 MHz	9.2 MHz	9.2 MHz
	Tx	9.9 MHz	9.4 MHz	9.4 MHz
Transmitting antenna height		20 m	16 m	22.5 m
Azimuth degrees		20 120° 270°	60 150° 290°	90 220° 335°
Polarization		Slant/Cross	Slant/Cross	Slant/Cross
Downlink frequency		887.2 MHz	887.2 MHz	887.2 MHz
Downlink bandwidth		4.85 MHz	4.85 MHz	4.85 MHz

* e.i.r.p. levels as provided by the ACMA database. It was not possible to check the actual transmitting power.

FIGURE 15

Downlink measurement at Shepherd Street

FIGURE 16

Downlink measurement at Gosse Court

FIGURE 17

Downlink measurement at Potter Field

6.2 Uplink signals

Two 5 MHz uplink channels constitute the 10 MHz spectrum between 835-845 MHz with the respective carrier frequencies at 837.5 MHz and 842.5 MHz, as per the 3GPP specification. It is also stated in the 3GPP specification that the nominal maximum output power from a user equipment (UE), e.g. mobile handset or mobile broadband card, shall not exceed +24 dBm (+1/−3 dB) and +21 dBm (+2/−2 dB) for Power Classes 3 and 4 equipment, respectively.

Spectrum scan results indicated that majority areas of Sydney perceive only one uplink channel of bandwidth approximately 4.85 MHz at centre frequency of approximately 842.2 MHz. Sydney CBD is the only exception where at this location UMTS utilizes both uplink channels most probably due to the rise in noise levels and to meet the demand of a higher capacity of admitted users in the CBD network. It is noted that the centre frequencies of the lower and upper uplink channels are offset by approximately −0.3 MHz to 837.2 MHz and 842.2 MHz, respectively, when compared to the 3GPP specification.

Several measurements were made at different locations in Sydney CBD and North Sydney using the mobile terminal as transmitter and the signal level was measured using a Yagi antenna. See Figs. 18 and 19 illustrating examples of these measurements.

FIGURE 18

Outdoor measurement of uplink and downlink signals received with a portable antenna (Example 1)

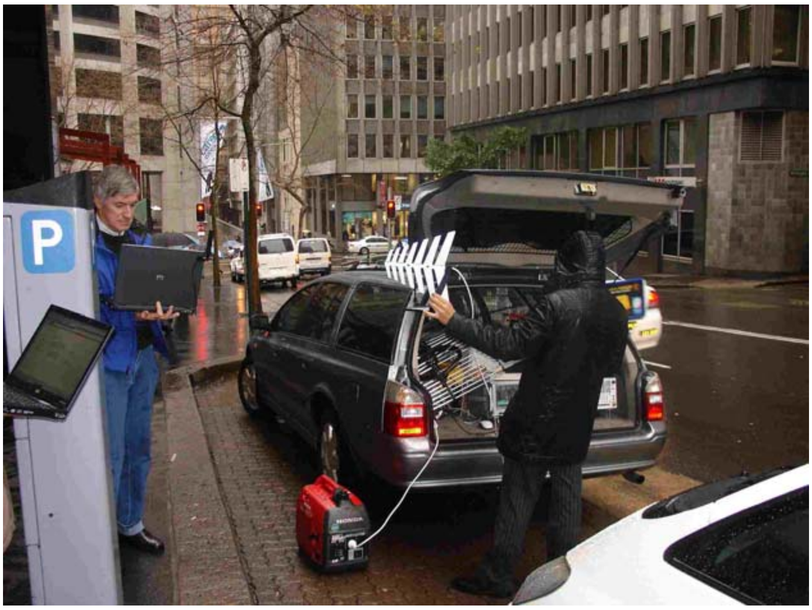


FIGURE 19

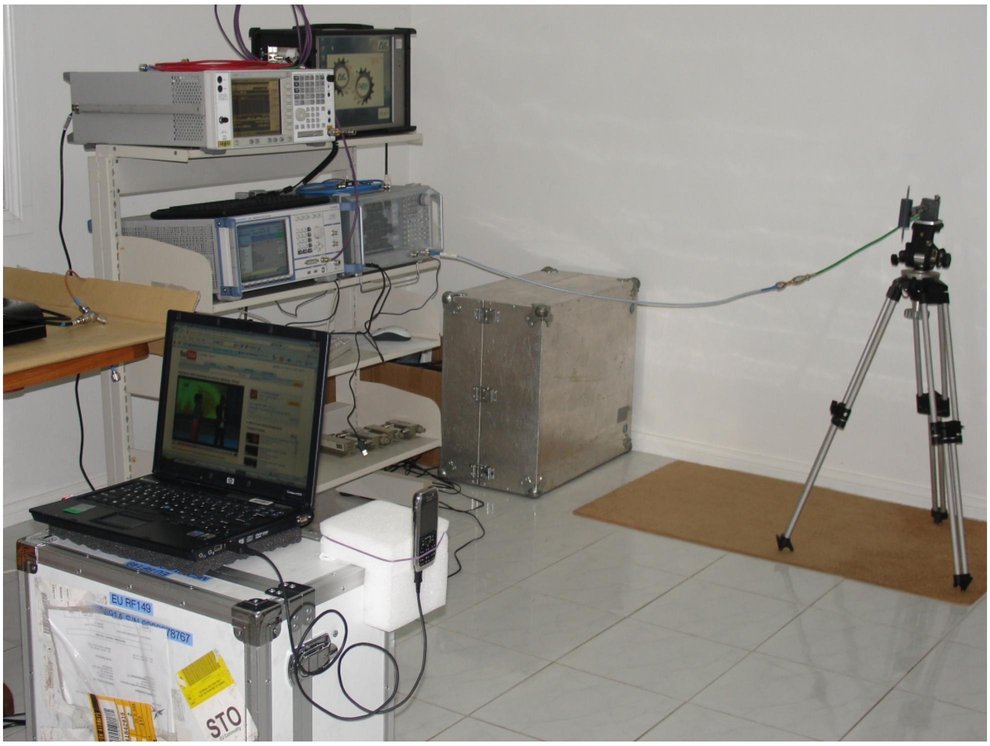
Outdoor measurement of uplink and downlink signals received with a portable antenna (Example 2)

6.2.1 User equipment uplink measurement at 13A Mill Place, St Clair

The user equipment (UE) selected for this measurement included a mobile handset and a mobile broadband card (HSDPA Turbo G-series card, with an optional external antenna). By establishing a voice/data call, a constant uplink signal was received. The uplink signal generated by the selected UE, which was located at some constant distance (0 m to 2.5 m) away from the fixed receive (Rx) antenna, was measured by a spectrum analyser. The measurement configuration with a calibrated dipole as Rx is shown in Fig. 20. A similar arrangement was repeated with a portable indoor Yagi antenna.

FIGURE 20

UE uplink measurement configuration (indoor)



The channel power of the uplink signals generated at various distances away from different fixed Rx is tabulated in Table 2. It is noted that the mobile broadband card has an antenna socket for optional connection to an external antenna. This enabled a direct measurement of its output power by directly connecting the spectrum analyser to the mobile broadband card through the antenna socket.

TABLE 2

Uplink signals generated from UE at St Clair

Tx/Rx	Distance between UE and Rx antenna (m)	Channel power (dBm)
Mobile handset/YAGI	0	−23
	0.5	−42
	1.0	−51
	1.5	−47
	2.0	−51
	2.5	−54
Mobile handset/calibrated DIPOLE	0	−26
	0.5	−47
	1.0	−54
	1.5	−52
	2.0	−55
	2.5	−58
Broadband card/YAGI	0.5	−32
	1.5	−50
	2.5	−54
Broadband card with external antenna/YAGI	0.5	−34
	1.5	−45
	2.5	−49
Broadband card/direct input	0	−5

6.2.2 UE uplink measurement at 44 Avenue Road, Mosman

The UE selected for this measurement similarly also includes a mobile handset and a mobile broadband card (HSDPA Turbo G-series card, with an optional external antenna). The uplink signal generated by the selected UE, which was located at some constant distance (0 m to 2.5 m) away from the portable indoor Yagi antenna, was measured by a spectrum analyser.

The measurement results are tabulated in Table 3. It is noted that the downlink signal at 44 Avenue Road, Mosman was significantly lower than other studied locations. Therefore, the UE was relying on the Transmit Power Control (TPC) to tune up the output power in order to maintain constant level of Quality of Service (QoS). The tabulated results, particularly the direct input measurement of +15.5 dBm, intuitively suggested that the mobile broadband card was capable of generating an output power that is reasonably close to the nominal maximum output power level as stated in the 3GPP specification.

TABLE 3

Uplink signals generated from UE at Mosman − Part 1 − August 2008

Tx/Rx	Distance between UE and Rx antenna (m)	Channel power (dBm)
Mobile handset/YAGI	0.5	−21.2
	1.0	−15.3
	2.5	−20.6
Broadband card with external antenna/YAGI	0.5	−11.8
	1.0	−16.5
	2.5	−25.8
Broadband card/direct input	0	+15.5

Interference on portable indoor DVB-T reception from real UMTS mobile phone with insufficient guardband has been shown and recorded on video[8]. Figures 21 and 22 show captured frames of one of the videos.

FIGURE 21

Captures of a recorded video showing interference on portable indoor DVB-T reception from real UMTS mobile phone with insufficient guard (7 MHz DVB-T signal centred at 830.5 MHz and 4.6 MHz UMTS uplink signal centred at 842.1 MHz, i.e. guardband of 5.8 MHz) − First Frame

8 These videos are available upon request to EBU.

FIGURE 22

Captures of a recorded video showing interference on portable indoor DVB-T reception from real UMTS mobile phone with insufficient guard (7 MHz DVB-T signal centred at 830.5 MHz and 4.6 MHz UMTS uplink signal centred at 842.1 MHz, i.e. guardband of 5.8 MHz) − Picture block artefacts and loss of signal observed

Additional measurements carried out in January 2009

The objective was to take similar measurements as the preceding (0.5 m, 1 m, 1.5 m, 2 m and 2.5 m and direct input, between indoor TV receive antenna and UMTS mobile terminal at height 1.5 m above ground level) with the difference that the UMTS mobile terminal is constantly uploading data to ensure establishment of uplink. For comparison and verification purpose, same measurements were also conducted when the UMTS mobile terminal is constantly downloading data.

The results are shown in Table 4.

TABLE 4

Uplink signals generated from UE at Mosman − Part 2 − January 2009

Tx/Rx	Distance between UE and Rx antenna (m)	Channel power during upload session (in average mode) (dBm)	Channel power during download session (in average mode) (dBm)
Broadband card with external antenna/Yagi	0.5	−22.02	−25.98
	1	−22.17	−29.70
	1.5	−24.41	−30.10
	2	−21.24	−24.24
	2.5	−20.42	−30.57
Broadband card without external antenna/Yagi	0.5	−17.79	−23.86
	1	−23.38	−29.58
	1.5	−26.19	−27.41
	2	−32.38	−37.18
	2.5	−31.14	−32.81
Broadband card/direct input	0	+20.46	+19.50

These additional measurements show mainly two things:

1) the transmit power of the mobile terminal is higher in an upload session than in a download session;

2) the mobile terminal almost reaches the maximum transmit power (according to the specifications, i.e. 21 dBm).

7 Set-top box sensitivity testing

A series of tests were performed on a number of selected Australian and European set-top boxes (STB), which also included a USB stick receiver, to determine the sensitivity of each receiver and its susceptibility to interference caused by other signals transmitting at adjacent and image channels.

The conducted tests are described as follows:

− Sensitivity: Each receiver was fed with a DVB-T wanted signal level at one particular carrier frequency and the level was decreased. The threshold level immediately before the first picture break up was observed and recorded.

− Adjacent channel: Each receiver was fed with fixed DVB-T wanted signal levels (−40 dBm/−60 dBm) and mixed with an interferer DVB-T signal. The interferer signal was operating at the immediate upper and lower adjacent channel of the wanted signal. The interferer signal level was increased in constant steps. When the first picture break up was observed, the interferer level was recorded.

− Image channel: Each receiver was fed with fixed DVB-T wanted signal levels (−40 dBm/−60 dBm) and mixed with an interferer DVB-T signal. The interferer signal was operating at 9/10/11 channels above the wanted signal. The interferer signal level was increased in constant steps. When the first picture break up was observed, the interferer level was recorded.

All results are tabulated in the following tables:

Tables 5 and 8 outline the sensitivity of the Australian and European STBs, respectively, whereas Tables 6 and 9 show the achievable protection ratio of the respective STBs. The achievable protection ratios of the majority tested STBs are highlighted in red as they did not meet the expected protection ratios for adjacent and image channels, which are commonly defined at −30 dB and −40 dB, respectively. Given that Australian broadcasters also provide DVB-T services via VHF Band III spectrum, similar sensitivity and adjacent channel tests were conducted on Australian STBs in VHF Band III frequencies. The respective results are tabulated in Table 7.

TABLE 5

Sensitivity of Australian STBs operating in 7 MHz channel raster

		Wanted signal			Interference signal				
Model	**Sensi-tivity (dBm)**	**Freq. (MHz)**	**Ch.**	**Signal level (dBm)**	**Adjacent interferer (n+1) (dBm)**	**Adjacent interferer (n-1) (dBm)**	**Image interferer (n+9) (dBm)**	**Image interferer (n+10) (dBm)**	**Image interferer (n+11) (dBm)**
STB1-7 MHz	−84.8	704.5	53	−40	−13.7	−16.5	1.1	−4.0	−0.8
				−60	−31.8	−34.2	−11.8	−24.8	−21.3
STB2-7 MHz	−83.1	704.5	53	−40	−11.5	−14.4	5.6	−1.7	3.1
				−60	−32.0	−35.2	−12.0	−22.0	−17.2
STB3-7 MHz	−81.2	704.5	53	−40	−13.2	−12.7	0.9	−7.3	−3.3
				−60	−29.5	−27.5	−11.9	−26.5	−23.2
STB7-7 MHz (USB)	−81.3	704.5	53	−40	−19.6	−20.1	−14.6	−13.3	−12.2
				−60	−34.4	−28.5	−19.1	−21.0	−20.7

TABLE 6

Australian STBs achievable protection ratios

Model	Signal level (dBm)	Carrier/interference: Adjacent interferer (n+1) (dB)	Adjacent interferer (n-1) (dB)	Image interferer (n+9) (dB)	Image interferer (n+10) (dB)	Image interferer (n+11) (dB)
STB1-7 MHz	−40	−26.3	−23.5	−41.1	−36.0	−39.2
	−60	−28.2	−25.8	−48.2	−35.2	−38.7
STB2-7 MHz	−40	−28.5	−25.6	−45.6	−38.3	−43.1
	−60	−28.0	−24.8	−48.0	−38.0	−42.8
STB3-7 MHz	−40	−26.8	−27.3	−40.9	−32.7	−36.7
	−60	−30.5	−32.5	−48.1	−33.5	−36.8
STB7-7 MHz	−40	−20.4	−19.9	−25.4	−26.7	−27.8
(USB)	−60	−25.6	−31.5	−40.9	−39.0	−39.3

TABLE 7

Sensitivity and achievable protection ratios of Australian STBs operating in VHF band III

		Wanted signal			Interference signal		Carrier/Interference	
Model	Sensiti-vity (dBm)	Freq. (MHz)	Ch.	Signal level (dBm)	Adjacent interferer (n+1) (dBm)	Adjacent interferer (n-1) (dBm)	Adjacent interferer (n+1) (dB)	Adjacent interferer (n-1) (dB)
STB1-7 MHz	−69.1	198.5	9	−40	−9.7	−12.2	−30.3	−27.8
				−60	−26.2	−26.9	−33.8	−33.1
STB2-7 MHz	−73.1	198.5	9	−40	−15.0	−15.0	−25.0	−25.0
				−60	−33.2	−35.2	−26.8	−24.8
STB3-7 MHz	−81.7	198.5	9	−40	−9.7	−8.1	−30.3	−31.9
				−60	−29.6	−29.0	−30.4	−31.0

TABLE 8

Sensitivity of European STBs operating in 8 MHz channel raster

		Wanted signal			Interference signal		
Model	**Sensitivity (dBm)**	**Freq. (MHz)**	**Ch.**	**Signal level (dBm)**	**Adjacent interferer (n+1) (dBm)**	**Adjacent interferer (n-1) (dBm)**	**Image interferer (n+9) (dBm)**
STB6-8 MHz	−83.0	786	60	−40 −60	−7.9 −27.5	−11.2 −30.9	6.2 −12.8
STB8-8 MHz	−81.2	786	60	−40 −60	−8.9 −26.2	−8.8 −32.2	8.7 −12.7
STB5-8 MHz	−81.5	786	60	−40 −60	−9.5 −23.2	−11.6 −29.0	−4.6 −22.5
STB9-8 MHz	−81.8	786	60	−40 −60	−12.0 −25.8	−11.0 −30.1	−10.9 −15.5
STB4-8 MHz	−81.6	786	60	−40 −60	−11.1 −23.2	−12.6 −26.3	−7.7 −24.1
STB10-8 MHz	−81.1	786	60	−40 −60	−11.1 −23.7	−8.3 −23.7	−8.5 −14.4
STB11-8 MHz (USB)	−81.3	786	60	−40 −60	−17.3 −33.8	−17.5 −34.9	−12.3 −15.7

TABLE 9

European STBs achievable protection ratios

Model	Signal level (dBm)	Carrier/interference Adjacent interferer (n+1) (dB)	Adjacent interferer (n-1) (dB)	Image interferer (n+9) (dB)
STB6-8 MHz	−40 −60	−32.1 −32.5	−28.8 −29.1	−46.2 −47.2
STB8-8 MHz	−40 −60	−31.1 −33.8	−31.2 −27.8	−48.7 −47.3
STB5-8 MHz	−40 −60	−30.5 −36.8	−28.4 −31.0	−35.4 −37.5
STB9-8 MHz	−40 −60	−28.0 −34.2	−29.0 −29.9	−29.1 −44.5
STB4-8 MHz	−40 −60	−28.9 −36.8	−27.4 −33.7	−32.3 −35.9
STB10-8 MHz	−40 −60	−28.9 −36.3	−31.7 −36.3	−31.5 −45.6
STB11-8 MHz (USB)	−40 −60	−22.7 −26.2	−22.5 −25.1	−27.7 −44.3

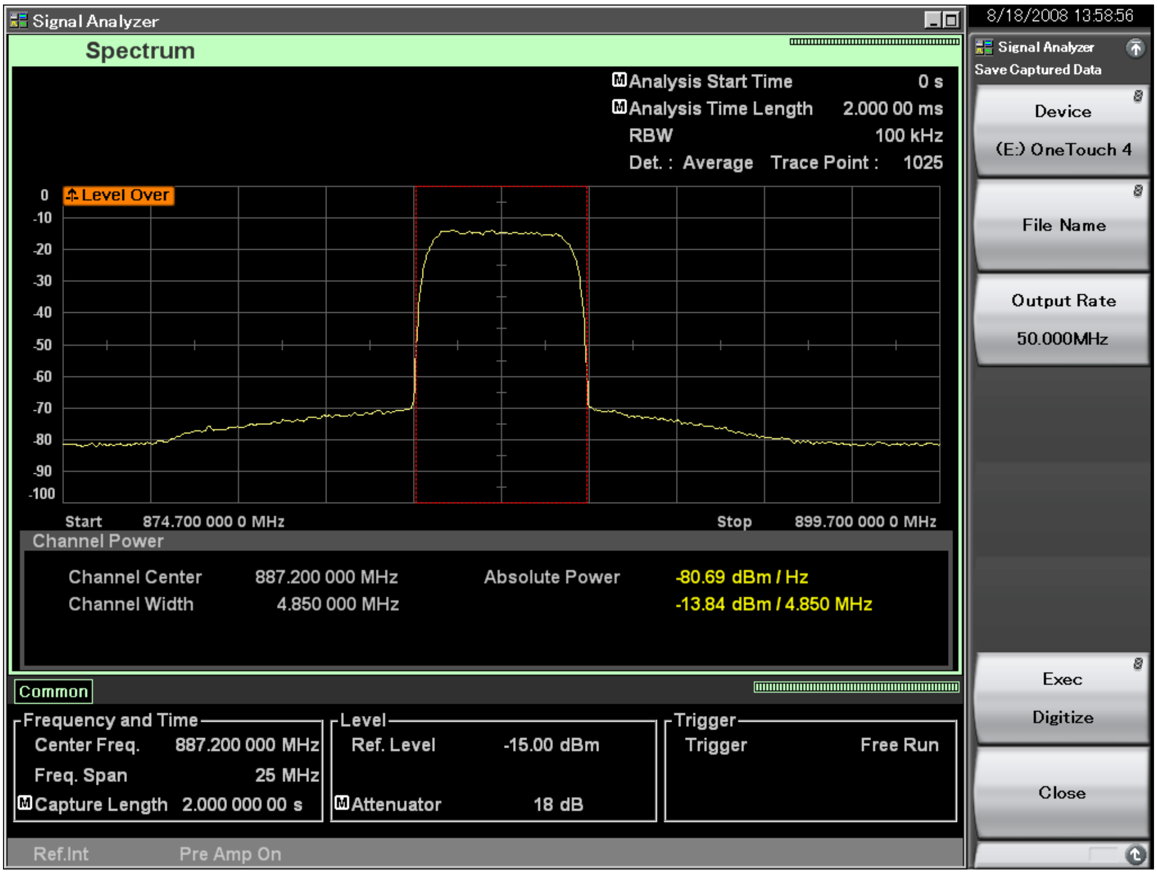
8 Field survey results

8.1 Downlink signal analysis

8.1.1 Downlink signal spectrum shape

FIGURE 23

Spectrum chart at Gosse Court (picked up via a phased array antenna at 10 m height)



8.1.2 Downlink signal levels received with a roof top antenna

Table 10 summarizes the measurements made with the vehicle equipped with the 10 m mast.

TABLE 10

Summary of downlink signal measurements made with the vehicle equipped with the 10 m mast

Site	ERP W	Study location GPS	Distance (m)	Received input power (dBm)	Comments
Gosse Court	40.6	33 47 24.2 S 150 47 37.2 E	463	−40	
Gosse Court	40.6	33 47 31.5 S 150 47 22.4 E	28	−29	Vertical antenna pattern has an effect
Gosse Court	40.6	33 47 31.0 S 150 47 24.0 E	65	−14.5	Signal captured for off-line measurements
Potter Field	39.5	33 47 08.2 S 150 47 18.9 E	140	−22.5	Vertical and horizontal polar identical
Shepherd Street	501	33 47 28.6 S 150 48 07.2 E	467	−49	
Shepherd Street	501	33 47 31.4 S 150 48 17.0 E	282	−36	
Shepherd Street	501	33 47 34.8 S 150 48 21.7 E	308	−37	
Shepherd Street	501	33 47 22.5 S 150 48 24.5 E	80	−16.5	Vertical and horizontal polar identical

Two main outcomes are:

1) the three measured base stations use mixed polarization, this eliminates the possible protection of the broadcasting fixed reception using antenna polarization discrimination (however an equivalent protection of 3 dB is already there as the transmit power is divided equally between the two polarizations);

2) the levels received at the receiver input could reach relatively high values (a signal level of −14.5 dBm was received at a distance of 65, in a point located between houses equipped with roof top antennas, see table above).

Taking into consideration the measured levels, two typical levels were selected for the compatibility tests:

- −20 dBm representing high level of interference, and
- −40 dBm representing intermediate level.

8.1.3 Downlink signal levels received with a portable antenna

A significant number of measurements were collated from the study locations described in § 4. Examples are shown in § 5. They include measured levels of input signals received from the base stations with a portable receiving antenna.

The main outcomes are:

1) the levels received from base stations with portable antennas (Yagi, dipole) exceed −20 dBm at certain locations. The levels measured in Sydney suburbs and in the city range from −20 to −62 dBm;

2) in areas of high traffic (in the city) two downlink signals are measured, sometimes with equal levels (see § 5);

3) the signal received from a base station in an urban environment with high traffic varies continuously. It reaches its maximum level by frequent bursts. For this reason, measured levels are obtained from max-hold plots of channel power.

8.1.4 Compatibility tests

According to the methodology described in § 3.4, with the availability of a signal analyser that is capable of digitizing the captured UMTS uplink/downlink signals and down-converting the respective signals to a nominated frequency for analyses, both downlink and uplink studies were conducted in a laboratory environment.

Tables 11 and 12 below show a synthesis of these measurements for Australian set-top boxes (7 MHz signal bandwidth) and for European set-top boxes (8 MHz signal bandwidth) respectively. The aim of this form of presentation is to assess:

– the required guardband for the two selected levels of UMTS signals at the DVB-T receiver input;

– the allowable level of UMTS signal at the DVB-T receiver input for given values of guardbands and for the image channel configuration.

TABLE 11

Synthesis of compatibility tests with downlink interference for Australian set-top boxes (7 MHz signal bandwidth)

Average allowable level of the UMTS input (dBm)	UMTS input (dBm)	Guardband at limit of coverage area Pw = −80 dBm (MHz)	Average allowable level of the UMTS input (dBm)	UMTS input (dBm)	Guardband inside the coverage area Pw = −60 dBm (MHz)	Set-top boxes
Required guardband for a given unwanted signal level						
	−20	Overload		−20	5.725	STB1-7 MHz
	−20	Overload		−20	6.425	STB2-7 MHz
	−20	Overload		−20	8.925	STB3-7 MHz
	−40	7.325		−40	0	STB1-7 MHz
	−40	5.625		−40	0	STB2-7 MHz
	−40	9.325		−40	0	STB3-7 MHz

TABLE 11 (*end*)

Average allowable level of the UMTS input (dBm)	UMTS input (dBm)	Guardband at limit of coverage area Pw = −80 dBm (MHz)	Average allowable level of the UMTS input (dBm)	UMTS input (dBm)	Guardband inside the coverage area Pw = −60 dBm (MHz)	Set-top boxes
Maximum allowable unwanted signal level for a given guardband						
−43.4	−42.3	5.025	−22.7	−21	5.025	STB1-7 MHz
	−40.5	5.025		−21.5	5.025	STB2-7 MHz
	−47.5	5.025		−25.5	5.025	STB3-7 MHz
−49.5	−49.5	1.025	−30.2	−30	1.025	STB1-7 MHz
	−46.5	1.025		−29.5	1.025	STB2-7 MHz
	−52.5	1.025		−31	1.025	STB3-7 MHz
−54.5	−53.5	0.025	−33.7	−32.5	0.025	STB1-7 MHz
	−53	0.025		−33	0.025	STB2-7 MHz
	−57	0.025		−35.5	0.025	STB3-7 MHz
Maximum allowable unwanted signal level for image channel configuration						
−54.5	−44	64.625	−24.5	−22.5	64.625	STB1-7 MHz
	−33	66.025		N/A	66.025	STB2-7 MHz
	−48.5	66.025		−26.5	66.025	STB3-7 MHz

TABLE 12

Synthesis of compatibility tests with downlink interference for European set-top boxes (8 MHz signal bandwidth)

Average allowable level of the UMTS in put (dBm)	UMTS input (dBm)	Guardband at limit of coverage area Pw = −80 dBm (MHz)	Average allowable level of the UMTS input (dBm)	UMTS input (dBm)	Guardband inside the coverage area Pw = −60 dBm (MHz)	Set-top boxes
Required guardband for a given unwanted signal level						
	−20	Overload		−20	6.525	STB4-8 MHz
	−20	Overload		−20	32.225	STB5-8 MHz
	−20	Overload		−20	32.025	STB6-8 MHz
	−40	5.925		−40	0	STB4-8 MHz
	−40	15.525		−40	0	STB5-8 MHz
	−40	9.525		−40	0	STB6-8 MHz
Maximum allowable unwanted signal level for a given guardband						
−44.7	−41	5.025	−23.7	−21.5	5.025	STB4-8 MHz
	−44.5	5.025		−22.5	5.025	STB5-8 MHz
	−48.5	5.025		−27	5.025	STB6-8 MHz
−48.3	−45	1.525	−28.2	−27	1.525	STB4-8 MHz
	−48	1.525		−27	1.525	STB5-8 MHz
	−52	1.525		−30.5	1.525	STB6-8 MHz
−54.3	−55.5	0.025	−32.3	−34.5	0.025	STB4-8 MHz
	−53.5	0.025		−30	0.025	STB5-8 MHz
	−54	0.025		−32.5	0.025	STB6-8 MHz
Maximum allowable unwanted signal level for image channel configuration						
−42.2	−47	65.025	−20.0	−25.5	65.025	STB4-8 MHz
	−46.5	65.525		−23	65.525	STB5-8 MHz
	−33	65.525		−11.5	65.525	STB6-8 MHz

8.1.5 Analysis

The measured levels of the downlink UMTS signal at the receiver input is to be compared to the average allowable level for each guardband.

Table 13 below shows the main outcome of this analysis. See explanation and discussion below the table.

TABLE 13

Analysis of the compatibility tests results

Guardband (MHz)	Maxi-mum allowable level (dBm)	Possible received level at around 100 m (dBm)	Assumed interfe-ring e.i.r.p (dBm)	Lack of protection (dB)	Possible additional protection by cross-polarization valid only for fixed reception (dB)*	Possible additional protection by improved filtering (reduction of out-of-band emission level) assumption (dB)	Remai-ning lack of protection (dB)	Maxi-mum allowable power (dBm)	Maxi-mum allowable power (W)
Interior of the broadcasting coverage area (Wanted level at receiver input: −60 dBm)									
0	−33	−14	46	−19	13	6	0	46	40
1	−29	−14	46	−15	13	6	4	50	100
5	−23	−14	46	−9	13	6	10	56	398
Image channel	−22	−14	46	−8	13		5	51	126
Edge of the broadcasting coverage area (Wanted level at receiver input: −80 dBm)									
0	−54	−14	46	−40	13	6	−21	25	0.32
1	−49	−14	46	−35	13	6	−16	30	1.00
5	−44	−14	46	−30	13	6	−11	35	3.16
Image channel	−42	−14	46	−28	13		−15	31	1.26

* The “nominal” protection by cross-polarization is 16 dB according to Recommendation ITU-R BT.419. However, as the BS uses slant polarization, half of the power is delivered in each polarization (H and V). The measured level with a linearly polarized antenna of a slant polarization signal affords already a 3 dB protection. Therefore, the use of full cross-polarization would only afford 13 (i.e. 16^{-3}) dB additional protection.

The −60 dBm level of the DVB-T wanted signal corresponds to the interior of the broadcast coverage area of a broadcasting transmitter. For this wanted signal level, and with no guardband (0.025 MHz), the average allowable UMTS signal level is −33.7 dBm for the Australian STBs and −32.7 dBm for the European STBs. A common level of −33 dBm is considered in the following.

For fixed reception through roof top antennas, the measurements have shown that the UMTS signal at the receiver input could reach levels as high as −14 dBm at typical distances between houses and base stations transmitting at 40 W e.i.r.p. (46 dBm). In this configuration, a lack of protection of −19 dB is noted. Using cross polarization between the UMTS base station and the DVB-T transmitter would afford an additional 13 dB (in addition to the 3 dB protection due to the use of slant polarization; see footnote under Table 13). Moreover, improved filtering of the base station signal could afford additional protection by reducing the out-of-band emission level which falls in the broadcasting channel. This possible additional protection is assumed here to be 6 dB, but assessing its effective value would require laboratory measurements with different out-of-band levels. With these measures, the lack of protection would be cancelled and the e.i.r.p of 46 dBm could therefore be used in this configuration. If higher e.i.r.p.s are foreseen, the table shows that a guardband would be needed. A guardband of 5 MHz permits an average allowable UMTS signal level of −22.7 dBm for the Australian STBs and −23.7 dBm for the European STBs according to the compatibility tests. A common level of −23 dBm is considered. This would permit a 10 dB increase of the e.i.r.p., up to 56 dBm (398 W).

The −80 dBm level of the DVB-T wanted signal corresponds to the edge of the broadcast coverage area. For this wanted signal level and with no guardband (0.025 MHz), the average allowable UMTS signal level is −54.5 dBm for the Australian STBs and −54.3 dBm for the European STBs. A common level of −54 dBm is considered in the following. A similar analysis as above shows that in this case the configuration with no guardband is very restrictive in terms of maximum allowable e.i.r.p (25 dBm or 0.32 W). As above, a 5 MHz guardband would permit a 10 dB increase of the maximum allowable e.i.r.p., up to 35 dBm (3.16 W).

Concerning the image channel (72 MHz frequency offset for the European set-top boxes and around 70 MHz frequency offset for the Australian set-top boxes), the maximum allowable unwanted signal level is −42 dBm (average between −41.8 dBm for Australian set-top boxes and −42.2 dBm for European set-top boxes), corresponding to a wanted DVB-T signal representative of the edge of broadcast coverage area, and −20 dBm (average between −24.5 dBm for Australian set-top boxes and −20 dBm for European set-top boxes), corresponding to a wanted DVB-T signal representative of the interior of the coverage area. The reduction of the out-of-band emission level has no effect on the protection as the interference is caused by translation of the interfering image channel into the wanted channel at intermediate frequency. The cross-polarization is still effective to improve protection. The e.i.r.p. limitation resulting from the consideration of the image channel is significant and numerically close to the limitation corresponding to a guardband of 1 MHz. However, the tests have shown large differences between the receivers with regard to their immunity to image channel interference. The risk of image channel interference for a given e.i.r.p. of the mobile service downlink and a given wanted DVB-T signal level will depend on the type of set-top box used in the vicinity of the base station. Installation of rejection filters at the victim receiver side could be the ultimate solution to solve the possible cases of interference.

For the protection of portable DVB-T reception, the maximum UMTS received levels at several points in suburban and urban areas range from −20 to −62 dBm. It was not possible to identify which base station(s) was measured in the urban area and what was the corresponding e.i.r.p. However, available information suggests that there is a mixture of different e.i.r.p. values like 0.06 W, 5.6 W, 31.6 W and 501 W. Further investigation would therefore be needed with regard to the impact of the downlink on portable DVB-T reception.

8.2 Uplink signal analysis

8.2.1 Uplink signal spectrum shape

FIGURE 24

Spectrum of the UMTS uplink signal (generated with an HSDPA card with direct connection between the antenna socket and the spectrum analyser)

The screen shot above shows the spectrum of the UMTS uplink signal generated with an HSDPA card with direct connection between the antenna socket and the spectrum analyser. Therefore, the level of −5.6 dBm corresponds approximately to the output power of the terminal. This power level is determined by the network according to the link budget between the terminal and the base station. According to the UMTS specifications, a UMTS terminal can have a maximum transmit power of +21 dBm or +24 dBm depending on its category.

The screen shot shows a significant level of out-of-band emissions of the terminal in the adjacent bands (shoulders) but also spurious emissions at larger frequency separations. The attenuation of the shoulders is in the order of −45 dB relative to the in-band emission level. The spurious emissions are between −45 and −60 dB below the signal level.

8.2.2 Uplink signal levels received with a roof top antenna

TABLE 14

UMTS uplink signal perceived from fixed rooftop antenna (phased array)

UMTS uplink signal perceived from fixed rooftop antenna (phased array) Frequency = 842.15 MHz

0 dBm output from signal generator with 3 dB cable loss, 0.9 dBd gain, effective radiated power is −2.1 dBm ERP or 0 dBm e.i.r.p.

Dipole as Tx antenna and phased array as fixed antenna

In axis means both antennas are tilted to form direct LoS

Off axis means phased array antenna is not tilted

Line No.	Antenna	Polarization	Height agl (m)	Distance (m)	Ch. power (dBm)	Remark
1	Dipole	Vertical	0.8	7.2	−38	In axis
	Phased array	Vertical	5			
2	Dipole	Horizontal	0.8	7.2	−39	In axis
	Phased array	Horizontal	5			
3	Dipole	Vertical	0.8	10.2	−44	In axis
	Phased array	Vertical	10			
4	Dipole	Horizontal	0.8	10.2	−43	In axis
	Phased array	Horizontal	10			
5	Dipole	Vertical	0.8	7.2	−57	In axis
	Phased array	Horizontal	5			
6	Dipole	Vertical	0.8	10.2	−64	In axis
	Phased array	Horizontal	10			
7	Dipole	Horizontal	0.8	10.2	−58	In axis
	Phased array	Vertical	10			
8	Dipole	Vertical	0.8	10.2	−53	Off axis
	Phased array	Vertical	10			
9	Dipole	Horizontal	0.8	10.2	−56	Off axis
	Phased array	Horizontal	10			
10	Dipole	Vertical	0.8	10.2	−59	Off axis
	Phased array	Horizontal	10			
11	Dipole	Horizontal	0.8	10.2	−56	Off axis
	Phased array	Vertical	10			

Assuming a minimum distance between the mobile UMTS terminal and the DVB-T fixed roof top antenna of 10 m, the following considerations are made to select the typical levels to be used for the compatibility tests:

– In the configuration “in axis”: The polarization discrimination offers, according to these measurements, an attenuation of the unwanted signal between 15 and 20 dB depending on the combination of the polarizations between the two parts. However, the polarization of the uplink signal depends on the real position and orientation of the mobile terminal, which cannot be fully controlled. Therefore, for the compatibility tests, the assumed level is taken from the configuration, in line 4, corresponding to the horizontal polarization of both signals. This level is −43 dBm for an e.i.r.p. of 0 dBm. It is −22 dBm for an e.i.r.p. of 21 dBm which is the maximum transmit power in the UMTS specifications.

– In the configuration "off axis": for the same argument as above, the assumed level is taken from the configuration, in line 9, corresponding to the horizontal polarization of both signals. This level is −56 dBm for an e.i.r.p. of 0 dBm. It is −35 dBm for an e.i.r.p. of 21 dBm, which is the maximum transmit power in the UMTS specifications.

8.2.3 Uplink signal levels received with an indoor portable antenna

Within many administrations, particularly in high-density and non-owner occupied accommodation, DTV television reception is by way of indoor television antennas. This is the case in Australia. However, it is observed that the planning guidelines for DVB-T reception in Australia do not take into account portable indoor reception and building penetration loss; as is the case in some European countries.

Section 6.2 showed the uplink signal levels received with an indoor Yagi antenna from a UMTS mobile terminal in a house located in a Sydney suburban area. It should be noted that the Sydney residential suburban area where the measurements were carried out is covered with multiple UMTS base stations offering therefore an adequately high level of the downlink signal. In this configuration, the link budget requires a low level of mobile transmit power and the TPC will keep this mobile transmit power low.

In § 6.2.1, the levels measured at distances from 0.5 to 2.5 m between the mobile terminal and the portable indoor receiving antenna have been reproduced with the signal generator at a transmit power level of −24 dBm.

Section 6.2.2 shows the effect of the TPC on the mobile transmit power in a configuration where the link budget requires an increased power level. In an urban area where a low level of the downlink signal was received, the transmit power of the mobile terminal was increased to +15.5 dBm which is close to the maximum transmit power in the UMTS specifications.

The main outcomes are:

1) the levels received from mobile terminals with portable indoor Yagi antennas reach −11 dBm at certain locations. The levels measured in Sydney suburbs and in the city range from −11 to −48 dBm;
2) the signal received from a mobile terminal in an urban environment with high traffic varies continuously. It reaches its maximum level by frequent bursts.

Based on these measurements, three levels of the uplink signal were selected for the compatibility tests:

- −11 dBm: this is the maximum level received with the Yagi antenna at 0.5 m from the mobile terminal in a location where the TPC has set the transmit power to +15.5 dBm;
- −36 dBm: this is an intermediate level;
- −57 dBm: this is close to the lowest level measured from the uplink at 2.5 m separation distance between the mobile terminal and the portable indoor antenna. This was measured in a location where the TPC has set the transmit power to around −24 dBm.

8.2.4 Compatibility tests

Like in § 8.1.4, and according to the methodology described in § 3, compatibility tests have been carried out in a laboratory environment by regenerating the uplink signal captured in the field. This ensures that the spectral and temporal characteristics of the signal are consistent with the implemented UMTS downlink signal.

Table 15 below shows a synthesis of these measurements, with the aim to assess:

– the required guardband for the three typical levels of UMTS signals at the DVB-T receiver input;

– the allowable level of UMTS signal at the DVB-T receiver input for given values of guardband and for the image channel configuration.

TABLE 15

Synthesis of compatibility tests with uplink interference for Australian set-top boxes (7 MHz signal bandwidth)

Average level of the UMTS input (dBm)	UMTS input (dBm)	Guardband at limit of coverage area Pw = −80 dBm (MHz)	Average level of the UMTS input (dBm)	UMTS input (dBm)	Guardband inside the coverage area Pw = −60 dBm (MHz)	Set-top boxes
Required guardband for a given unwanted signal level						
	−11	Infinity		−11	39.375	STB1-7 MHz
	−11	Infinity		−11	15.375	STB2-7 MHz
	−11	Infinity		−11	22.675	STB3-7 MHz
	−36	20.175		−36	2.875	STB1-7 MHz
	−36	13.475		−36	2.975	STB2-7 MHz
	−36	14.075		−36	10.475	STB3-7 MHz
	−57	2.975		−57	0.075	STB1-7 MHz
	−57	2.675		−57	0.075	STB2-7 MHz
	−57	3.075		−57	0.075	STB3-7 MHz

TABLE 15 (*end*)

Average level of the UMTS input (dBm)	**UMTS input (dBm)**	**Guardband at limit of coverage area Pw = −80 dBm (MHz)**	**Average level of the UMTS input (dBm)**	**UMTS input (dBm)**	**Guardband inside the coverage area Pw = −60 dBm (MHz)**	**Set-top boxes**
Maximum allowable unwanted signal level for a given guardband						
−52.3	−52	5.075	−35	−30	5.075	STB1-7 MHz
	−51.5	5.075		−31.5	5.075	STB2-7 MHz
	−53.5	5.075		−43.5	5.075	STB3-7 MHz
−63.5	−63.5	1.075	−45.5	−44.5	1.075	STB1-7 MHz
	−63	1.075		−42.5	1.075	STB2-7 MHz
	−64	1.075		−49.5	1.075	STB3-7 MHz
−67.5	−67.5	0.075	−48.5	−47.5	0.075	STB1-7 MHz
	−67	0.075		−47.5	0.075	STB2-7 MHz
	−68	0.075		−50.5	0.075	STB3-7 MHz
Maximum allowable unwanted signal level for image channel configuration						
−44.3	−46.5	64.675	−27.3	−24.5	64.675	STB1-7 MHz
	−35.5	66.075		N/A	66.075	STB2-7 MHz
	−51	66.075		−30	66.075	STB3-7 MHz

TABLE 16

Synthesis of compatibility tests with uplink interference for European set-top boxes (8 MHz signal bandwidth)

Average level of the UMTS input (dBm)	UMTS input (dBm)	Guardband at limit of coverage area Pw = −80 dBm (MHz)	Average level of the UMTS input (dBm)	UMTS input (dBm)	Guardband inside the coverage area Pw = −60 dBm (MHz)	Set-top boxes
Required guardband for a given unwanted signal level						
	−11	Infinity		−11	22.175	STB4-8 MHz
	−11	Infinity		−11	37.675	STB5-8 MHz
	−11	Infinity		−11	51.475	STB6-8 MHz
	−36	14.675		−36	2.975	STB4-8 MHz
	−36	31.975		−36	2.175	STB5-8 MHz
	−36	15.275		−36	9.775	STB6-8 MHz
	−57	2.675		−57	0.075	STB4-8 MHz
	−57	2.975		−57	0.075	STB5-8 MHz
	−57	2.775		−57	0.075	STB6-8 MHz
Maximum allowable unwanted signal level for a given guardband						
−52.5	−51.5	5.075	−35.2	−31.5	5.075	STB4-8 MHz
	−52.5	5.075		−28.5	5.075	STB5-8 MHz
	−53.5	5.075		−45.5	5.075	STB6-8 MHz
−61.0	−61	1.575	−43.2	−40	1.575	STB4-8 MHz
	−62	1.575		−38	1.575	STB5-8 MHz
	−60	1.575		−51.5	1.575	STB6-8 MHz
−66.8	−66.5	0.075	−48.2	−46.5	0.075	STB4-8 MHz
	−68	0.075		−44.5	0.075	STB5-8 MHz
	−66	0.075		−53.5	0.075	STB6-8 MHz
Maximum allowable unwanted signal level for image channel configuration						
−44.3	−49	65.575	−22.8	−29	65.575	STB4-8 MHz
	−49	65.575		−26.5	65.575	STB5-8 MHz
	−35	65.575		−13	65.575	STB6-8 MHz

8.2.5 Analysis

With the −60 dBm level of the wanted DVB-T signal, representative of the interior of the broadcast coverage area of a broadcasting transmitter, the following conclusions may be drawn:

1) An unwanted uplink signal level of −11 dBm requires a large guardband, between 15 MHz for the best case and 51 MHz for the worst case, depending on the selectivity of the receiver.

2) An intermediate uplink signal level of −36 dBm requires a guardband between 2 and 10 MHz depending on the receiver. On the other hand, a guardband of 5 MHz would allow a maximum UMTS uplink signal level of −35 dB on average.

With the −80 dBm level of the wanted DVB-T signal, representative of the edge of the coverage area, the following conclusions may be drawn:

3) The high level of −11 dBm would interfere with the wanted DVB-T signal, whatever the frequency separation. The receiver front end is overloaded with such a high signal level.

4) The intermediate level of −36 dBm requires a guardband between 13 MHz and 32 MHz depending on the receiver. On the other hand, a guardband of 5 MHz would allow a maximum UMTS uplink signal level of −52 dBm on average.

In order to take into consideration the possible wanted DVB-T signal levels between the edge of the broadcast coverage area and the interior of this coverage area, a guardband between 7 MHz (intermediate between 2 and 13 MHz) and 21 MHz (intermediate between 10 and 32 MHz) would be required.

Concerning the image channel configuration, the maximum allowable unwanted signal level is between −44.3 dBm (same for Australian and European tested set-top boxes), corresponding to a wanted DVB-T signal representative of the edge of the broadcast coverage area, and −24.6 dBm (average between −22.8 dBm for Australian set-top boxes and −27.3 dBm for European set-top boxes) corresponding to a wanted signal representative of the interior of the broadcast coverage area. Furthermore, the tests have shown large differences between the receivers with regard to their immunity to image channel interference. With an unwanted signal level at the intermediate level of −36 dBm, there might be cases of image channel interference on some types of receivers when receiving close to the edge of the broadcast coverage area. The installation of image channel rejection filters at the victim receiver side could be the ultimate solution to solve the possible cases of interference.

It was observed during the measurement that when the downlink signal at one location is weakly received, the respective uplink signal is often bursty. It is believed that the TPC is activated under a weak downlink environment. When a data/voice call is first initiated, an extremely high impulsive uplink signal can be observed. The network is then endeavoured to manipulate the TPC in order to reduce the uplink signal as the call is established. However, intermittent bursts can still be observed throughout the call. As could be expected, the transmit power of the mobile terminal is higher in an upload session than in a download session and it can almost reach the maximum transmit power (according to specifications, i.e. 21 dBm).

9 Call for further studies

This study has described field and laboratory interference measurements undertaken within the coverage area of an operating UMTS (WCDMA) network and provided analysis of the impact on DVB-T reception from a UMTS base station and mobile terminal transmissions. This analysis provides insights into a case of compatibility based upon the UMTS network design, base station architectural structures and cellular service characteristics in one country.

The collaborators of this study would encourage ITU-R to call for more studies on this topic so that the globally harmonized compatibility can be realized not only from the theoretical studies the JTG may perform but from actual UMTS and DTTB deployments across the regions.

10 Definitions

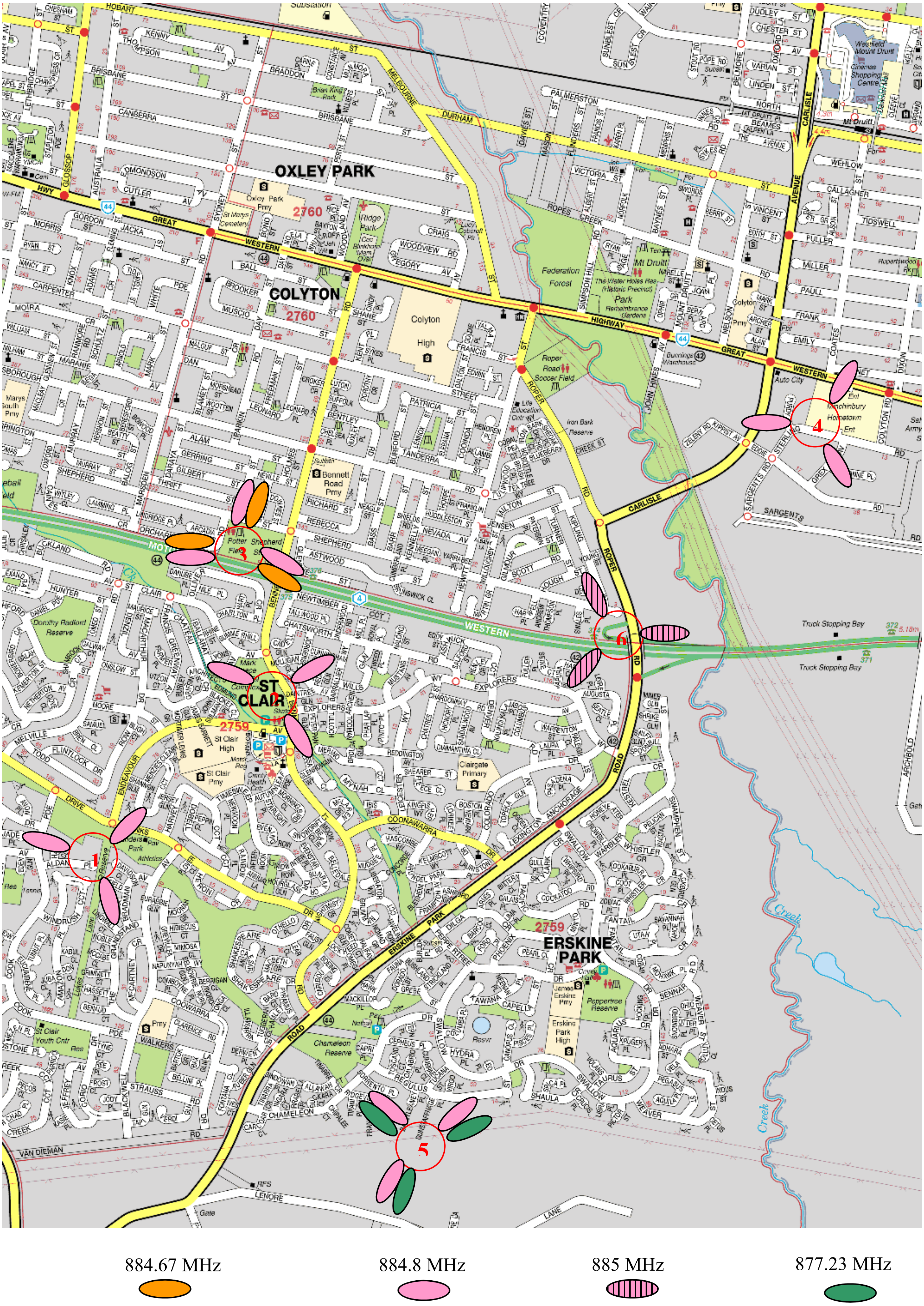
Guardband: frequency separation between the upper edge of one service and the lower edge of another service to achieve frequency planning compatibility between these services.

Frequency separation: difference between the centre frequencies of two channels.

Annex 1
UMTS and DVB-T sharing study site − St Clair

FIGURE 24

UMTS and DVB-T sharing study site − St Clair

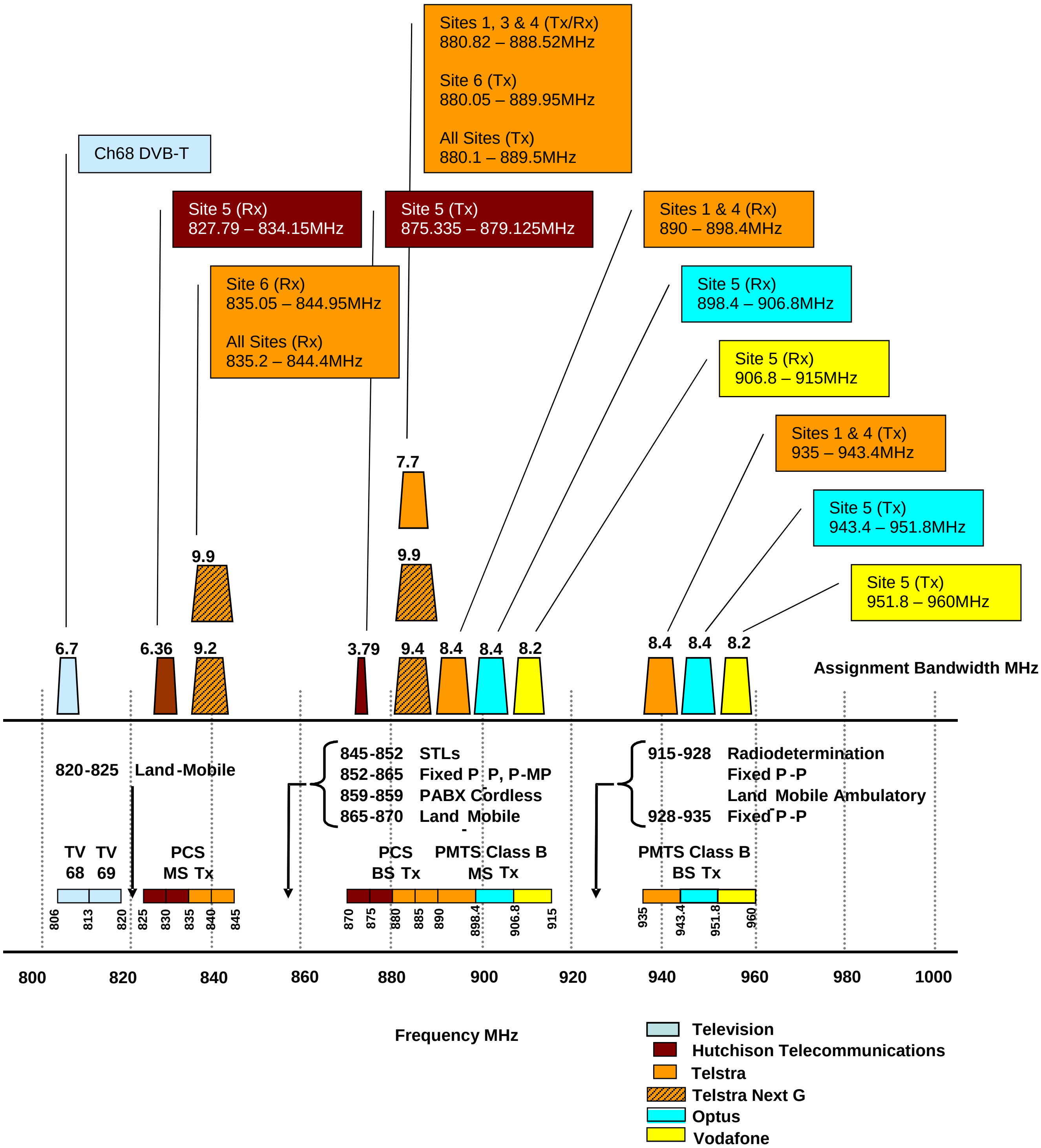


Annex 2

Channel plan and assignments

FIGURE 25

Channel plan and assignments



Annex 3

Impact of adjacent channel IMT-2000 base stations on broadcast coverage

1 Introduction

Many theoretical investigations have been carried out on DTTB-IMT-2000 compatibility. The results show a very significant interference effect, for the “reverse duplex” case when an IMT-2000 base station network is situated close to a co-channel DTTB service or is overlapping an adjacent channel DTTB service. Further reports of studies are contemplated and listed in § 8 of this Report.

The aim of this specific study is to examine the overlapping, adjacent channel interference scenario using IMT-2000 technical characteristics which are likely to be used in a “real world” situation. During the course of the studies within the Joint Task Group 5-6 an existing IMT-2000 network in Australia was surveyed and as a result a large amount of survey data and network characteristics were collected.

For specific examples, we have chosen two distinct DTTB coverage areas in Australia, one in a suburban environment (approximately 3 km × 1.6 km), St Clair (see Fig. 26), and the other in a rural environment (approximately 7.2 km × 7.6 km), Goulburn (see Fig. 27) (see larger views in Appendices 1 and 2).

FIGURE 26

St Clair coverage area

FIGURE 27

Goulburn coverage area

Although the test “scenarios” are located in Australia (where the current deployed IMT-2000 (UMTS) use “conventional duplex” transmission), the technical parameters were chosen to simulate the reverse duplex IMT-2000 case as this was the scenario previously studied.

In particular, the reverse duplex case is investigated in which three IMT-2000 base stations operate in Channel 61 (791-798 MHz) inside of a DTTB coverage area being served by an adjacent channel, 60 (782-790 MHz), 59 (774-782 MHz) or 58 (768-774 MHz) (i.e. with 1st, 2nd or 3rd channel adjacency) as this will be the model being planned in Europe.

Both St Clair and Goulburn have IMT-2000 services already operating in nearby frequency bands (between 800 to 900 MHz). Because those frequencies are close to frequencies expected to be used in the band above 790 MHz in Europe, the existing base station technical characteristics have been employed with the frequency "transposed" to channel 60, the relevant IMT-2000 adjacent channel position.

In order to conduct a meaningful study, the parameters to be used (other than the "transposed" frequency) were carefully selected to correspond to those actually used in practice in the base stations operating in St Clair and Goulburn, respectively.

Similarly, the broadcast frequencies used in St Clair and Goulburn are "transposed" to channels 58, 59 and 60 for the sake of the investigation. All other technical parameters are those actually used by the St Clair and Goulburn DTTB broadcast stations, respectively.

The present study deals with:

– the suburban DTTB coverage situation in the vicinity of St Clair.

  The complete set of technical parameters used for DTTB and IMT-2000 are provided in Appendix 1;

– the rural DTTB coverage situation in the vicinity of Mt Gray (Goulburn).

  The complete set of technical parameters used for DTTB and IMT-2000 are provided in Appendix 2.

In addition, ITU-R DTTB Planning Handbook parameters are used. In particular, a 95% location probability for "good" reception is used for planning, and a 70% location probability for "adequate" reception.

A computer program has been written to calculate the interference effects on a "local" basis. That is to say, the two DTTB coverage areas, rural and suburban, were divided into small-area "pixels" (i.e. approximately 100 m × 100 m) and the interference effects were evaluated within each pixel. In order to provide the most accurate calculation results, Monte-Carlo simulations were used.

The present report details the results of the corresponding downlink interference calculations.

2 The calculation methodology

The interference caused to the DTTB coverage areas was calculated using Monte-Carlo techniques.

In particular, interference situations involving 1st adjacent channel, 2nd adjacent channel and 3rd adjacent channel IMT-2000 interference, with corresponding protection ratios, were investigated.

Two basic scenarios were investigated – a suburban DTTB reception area and a rural DTTB reception area. The areas are approximately 3 km × 1.6 km and 7.6 km × 7.2 km in size, respectively. The actual DTTB transmit and receive antenna patterns were taken into account (both vertical and horizontal discrimination).

Three base station interferers were investigated in each scenario. Each base station transmits with a multi-sectored antenna (and/or an omnidirectional antenna in the case of Goulburn). The actual transmit antenna patterns were taken into account (using both the vertical and horizontal discrimination patterns).

The location probabilities within each 100 m × 100 m pixel were calculated throughout the two test areas in the presence of noise and also in the presence of the three interfering base stations. Cumulative interference effects were calculated. The results of the location probabilities calculated are shown in pictorial format. Location probabilities which fall below 95% ("good" coverage) and 70% ("adequate" coverage) are examined in more detail.

The degradation in the location probability, Δ_{LP}, (or "interference loss", IL) which is equivalent to the probability of lost DTTB reception due to the base station interference was also calculated in each pixel and the results are also presented in a pictorial format.

3 The parameters

Two representative DTTB coverage scenarios in Australia were chosen:

– a suburban DTTB reception area ("St Clair");

– a rural DTTB reception area ("Goulburn").

The technical parameters for the DTTB and base station transmitters for the St Clair calculations are summarized in Appendix 1.

The technical parameters for the DTTB and base station transmitters for the Goulburn calculations are summarized in Appendix 2.

4 The calculations

Monte-Carlo simulations are used to determine the location probability and interference loss (the degradation of the location probability) on a "local basis". That is to say, DTTB coverage areas investigated are divided into a set of 100 m × 100 m pixels. To provide "good" statistics, in the St Clair simulation, the wanted and interfering signals are calculated at 250 000 randomly selected points within each pixel; in the Goulburn simulation, 150 000 random points were selected in each pixel.

The wanted field strength and the interfering base station field strengths were calculated at each random point using the JTG 5-6 propagation prediction methodology. This methodology allows propagation predictions to be made for distances between 1 m and 1 000 km.

If the wanted field strength is greater than the nuisance field (i.e. the power summed individual nuisance fields of the base station interferers and the noise nuisance field) at a given point of investigation, the point is considered to be "covered" (i.e. to give an acceptable reception quality), otherwise the point is not covered.

The percentage of the points which are covered determines the "location probability" (LP) within each pixel.

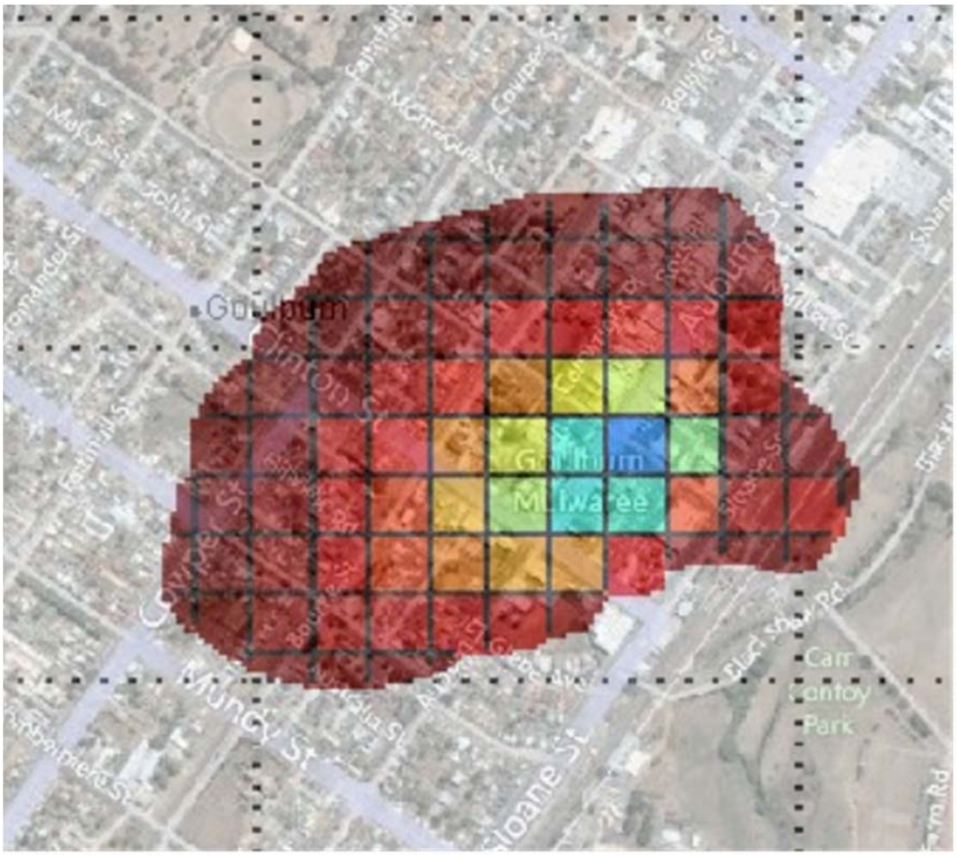
The difference between the LP in the presence of noise only and the LP in the presence of noise and the base station interference determines the degradation of the location probability, Δ_{LP}, for DTTB reception. For example, if the LP in the presence of noise only is LP_N and the LP in the presence of noise and base station interference is LP_{NBS}, then $\Delta_{LP} = LP_N - LP_{NBS}$, which represents the percentage loss of coverage due to the interference. In some of the figures given in the results this loss is also referred to as "IL" (interference loss).

If the population statistics of each pixel are also known, then the loss of viewers in each pixel can be calculated. For example, if the location probabilities with noise only, and with noise and base station interference are LP_N = 98% and LP_{NBS} = 92%, respectively, then the degradation in location probability is Δ_{LP} = 98 – 92 = 6%. If there are, say, approximately 100 viewers within the pixel under consideration, then .06 × 100 = 6 viewers in that pixel will be lost due to the base station interference.

For a visual example, we take a preview look at some of the results discussed below. In Fig. 28, we see a coloured grid which overlays a geographical map. The geographical map has an indication of existing houses. The colours of the little (100 m × 100 m) squares represent the location probabilities within the corresponding little squares. The "blue" to "yellow" shadings represents a location probability loss ranging from 50% to 95%, respectively. This means that between approximately 50% to 95% of the households/viewers within those pixels will lose DTTB coverage when subject to an adjacent channel base station interferer.

FIGURE 28

Location probability can be translated into population/viewer loss statistics



5 The results

The pixels of the coverage areas being considered are projected on the coordinate axes as shown in the figures. The longitude (in degrees) is shown on the horizontal axis, and the latitude (in degrees) is shown on the vertical axis. The very small squares within the coverage areas represent the 100 m × 100 m pixels within those areas. The location probabilities (LPs) within each pixel are indicated using a colour scale.

The suburban results are presented in § 5.1, the urban results in § 5.2. The subsections deal with the 1st, 2nd and 3rd adjacent channel interference, respectively.

It will be seen that the effect of the IMT-2000 interference on adjacent channels will be to "punch" "DTTB coverage holes" into the otherwise "good" DTTB coverage areas.

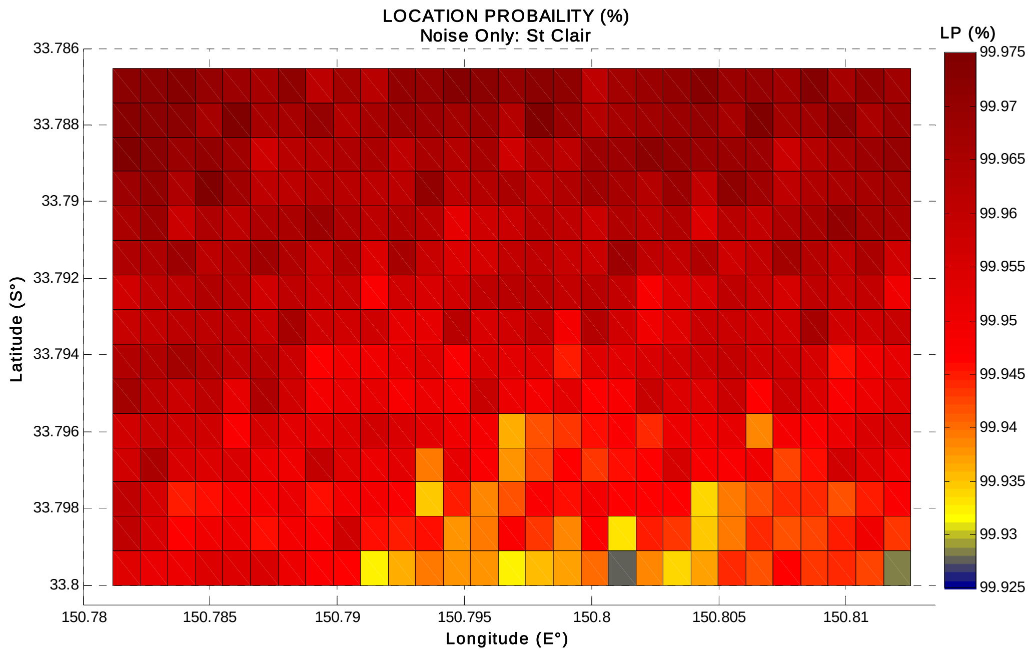
5.1 Suburban DTTB scenario (St Clair)

In Fig. 29, the portion of the St Clair coverage area being considered is projected on the coordinate axis shown. The multi-coloured "rectangle" (and the small square pixels) within the coordinate grid represents the St Clair coverage area under study.

Monte-Carlo simulations were carried out within each pixel to determine the location probability in the presence of noise only. Figure 29 shows that, in the presence of noise only, the LP in each pixel is above 99.928%. Figure 29, dealing only with noise, is independent of whether the 1st, 2nd or 3rd adjacent channel interference is being considered, and will be referred to repeatedly in the following subsections.

FIGURE 29

Location probability: St Clair, noise only



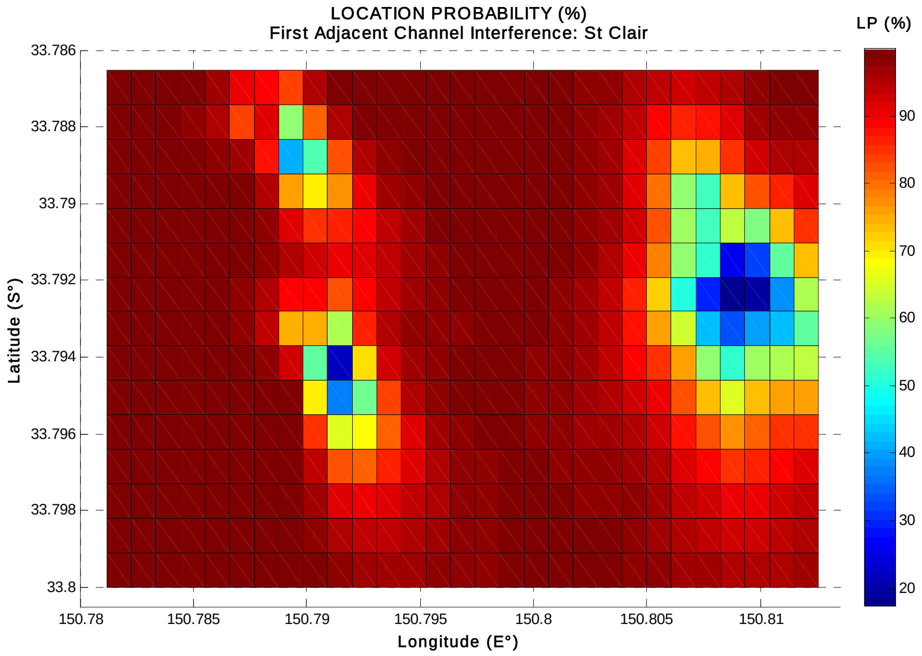
5.1.1 1st adjacent channel base station interference (protection ratio = −30 dB)

Figure 30 shows the LP within each pixel in the presence of noise and the first adjacent channel interference (PR = −30 dB) due to the three base stations. Recall that each pixel is a 100 m × 100 m square.

The three multi-coloured "patches" correspond to base station site 2 ("Shepherd St", upper left-hand "patch"), base station site 3 ("Bennett Rd", lower left-hand "patch") and base station site 3 ("Roper Rd", right-hand "patch"), respectively.

FIGURE 30

Location probability: noise and 1st adjacent channel IMT-2000 interference

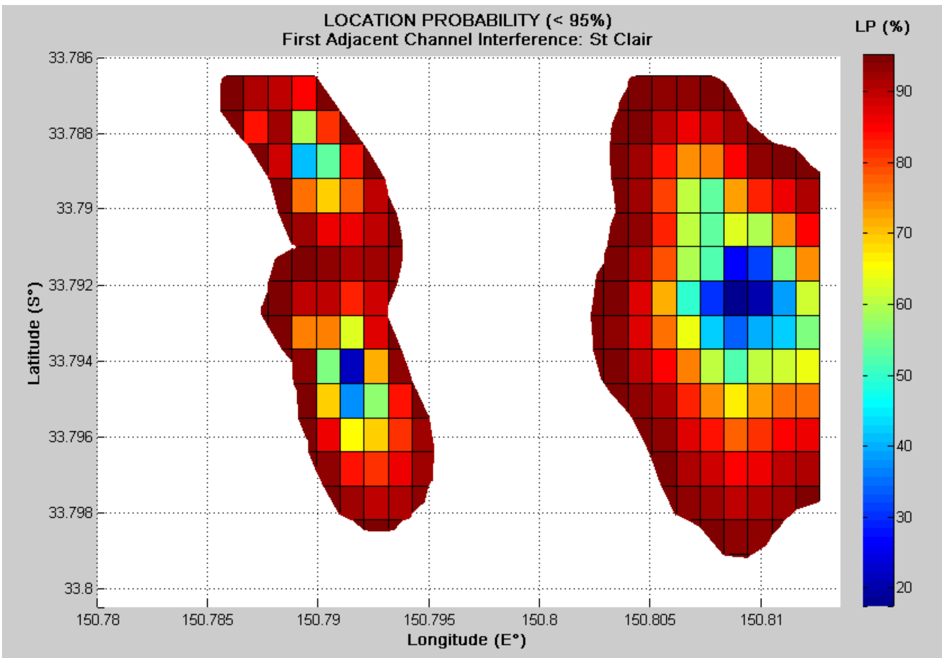


5.1.1.1 LP < 95%

Figure 31 is a close-up view of Fig. 30, giving the details of those pixels whose LPs have dropped from ≅ 100% to below 95% (the level above which the coverage in the pixel is considered to be "good"). Levels as low as LP = 17.5% are reached. It is seen that the interfered pixels cover a total area of the order of nearly 500 m × 1 500 m up to 1 000 m × 1 500 m.

FIGURE 31

Coverage areas with location probability below 95%

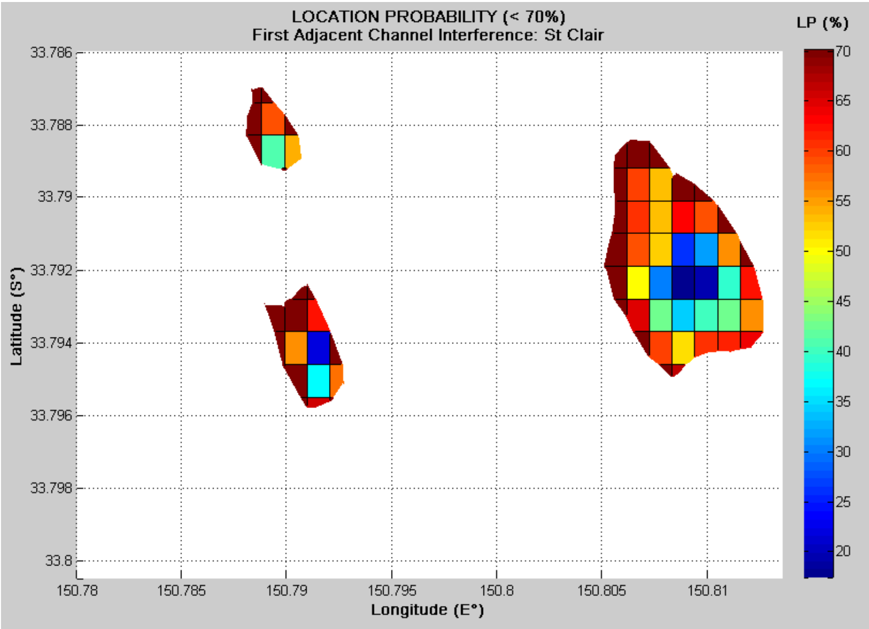


5.1.1.2 LP < 70%

Figure 32 is a close-up view of Fig. 30, giving the details of those pixels whose LPs have dropped from ≅ 100% to below 70% (the level above which the coverage in the pixel is considered to be "adequate"). Levels as low as LP = 17.5% are reached. It is seen that the interfered pixels cover areas of the order of nearly 200 m × 200 m, 300 m × 300 m, up to approximately 700 m × 700 m.

FIGURE 32

Coverage areas with location probability below 70%

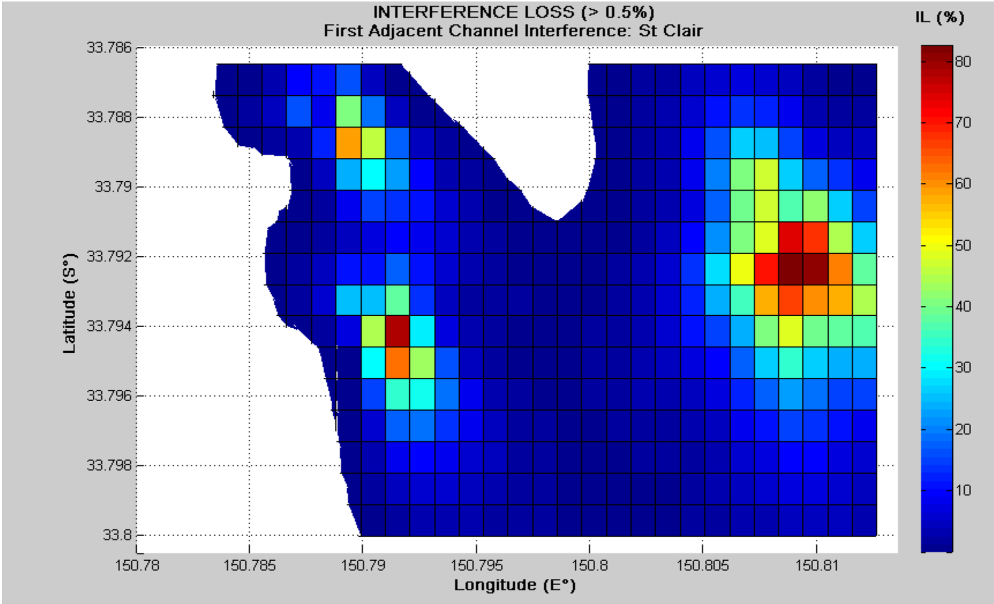


5.1.1.3 IL > 0.5%

Figure 33 shows Δ_{LP} (the "interference loss", IL) for the pixels within the coverage area under consideration. It is seen that the interference loss can range from less than 1% to approximately 82.5%, and this loss affects more that 75% of the area under consideration. Recall, this means that from 1% to approximately 82.5% of the viewers would most likely be lost within the pixels in question.

FIGURE 33

Coverage areas with interference loss (Δ_{LP}) greater than 0.5%



5.1.2 2nd adjacent channel base station interference (protection ratio = −40 dB)

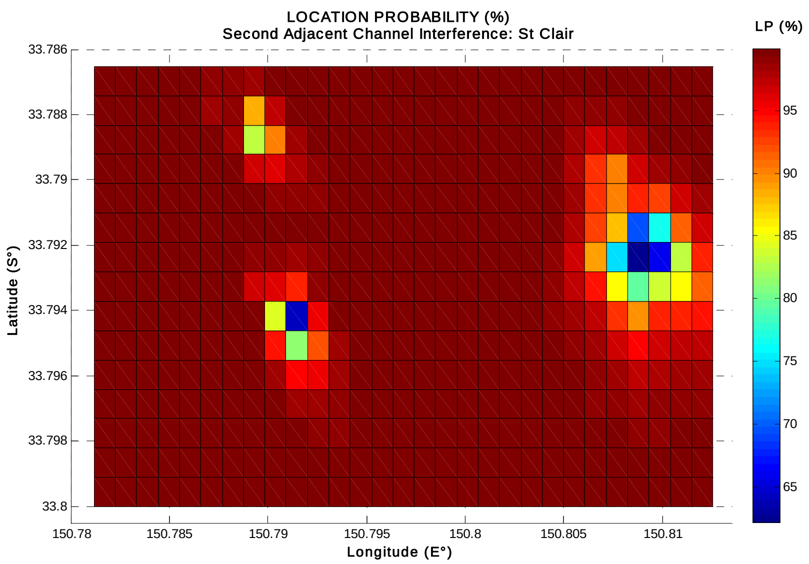
As in the 1st adjacent channel case, Fig. 29 shows that, in the presence of noise only, the LP in each pixel is, essentially, 100%.

Figure 34 shows the LP within each pixel in the presence of noise and the second adjacent channel interference (PR = −40 dB) due to the three base stations. Recall that each pixel is a 100 m × 100 m square.

The three multi-coloured "patches" correspond to base station site 2 ("Shepherd St", upper left-hand "patch"), base station site 3 ("Bennett Rd", lower left-hand "patch") and base station site 3 ("Roper Rd", right-hand "patch"), respectively.

FIGURE 34

Location probability: noise and 2nd adjacent channel IMT-2000 interference

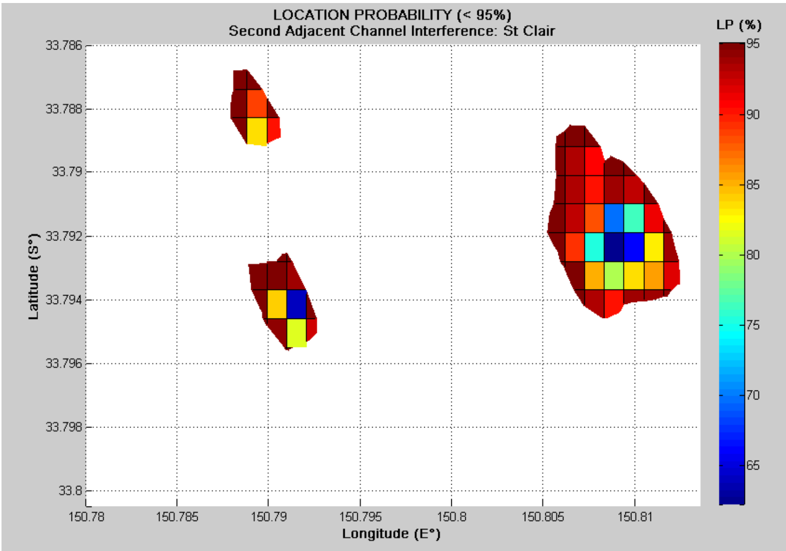


5.1.2.1 LP < 95%

Figure 35 is a close-up view of Fig. 34, giving the details of those pixels whose LPs have dropped from ≅ 100% to below 95% (the level above which the coverage in the pixel is considered to be "good"). Levels as low as LP = 62% are reached. It is seen that the interfered pixels cover area of the order of nearly 200 m × 200 m, 300 m × 300 m, up to approximately 700 m × 700 m.

FIGURE 35

Coverage areas with location probability below 95%

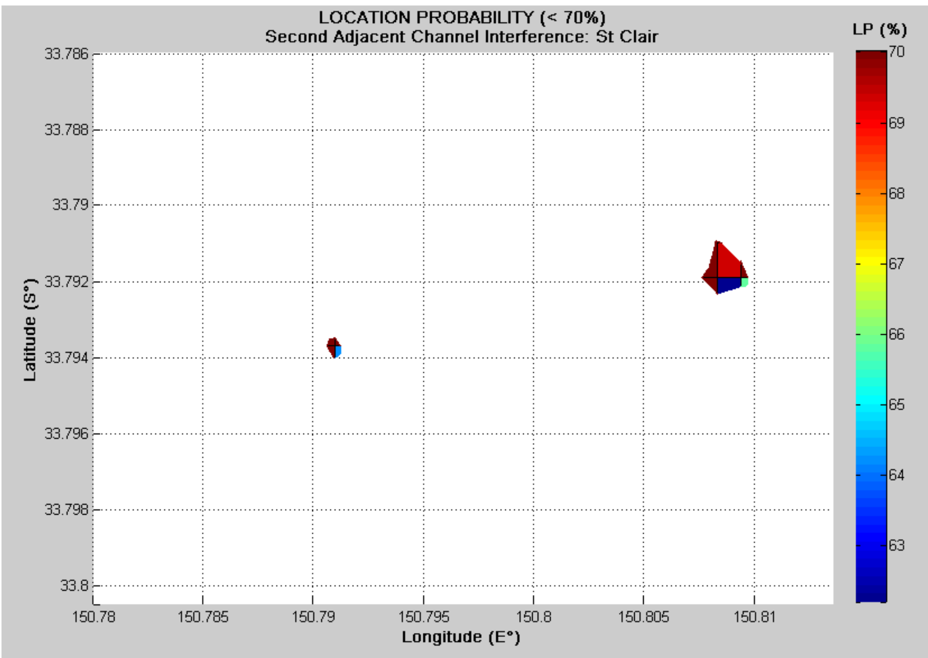


5.1.2.2 LP < 70%

Figure 36 is a close-up view of Fig. 34, giving the details of those pixels whose LPs have dropped from ≅ 100% to below 70% (the level above which the coverage in the pixel is considered to be "adequate").

FIGURE 36

Coverage areas with location probability below 70%

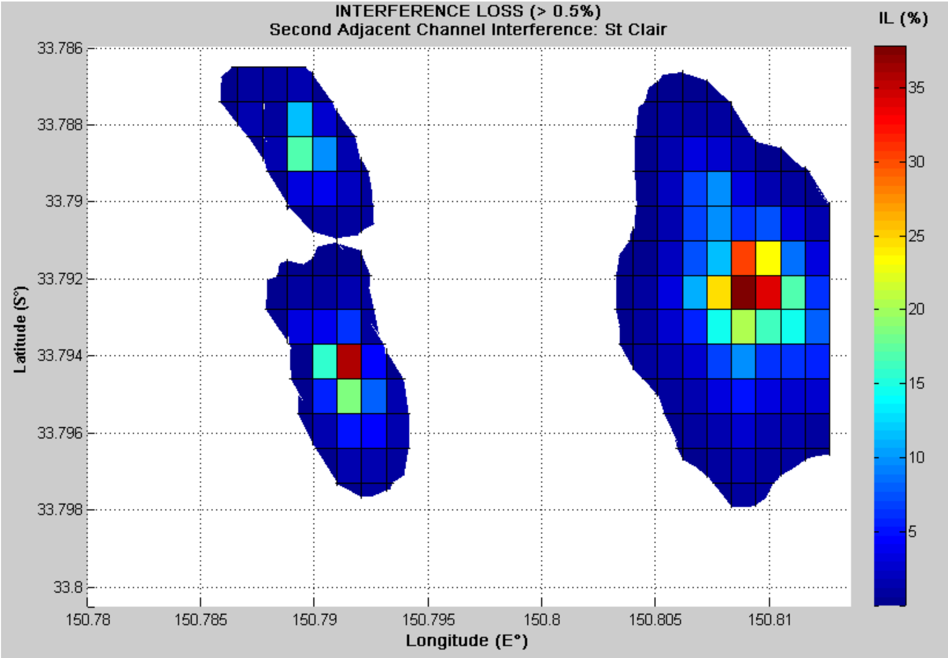


5.1.2.3 IL > 0.5%

Figure 37 shows the Δ_{LP} (interference loss, IL) for the pixels within the coverage area under consideration. It is seen that the IL can range from less than 1% to approximately 38%.

FIGURE 37

Coverage areas with interference loss (Δ_{LP}) greater than 0.5%



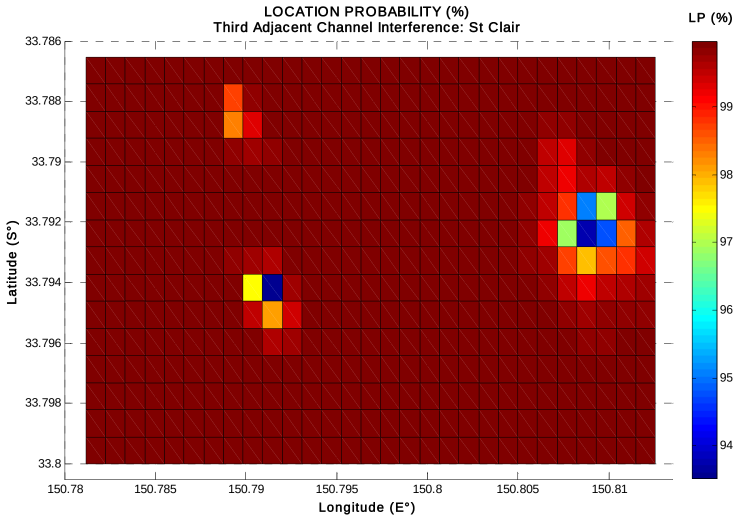
5.1.3 3rd adjacent channel base station interference (protection ratio = −50 dB)

As in the 1st adjacent channel case, Fig. 29 shows that, in the presence of noise only, the LP in each pixel is ≅ 100%.

Figure 38 shows the LP within each pixel in the presence of noise and the third adjacent channel interference (PR = −50 dB) due to the three base stations. The three multi-coloured "patches" correspond to base station site 2 ("Shepherd St", upper left-hand "patch"), base station site 3 ("Bennett Rd", lower left-hand "patch") and base station site 1 ("Roper Rd", right-hand "patch"), respectively.

FIGURE 38

Location probability: noise and 3rd adjacent channel IMT-2000 interference

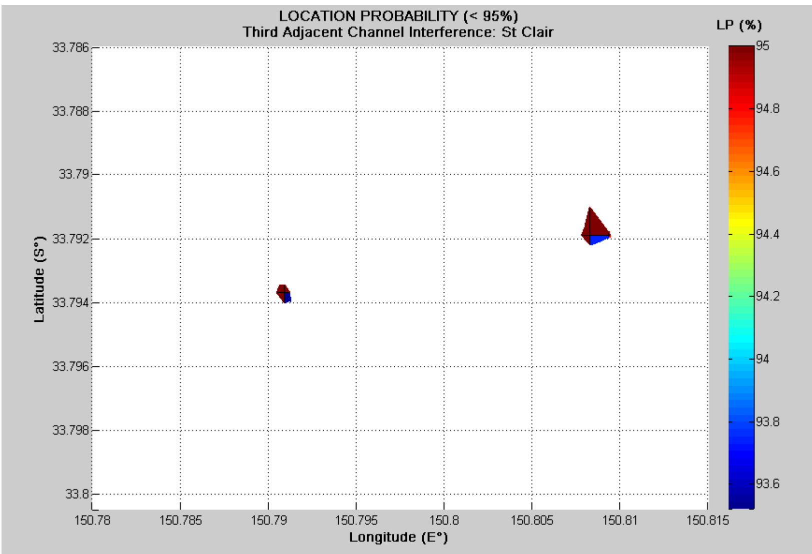


5.1.3.1 LP < 95%

Figure 39 is a close-up view of Fig. 38, giving the details of those pixels whose LPs have dropped from ≅ 100% to 95% (the level above which a pixel is considered have "good" coverage). Levels as low as LP = 93.5% are reached. It is seen that the interfered area is the size of a pixel.

FIGURE 39

Coverage areas with location probability below 95%

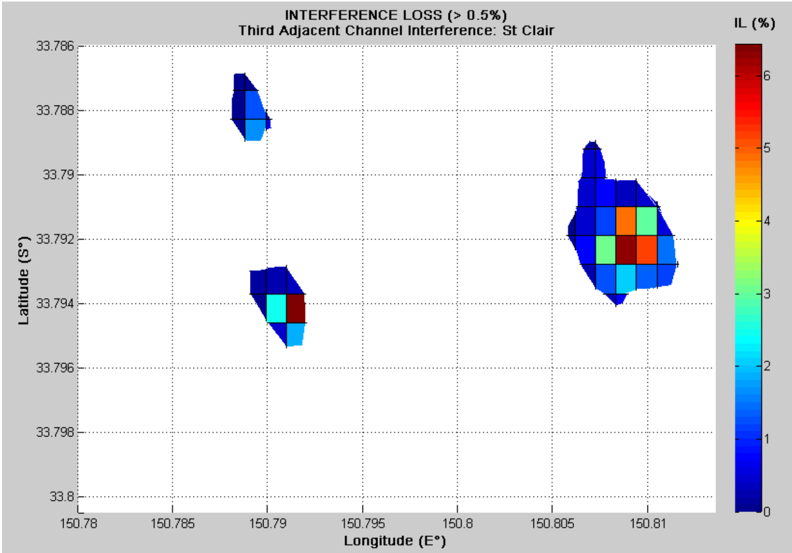


5.1.3.2 IL > 0.5%

Figure 40 shows the IL for the pixels within the coverage area under consideration. It is seen that the IL can range from less than 1% to approximately 6.5%.

FIGURE 40

Coverage areas with interference loss (Δ_{LP}) greater than 0.5%



5.2 Rural DTTB scenario (Goulburn)

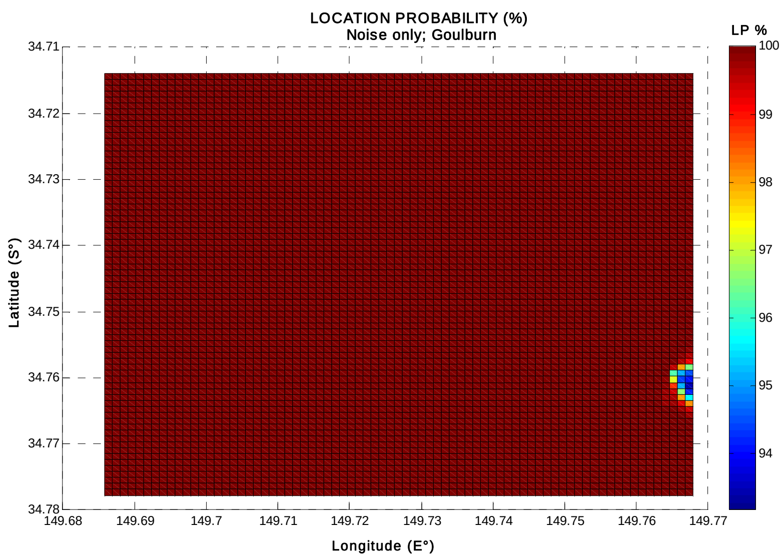
In this section we will consider the "sectored" base station transmit antenna type. The omni-sectors present at the Goulburn base stations (as indicated in Table 28 of Appendix 2) have not been included in this study and the impact relating to the aggregate effect of the combined omni/sector panels would require further study.

In Fig. 41, the portion of the Goulburn coverage area being considered is shown (the rectangle within the "grid"). The very small squares (5 472 of them) represent the pixels within that area.

Figure 41 shows that, in the presence of noise only, the LP in each pixel is 100%, except in the proximity of the DTTB transmitter (due to the transmit antenna vertical attenuation) where the LP only reaches 93.2% (multi-coloured "patch" at the right). Figure 41 is independent of whether the 1st, 2nd or 3rd adjacent channel interference is being considered.

FIGURE 41

Location probability: Goulburn, noise only



5.2.1 Multi-sectored base station antenna

In Fig. 41, the portion of the Goulburn coverage area being considered is shown (the rectangle within the "grid"). The very small squares (5 472 of them) represent the pixels within that area.

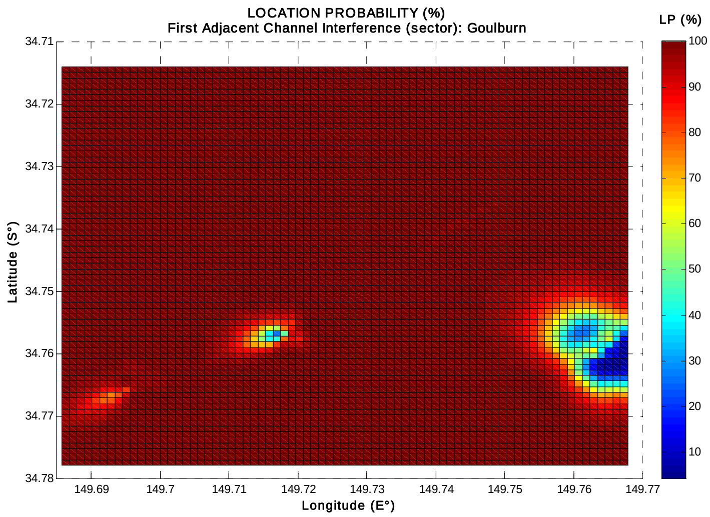
Figure 41 shows that, in the presence of noise only, the LP in each pixel is 100%. Figure 41 is independent of whether the 1st, 2nd or 3rd adjacent channel interference is being considered.

5.2.1.1 1st adjacent channel base station interference (protection ratio = −30 dB)

Figure G.1.1 shows the LP within each pixel in the presence of noise and the first adjacent channel interference (PR = −30 dB) due to the three base stations. The three multi-coloured "patches" correspond to base station site 2 ("Auburn St", middle upper "patch") and base station site 3 ("Knox St", lower left hand "patch"), and base station 1 ("Mt Gray", large, right hand "patch").

FIGURE 42

Location probability: noise and 1st adjacent channel IMT-2000 interference

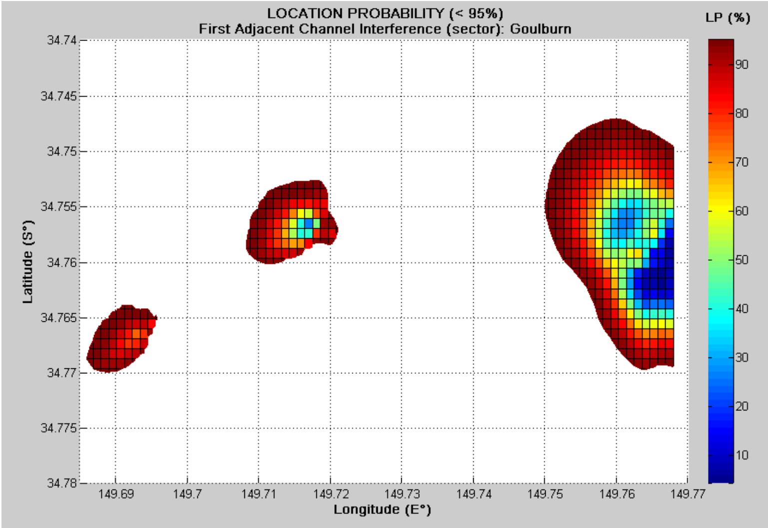


5.2.1.2 LP < 95%

Figure 43 is a close-up view of Fig. 42, giving the details of those pixels whose LPs have dropped from 100% (93.2%) to below 95% (the level above which the coverage in the pixel is considered to be "good"), as low as 9%. It is seen that the interfered pixels cover total area of the order of nearly 700 m × 700 m up to 2 500 m × 2 500 m.

FIGURE 43

Coverage areas with location probability below 95%

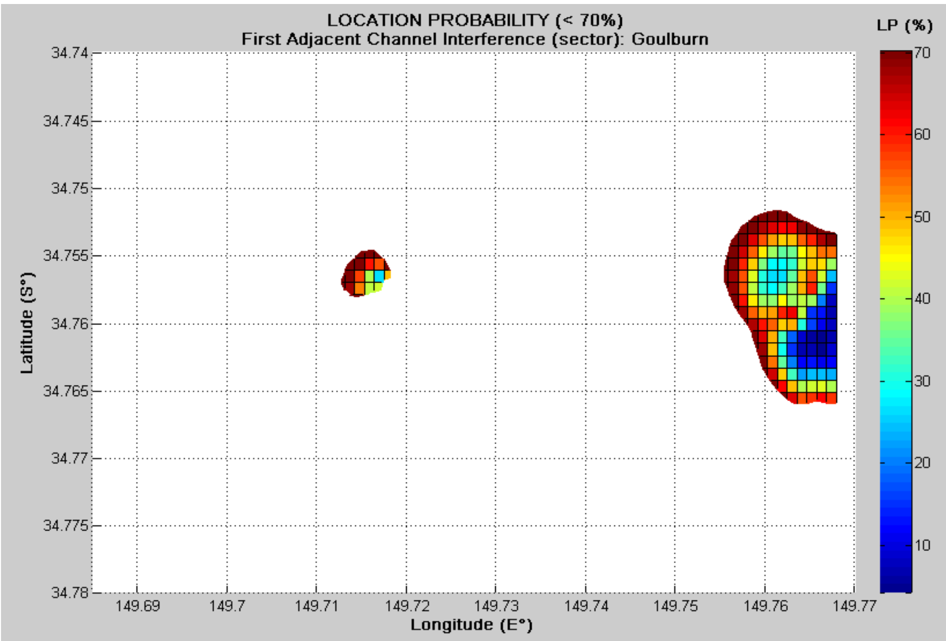


5.2.1.3 LP < 70%

Figure 44 is a close-up view of Fig. 42, giving the details of those pixels whose LPs have dropped from 100% to below 70% (the level above which the coverage in the pixel is considered to be "adequate"). Note that site 3 ("Knox St", lower left hand "patch") does not dip below 70% (and so is no longer visible).

FIGURE 44

Coverage areas with location probability below 70%

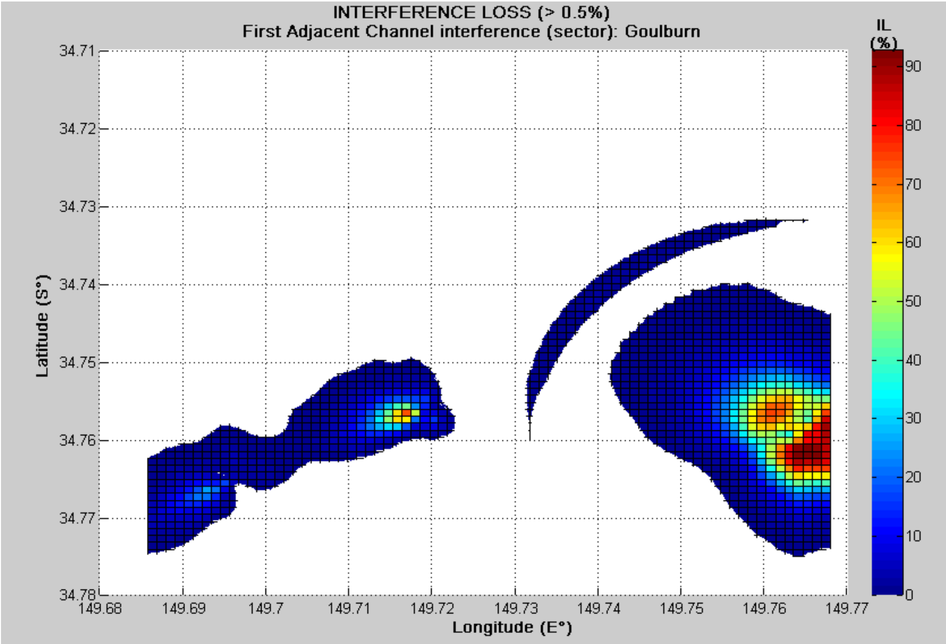


5.2.1.4 IL > 0.5%

Figure 45 shows the IL for the pixels within the coverage area under consideration. It is seen that the IL can range from less than 1% to approximately 93%. Recall, this means that between approximately 1% to approximately 93% of the viewers would most likely be lost within the pixels in question.

FIGURE 45

Coverage areas with interference loss (Δ_{LP}) greater than 0.5%



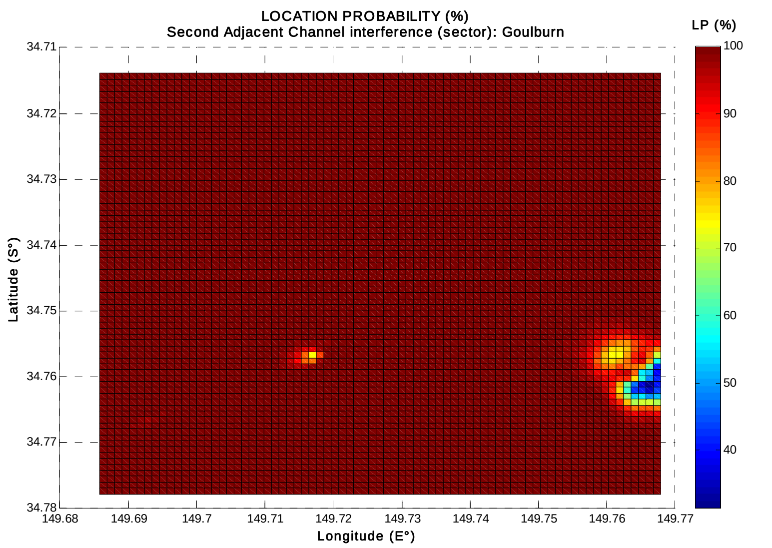
5.2.2 2nd adjacent channel base station interference (protection ratio = −40 dB)

As in the 1st adjacent channel case, Fig. 41 shows that, in the presence of noise only, the LP in each pixel is 100%.

Figure 46 shows the LP within each pixel in the presence of noise and the first adjacent channel interference (PR = −40 dB) due to the three base stations. The two multi-coloured "patches" correspond to base station site 2 ("Auburn St", middle "patch"), and base station 1 ("Mt Gray", right hand "patch"). Base station site 3 ("Knox St") does not cause significant interference, and thus is not visible in the figure.

FIGURE 46

Location probability: noise and 2nd adjacent channel IMT-2000 interference

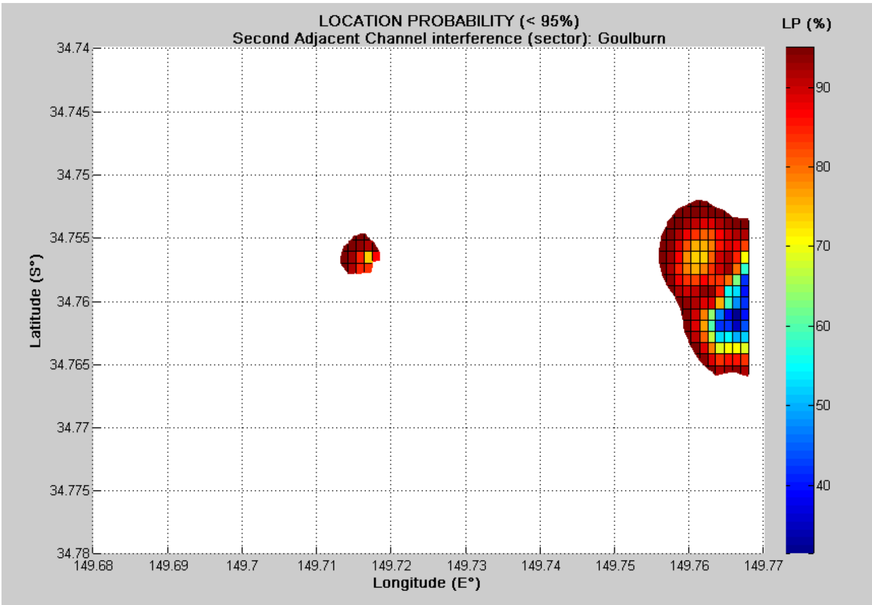


5.2.2.1 LP < 95%

Figure 47 is a close-up view of Fig. 46, giving the details of those pixels whose LPs have dropped from 100% to below 95% (the level above which a pixel is considered have "good" coverage), as low as 31%. It is seen that the interfered pixels cover total area of the order of nearly 300 m × 300 m up to 1 400 m × 1 400 m.

FIGURE 47

Coverage areas with location probability below 95%

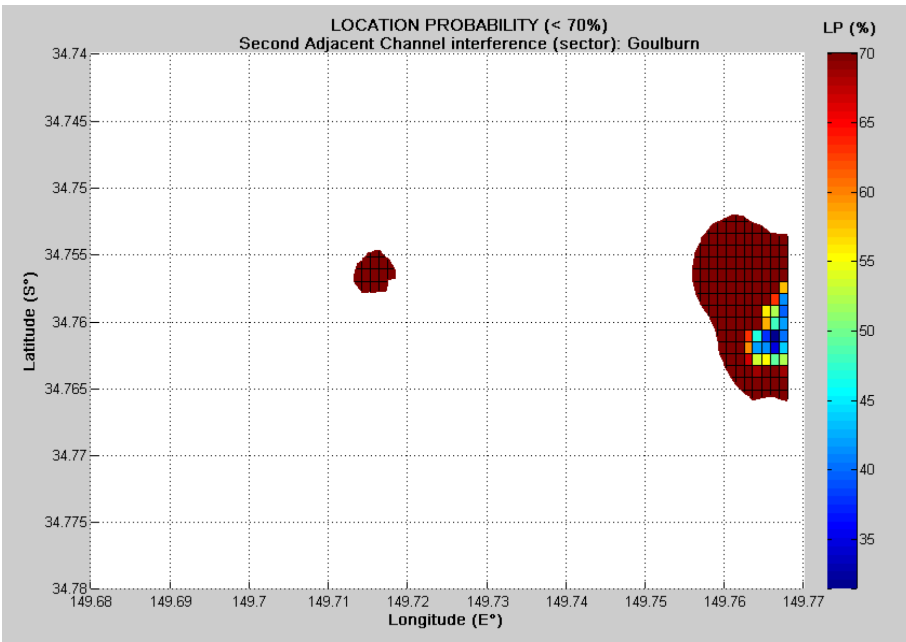


5.2.2.2 LP < 70%

Figure 48 is a close-up view of Fig. 46, giving the details of those pixels whose LPs have dropped from 100% to below 70% (the level above which a pixel is considered have "adequate" coverage).

FIGURE 48

Coverage areas with location probability below 70%

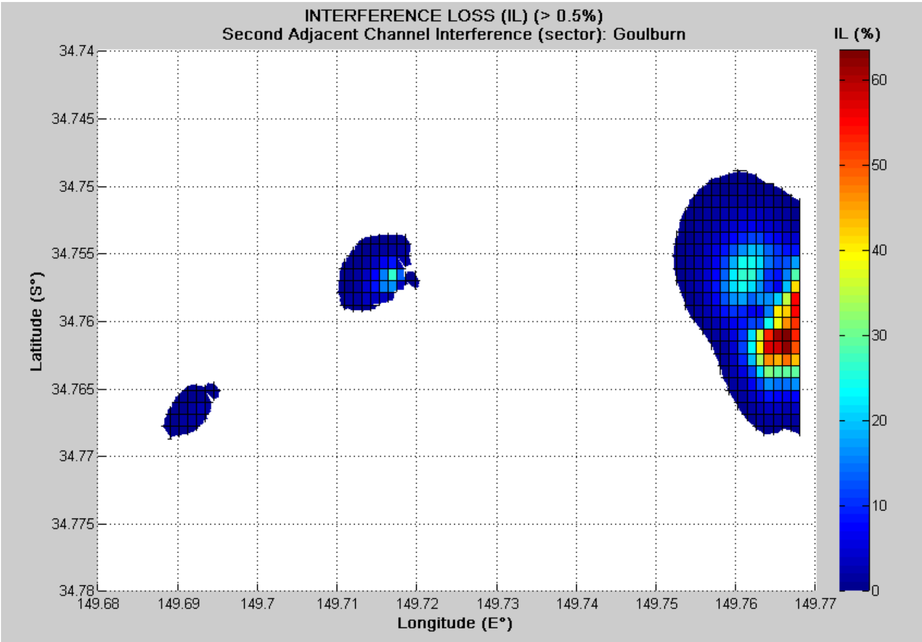


5.2.2.3 IL > 0.5%

Figure 49 shows the IL for the pixels within the coverage area under consideration. It is seen that the IL can range from less than 1% to approximately 64%. Base station site 3 ("Knox St") reappears in this figure as it causes 1 or 2% interference loss.

FIGURE 49

Coverage areas with interference loss (Δ_{LP}) greater than 0.5%



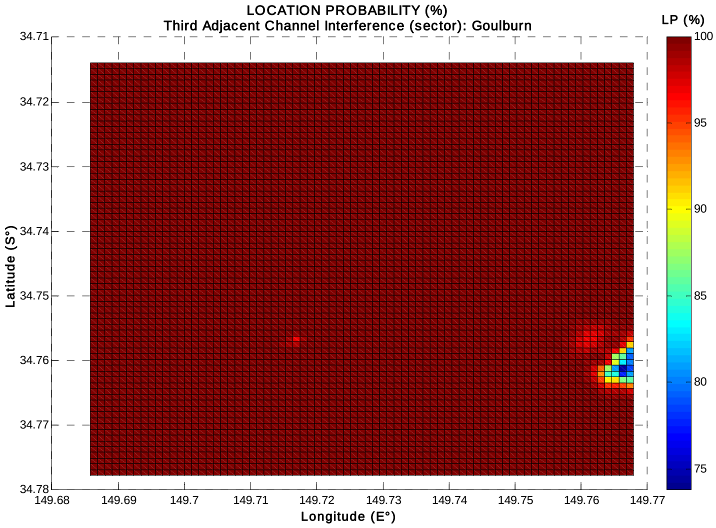
5.2.3 3rd adjacent channel base station interference (protection ratio = −50 dB)

As in the 1st and 2nd adjacent channel cases, Fig. 41 shows that, in the presence of noise only, the LP in each pixel is 100%.

Figure 50 shows the LP within each pixel in the presence of noise and the first adjacent channel interference (PR = −50 dB) due to the three base stations. The two multi-coloured "patches" correspond to base station site 2 ("Auburn St", middle upper "patch"), and base station 1 ("Mt Gray", large, right hand "patch"). Base station site 3 ("Knox St") does not appear as the interference it causes is minimal.

FIGURE 50

Location probability: noise and 3rd adjacent channel IMT-2000 interference

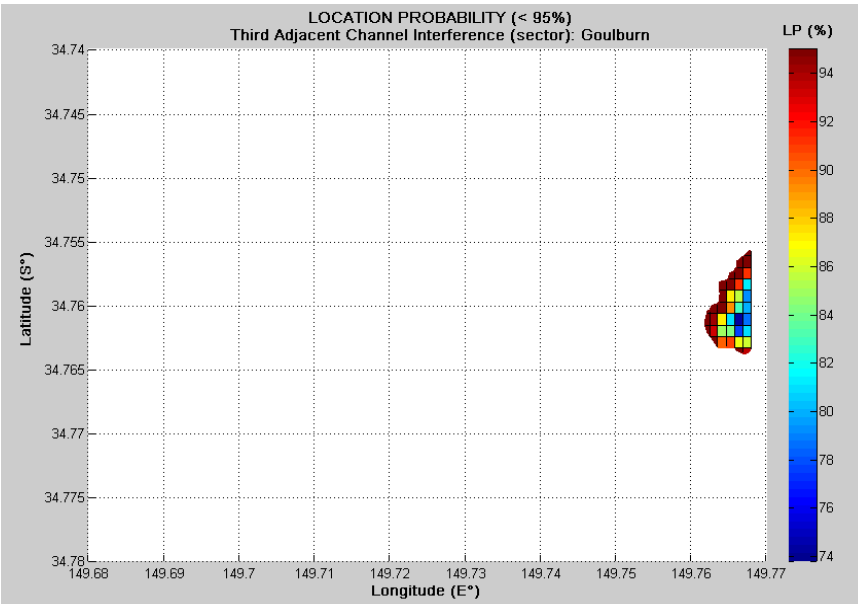


5.2.3.1 LP < 95%

Figure 51 is a close-up view of Fig. 50, giving the details of those pixels whose LPs have dropped from 93.2% to approximately 74%. It is seen that the interfered pixels cover total area of the order of nearly 800 m × 800.

FIGURE 51

Coverage areas with location probability below 95%

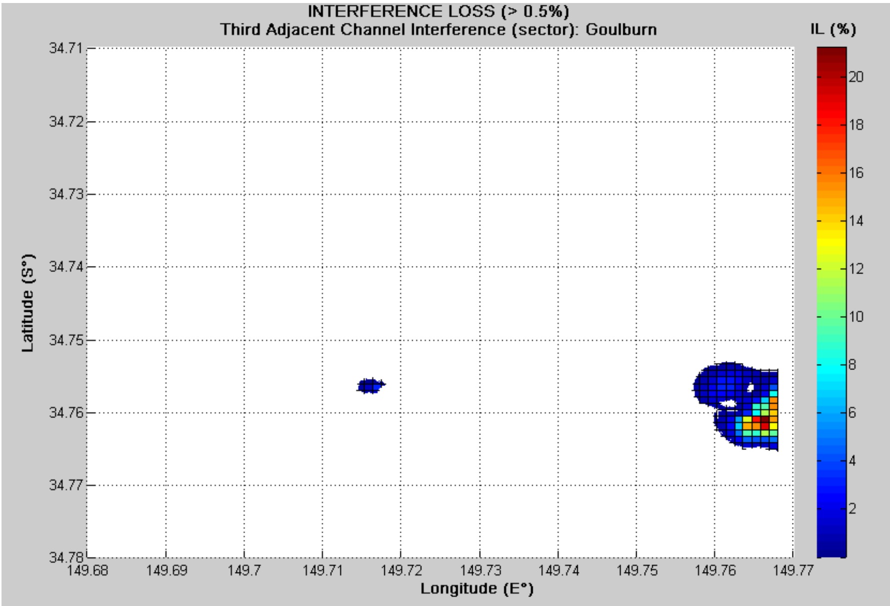


5.2.3.2 IL > 0.5%

Figure 52 shows the IL for the pixels within the coverage area under consideration. It is seen that the IL can range from less than 1% to approximately 21%. The base station transmitter site 3 (Knox St) does not appear in Fig. 52 (because the IL values are below 0.5%).

FIGURE 52

Coverage areas with interference loss (Δ_{LP}) greater than 0.5%



6 Practical coverage implications

Section 5 has shown the results of the Monte-Carlo interference calculations in terms of loss in location probability.

In both areas considered, St Clair and Goulburn, sub-areas were calculated where the original location probability has dropped from nearly 100% in the presence of noise only, to as low as 5% in the presence of base station adjacent channel interference.

6.1 St Clair

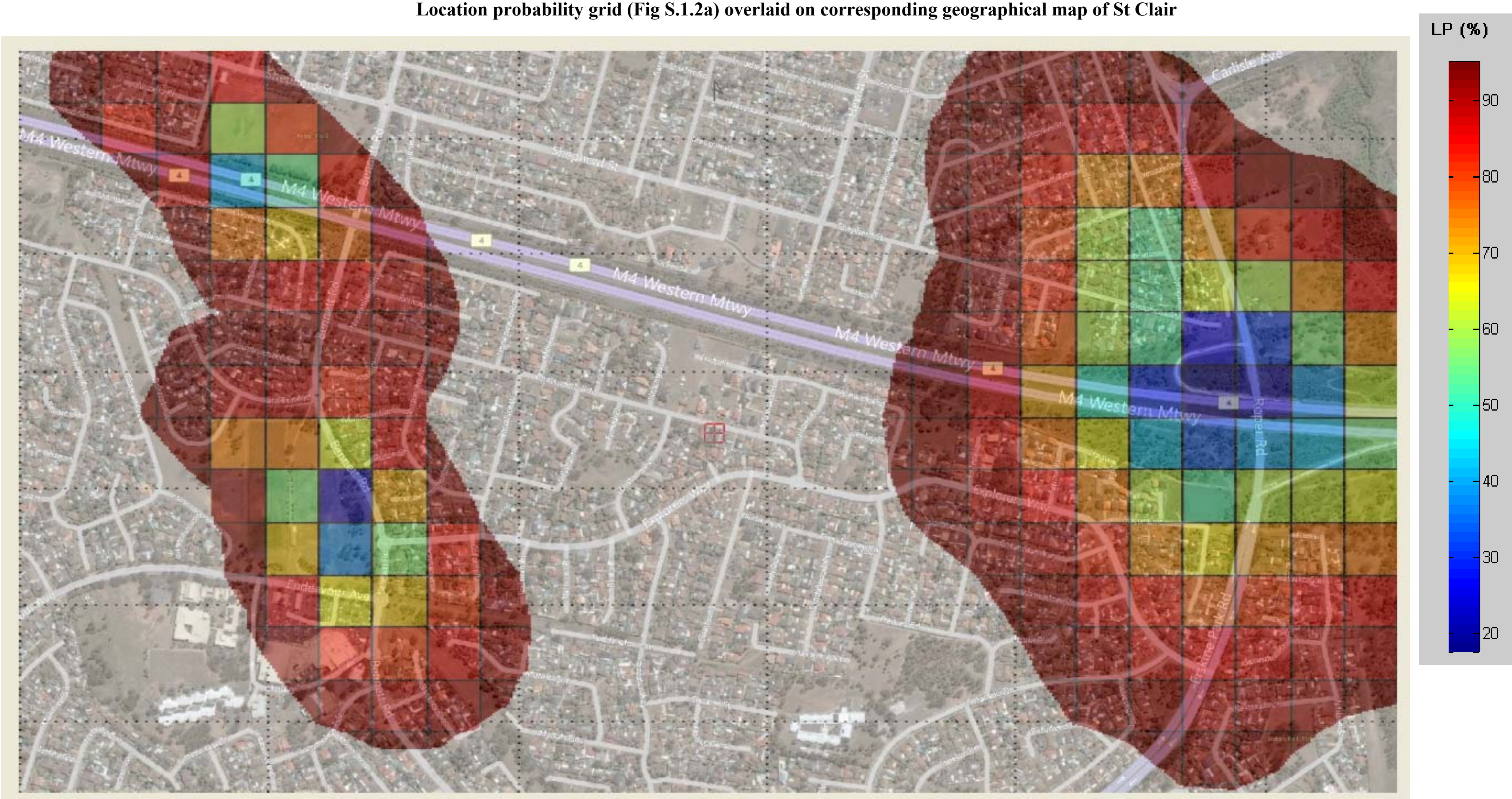
In Fig. 53 we see an overlay of Fig. 31 (location probability with 1st adjacent channel interference in St Clair) on an overhead view of the area considered.

For the present study, we estimated the number of households contained within the 95% contour lines shown in Fig. 53 for St Clair. This has been concluded as the number of "rooftops" in the concerned areas at approximately 265 households in total under the two contours (the right-most contour is really the fusion of two contours).

The loss in location probability ranges from approximately 5% (= 100% – 95%) up to approximately 82% (= 100% – 18%). For the purpose of establishing an estimate, we take an average loss of 50%, meaning approximately 132 households losing DTTB reception. And counting 2.6 viewers per household, we can estimate approximately 343 lost DTTB viewers.

FIGURE 53

Location probability grid (Fig S.1.2a) overlaid on corresponding geographical map of St Clair



6.2 Goulburn

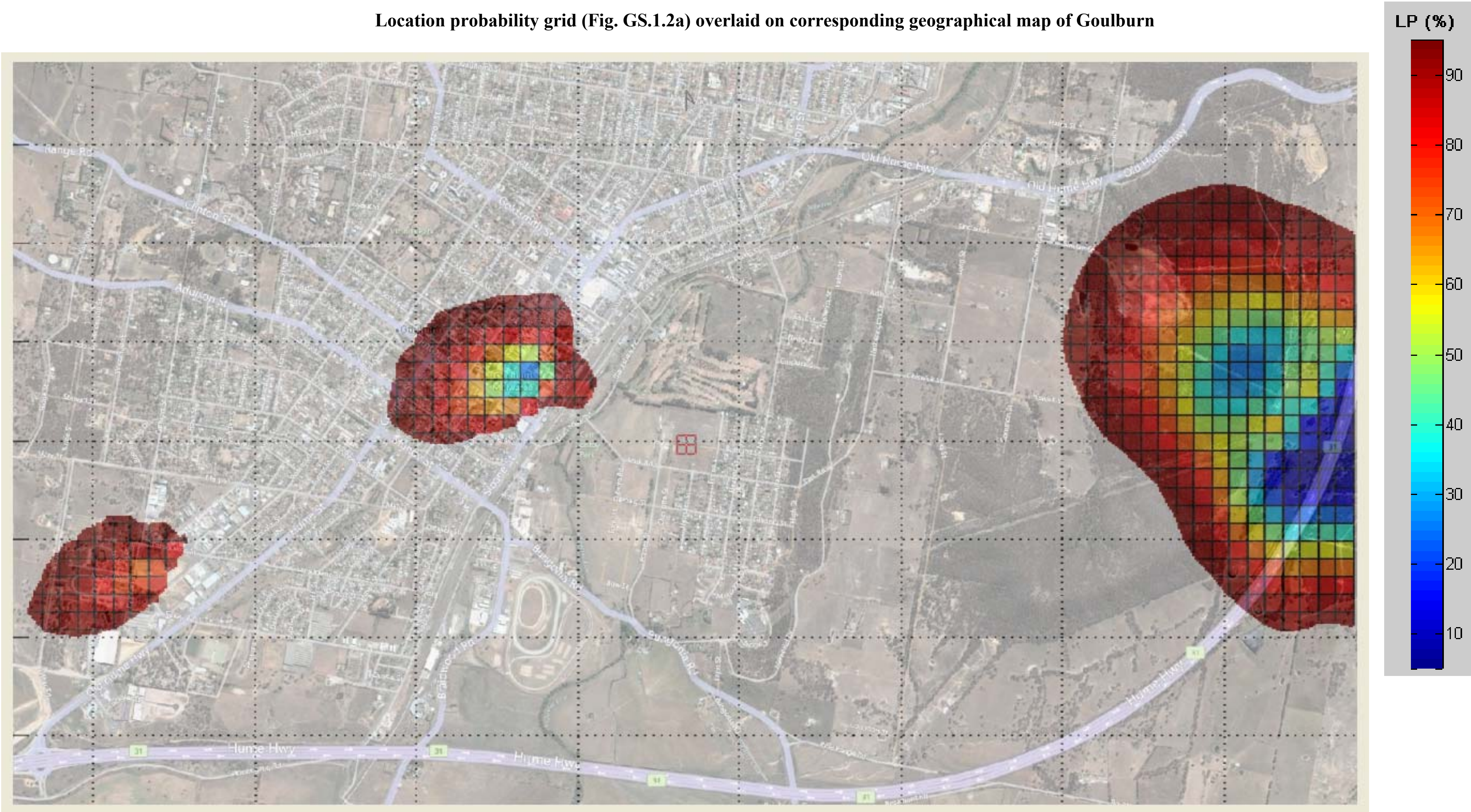
Similarly, in Fig. 54, we see an overlay of Fig. 43 (location probability with the 1st adjacent channel interference in Goulburn) on an overhead view of the area considered.

We have also made an estimate of the number of households contained within the 95% contour lines shown in Fig. 54 for Goulburn. This has been concluded as again the number of "rooftops" in the concerned areas at approximately 612 households in total under the three contours. But note that in the middle patch, since the base station is in the midst of Goulburn town centre, the contour covers some larger buildings likely to be shopping malls, warehouses and office blocks.

In this case, the loss in location probability ranges from approximately 5% (= 100% – 95%) up to approximately 95% (= 100% – 5%). Again for the purpose of establishing an estimate, we again take an average loss of 50%, meaning approximately 306 households losing DTTB reception. And counting 2.6 viewers per household, we can estimate approximately 795 lost DTTB viewers.

FIGURE 54

Location probability grid (Fig. GS.1.2a) overlaid on corresponding geographical map of Goulburn



7 Conclusions

Coverage and interference calculations have been carried out for two DTTB coverage areas (one in a suburban environment and the other rural) each containing three IMT-2000 base station transmitters.

The areas considered had high wanted DTTB signal strength (in the presence of noise only, reaching more than 99.92% location probability in the coverage areas concerned).

When the IMT-2000 interference is introduced (using the base station technical parameters) it was found that, in the vicinity of the base stations (that is, several hundred meters up to a kilometre around the base station), the location probability drops dramatically when the DTTB coverage is using the first adjacent channel.

Overall results are compared in Table 17.

The scenarios for St Clair and Goulburn are compared. "LP_{min}" is the minimum LP for pixels in the presence of the IMT-2000 interference; "IL_{max}" is the maximum decrease in the LP for pixels in the presence of IMT-2000 interference; "$radius_{95}$" is approximately the "radius" of the largest "holes" (i.e. those pixel areas where the LP has been reduced below 95%) punched in the DTTB coverage areas.

TABLE 17

Comparison of calculated results

Relative frequency		**St Clair (see § 6.1)**	**Goulburn (see § 6.2)**
1st adjacent	LP_{min}	17.5%	8%
	IL_{max}	82.5%	93%
	"radius95"	≈ 600 m	≈ 1 200 m
2nd adjacent	LP_{min}	62%	32%
	IL_{max}	38%	64%
	"radius95"	≈ 300 m	≈ 700 m
3rd adjacent	LP_{min}	93.5%	74%
	IL_{max}	6.5%	21%
	"radius95"	≈ 50 m	≈ 400 m

It should be noted that these calculations were carried out in areas which are "well covered", that is in regions of high wanted field strength (e.g. near the DTTB transmitter).

In more sensitive areas, where the wanted field strength values are near the minimum median values (and the pixel LPs are approximately 95%), the drop in LP in the presence of IMT-2000 interference will be even more significant.

8 Proposal

Given that administrations are seeking guidance on these matters and the studies are ongoing, it is proposed the report of this study be appended to the previous field study reports contained within Document 6A/546, Annex 11 and carried forward as part of the body of work for Working Party 6A in the next study period.

9 Further areas of study

The present study represents only a part of the overall areas requiring further study. Within this report we have presented only the "reverse duplex" scenario for adjacent channel base station interference to DTTB coverage areas.

– We have used parameters for both DTTB and base stations which are actually in use. The relevant parameters are contained in the various Annexes. Some of the given parameters however have not been used, for example at Goulburn the base stations are indicated as having an omnidirectional transmit antenna as well as sectored transmit antennas. Further studies are required to investigate the effects of these alternative transmit antenna configurations.
– This Report has provided only an estimate of the loss in population/viewer coverage for the two scenarios considered. A more detailed analysis/count of the population/viewer loss due to base station interference is foreseen.
– For completeness and in keeping with previous reports on these study areas investigation is required into the "conventional duplex" scenario in order to determine the interference effects of the adjacent channel UE usage within a DTTB coverage area.
– A further topic of investigation concerns the interference scenario to portable DTTB reception with respect to both base station and UE interference.

Appendix 1

Technical parameters for the St Clair reception area (Suburban coverage scenario)

A suburban DTTB coverage scenario is considered at St Clair.

Section A

Coverage scenario at St Clair

FIGURE 55

The four yellow "thumbtacks" (marked "A", "B", "C", "D") mark the DTTB coverage area investigated. (The black-white-black circles indicate the interfering base stations.)

The coverage area studied is defined in the Table 18 and the coordinates of the DTTB transmitter and the base station transmitters are also given there.

TABLE 18

Study grid: Lat/Long Top Left Lat/Long Top Right Lat/Long Bottom Left Lat/Long Bottom Right	3.0 km EW × 1.6 km NS 33 47 9.85 S / 150 46 50.32 E 33 47 9.85 S / 150 48 47.18 E 33 48 01.65 S / 150 46 50.32 E 33 48 01.65 S / 150 48 47.18 E For 100 m separation NS Δθ = 3.238′′ For 100 m separation EW Δφ = 3.895′′
DTTB Transmitter site: Kurrajong Height	33 32 39.5 S / 150 37 13.9 E
BS Transmitter site 1: Roper Rd	33 47 25.1 S / 150 48 24.9 E
BS Transmitter site 2: Shepherd St	33 47 12.3 S / 150 47 14.9 E
BS Transmitter site 3: Bennett Rd	33 47 33.3 S / 150 47 22.3 E

Section B

DTTB parameters

H_{eff}: Effective antenna height (maximum) 610 m (height pattern to be provided later?)

ERP: 1667 W = 2.22 dBkW

Polarization: H

Transmit antenna tilt: 0.9°

C*/*N: 20 dB

Median field strength to be protected: 57 dBµV/m for 95% location probability

NOTE – E_{med} represents the minimum median field strength needed for location probability of 70% or 95% (as per *ITU DTTB Planning Handbook*, Chapter 5). Other values for E_{med} may be adopted to reflect the planning values chosen by administrations.

DTTB reception mode: fixed reception at 10 m agl

DTTB channels to be studied: channel 58 (766-774 MHz), 59 (774-782 MHz), 60 (782-790 MHz)

Protection ratios: 1st adjacent channel (ch. 60), −30 dB; 2nd adjacent channel (ch. 59), −40 dB; 3rd adjacent channel (ch. 58), −50 dB

Section C

Base station parameters

Three base stations considered have the technical characteristics listed in Table 19.

TABLE 19

TABLE 18 Base stations at St Clair and surrounding areas			**Downlink: Channel 61 (790-798 MHz)**			
Site ID	**Lat/Long (GoogleEarth)**	**Site Name**	**Height (m)**	**ERP/EIRP (W)**	**Azimuth (degree)**	**Down Tilt**
9007685 *Panel Type 1*	33 47 25.1 S 150 48 24.9 E	Site #1: Telstra Site Cnr M4 and Roper Rd COLYTON	20 20 20	501 501 501	90 220 335	0 0 0
133561 *Panel Type 2*	33 47 12.3 S 150 47 14.9 E	Site #2: Telstra Site Shepherd St COLYTON	22.5 22.5 22.5	31.6 31.6 31.6	20 120 270	0 0 0
133747 *Panel Type 3*	33 47 33.3 S 150 47 22.3 E	Site #3: Bennett Rd ST CLAIR	16 16 16	31.6 31.6 31.6	60 150 290	0 0 0

Section D

Antenna discrimination

In performing the calculations for the wanted signal (DTTB) and the interfering signals (IMT-2000 base stations), a complete account of antenna discrimination was implemented. That is to say:

– Directivity discrimination of the DTTB receiver antenna (see § D.1 below)

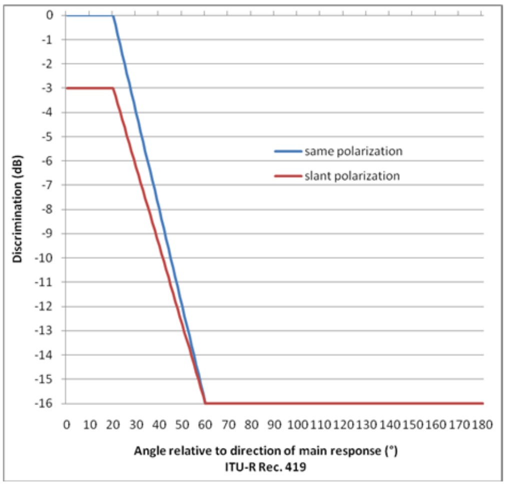
– Horizontal and vertical antenna patterns for the DTTB transmitter (see § D.2 below)

– Horizontal and vertical antenna patterns for the base station transmitters (see § D.3 below)

D.1 DTTB receive antenna discrimination

Recommendation ITU-R BT.419 is used for the determination of the DTTB receive antenna discrimination (see Fig. 56). The "same polarization" curve is used for the wanted DTTB signals. The "slant polarization" curve is used for the interferers because the DTTB signals are horizontally polarized and the base station signals are slant polarized.

FIGURE 56



D.2 DTTB transmit antenna patterns

The DTTB transmitter has the following technical characteristics:

Height: 610 m

ERP: 1 667 W = 2.2 dB kW

Polarization: H

Tilt: 0.9°

Antenna pattern

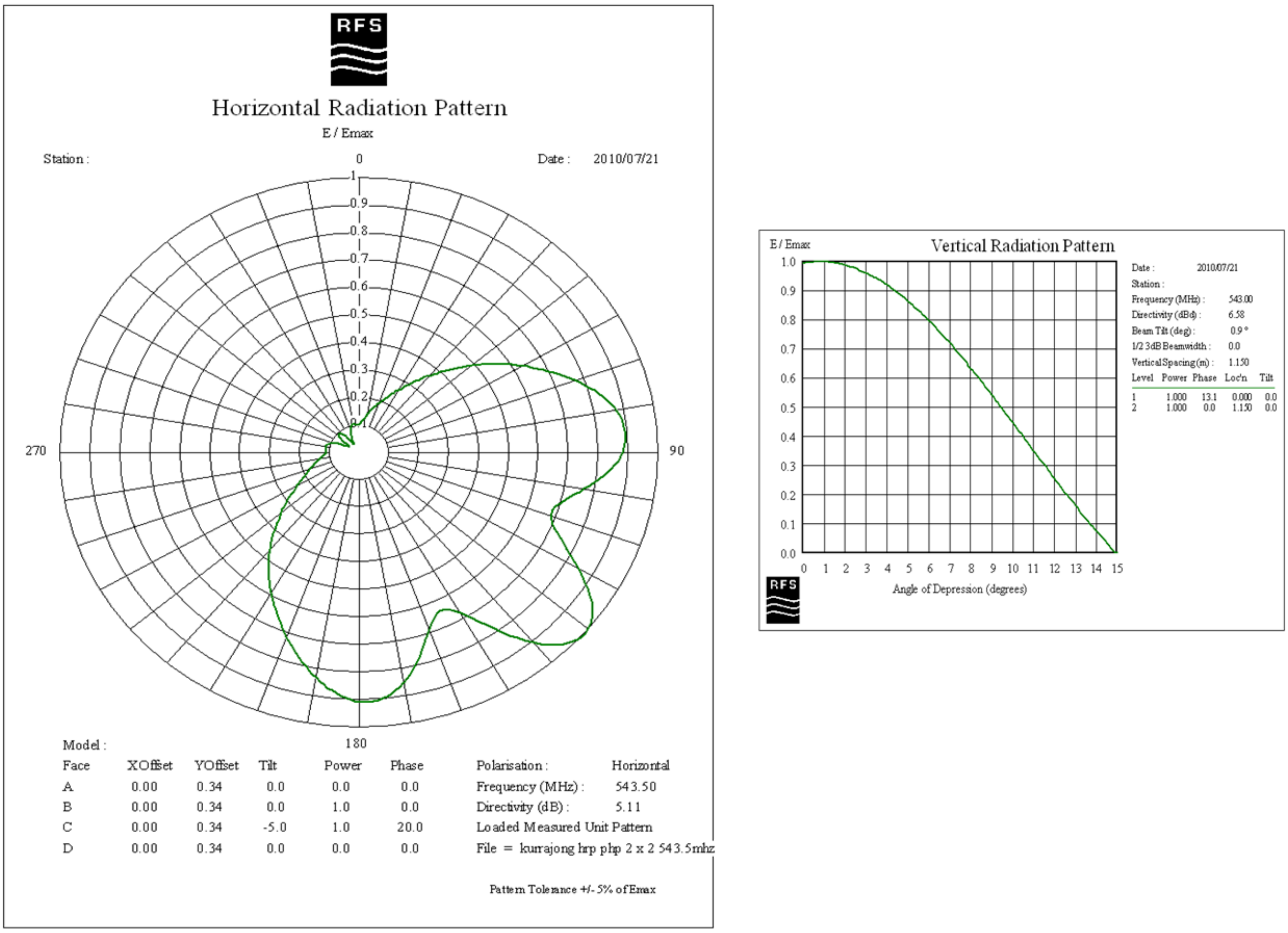
Horizontal: see pattern in Fig. 56 and the approximation in Table 20 ("AZIMUTHAL")

Vertical: see pattern in Fig. 57 and the approximation in Table 20 ("ELEVATION")

TABLE 20

<table>
<tr><th colspan="6">RADIATION PATTERNS (attenuation: linear E/E_{max}; −20 log(E/E_{max}) dB)</th></tr>
<tr><th colspan="4">AZIMUTHAL</th><th colspan="2">ELEVATION</th></tr>
<tr><td>0°</td><td>.100/20</td><td colspan="2"></td><td>0°</td><td>.995/.04</td></tr>
<tr><td>10°</td><td>.135/17.4</td><td>190°</td><td>.830/1.6</td><td>−1°</td><td>1.00/0</td></tr>
<tr><td>20°</td><td>.195/14.2</td><td>200°</td><td>.715/2.9</td><td>−2°</td><td>.985/.13</td></tr>
<tr><td>30°</td><td>.260/11.7</td><td>210°</td><td>.590/4.6</td><td>−3°</td><td>.958/.4</td></tr>
<tr><td>40°</td><td>.370/8.6</td><td>220°</td><td>.475/6.5</td><td>−4°</td><td>.918/.7</td></tr>
<tr><td>50°</td><td>.495/6.1</td><td>230°</td><td>.350/9.1</td><td>−5°</td><td>.867/1.2</td></tr>
<tr><td>60°</td><td>.630/4</td><td>240°</td><td>.240/12.4</td><td>−6°</td><td>.800/1.9</td></tr>
<tr><td>70°</td><td>.775/2.2</td><td>250°</td><td>.180/14.9</td><td>−7°</td><td>.720/2.9</td></tr>
<tr><td>80°</td><td>.880/1.1</td><td>260°</td><td>.130/17.7</td><td>−8°</td><td>.620/4.2</td></tr>
<tr><td>90°</td><td>.885/1.1</td><td>270°</td><td>.115/18.8</td><td>−9°</td><td>.540/5.4</td></tr>
<tr><td>100°</td><td>.760/2.4</td><td>280°</td><td>.115/18.8</td><td>−10°</td><td>.445/7</td></tr>
<tr><td>110°</td><td>.685/3.3</td><td>290°</td><td>.100/20</td><td>−11°</td><td>.350/9.1</td></tr>
<tr><td>120°</td><td>.850/1.4</td><td>300°</td><td>.050/26</td><td>−12°</td><td>.250/12</td></tr>
<tr><td>130°</td><td>1.00/0</td><td>310°</td><td>.100/20</td><td>−13°</td><td>.162/15.8</td></tr>
<tr><td>140°</td><td>.910/.8</td><td>320°</td><td>.100/20</td><td>−14°</td><td>.073/22.7</td></tr>
<tr><td>150°</td><td>.685/3.3</td><td>330°</td><td>.050/26</td><td>−15°</td><td>.001/30</td></tr>
<tr><td>160°</td><td>.690/3.2</td><td>340°</td><td>.100/20</td><td colspan="2" rowspan="3">NOTE – The vertical pattern already includes 0.9° tilt.</td></tr>
<tr><td>170°</td><td>.850/1.4</td><td>350°</td><td>.100/20</td></tr>
<tr><td>180°</td><td>.910/.8</td><td>360°</td><td>.100/20</td></tr>
</table>

FIGURE 57



D.3 Base station transmit antenna patterns

The base station transmit antennas have a tri-sector structure.

The azimuths of the main beams of the antennas are indicated in Table 18 above.

Notes for the horizontal patterns:

NOTE 1 – The horizontal patterns seem to be essentially the same for the three types.

NOTE 2 – The horizontal patterns (in the figures (running from 0° to ±180° relative to the main beam direction) are "shifted" to a "N" direction in the corresponding Tables. Then the values are given clockwise from 0° to 360° such that: 0° in the figure corresponds to 0° in the Table, −10° in the figure corresponds to 10° in the Table,..., −170° in the figure corresponds to 170° in the Table, 180° in the figure corresponds to 180° in the Table, 170° in the figure corresponds to 190° in the Table, ..., 10° in the figure corresponds to 350° in the Table, 0° in the figure corresponds to 360° in the Table. A maximum 30 dB back-to-front ratio is assumed.

To use the Tables, the direction ("azimuth") of the main beam, A_{mb}, is subtracted from the direction of interest, A_{in}, to obtain the relative angle, A_{rel} ($A_{rel} = A_{in} - A_{mb}$). The attenuation is read from the Table for the relative angle.

D.3.1 Site 1 (Roper Rd)

Height: 20 m

ERP: 501 W = −3 dBkW

Polarization: ±45° slant

Antenna pattern

Vertical: see pattern (Type 1), Fig. 58 and approximation in Table 21

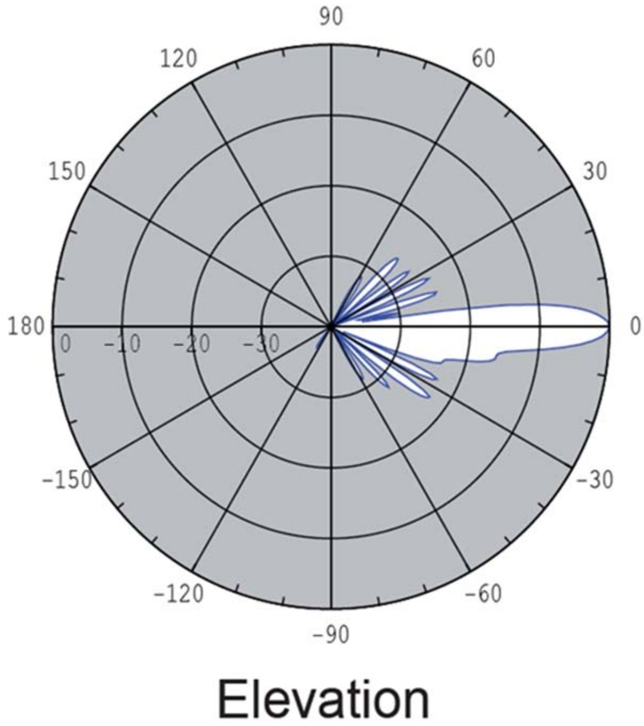
Horizontal: see pattern (Type 1, 3 sectors) Fig. 59 and approximation in Table 22

D.3.1.1 Vertical pattern (7.5° half-beamwidth)

TABLE 21

ELEVATION	Attenuation (dB)
6°	9.50
5°	7.00
4°	4.00
3°	2.50
2°	1.00
1°	0.25
0°	0.00
−1°	0.25
−2°	1.00
−3°	2.50
−4°	4.00
−5°	7.00
−6°	9.50
−7°	12.0
−8°	15.5
−9°	16.00
−10°	16.25
−11°	16.4
−12°	16.5
−13°	18.5
−14°	20.0
−15°	22.0
−16° to −35°	22.5
> −35°	30.0

FIGURE 58



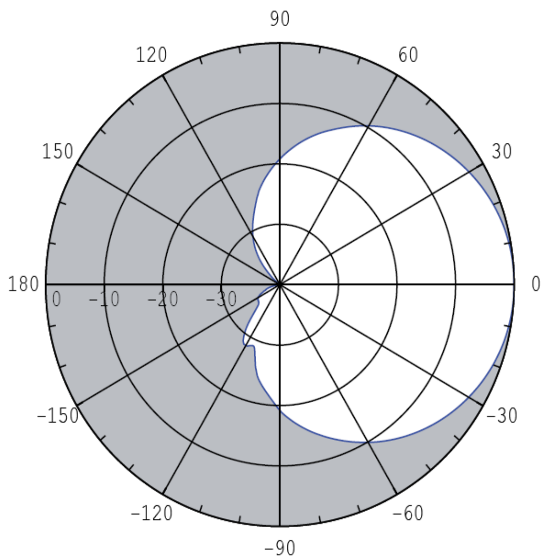
Type 1, Vertical antenna pattern

D.3.1.2 Horizontal pattern (67° half-beamwidth)

TABLE 22

Azimuth	Atten. (dB)	Azimuth	Atten. (dB)
0°	0.0		
10°	0.5	190°	30.0
20°	1.8	200°	30.0
30°	2.6	210°	30.0
40°	5.0	220°	30.0
50°	7.5	230°	30.0
60°	10.0	240°	30.0
70°	13.0	250°	28.2
80°	16.0	260°	23.0
90°	19.0	270°	19.0
100°	23.0	280°	16.0
110°	28.2	290°	13.0
120°	30.0	300°	10.0
130°	30.0	310°	7.5
140°	30.0	320°	5.0
150°	30.0	330°	2.6
160°	30.0	340°	1.8
170°	30.0	350°	0.5
180°	30.0	360°	0.0

FIGURE 59



Azimuth

Type 1, Horizontal antenna pattern

D.3.2 Site 2 (Shepherd St)

Height: 22.5 m

ERP: 31.6 W = −15 dBkW

Polarization: ±45° slant

Antenna pattern

Vertical: see pattern (Type 2) Fig. 60 and approximation in Table 23

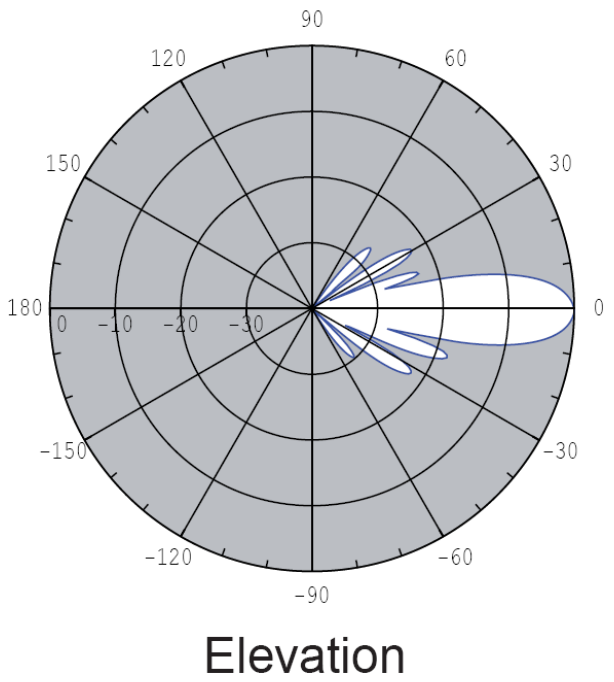
Horizontal: see pattern (Type 2, 3 sectors) Fig. 61 and approximation in Table 24

D.3.2.1 Vertical pattern (13° half-beam width)

TABLE 23

ELEVATION	Attenuation (dB)
6°	2.5
5°	1.8
4°	1.1
3°	0.64
2°	0.28
1°	0.07
0°	0.00
−1°	0.07
−2°	0.28
−3°	0.64
−4°	1.1
−5°	1.8
−6°	2.5
−7°	3.5
−8°	4.5
−9°	6.3
−10°	8.5
−11°	11.0
−12°	13.5
−13°	18.0
−14°	18.0
−15°	18.0
−16°	18.0
−17°	18.0
−18°	18.0
−19°	18.0
−20°	18.0
−21°	19.0
−22°	20.0
−23° to −33°	21.5
> −33°	30.0

FIGURE 60



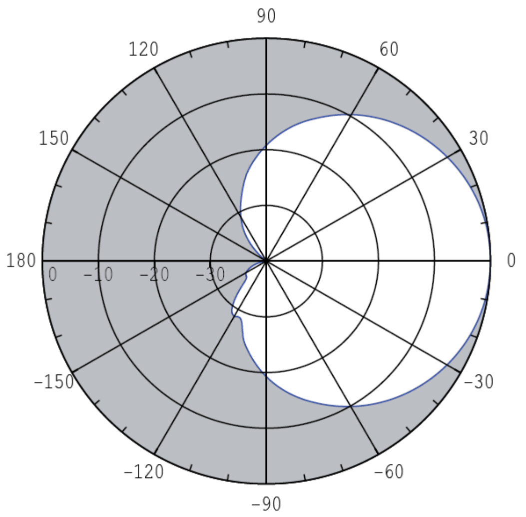
Type 2, Vertical antenna pattern

D.3.2.2 Horizontal pattern (65° half-beam width)

TABLE 24

Azimuth	Atten. (dB)	Azimuth	Atten. (dB)
0°	0.0		
10°	0.5	190°	30.0
20°	1.8	200°	30.0
30°	2.6	210°	30.0
40°	5.0	220°	30.0
50°	7.5	230°	30.0
60°	10.0	240°	30.0
70°	13.0	250°	28.2
80°	16.0	260°	23.0
90°	19.0	270°	19.0
100°	23.0	280°	16.0
110°	28.2	290°	13.0
120°	30.0	300°	10.0
130°	30.0	310°	7.5
140°	30.0	320°	5.0
150°	30.0	330°	2.6
160°	30.0	340°	1.8
170°	30.0	350°	0.5
180°	30.0	360°	0.0

FIGURE 61



Azimuth

Type 2, Horizontal antenna pattern

D.3.3 Site 3 (Bennett Rd):

Height: 16 m

ERP: 31.6 W = −15 dBkW

Polarization: ±45° slant

Antenna pattern

Vertical: see pattern (Type 3) Fig. 62 and approximation in Table 25

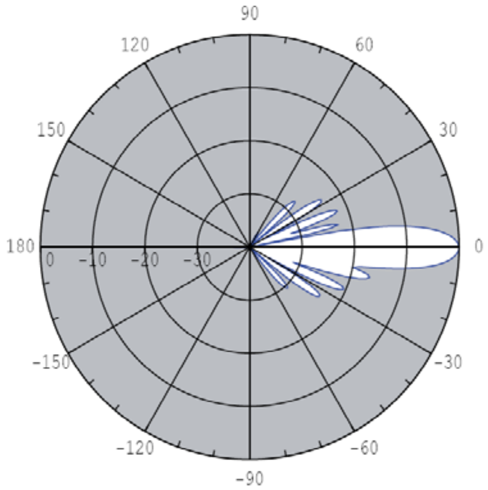
Horizontal: see pattern (Type 3, 3 sectors) Fig. 63 and approximation in Table 27

D.3.3.1 Vertical pattern (9.5° half-beamwidth)

TABLE 25

ELEVATION	Attenuation (dB)
6°	4.8
5°	3.3
4°	2.1
3°	1.2
2°	0.53
1°	0.13
0°	0.00
−1°	0.13
−2°	0.53
−3°	1.2
−4°	2.1
−5°	3.3
−6°	4.8
−7°	8.0
−8°	11.0
−9°	15.0
−10° to −17°	18.0
−18° to −30°	20.0
−30° to −35°	25.0
> −35°	30.0

FIGURE 62



Elevation

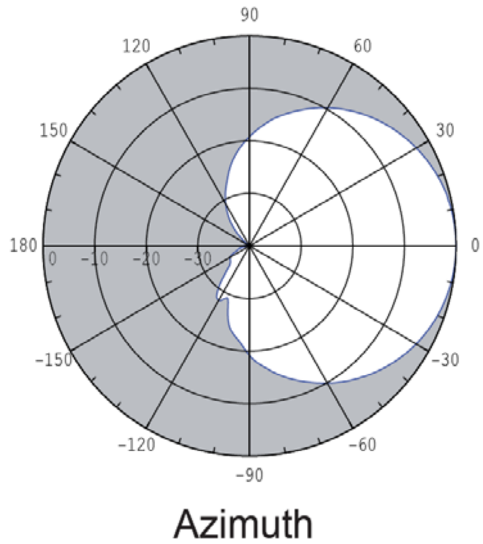
Type 3, Vertical antenna pattern

D.3.3.2 Horizontal pattern (65° half-beamwidth)

TABLE 26

Azimuth	Atten. (dB)	Azimuth	Atten. (dB)
0°	0.0		
10°	0.5	190°	30.0
20°	1.8	200°	30.0
30°	2.6	210°	30.0
40°	5.0	220°	30.0
50°	7.5	230°	30.0
60°	10.0	240°	30.0
70°	13.0	250°	28.2
80°	16.0	260°	23.0
90°	19.0	270°	19.0
100°	23.0	280°	16.0
110°	28.2	290°	13.0
120°	30.0	300°	10.0
130°	30.0	310°	7.5
140°	30.0	320°	5.0
150°	30.0	330°	2.6
160°	30.0	340°	1.8
170°	30.0	350°	0.5
180°	30.0	360°	0.0

FIGURE 63



Type 3, Horizontal antenna pattern

Appendix 2

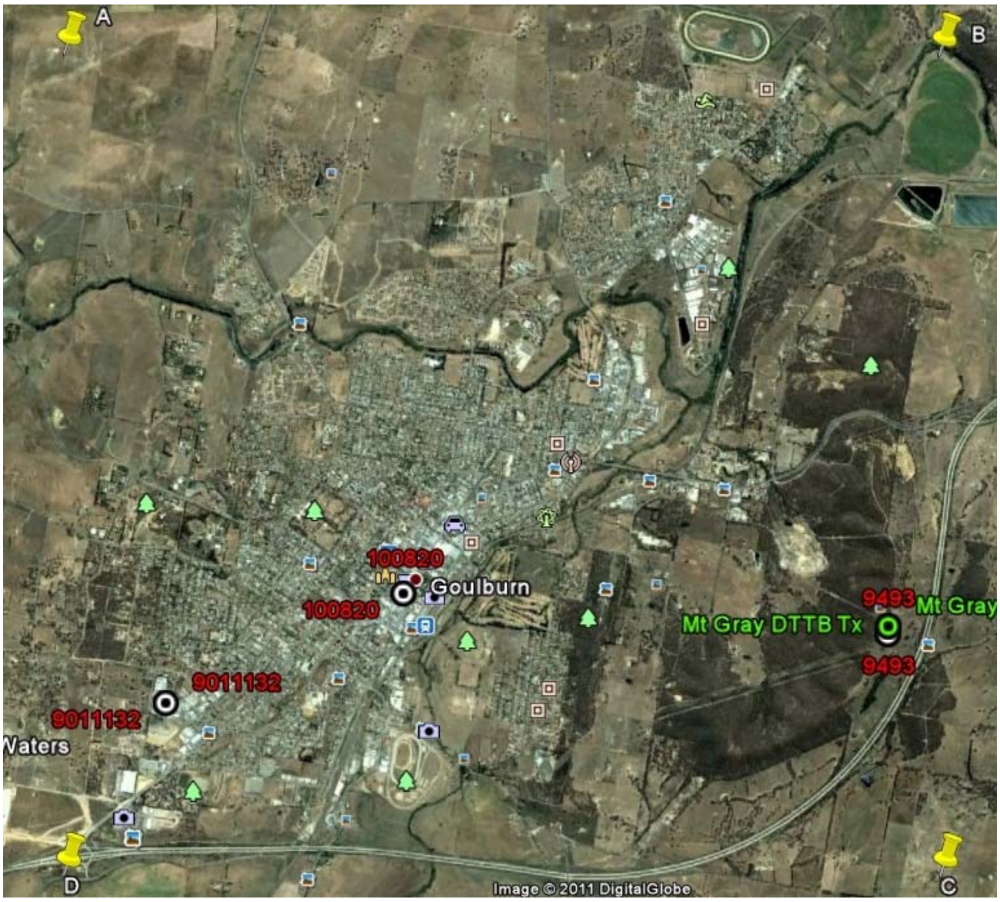
Technical parameters for the Goulburn reception area (Rural coverage scenario)

A rural DTTB coverage scenario is considered at Goulburn.

Section A

Coverage scenario at Goulburn

FIGURE 64



The four yellow "thumbtacks" (marked "A", "B", "C", "D") mark the DTTB coverage area investigated. (The black-white-black circles indicate the interfering base stations. The black-yellow-black circle indicates the DTTB transmitter.)

The coverage area studied is defined in the following Table 27 and the coordinates of the DTTB transmitter and the base station transmitters are also given there.

TABLE 27

Study grid: Lat/Long Top Left Lat/Long Top Right Lat/Long Bottom Left Lat/Long Bottom Right	7.6 km EW × 7.2 km NS 34 42 48.5 S / 149 41 06.7 E 34 42 48.5 S / 149 46 06.2 E 34 46 41.6 S / 149 41 06.7 E 34 46 41.6 S / 149 46 06.2 E For 100 m separation NS Δθ = 3.23756″ For 100 m separation EW Δφ = 3.94013″
DTTB Transmitter site: Mt Gray	34 45 29.5 S / 149 45 47.4 E
BS Transmitter site 1: Mt Gray	34 45 29.5 S / 149 45 47.4 E
BS Transmitter site 2: Auburn St	34 45 20.5 S / 149 43 03.5 E
BS Transmitter site 3: Knox St	34 45 52.0 S / 149 41 42.0 E

Section B

DTTB parameters

H_{eff}: Effective antenna height (maximum) 860 m (height pattern to be provided later?)

ERP: 400 W = −4 dBkW

Polarization: H

Transmit antenna tilt: 1.7°

C/N: 20 dB

Median field strength to be protected: 57 dBμV/m for 95% location probability

NOTE – E_{med} represents the minimum median field strength needed for location probability of 70% or 95% (as per ITU DTTB Planning Handbook, Chapter 5). Other values for E_{med} may be adopted to reflect the planning values chosen by administrations.

DTTB reception mode: fixed reception at 10 m agl

DTTB channels to be studied: channel 58 (766-774 MHz), 59 (774-782 MHz), 60 (782-790 MHz)

Protection ratios: 1st adjacent channel (ch. 60), −30 dB; 2nd adjacent channel (ch. 59), −40 dB; 3rd adjacent channel (ch 58), −50 dB

Section C

Base station parameters

TABLE 28

TABLE 27 Base stations at Goulburn and surrounding areas			**Downlink: Channel 61 (790-798 MHz)**			
Site ID	**Lat/Long (GoogleEarth)**	**Site Name**	**Height (m)**	**ERP (W)**	**Azimuth (degree)**	**Down Tilt**
9493 *Panel Type 1*	34 45 29.5 S 149 45 47.4 E	Site #1 Telstra Site MT GRAY	47 47 47 47 47 47	501 501 501 501 501 501	75 185 295 315 340 Omni	2 5 0 2 0 0
100820 *Panel Type 1*	34 45 20.5 S 149 43 3.5 E	Site #2 Telstra Exchange Auburn Street GOULBURN	22 22 22 22	501 501 501 501	0 130 240 Omni	0 0 0 0
9011132 *Panel Type 1*	34 45 52 S 149 41 42 E	Site #3 Telstra RBS Site 72 Knox St GOULBURN	35 35 35 35	501 501 501 501	0 80 210 0	0 0 0 0*

* This “Omni” is included to complete the “Omni” at site #1 and site #2.

Section D

Antenna discrimination

In performing the calculations for the wanted signal (DTTB) and the interfering signals (IMT-2000 base stations), a complete account of antenna discrimination was implemented. That is to say:

– Directivity discrimination of the DTTB receiver antenna (see § D.1 below)

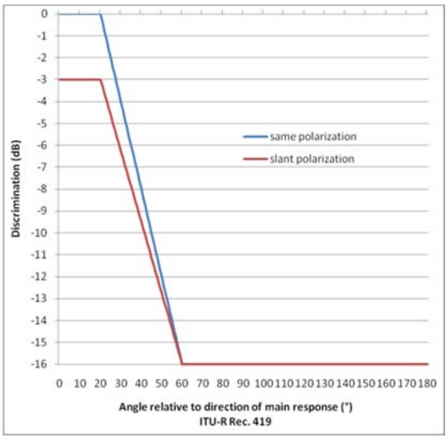
– Horizontal and vertical antenna patterns for the DTTB transmitter (see § D.2 below)

– Horizontal and vertical antenna patterns for the base station transmitters (see § D.3 below)

D.1 DTTB receive antenna discrimination

Recommendation ITU-R BT.419 is used for the determination of the DTTB receive antenna discrimination. The "same polarization" curve is used for the wanted DTTB signals. The "slant polarization" curve is used for the interferers because the DTTB signals are horizontally polarized and the base station signals are slant polarized.

FIGURE 65



D.2 DTTB transmit antenna patterns

Height: 860 m

ERP: 400 W = −4 dBkW

Polarization: H

Tilt: 1.7°

Antenna pattern

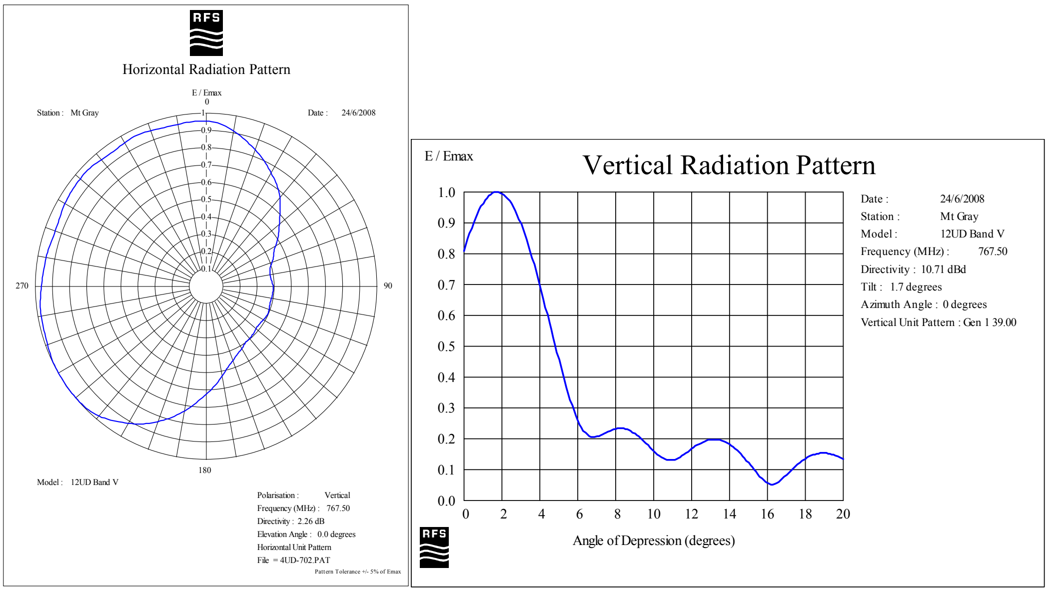
Horizontal: see pattern and approximation in the Table ("AZIMUTHAL")

Vertical: see pattern and approximation in the Table ("ELEVATION")

TABLE 29

DTTB RADIATION PATTERNS (attenuation: linear E/E_{max}; −20 log(E/E_{max}) dB)					
AZIMUTHAL				**ELEVATION (1.7° tilt)**	
0°	.950/.4			0°	.812/1.8
10°	.920/.7	190°	.735/2.7	−1°	.960/.35
20°	.840/1.5	200°	.830/1.6	−2°	.994/.05
30°	.760/2.4	210°	.915/.7	−3°	.900/.9
40°	.670/3.5	220°	.975/.2	−4°	.700/3.1
50°	.560/5	230°	1.00/0	−5°	.463/6.7
60°	.475/6.5	240°	1.00/0	−6°	.263/11.6
70°	.415/7.6	250°	.990/.09	−7°	.209/13.6
80°	.285/10.9	260°	.980/.18	−8°	.234/12.6
90°	.300/10.5	270°	.970/.26	−9°	.219/13.2
100°	.290/10.8	280°	.955/.4	−10°	.158/16
110°	.295/10.6	290°	.945/.5	−11°	.134/17.5
120°	.285/10.9	300°	.960/.35	−12°	.170/15.4
130°	.280/11.1	310°	.970/.26	−13°	.200/14
140°	.300/10.5	320°	.960/.35	−14°	.180/14.9
150°	.320/9.9	330°	.960/.35	−15°	.122/18.3
160°	.460/6.7	340°	.960/.35	−16°	.058/24.7
170°	.630/4	350°	.950/.45	−17°	.086/21.3
180°	.625/3.1	360°	.950/.45	−18°	.138/17.2
				−19°	.170/15.4
				−20°	.138/17.2
				> −20°	.100/20
				NOTE – The vertical pattern already includes 1.7° tilt.	

FIGURE 66



D.3 Base station transmit antenna patterns

D.3.1 Omnidirectional antennas

The vertical patterns are assumed to have the same attenuation as the sectored antennas.

OR: The vertical pattern is assumed to have a 75° beamwidth and the pattern to have the form:

$$ATT = -3(\varphi°/37.5)^2,$$

where φ° is the vertical elevation angle.

D.3.2 Sectored antennas

The base station transmit antennas have a tri-sector structure.

The azimuths of the main beams of the antennas are indicated in Table 27 above.

Note for the horizontal pattern for Type 1 base station antenna:

The horizontal pattern (in the figures (running from 0° to ±180° relative to the main beam direction) are “shifted” to a “N” direction in the corresponding Tables. Then the values are given clockwise from 0° to 360° such that: 0° in the figure corresponds to 0° in the Table, −10° in the figure corresponds to 10° in the Table,..., −170° in the figure corresponds to 170° in the Table, 180° in the figure corresponds to 180° in the Table, 170° in the figure corresponds to 190° in the Table, ..., 10° in the figure corresponds to 350° in the Table, 0° in the figure corresponds to 360° in the Table. A maximum 30 dB back-to-front ratio is assumed.

To use the Tables, the direction (“azimuth”) of the main beam, A_{mb}, is subtracted from the direction of interest, A_{in}, to obtain the relative angle, A_{rel} ($A_{rel} = A_{in} - A_{mb}$). The attenuation is read from the Table for the relative angle.

D.3.3 Site 1 (Mt Gray)

Height: 47 m

ERP: 501 W = −3 dBkW

Polarization: ±45° slant

Antenna pattern

Vertical: see pattern (Type 1), Fig. 67 and approximation in Table 30

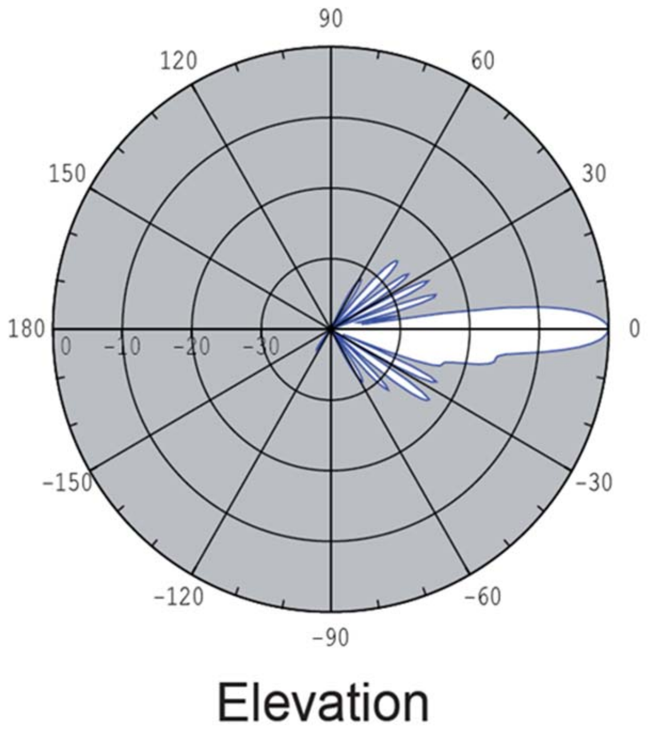
Horizontal: see pattern (Type 1, 6 sectors), Fig. 68 and approximation in Table 31

D.3.3.1 Vertical pattern (7.5° half-beamwidth)

TABLE 30

ELEVATION	Attenuation (dB)
6°	12.0
5°	7.00
4°	4.00
3°	2.50
2°	1.00
1°	0.25
0°	0.00
−1°	0.25
−2°	1.00
−3°	2.50
−4°	4.00
−5°	7.00
−6°	9.50
−7°	12.0
−8°	15.5
−9°	16.00
−10°	16.25
−11°	16.4
−12°	16.5
−13°	18.5
−14°	20.0
−15°	22.0
−16° to −35°	22.5
> −35°	30.0

FIGURE 67



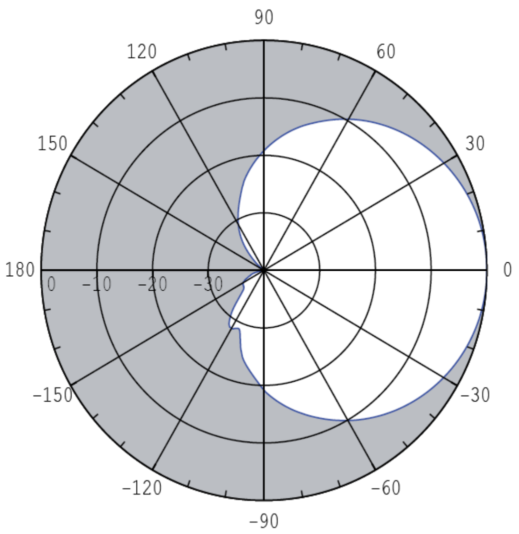
Type 1, Vertical antenna pattern

D.3.3.2 Horizontal pattern (67° half-beamwidth)

TABLE 31

Azimuth	Atten. (dB)	Azimuth	Atten. (dB)
0°	0.0		
10°	0.5	190°	30.0
20°	1.8	200°	30.0
30°	2.6	210°	30.0
40°	5.0	220°	30.0
50°	7.5	230°	30.0
60°	10.0	240°	30.0
70°	13.0	250°	28.2
80°	16.0	260°	23.0
90°	19.0	270°	19.0
100°	23.0	280°	16.0
110°	28.2	290°	13.0
120°	30.0	300°	10.0
130°	30.0	310°	7.5
140°	30.0	320°	5.0
150°	30.0	330°	2.6
160°	30.0	340°	1.8
170°	30.0	350°	0.5
180°	30.0	360°	0.0

FIGURE 68



Azimuth

Type 1, Horizontal antenna pattern

D.3.4 Site 2 (Auburn St)

Height: 22 m

ERP: 501 W = −3 dBkW

Polarization: ±45° slant

Antenna pattern

Vertical: see pattern (Type 1), Fig. 67 and approximation in Table 30

Horizontal: see pattern (Type 1, 4 sectors), Fig. 68 and approximation in Table 31

D.3.5 Site 3 (Knox St):

Height: 35 m

ERP: 501 W = −3 dBkW

Polarization: ±45° slant

Antenna pattern

Vertical: see pattern (Type 1), Fig. 67 and approximation in Table 30

Horizontal: see pattern (Type 1, 3 sectors), Fig. 68 and approximation in Table 31

Chapter 2

Field study of uplink and downlink signals

1 Introduction

This study supports previous measurements and provides insights into a case of compatibility based upon the UMTS network design, base station architectural structures and cellular service characteristics.

The study analyses the characteristics of:

− Uplink; i.e. user equipment power levels, in the band 825-845 MHz;

− downlink; i.e. base station power levels, in the band 870-890 MHz;

within urban, suburban and rural broadcasting environments in Australia. Refer to Appendix 1 for more information on Australian radio frequency spectrum allocations in the band 750-900 MHz.

The objectives of this study are:

a) to measure the uplink power levels directly from the output of a user equipment which is positioned at 1.5 m above ground level and has an established uplink connection with a base station located in urban, suburban and rural broadcasting environments, respectively;

b) to measure the downlink power levels of the base station located in urban, suburban and rural broadcasting environments, respectively, via an external TV receive antenna positioned at 10 m above ground level.

The outcome of this study would help assessing the impact of output power levels from base stations and user equipment onto other incumbent services operating in adjacent bands, e.g. broadcast services.

2 Methodology

2.1 Uplink measurements

By connecting a spectrum analyser to the antenna output of a UMTS user equipment via a patch antenna adaptor, and positioning the user equipment at a height of approximately 1.5 m above ground, the uplink measurements were carried out according to the following steps:

1) Capture the spectrum plot for the frequency range of 750-900 MHz in max-hold mode of the spectrum analyser to observe the instantaneous level (dBm) when uplink connection is initially established without any upload/download activity.

2) Measure uplink power level (dBm/5 MHz) on the respective uplink channel raster.

3) Repeat the above steps when the user equipment is continuously uploading data.

2.2 Downlink measurements

By connecting a spectrum analyser to an external TV receive antenna positioned at 10 m above ground level, directional to the location of the respective base station, the downlink measurements were carried out according to the following steps:

1) Capture the spectrum plot for the frequency range of 750-900 MHz to observe the instantaneous transmit level (dBm) from the respective base station at some distance away.

2) Measure downlink power level (dBm/5 MHz) on the respective downlink channel raster.

3) Repeat the above steps at ±2 m from the respective location, if practicable, to check that the measurement is not affected by significant variation due to reflections and/or multipath effects.

2.3 Equipment used in the measurements

A calibrated Agilent E4440 spectrum analyser was used to measure all results presented in this study.

The user equipment used in the uplink measurements is a mobile data card with a PCMCIA interface that can be attached to a laptop computer. Measurements were conducted in an outdoor environment using a SIM card registered to the carrier network.

The receive antenna used in the downlink measurements is a 6-element Yagi antenna with a 17.5 dB front-to-back ratio, 9 dBd antenna gain and 50 Ω output impedance. It was connected to a 12 m long RG58-CU feeder cable with 8.7 dB cable loss tested at 850 MHz.

3 Locations selected for this study

The locations chosen for the survey are considered urban, suburban and rural broadcasting environments in Australia. Note that any technical information, e.g. antenna height, panel directions, maximum effective radiation power[9] (e.r.p.) levels and antenna tilt angle of base stations considered in this study were sourced from a register of radiocommunication licences[10].

3.1 Suburban environment

In the context of this study a suburban environment can be categorized as areas, usually residential, but with much less high rise clutter. It is observed that the UMTS network base station configuration in suburban areas often comprises mostly medium power (30-40 W e.i.r.p.) base stations with a few high power (398 W and/or 501 W e.r.p.) base stations. It is also noted that only one downlink channel, either 880-885 MHz or 885-890 MHz, is occupied within the coverage of a suburban environment.

As with the previous field studies reported in Annexes 1 and 2, these suburban studies were also conducted in and around St Clair − in the western suburbs of Sydney.

A number of previous and additional measurement locations in St Clair and its nearby suburbs were selected for this study and they include:

− Shepherd Street (33 47 22.56 S/150 48 23.03 E, refer to Fig. 15)
− Augusta Place (33 47 35.08 S/150 48 23.66 E)
− Gosse Court (33 47 30.87 S/150 47 24.26 E, refer to Fig. 16)
− Ballarat Avenue (33 47 29.16 S/150 47 13.49 E)
− Potter Field (33 47 7.79 S/150 47 17.62 E, refer to Fig. 17)
− Underwood Road (33 47 21.95 S/150 47 34.20 E)

---

9 Power levels for some base stations are quoted in e.r.p. due to the unavailability of e.i.r.p. values for these base stations registered in the online database.

10 This register is maintained by the Australian Communications and Media Authority (ACMA) and published in this link: http://web.acma.gov.au/pls/radcom/register_search.main_page.

FIGURE 69

Base station at Shepherd Street cul-de-sac, St Clair

3.2 Urban environment

In the studies described in Annexes 1 and 2, ground level measurements were undertaken in a number of urban environments in central and northern Sydney city. The UMTS network configuration in urban environments in Sydney comprises a mixture of low power (0.06-2 W e.i.r.p.), medium power (30-40 W e.i.r.p.) and high power (398 W and/or 501 W e.r.p.) base stations scattered in close proximity, often with overlapped coverage. It is also noted that two downlink channels 880-885 MHz and 885-890 MHz are occupied within the coverage of these urban environments.

The previous surveys in the urban areas of Sydney as reported in Annexes 1 and 2, present considerable difficulties to deploy a field survey vehicle mounted with a 10 m telescopic mast in and around a crowded urban/business district environment without contravening a number of government regulations.

An alternative high-rise clutter urban area selected for this study is Parramatta. The central business district of Parramatta emulates a similar UMTS network configuration to those found in other crowded urban/business district environments.

Two measurement locations in Parramatta were selected for this study:

− Parramatta Park facing Marsden Street base station (33 48 44.72 S/150 59 48.74 E, refer to Fig. 70);

− Rear of Mercure Hotel base station (33 49 04.13 S/151 1 13.47 E, refer to Fig. 71).

FIGURE 70

Base station at Marsden Street, Parramatta

FIGURE 71

Base station at Mercure Hotel

3.3 Rural environment

For this study the selected rural environments are areas with low-population density and minimal building-like clutter. In many rural cities in Australia, there is a concentration of communications facilities at or nearby to positions of dominant elevated terrain to provide services such as terrestrial radio/television broadcast, mobile trunked network and point-to-point links into the respective areas. Some UMTS base stations are co-sited with these communications facilities, with many of these base stations classified as high power (398 W and/or 501 W e.r.p.).

An operating cell (Sloping Hummock) located to the east of the rural city of Bundaberg in Queensland, Australia, is considered to be an environment typical of populated rural (border) regions. The Sloping Hummock base station tower (refer to Fig. 72) is upon an elevated extinct volcano rising above a large sugar cane growing area.

The base station located at Sloping Hummock is at some distance (i.e. further than the cell coverage) from the populated town centre of Bundaberg. It was noted that another high power (501W e.r.p.) base station is at East Bundaberg (refer to Fig. 73) to complement the UMTS network coverage in this area. During the field survey, it was noted that two (or all three) downlink channels in 875-880 MHz, 880-885 MHz and/or 885-890 MHz are utilized in this rural environment.

A number of measurement locations in and around Sloping Hummock and East Bundaberg (namely Rural Case A) were selected for this study:

- Finemore Crescent cul-de-sac (24 50 36.7 S/152 25 26.6 E)
- Rehbein Avenue (24 50 26.3 S/152 25 37.5 E)
- Cattermull Avenue (24 50 51.6 S/152 24 28.3 E)
- Corner of Fe Walker Road and Windermere Road (24 51 22.3 S/152 24 21.3 E)
- Fe Walker Road (24 51 43.7 S/152 23 55.5 E)
- Hill Street (24 51.13.1 S/152 22 2.3 E)
- Hofer Crescent (24 51 19.1 S/152 22 40.2 E)
- Corner of Victoria Street and Ann Street (24 51 31.6 S/152 22 15.8 E)
- Corner of Victoria Street and Scotland Street (24 51 43.7 S/152 22 4.9 E)
- Collins Street (24 51 13.9 S/152 22 20.8 E).

FIGURE 72

Base station at Sloping Hummock, East of Bundaberg

FIGURE 73

Base station at East Bundaberg

To compare the characteristics of an operating UMTS base station site in a rural environment, this study also covered another area that exhibits a similar network configuration to that found at Sloping Hummock. It is located at Goulburn, a rural town centre in New South Wales, Australia.

Goulburn is also served by one high power (501 W e.r.p.) base station located at a dominant elevated terrain, Mt Gray (refer to Fig. 74), which is also the site of various other communications facilities. Similarly, another high power (501 W e.r.p.) base station is found at Goulburn city centre (refer to Fig. 75) to complement the UMTS network coverage.

A number of measurement locations in and around Goulburn (namely Rural Case B) were selected for this study:

- Mt Gray South (34 45 30.90 S/149 45 47.30 E)
- Mt Gray North (34 45 21.22 S/149 45 48.59 E)
- Sydney Road service station (34 44 54.25 S/149 44 57.78 E)
- Corner of Chiswick Street and Common Street (34 45 26.94 S/149 44 48.06 E)
- Goulburn Woodworks (34 44 09.69 S/149 44 11.52 E)
- Blackshaw Road (34 45 27.60 S/149 43 19.55 E)
- Goldsmith Street School (34 44 59.81 S/149 43 06.25 E)
- Corner of Australia Street and Bourke Street (34 45 35.13 S/149 42 37.82 E)
- Tourist Centre (34 45 19.78 S/149 43 15.59 E)
- Market Place (34 45 28.31 S/149 43 01.18 E)
- Corner of Bathurst Street and Emma Street (34 45 37.82 S/149 43 42.38 E).

FIGURE 74

Base station at Mt Gray, East of Goulburn

FIGURE 75

Base station at Goulburn city centre

4 Main results

4.1 Uplink measurements

The user equipment (i.e. PCMCIA card) was positioned at approximately 1.5 m above ground level during outdoor uplink measurements. Figures 76 to 82 are results of the measurements taken directly from the external antenna port of the user equipment via a patch antenna adaptor.

There are three lines in these figures individually representing: i) the average uplink channel power emitted from the user equipment when it was continuously uploading a large file as an attachment onto a webmail server; ii) the average uplink channel power emitted from the user equipment when an uplink connection was initially established (without upload/download activity); and iii) the downlink levels as received by the internal antenna embedded in the user equipment.

The first two lines are provided to indicate differences in uplink power levels when the user equipment establishes initial connection and when the user equipment continuously uploads data. The third line is included to provide some insight into the correlation between uplink and downlink levels. However, this only gives an indication of the downlink levels as received by the internal antenna of the user equipment through the antenna output. More data on this characteristic is not available due to insufficient information being readily available from the manufacturer of the internal antenna and the receiver design of this user equipment.

Note that the average channel power is determined in channel power mode by averaging 100 samples at 300 kHz resolution bandwidth (Res BW) within a 5 MHz channel bandwidth.

FIGURE 76

Average uplink channel power in suburban environments − St Clair

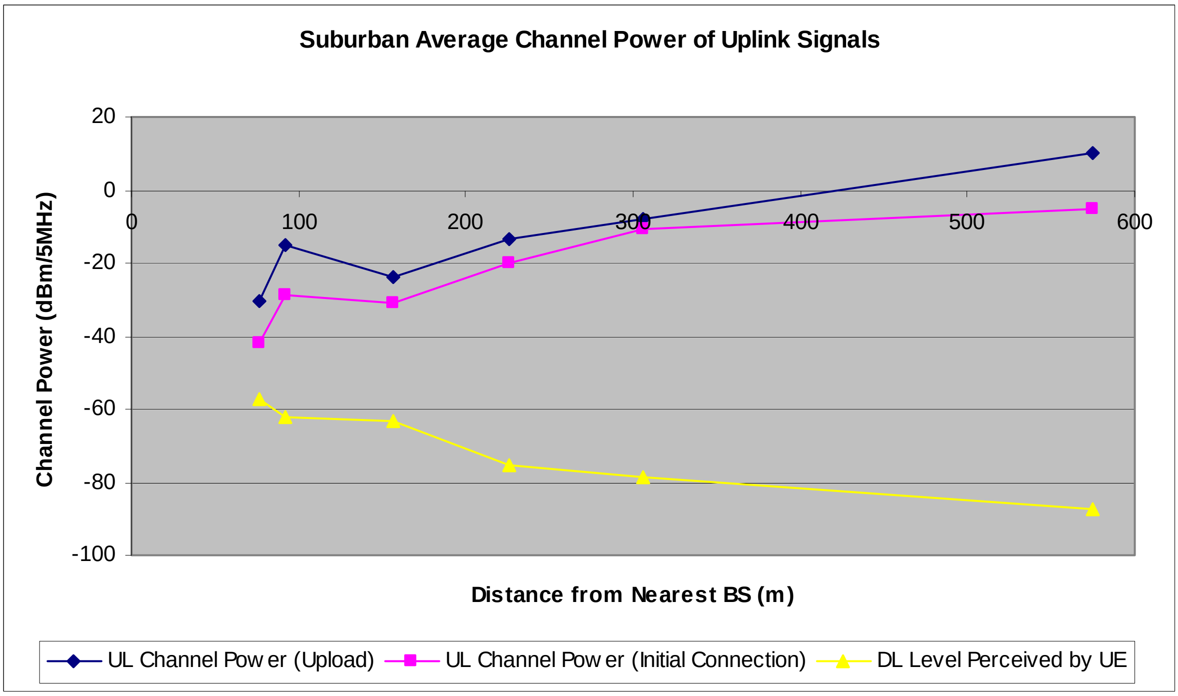


FIGURE 77

Average uplink channel power in urban environments – Parramatta

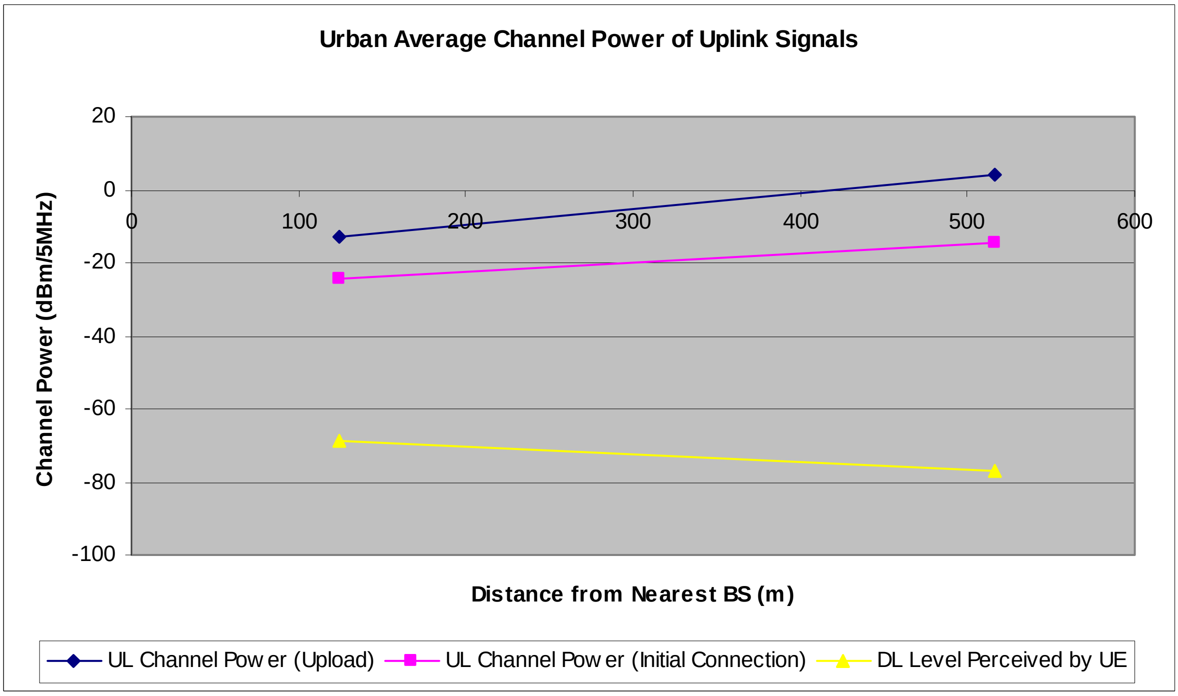


FIGURE 78

Average uplink channel power in rural environments − Case A (Sloping Hummock)

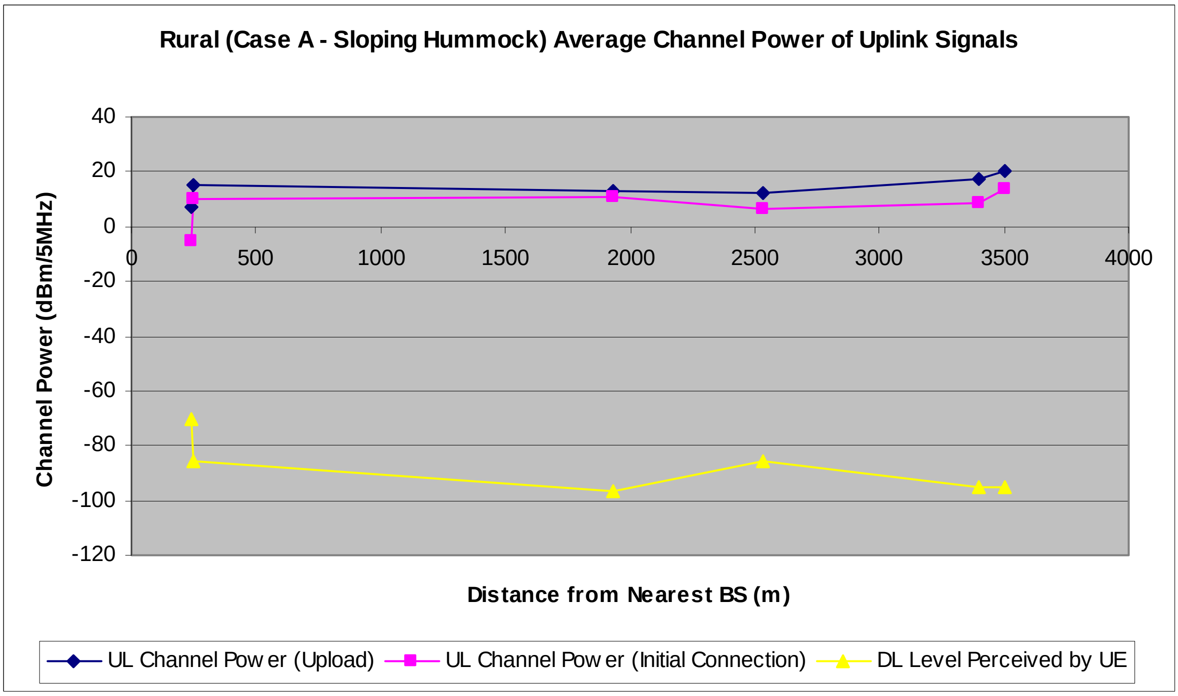


FIGURE 79

Average uplink channel power in rural environments – Case A (East Bundaberg)

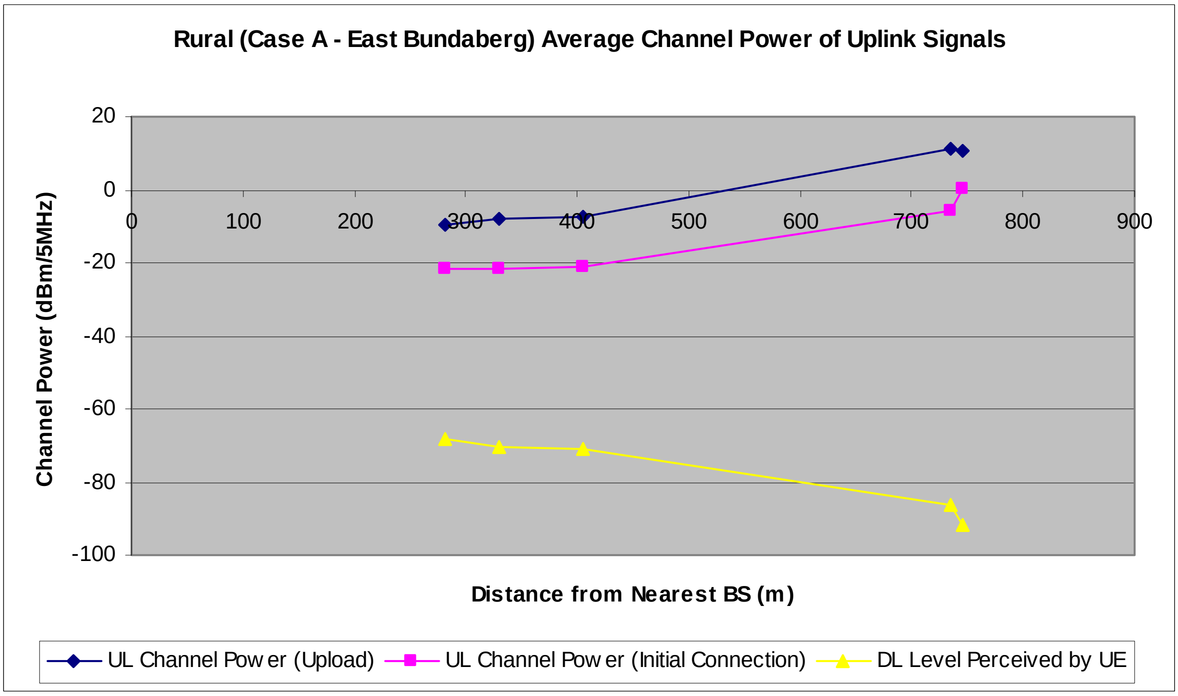


FIGURE 80

Average uplink channel power in rural environments – Case B (Mt Gray)

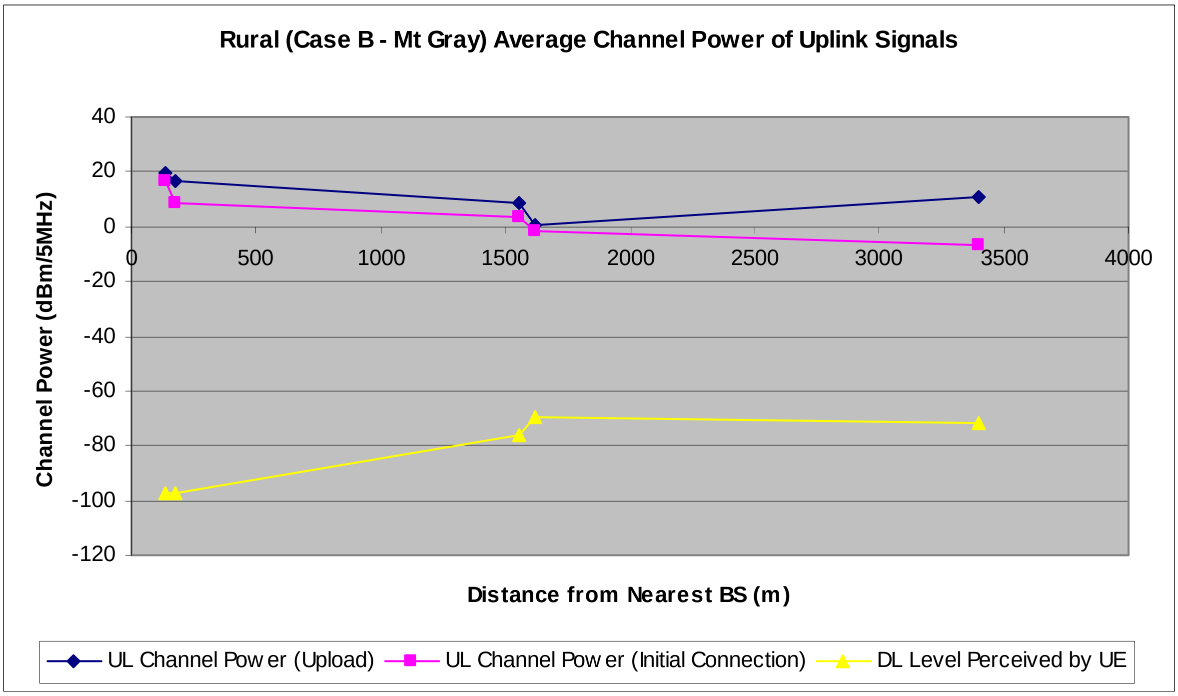


FIGURE 81

Average uplink channel power in rural environments – Case B (Goulburn city)

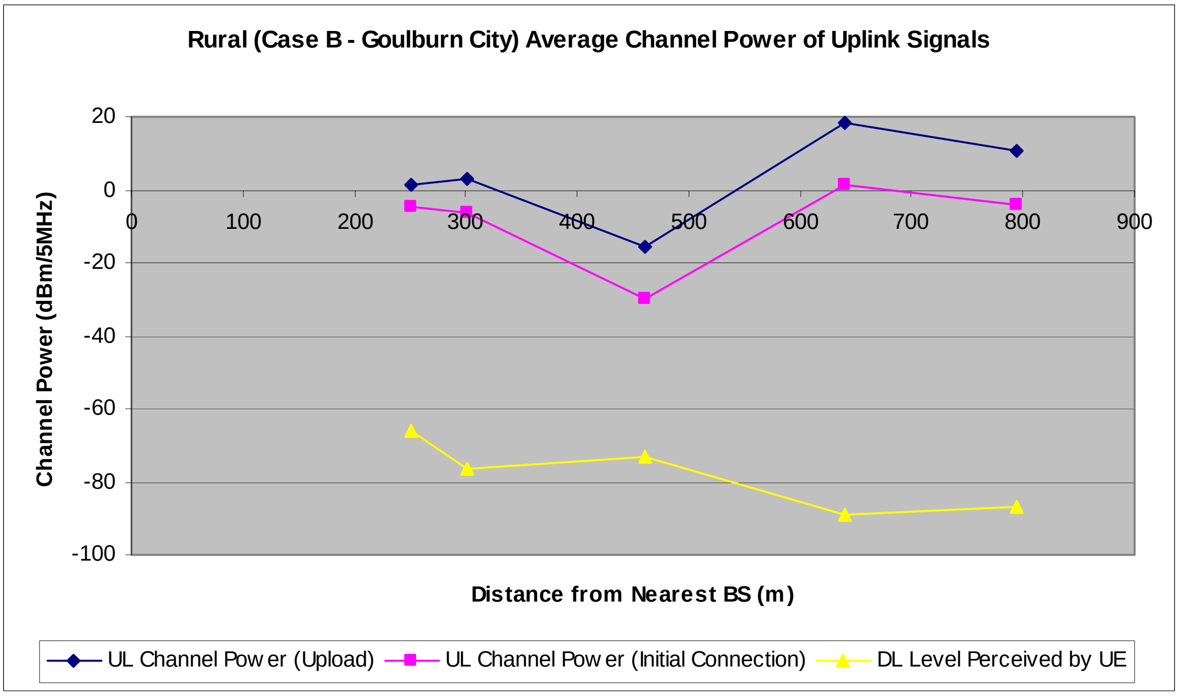
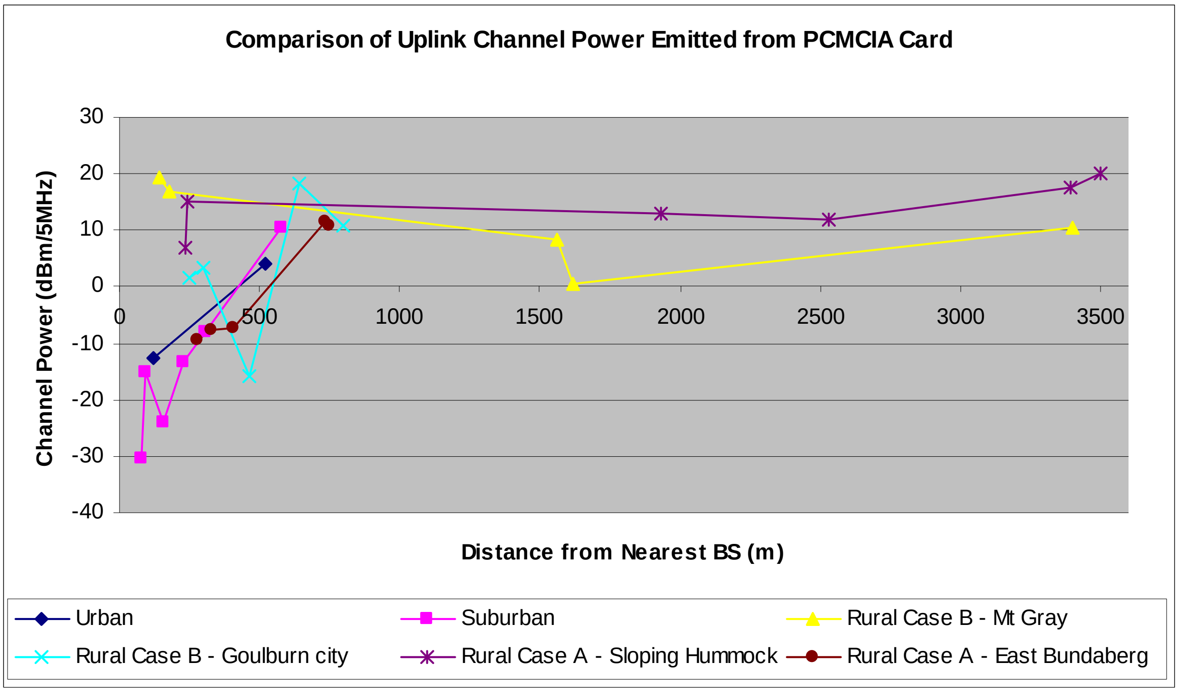


FIGURE 82

Comparison of average uplink channel power in different environments



4.2 Downlink measurements

Figures 83 to 89 are results of the downlink channel power measured from an external TV receive antenna directional to the respective base stations. The receive antenna was mounted on the telescopic mast of the field survey vehicle at 10 m above ground level. Note that the average channel power is determined in channel power mode by averaging 100 samples at a 300 kHz resolution bandwidth (Res BW) within a 5 MHz channel bandwidth.

FIGURE 83

Average downlink channel power in suburban environments − St Clair

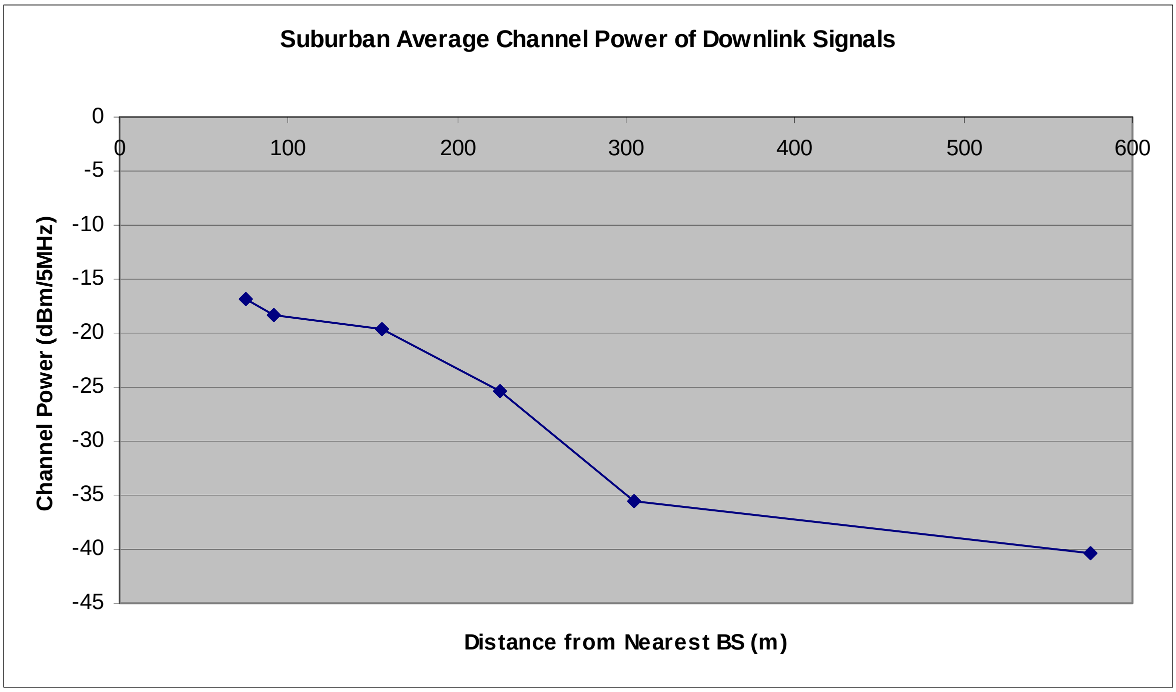


FIGURE 84

Average downlink channel power in urban environments − Parramatta

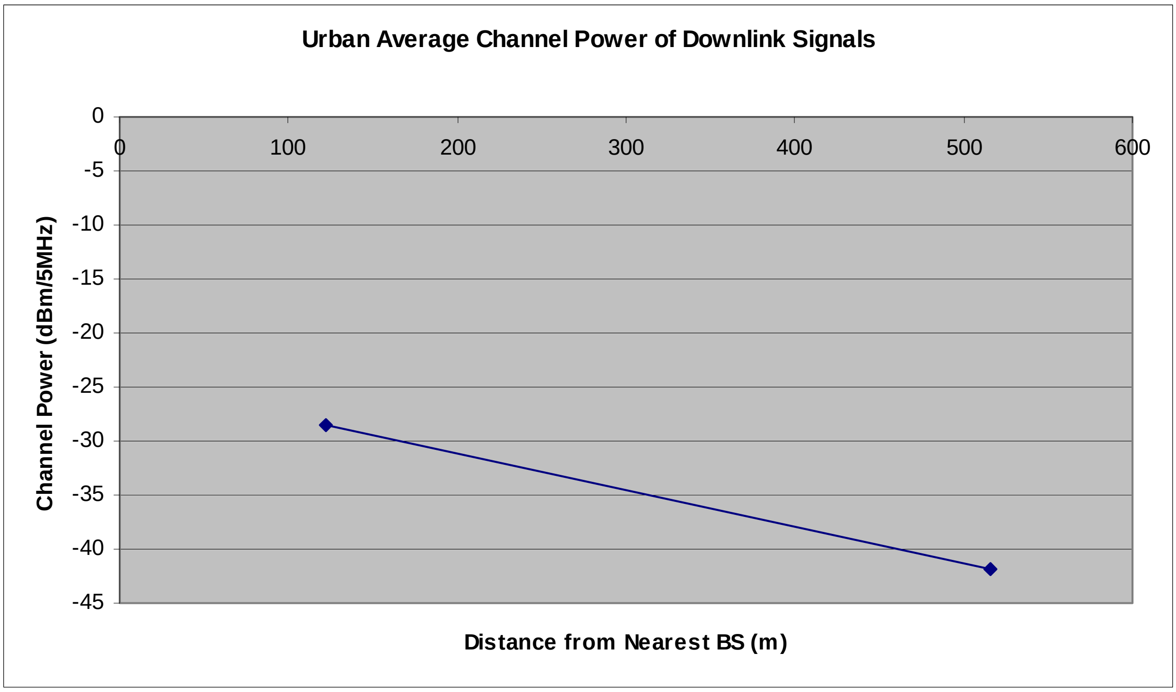


FIGURE 85

Average downlink channel power in rural environments – Case A (Sloping Hummock)

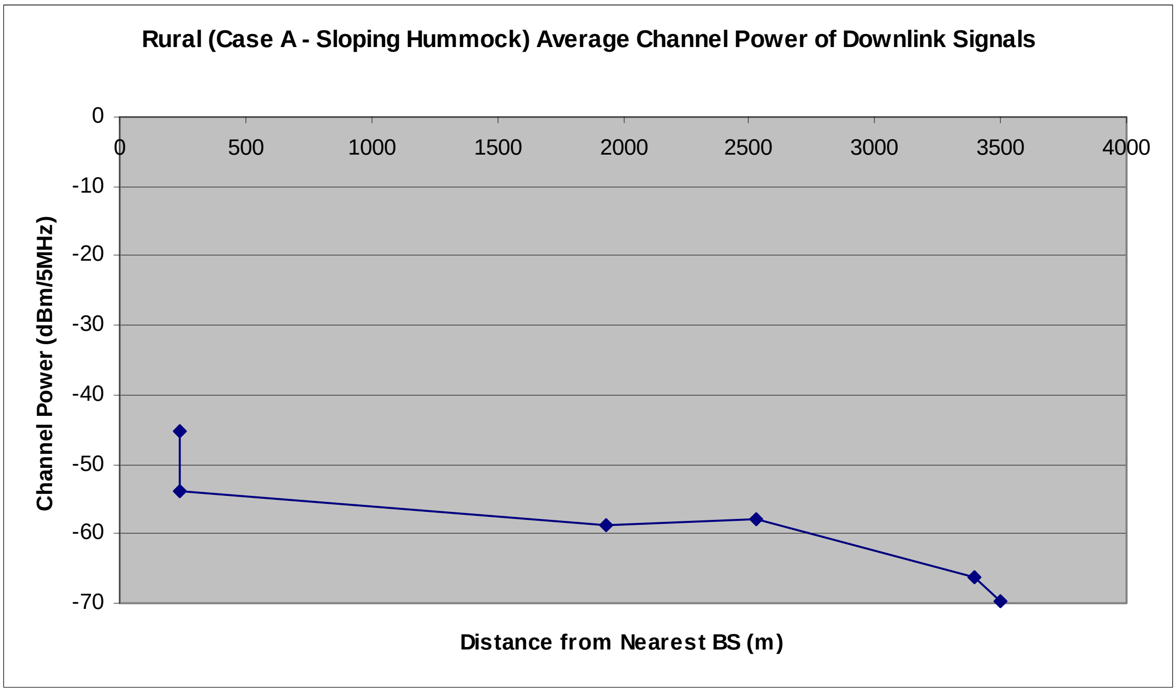


FIGURE 86

Average downlink channel power in rural environments – Case A (East Bundaberg)

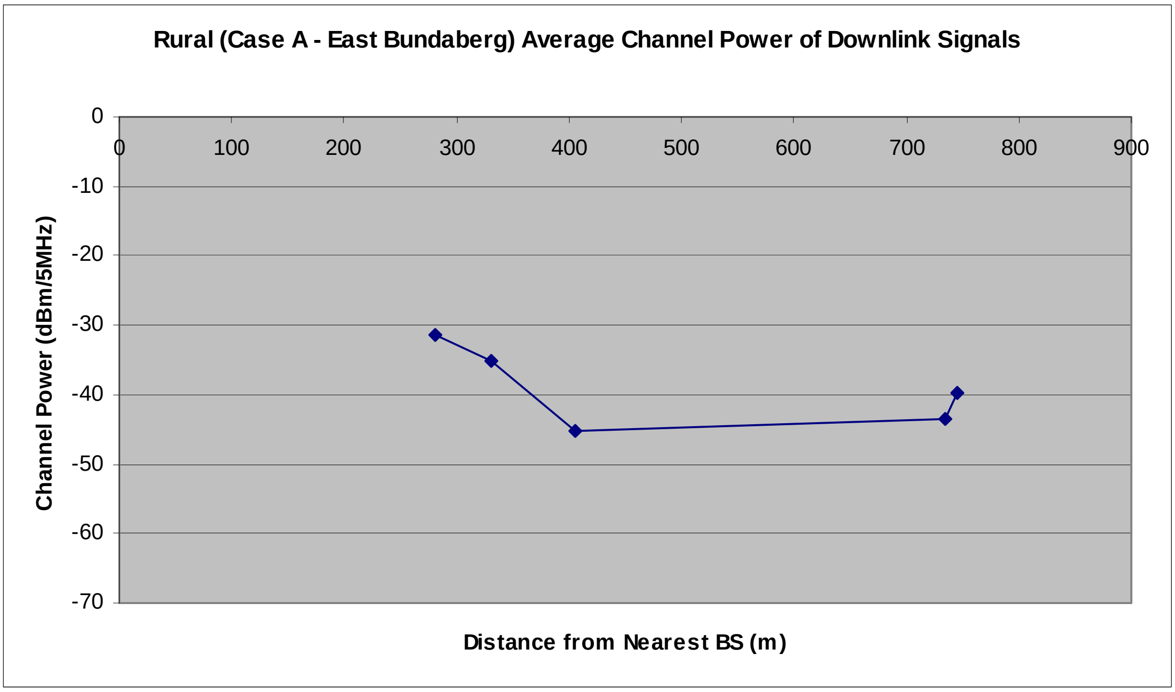


FIGURE 87

Average downlink channel power in rural environments – Case B (Mt Gray)

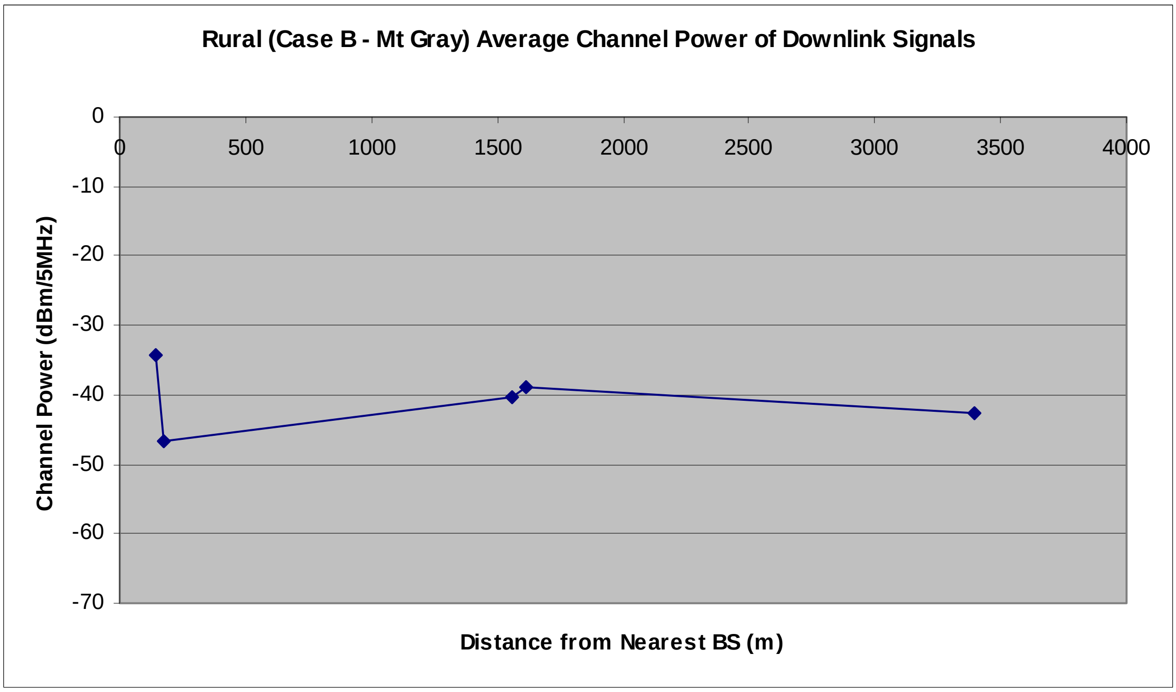


FIGURE 88

Average downlink channel power in rural environments – Case B (Goulburn city)

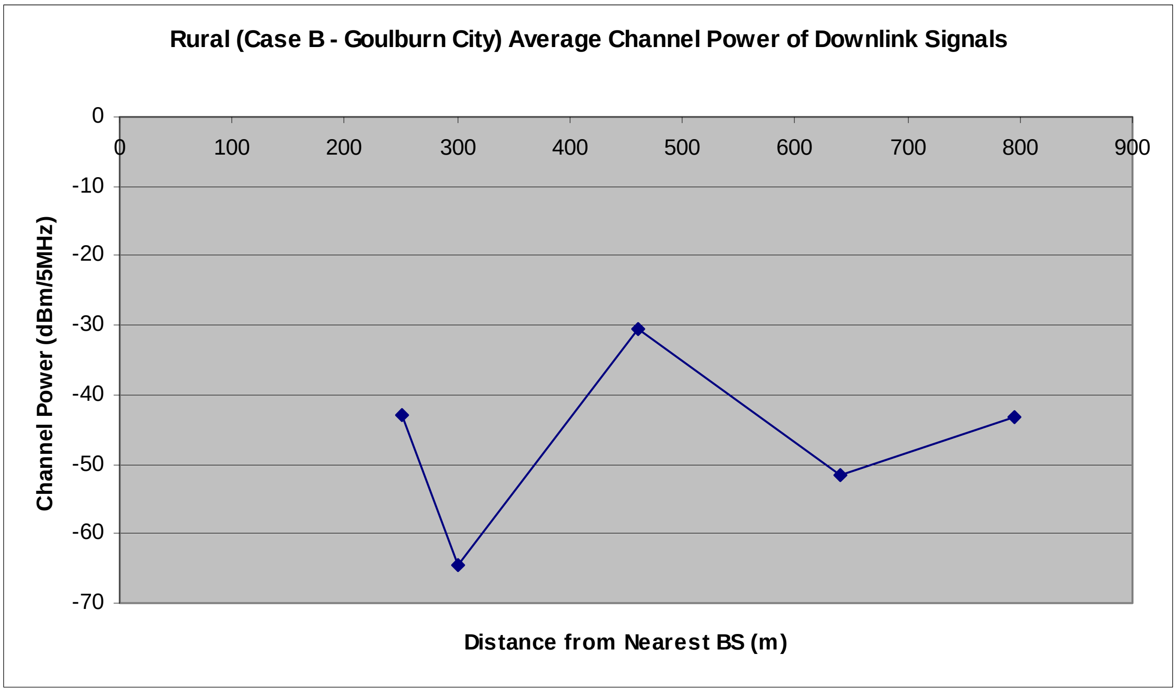
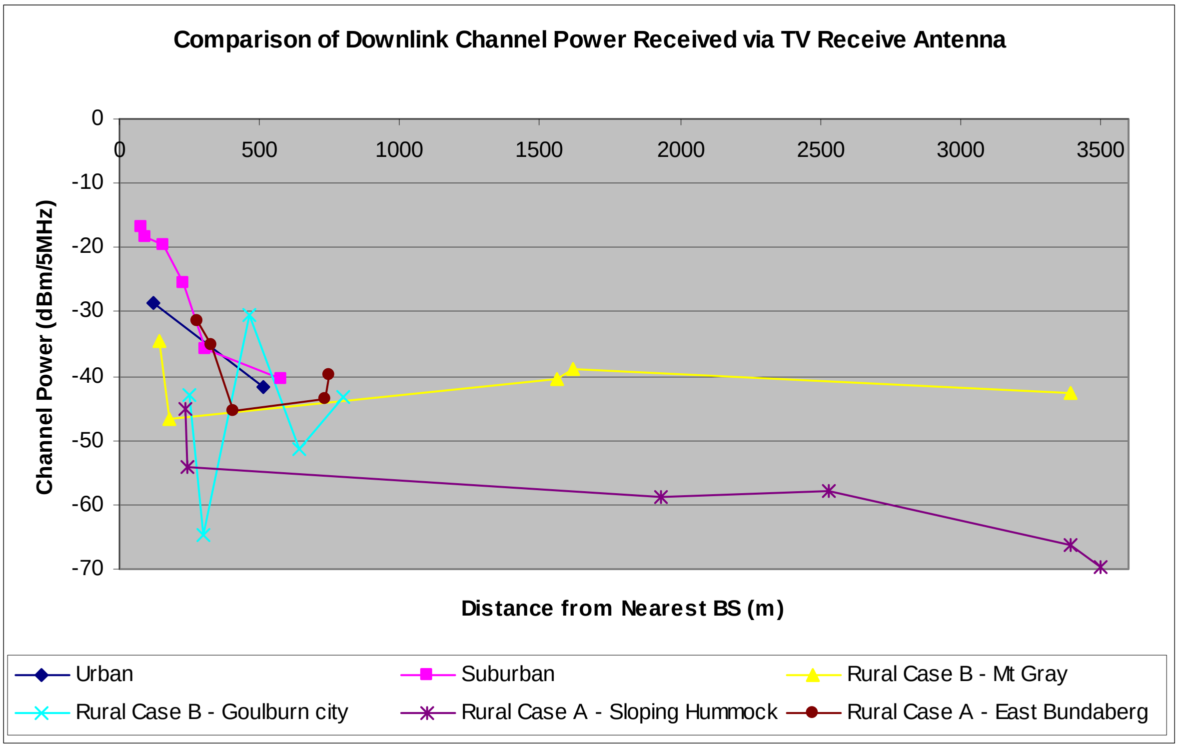


FIGURE 89

Comparison of average downlink channel power in different environments



5 Analysis and observations

5.1 Observations on uplink measurements (via PCMCIA Card)

In Fig. 76 (Suburban), Fig. 77 (Urban) and Fig. 79 (Rural Case A − East Bundaberg), the uplink channel power and the corresponding downlink levels (received by the internal antenna of the PCMCIA card) exhibit similar patterns relating to the magnitude of power levels. The uplink channel power measured in the range of −30 dBm/5 MHz to −10 dBm/5 MHz at some proximity (< 500 m) to the respective base stations. Measurements recorded further away from the base station indicate that the uplink channel power increases to +10 dBm/5 MHz or more. However, it does not reach the maximum output power of user equipment at the level of +24 dBm/5 MHz (+1/−3 dB tolerance) for power class 3 or +21 dBm/5 MHz (±2 dB tolerance) for power class 4 as specified in § 6.2.1 of 3GPP TS 25.101.

The first three measurement points as shown in Fig. 81 (Rural Case B − Goulburn city) were not consistent and portrayed a dissimilar pattern to those observed in Figs. 76, 77 and 79. Since the base station in Goulburn City is located in the midst of the township as shown in Fig. 75, the measurement results may be affected by severe multipath between the base station at a height of 22 m above ground level and its surrounding built-up suburban area of similar or slightly lower height than the base station.

Figure 78 (Rural Case A − Sloping Hummock) and Fig. 80 (Rural Case B − Mt Gray) are quite different from those mentioned above. The base stations at Sloping Hummock and Mt Gray have antennas at > 40 m above ground level. The uplink connections established within close proximity (< 250 m) to these base stations are often associated with low downlink levels received by the PCMCIA card and hence resulted in the uplink channel power approaching maximum output power at +21 dBm/5 MHz. When the measurements were taken at distances within 1-3 km away, the uplink channel power decreases slightly (but still remain > 0 dBm /5 MHz) and then approaches maximum again (or exhibits an incremental trend) when > 3 km away.

Based on the observations on the uplink measurements, it is noted that the UMTS network coverage exhibits two distinctive types, independent of the operation environments and e.r.p. levels of the base stations:

− The first type correlates to a smaller cell radius (in the range of 800 m or below) with uplink patterns as shown in Fig. 76 (suburban), Fig. 77 (urban) and Fig. 79 (Rural Case A − East Bundaberg). To some extent, Fig. 81 (Rural Case B − Goulburn city) could be considered under this type.

− The second type correlates to a larger cell radius (in the range of 4 km or below) with uplink channel power remaining at >0 dBm/5 MHz and occasionally approaching a maximum of +21 dBm/5 MHz. This is evident in Fig. 78 (Rural Case A − Sloping Hummock) and Fig. 80 (Rural Case B − Mt Gray).

5.2 Observations on downlink measurements (via external TV receive antenna)

Results as shown in Figs 83 to 89 gave an indication of the type of downlink power levels that would be present at a television receive antenna positioned at 10 m above ground level.

The majority of downlink measurements in Fig. 83 (Suburban), Fig. 84 (Urban) and Fig. 86 (Rural Case A − East Bundaberg) exhibit a similar pattern relating to the magnitude of power levels, i.e. downlink channel power is observed to be in the range of around −15 dBm/5 MHz to −50 dBm/5 MHz from the respective base stations. To some extent, Fig. 88 (Rural Case B – Goulburn city) could be considered similar to these figures.

In Fig. 85 (Rural Case A − Sloping Hummock), it is clearly shown that the measurements were lower than all other plots. The reason that Fig. 85 (Rural Case A – Sloping Hummock) differs from those in Fig. 87 (Rural Case B – Mt Gray) may be the differences in antenna tilting from the respective base stations. The base station at Mt Gray (terrain height of 810 m) has deployed antennas at 2-5 degree tilting towards undulating/hilly terrain in order to serve communities around the Goulburn region (terrain height around 630-680 m). Whereas the base station at Sloping Hummock (terrain height of 95 m) did not apply any tilting to its antennas due to the flatter terrain around the Sloping Hummock region (terrain height of 20-30 m).

One observation made from the downlink measurements is that the trend for downlink signals at the dominant terrain sites (i.e. Sloping Hummock and Mt Gray) in rural environments are at a distinctive lower level than the rest. More studies may be required to verify the characteristics of these high power base stations in rural environments.

5.3 Observations on out-of-band emissions from a PCMCIA card

The following plots were captured in one of the rural measurements conducted at Mt Gray North, where the UMTS base station was located in an approximate distance of 130 m to a broadcast site that is transmitting DVB-T signals at 806-813 MHz.

There are two lines in Figs 90, 91 and 92. The yellow line indicates the instantaneous signal level in max-hold mode for the spectrum across 750-900 MHz, whereas the blue line indicates the instantaneous level at that time when these plots were captured. For more information regarding the Australian radio-frequency spectrum allocations in 750-900 MHz band, refer to:

FIGURE 90

Instantaneous levels measured via PCMCIA card at Mt Gray North

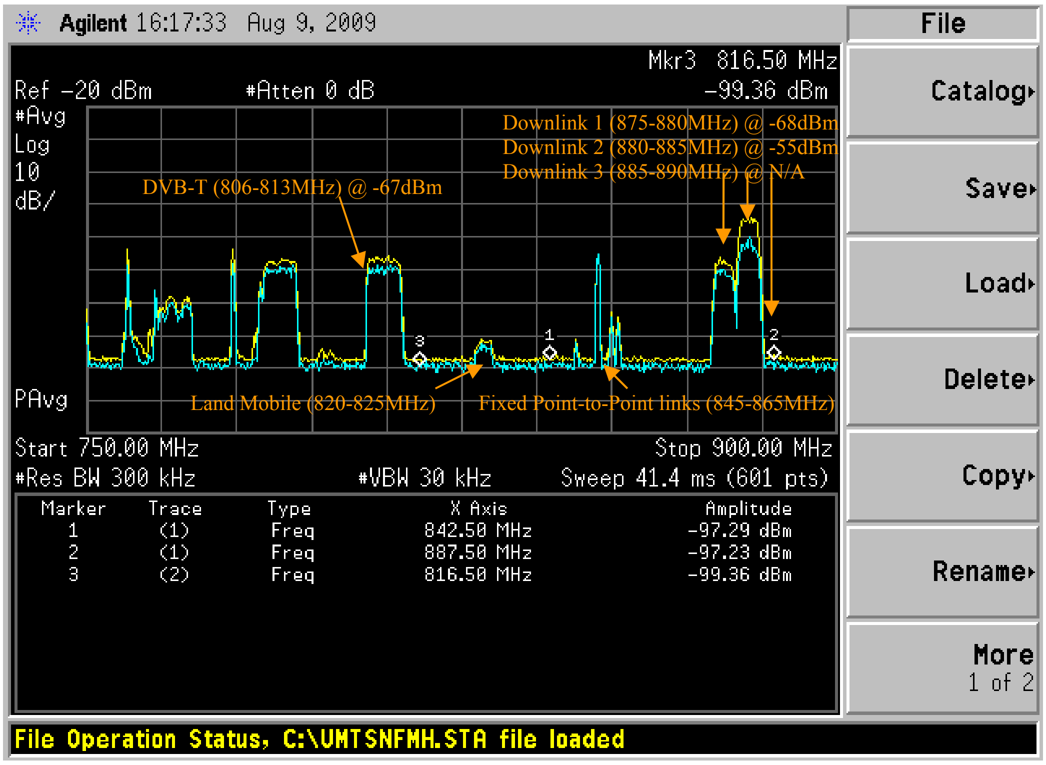


FIGURE 91

Instantaneous DL/UL levels measured via PCMCIA card when connection was initially established (note that 30 dB input attenuation was applied)

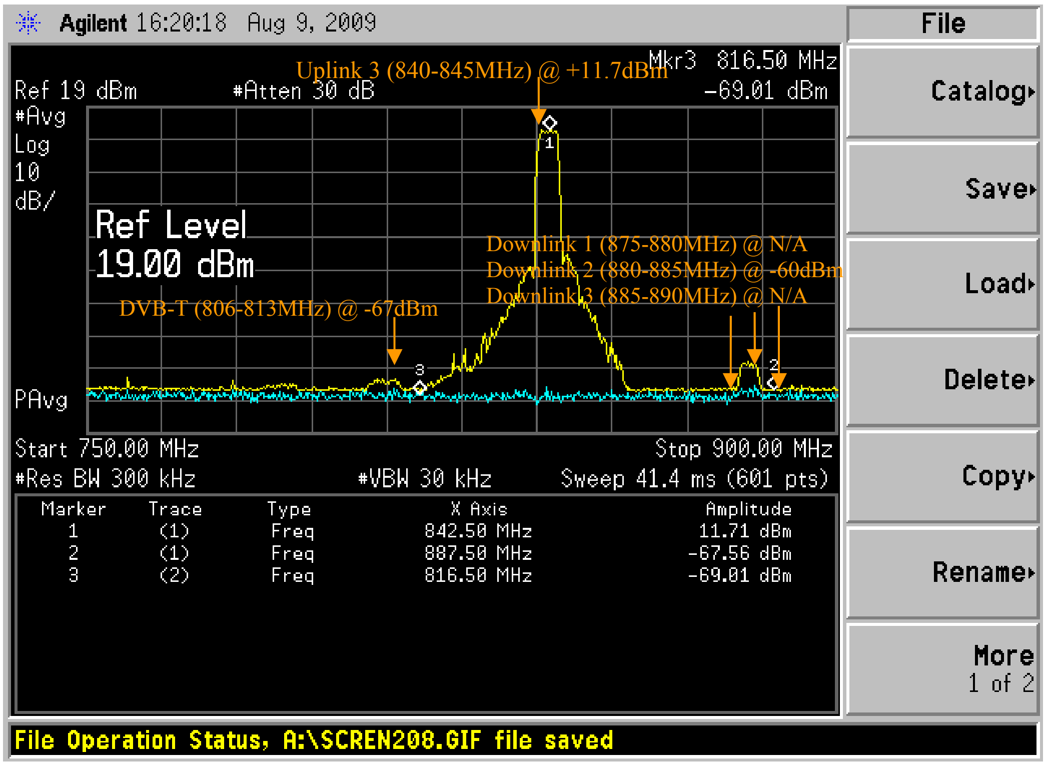


FIGURE 92

Instantaneous DL/UL levels measured via PCMCIA card when constantly uploading (note that 30 dB input attenuation was applied)

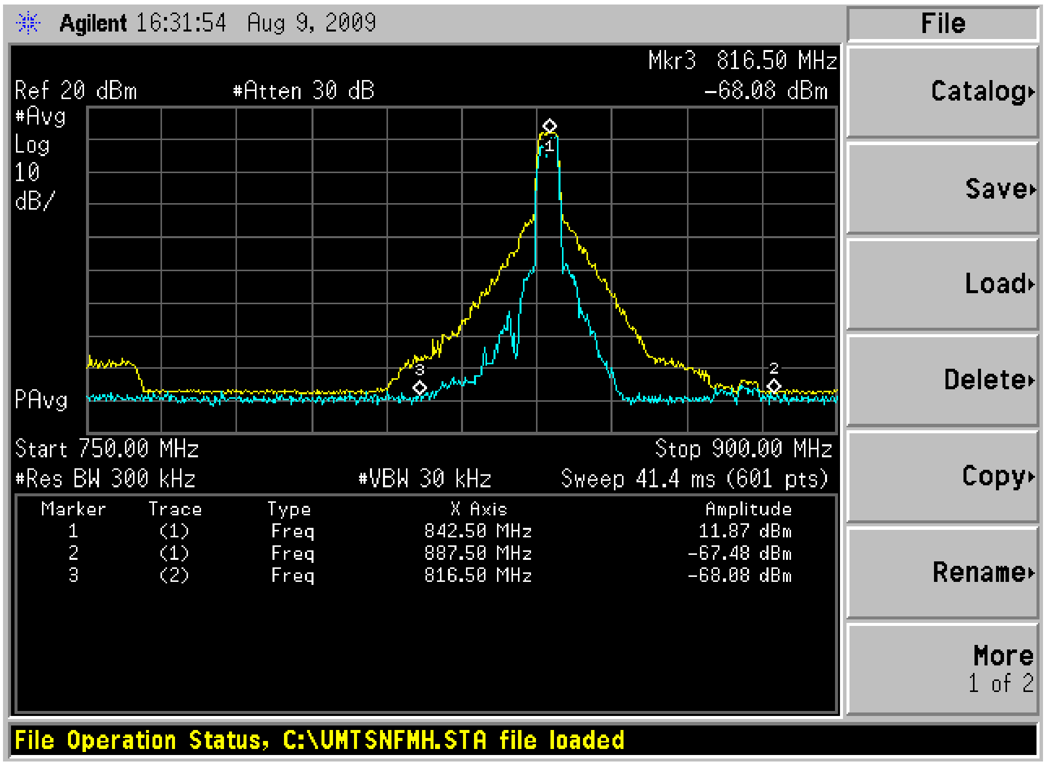
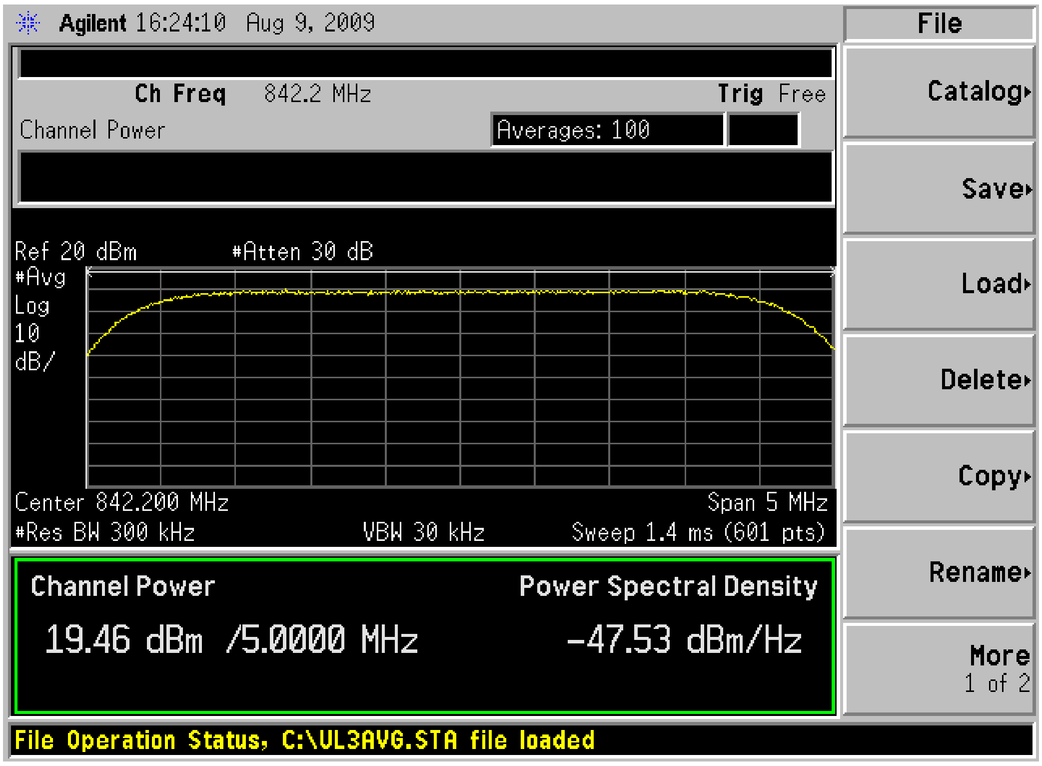


FIGURE 92*bis*

UL channel power measured via PCMCIA card when constantly uploading (note that 30 dB input attenuation was applied)



The following observations were made when analysing the above measurements:

– The uplink channel established during connection may not necessarily pair up with the strongest downlink signal. This was evident in Figs 91 and 92. The uplink connection was established at the uplink 3 (840-845 MHz) that was paired with downlink 3 (885-890 MHz). However, it is noted that the strongest downlink channel was at downlink 2 (880-885 MHz) which would have to pair up with uplink 2 (835-840 MHz). More studies may be required to verify this phenomenon.
– An instantaneous uplink level of +11.9 dBm in Fig. 92. The measurement in channel power mode, as shown in Fig. 92*bis*, gives 19.5 dBm/5 MHz which is close to the maximum uplink power of +21 dBm/5 MHz. When this occurs, there could be potential disruption to the reception of the DVB-T broadcast channel at 806-813 MHz due to the observed and measured dispersive out-of-band emission(s) from the PCMCIA card. Moreover, there is also an unknown inter-modulation product that was measured around 750-760 MHz when the user equipment emits maximum power as shown in Fig. 92, but this was not observed in Fig. 91. More studies may be required to verify this phenomenon.

6 Further studies

The results presented in this study report and its predecessors in Annexes 1 and 2 provide insights into the possible variation in UMTS network design, base station architectural structures and cellular service characteristics for a particular mobile carrier in one country. The outcomes of these studies show that for maximum protection of reception of the digital television broadcasting service reverse-duplex of the UMTS uplink/downlink configuration is required given the consistency observed in the downlink measurements and also the number of mitigation techniques (e.g. filters for base station transmitters and/or guardbands) available to mitigate interference to digital television broadcasting. In light of the results of the measurements presented in this contribution, further study may be required to confirm appropriate mitigation techniques.

This study identified an unexplainable phenomenon from the PCMCIA card operation:

– it illustrated dispersive out-of-band emission(s) from the PCMCIA card when the uplink approaches a maximum output power at +21 dBm/5 MHz; and
– the out-of-band emissions may have exceeded the spectrum mask emission requirement as specified in § 6.6.2 of 3GPP TS 25.101, yet the filtering appeared to have a different characteristic when another manufacturer's PCMCIA card was tested.

In preparation for these studies the 3GPP specifications for user equipment (i.e. 3GPP TS 25.101) and base stations (i.e. 3GPP TS 25.104) were reviewed. A review of 3GPP specification's out-of-band emission limits (spectrum masks) for the base station and for the user equipment indicated that the out-of-band emission specifications appear to be minimal for sharing conditions with a digital terrestrial television broadcast (DTTB). As a result of existing user equipment design, DTTB would be required to potentially coexist with large numbers of user equipment which are immediately adjacent in the frequency band and have emission masks that would cause interference to the reception of DTTB signals.

This triggers the need for a potential further study on user equipment's filtering and out-of-band characteristics in UMTS and LTE networks as currently specified in § 6.6.2 of 3GPP TS 25.101 and TS 36.101, respectively.

As a result of observations made of the currently deployed UMTS network, other areas for further study for consideration are:

– Given that DTTB coverage is planned on the basis of time and location probability of the minimum median field strength, what are the potential audience losses that planned DTTB services may suffer from as a result of introduced IMT services (for the UMTS *normal* and *reverse* duplex cases) in the absence of sufficient interference mitigation techniques?
– As a corollary, given that the existing and planned IMT services are deployed on the basis of end-user reconnection in the event of signal loss, is there any degradation in quality of service in end-user disconnection from adjacent channel interference from DTTB services?
– As IMT networks migrate from legacy: 850 MHz W-CDMA and cdma2000; and 2 100 MHz W-CDMA services and overlay to wider bandwidth 700 MHz LTE onto their existing 3G network infrastructure, what likely aggregate increase in interference will occur to DTTB?

7 Conclusions

The studies undertaken to date point to potential variations in UMTS network configurations as presented in the outdoor measurements of the existing UMTS network.

The analysis of the UMTS configurations considered in this study indicate that there are two distinctive patterns as exhibited in the uplink/downlink measurements independent of the operation environments and e.r.p. levels of the base stations. The first type correlates to a smaller cell radius (in the range of 800 m or below) and it comprises the case in urban (e.g. Parramatta), suburban (e.g. St Clair) and rural township (e.g. East Bundaberg and Goulburn City). The second type correlates to a larger cell radius (in the range of 4 km or below) and it comprises the case in rural regions where base stations are located upon dominant elevated terrains (e.g. Sloping Hummock and Mt Gray).

For the uplink measurements, it is illustrated in the measurements clearly that there is a significant difference between the user equipment transmit levels when an uplink connection was initially established and when it was constantly uploading data. In the latter case, the user equipment transmit level is higher than the former.

Recommendation 1: It is therefore recommended that sharing study methodologies between UMTS and DTTB should be specified with the user equipment in continuously uploading mode.

As demonstrated in these measurements, the transmit power of the user equipment reaches its highest level at the edge of the cell coverage area. This level, in the range of the +10 dBm/5 MHz to +20 dBm/5 MHz, was similar for all types of environments and cell sizes considered in this study.

Recommendation 2: For sharing studies related to country border areas, which also corresponds to the fringe of the DTTB coverage, it is recommended that the user equipment transmit levels correspond to the range of +10 dBm/5 MHz to +20 dBm/5 MHz.

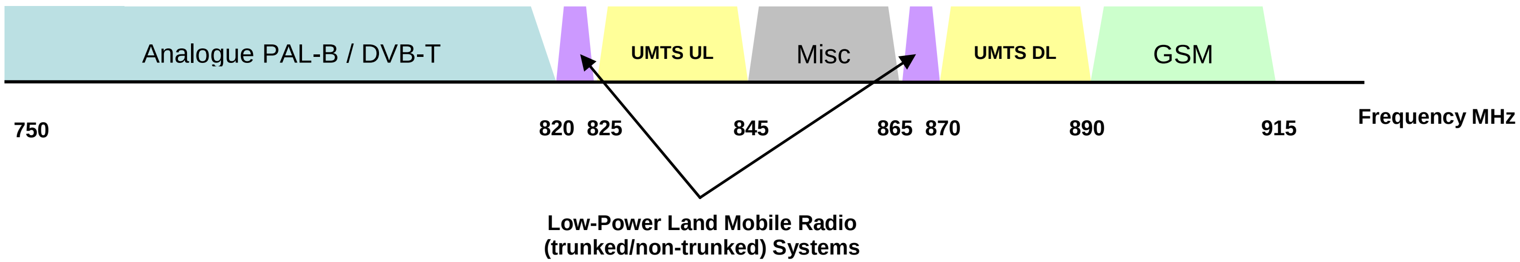
While over 460 measurements were taken in these recent field surveys across this existing UMTS network, the limited number of representative measurements presented in this contribution may not draw final conclusions, however they identify some potential variations in UMTS uplink/downlink signals within rural, suburban and urban broadcasting environments. It is therefore proposed that it is not possible to suggest "typical" characteristics for a UMTS network. More studies are required to investigate further characteristics of these UMTS networks, base stations and user equipment in a number of environments.

Annex 1

Australian radio-frequency spectrum allocations in the 750-900 MHz band

FIGURE 93

Australian radio-frequency spectrum allocations in the 750-900 MHz band



Misc includes services such as fixed point-to-point links or PABX cordless system.

UMTS network in Australia operates two paired of 5MHz channels each in the bands 835-845MHz (uplink) and 880-890MHz (downlink) in metropolitan areas whereas three paired of 5MHz channels each in the bands 830-845MHz (uplink) and 875-890MHz (downlink) in regional/rural areas. Note that 825-830MHz (uplink) and 870-875MHz (downlink) are spectrum licensed but remained as unused spectrum across Australia during this field survey.

Chapter 3

Estimation of UMTS cell coverage radius

1 Introduction

A series of field studies were undertaken in Australia in 2010 and 2011 which may be used to further determine potential interference to DTTB from entry of mobile services into the UHF band.

The locations chosen for the survey are considered suburban and rural broadcasting environments in Australia.

The first location chosen is for a suburban environment at St Clair within the western suburbs of Sydney. It has an undulating topography, likely symmetrical geographic UMTS cell size and likelihood of network presence. It has one high power (501 W e.r.p.) base station and two low power sites to complement the UMTS network coverage in the immediate area.

In addition a rural environment was surveyed at Goulburn, a rural town centre in New South Wales, Australia. Goulburn is also served by one high power (501 W e.r.p.) base station located at a dominant elevated terrain, Mt Gray, which is also the site of various other communications facilities. And similarly another high power (501 W e.r.p.) base station is found at Goulburn City Centre to complement the UMTS network coverage. These were both complemented by one low power site at Garfield.

2 Measurement of cell IDs within a UMTS coverage area

2.1 Objective

The objective was to take a record of the cell ID on a UMTS hand set at a range of distances from the reference base station(s). An observation of cell handover on a UMTS hand set was undertaken to estimate cell size.

A suitable measurement point was found within a 30 m radius (but not limited) to be in line with each panel of the reference base station. At any measurement point when the cell ID varied, in order to verify if the cell handover repeated itself, further measurements were undertaken at a radial distance of ±2 m from the respective measurement point.

2.2 Premeasurements

2.2.1 Equipment

Three Nokia E51 handsets (3G/UMTS), installed with a software capable of displaying cell ID and a GPS navigator were utilized in the field surveys. Testing was undertaken on three handsets is mainly to determine any manufacturing variations.

2.2.2 Cell ID verification

At each measurement location an initial assessment was undertaken to verify the cell ID of each base station in the selected study locations.

This was achieved by launching the software via the mobile handset at various points that were in close proximity (preferably within 10 m from the base station) facing each panel of the base station(s).

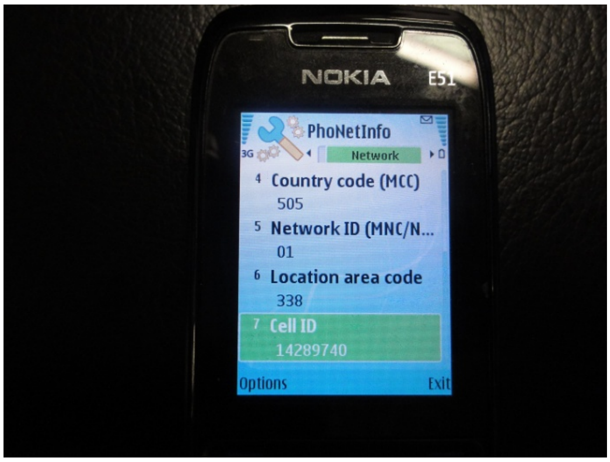
The first *N* decimal digits of the cell ID were observed not to change whereas the last digit changed indicating which panel "established" connection with the mobile handset.

FIGURE 94

Nokia E51 handsets

FIGURE 95

PhoNetInfo[11] application for cell identification



2.2.3 Selected field study areas

Suburban environment: Colyton/St Clair at Western Sydney

Rural environment: Goulburn/Mt Gray at 150 km SW of Sydney

2.2.4 Field study measurement template

The following measurement template was utilized to record measurements:

No.	Description	GPS (Lat/Long)	Cell ID	Distance from base station (m)	Remarks
P1	Street name and number or building remarks	GPS reading in WGS-84	N digits as displayed in the mobile handset	Desktop calculation or Google Earth	Observations (e.g. cell handover)
…	…	…	…	…	

2.3 Configuration of base stations

2.3.1 Base stations at St Clair/Colyton study area

The following base stations were selected for the study at the St Clair/Colyton areas (refer to Fig. 96):

NOTE – It was noted that the registered max ERP of 501 W as recorded in the regulators database could be max e.i.r.p.

---

[11] PhoNetInfo – refer http://www.patrickfrei.ch/phonetinfo/index.html.

TABLE 32

"Suburban" base stations in St Clair NSW

				Uplink 835.2-844.4 MHz Downlink 880.1-889.5 MHz Bandwidth 9.2 MHz/9.4 MHz			Uplink 835.05-844.95 MHz Downlink 880.05-889.95 MHz Bandwidth 9.9 MHz			Uplink 830.05-834.95 MHz Downlink 875.05-879.95 MHz Bandwidth 4.9 MHz		
Site ID	**Lat/Long (ACMA)**	**Lat/Long (Google Earth)**	**Site Name**	**Height (m)**	**ERP/ e.i.r.p. (W)**	**Azimuth (degree)**	**Height (m)**	**ERP/ e.i.r.p. (W)**	**Azimuth (degree)**	**Height (m)**	**ERP/ e.i.r.p. (W)**	**Azimuth (degree)**
9007685	33 47 26 S 150 48 27 E	33 47 25.1 S 150 48 24.9 E	Telstra Site Cnr M4 and Roper Rd COLYTON				20	501/NA	90 220 335			
133561	33 47 18 S 150 47 10 E	33 47 12.3 S 150 47 14.9 E	Telstra Site Colyton M4 Motorway Potter Field Shepherd St COLYTON	22.5	31.6/39.5	20 120 270						
133747	33 47 40 S 150 47 17 E	33 47 33.3 S 150 47 22.3 E	Bennett Rd ST CLAIR	16	31.6/40.6	60 150 290						

Legend for the following maps:

High-power sector

Low-power sector

FIGURE 96

Base stations mapping at Colyton/St Clair

2.3.2 Base stations at Goulburn/Mt Gray study area

The following base stations were selected for the study at Goulburn/Mt Gray (refer to Fig. 97):

NOTE − It was noted that the registered max ERP of 501 W as recorded in the regulators database could be max e.i.r.p.

TABLE 33

"Rural" base stations in Goulburn/Mt Gray NSW

				Uplink 835.2-844.4 MHz Downlink 880.1-889.5 MHz Bandwidth 9.2 MHz/9.4 MHz			Uplink 835.05-844.95 MHz Downlink 880.05-889.95 MHz Bandwidth 9.9 MHz			Uplink 830.05-834.95 MHz Downlink 875.05-879.95 MHz Bandwidth 4.9 MHz		
Site ID	**Lat/Long (ACMA)**	**Lat/Long (GoogleEarth)**	**Site Name**	**Height (m)**	**ERP/e.i.r.p. (W)**	**Azimuth (degree)**	**Height (m)**	**ERP/e.i.r.p. (W)**	**Azimuth (degree)**	**Height (m)**	**ERP/e.i.r.p. (W)**	**Azimuth (degree)**
9493	34 45 31 S 149 45 45 E	34 45 25.5 S 149 45 49 E	Telstra Site MT GRAY	47.7	107.2/41.1	Omni	47	501/NA	75 185 315 295 340	47	501/NA	75 185 315 295 340 Omni
100820	34 45 26 S 149 43 01 E	34 45 20.5 S 149 43 3.5 E	Telstra Exchange Auburn Street GOULBURN	22.5	28.2/35.8	Omni	22	501/NA	0 130 240	22	501/NA	0 130 240 Omni
9011132	34 45 55 S 149 41 39 E	34 45 52 S 149 41 42 E	Telstra RBS Site 72 Knox St GOULBURN				35	501/NA	0 80 210	35	501/NA	0 80 210

Legend for the following maps:

High-power sector

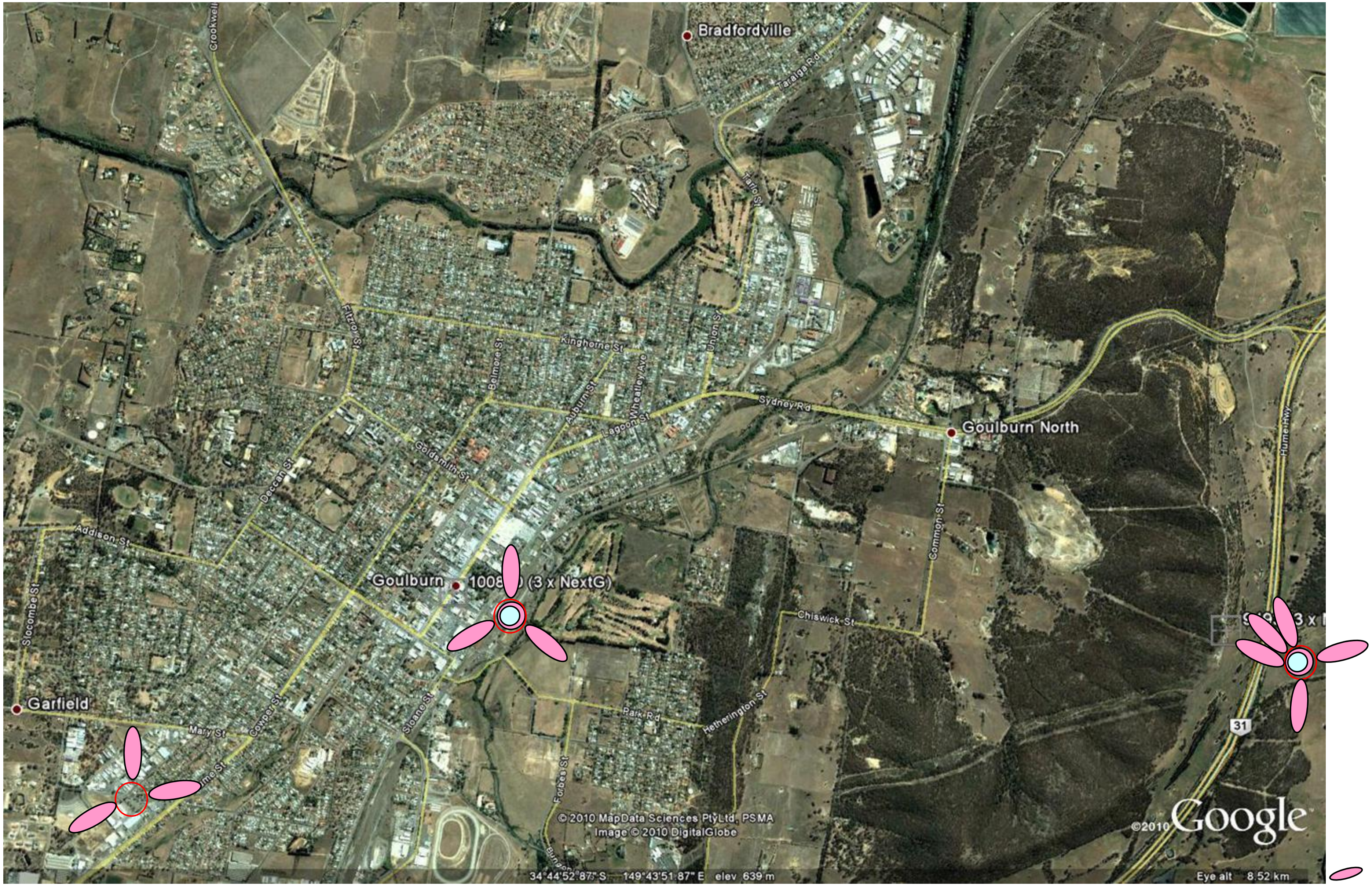
Low-power sector

High-power omni-sector

Low-power omni-sector

FIGURE 97

Base stations mapping at Goulburn/Mt Gray



3 Estimation of cell coverage radius

3.1 Objective

Measurement data at over 1 000 measurement spots was overlaid on aerial maps to demonstrate, to every extent possible, the estimation of the IMT base station coverage.

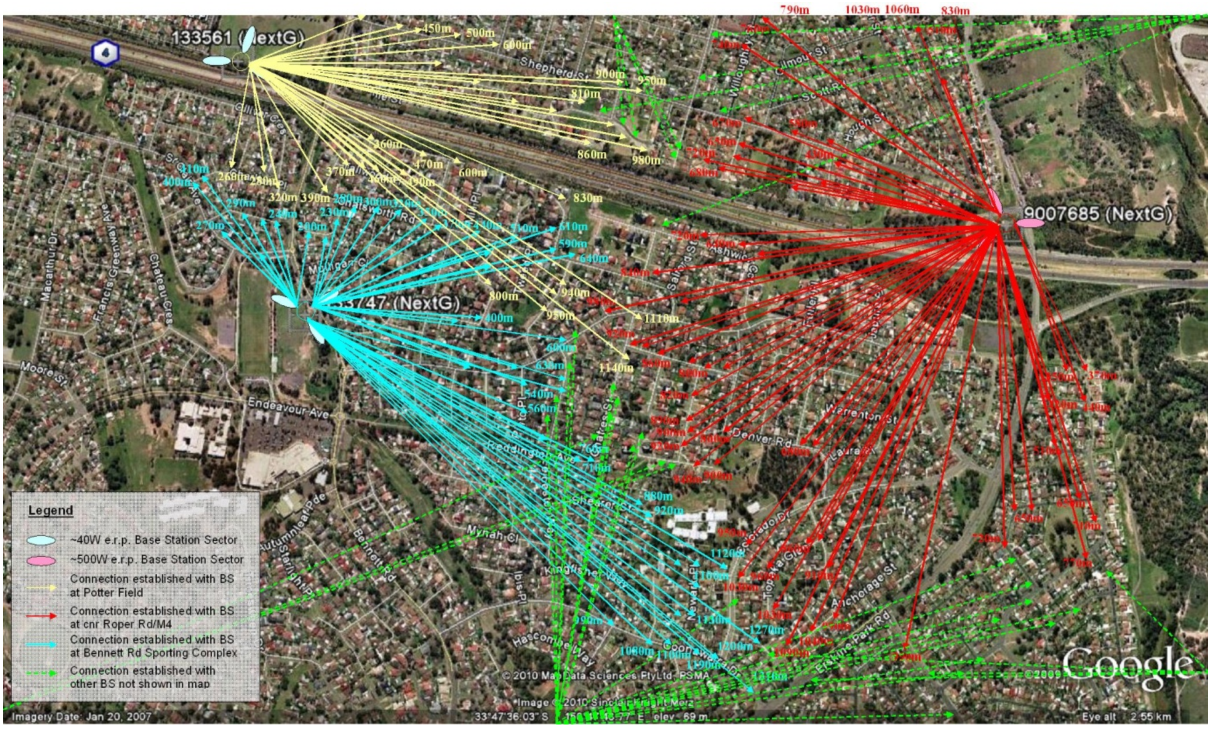
3.2 Methodology for cell coverage

3.2.1 Suburban environment − St Clair/Colyton

IMT cell coverage could be estimated by verifying the downlink signals (via cell id) from the respective base stations at selected locations within the studied area at St Clair.

FIGURE 98

Estimated base station coverage − Colyton/St Clair



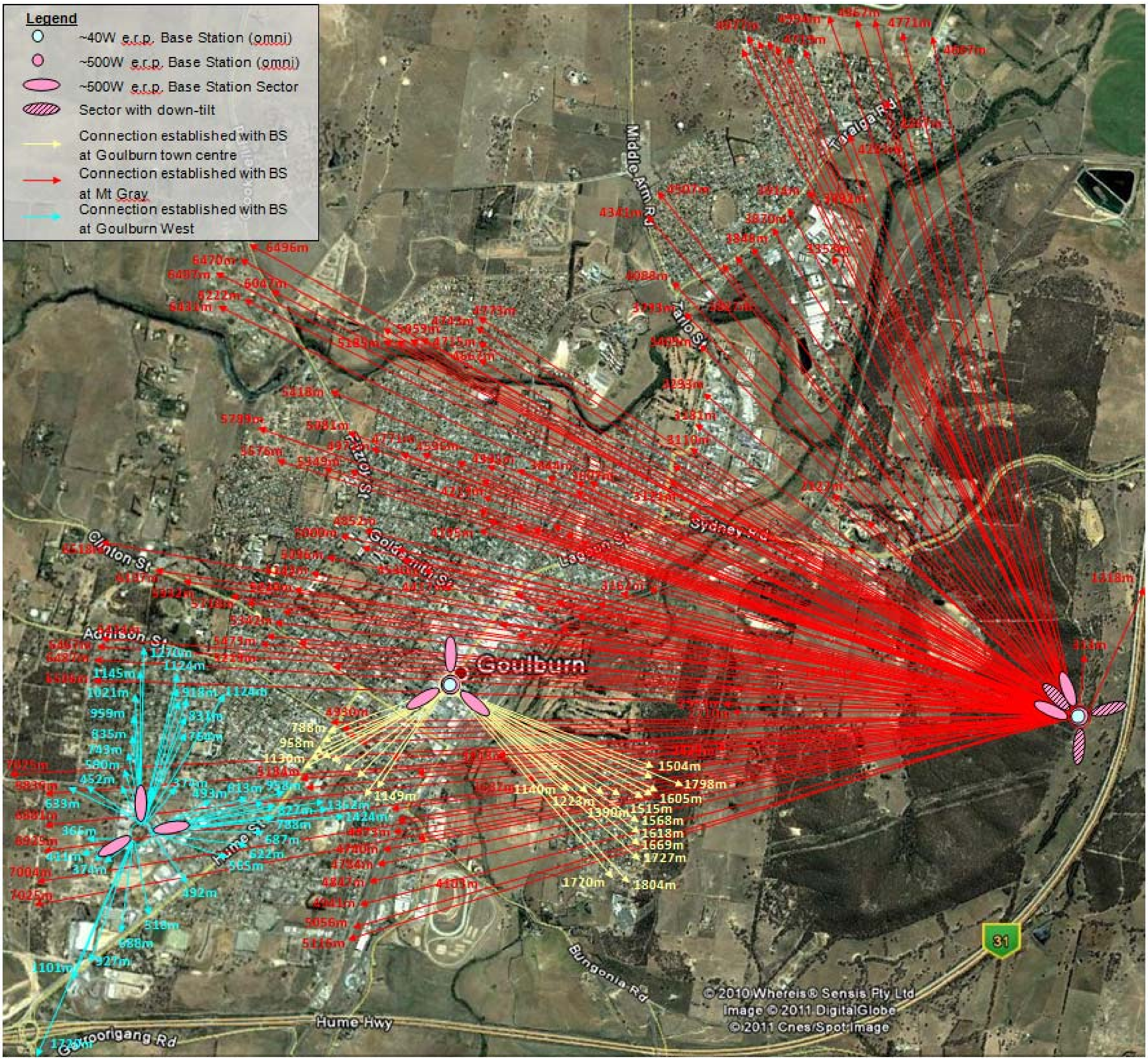
From the enclosed cell estimated coverage diagram, a number of studied areas (preferably in 100 m × 100 m study grid which is referred as one "pixel") would be selected to representatively indicate the profile of cellular coverage at Colyton/St Clair.

3.2.2 Rural environment − Goulburn/Mt Gray

IMT cell coverage was estimated by verifying real downlink signals (via cell id) from the respective base stations at selected locations within the studied area at Goulburn/Mt Gray.

FIGURE 99

Estimated base station coverage − Goulburn/Mt Gray



From the enclosed cell estimated coverage diagram, a number of studied area (preferably in 100 m × 100 m study grid which is referred as one "pixel") would be selected to representatively indicate the profile of Goulburn/Mt Gray.

4 Conclusions

Studies to date in ITU-R have determined cellular networks are based on a "typical" small mobile cell structure.

In the absence of definitive advice on determining "typical" cell coverage within a geographic area, the field studies undertaken within this campaign have provided a series of measurements to determine "actual" UMTS cell coverage radius within a geographic area.

Further studies are required to determine how these measurements may be applied to gauge potential interference to DTTB from mobile services in a geographic area.

Chapter 4

Technical analysis of LTE 800 MHz base station interference into DTT receivers

Ofcom UK is currently engaged in a consultation process on the "Coexistence of new services in the 800 MHz band with digital terrestrial television". Ofcom UK commissioned a set of measurements on the performance of TV receivers in the presence of LTE base station signals and a field trial to provide supporting input to this overall modelling analysis and assessment.

The overall technical analysis report bringing together all the aspects of this work is attached as an embedded document file below. The whole set of documents and reports in this current consultation process can be found with public access on the Ofcom UK website at:

http://stakeholders.ofcom.org.uk/consultations/coexistence-with-dtt/.

There are many factors to be taken into account in modelling potential interference, and what is presented here contains a description of a modelling toolkit for others to use, amend and improve as required to fit their own particular circumstances. Example of parameters which may be varied by country or regional area are propagation, geography issues such as terrain, TV reception mode and transmitter locations, spectrum channel plans, mobile network locations and powers, any mitigation options in place, TV receiver performance both current and future, and any in home distribution network. There is also a need for considerable care in the assessment of the data to avoid double or multiple counting of potential instances of interference. Finally you will need a detailed dataset of your predicted TV and mobile reception signal levels to a high spatial resolution.

This technical report provides detailed information on all the individual factors taken into account in the modelling assessment of the potential interference into TV reception from the introduction of 800 MHz LTE base stations in the UK. The consultation process in the UK is ongoing and the toolkit detailed in this report is available for further investigation of the effects of varying all the inter-related parameters. All the parameter values used in this initial modelling are detailed in the document, but please note that the values are subject to further amendment and improvement as the consultation work continues. The modelling software relies on a detailed TV transmitter signal strength prediction across the whole of the UK to the relatively high resolution of 100 m by 100 m squares. This data is an output of the UK Planning model which is the property of and supplied by the UK Broadcasters and transmission providers.

Adobe Acrobat Document

Chapter 5

The coexistence of LTE and digital TV services at UHF: a field trial

Ofcom UK is currently engaged in a consultation process on the “Coexistence of new services in the 800 MHz band with digital terrestrial television”. Ofcom UK commissioned a field trial to provide supporting input to this process. The report on this work is attached as an embedded word file below. The whole set of documents and reports in this current consultation process can be found with public access on the Ofcom UK website at:

http://stakeholders.ofcom.org.uk/consultations/coexistence-with-dtt/.

The field trial investigated the actual interactions between a set of three 10 MHz LTE base station transmissions and a test DVB-T and T2 transmission. The TV transmitter could be switched between European channels 59/60 (774-782MHz and 782-790 MHz) with controllable power level, and switchable DVB-T and DVB-T2 modulation formats.

The three 10 MHz LTE base station signals were individually controllable in the 791-821 MHz range known in Europe as blocks A, B, and C. The LTE base station signals were available as files recorded from genuine equipment and played back via signal generators. The two available signal formats used for the LTE were a fully loaded base station and an idle base station recording.

The signal strengths of these LTE and TV transmissions were evaluated around the area of a UK town to provide a set of experimental real world data which could be used in support of extensive modelling analysis work also being undertaken by Ofcom UK.

The field trial also allowed the practical testing and evaluation of some potential mitigation measures, namely filters in the TV receiver input, on channel repeaters, and polarization discrimination. The measurements provided supporting material for the typical propagation models which would be appropriate in the UK and other similar environments.

Field trial
attachment.doc

Chapter 6

Technical analysis of interference from mobile network base stations in the 800 MHz band to digital terrestrial television

Studies undertaken by Ofcom in the UK in 2011 investigated the impact of interference from future mobile network base stations in the 800 MHz band to digital terrestrial television (DTT) services below 790 MHz. These studies also drew on inputs from the UK Broadcasters to provide the TV service predicted field strengths providing the baseline for the assessments.

The studies consisted of analysis and computer modelling based on the UK's DTT network planning model (UKPM), building on our past contributions to CEPT, and drawing on the results of a number of measurement programmes that have been commissioned over the past two years.

The objectives of the studies were two-fold:

i) to investigate and to quantify, where possible, the efficacy of technical measures to mitigate the impact of interference from mobile/fixed communication network (MFCN) base stations to individual households;

ii) to assess the UK-wide impact of interference from mobile network base stations by estimating on a statistical basis the total number of households whose DTT reception might be affected.

Follow-up work by Ofcom in early 2012 resulted in the revision and updating of the original report, as well as performing a sensitivity analysis to explore the impact of different parameters, particularly relating to the MFCN network deployment and the performance of DTT receiver equipment.

They are also published on the Ofcom website for public access at:

http://stakeholders.ofcom.org.uk/consultations/coexistence-with-dtt/

http://stakeholders.ofcom.org.uk/consultations/second-coexistence-consultation/

[Ofcom] First DTT co-existence Technica

DTT Second Co-existence technica

Part B

Study on interference between ISDB-T and IMT in the 700 MHz band

TABLE OF CONTENTS

1 Introduction

Japan will reorganize the 700MHz band for the purpose of operating IMT in the 700 MHz after 2015. One of the fundamental views of the frequency reorganization is that the frequency for IMT base stations (downlink) shall be above 770 MHz to avoid harmful interference into the low noise amplifier for TV (LNA), which work under 770 MHz, previously allocated to the analogue television broadcasts. This Report provides the study on interference, necessary width of guardband and separation distance between digital ISDB-T terrestrial television broadcasting (DTTB) system and IMT (uplink and downlink) in the 700 MHz band. It also provides technical measures when interference occurs. The width of guardband between DTTB and IMT mobile station (uplink) in the 700 MHz band has been reflected in the frequency reorganization plan of Japan. It is noted that the channel number used in this Report is based on the frequency assignment in Japan. For example, channel 13 is from 470 to 476 MHz and channel 52 is from 704 to 710 MHz.

2 Technical parameters of mobile communication system in the 700 MHz band

2.1 Technical parameters of base station

(1) Characteristics of transmission and reception

The transmission/reception characteristics of base station used for the interference study are shown in Tables 2.1-1 and 2.1-2.

TABLE 2.1-1

LTE base station (information related to transmission side)

	LTE base station
Transmission frequency band	700 MHz
Antenna power	36 dBm/MHz [1]
Antenna gain	14 dBi [1]
Feeder loss	5 dB [1]
Antenna pattern characteristics (horizontal)	Fig. 2.1-1
Antenna pattern characteristics (vertical)	Fig. 2.1-2
Transmitting antenna height	40 m [1]
Band width (BWChannel)	5, 10, 15, 20 MHz
Adjacent channel leak power	High value of the following value or –13 dBm/MHz –44.2 dBc (BWChannel/2+2.5 MHz separation) –44.2 dBc (BWChannel/2+7.5 MHz separation)
Spurious emission (30 MHz-1 GHz) (1 GHz-12.75 GHz) (1884.5-1919.6 MHz)	–13 dBm/100 kHz [2] –13 dBm/MHz –41 dBm/300 kHz
Intermodulation distortion	Within the limits of allowable emission with an undesired wave lower than a desired wave by 30 dB
Spectrum mask characteristics	Not specified

TABLE 2.1-2 (*end*)

	LTE base station
Transmission filter characteristics	Table 2.1-3
Other losses	–

[1] Report 'Committee on Effective Utilization of Spectrum (31 May, 2005)'.

[2] 3GPP TS36 104 v8.3.0 (2008-9).

TABLE 2.1-2

LTE Base station (information related to reception side)

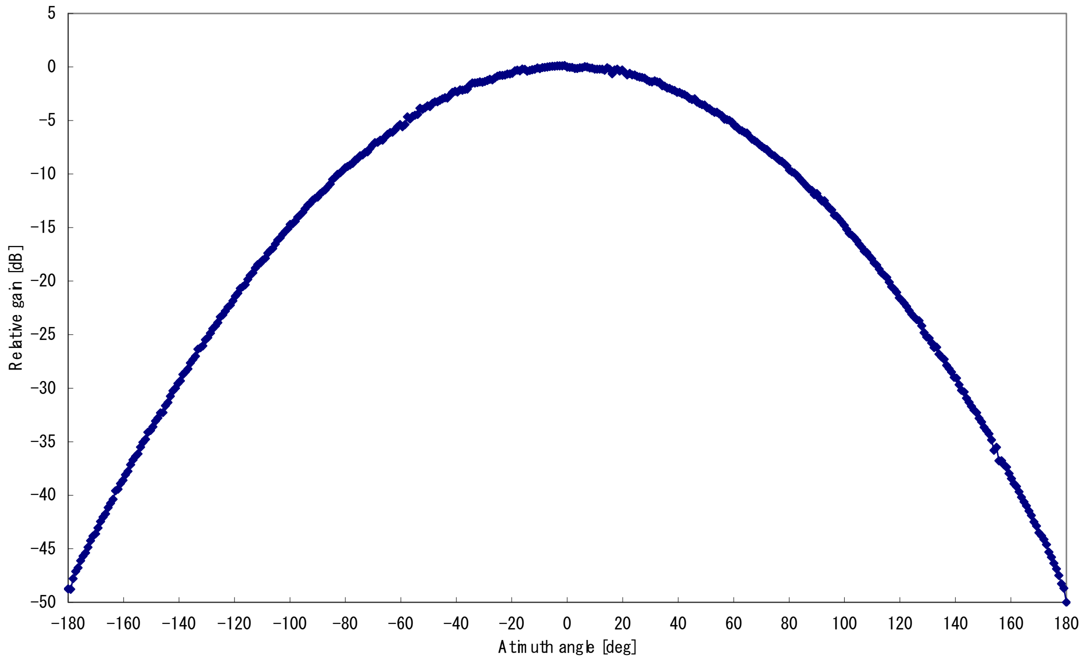
	LTE base station
Reception frequency	700 MHz
Allowable interference power	–119 dBm/MHz (I/N=–10 dB)
Allowable desensitization repressing power	–43 dBm [1]
Receiving antenna gain	14 dBi
Feeder loss	5 dB
Transmitting antenna height	40 m [2]
Other loss	—

[1] 3GPP TS36 104 v8.3.0 (2008-9).

[2] Report 'Committee on Effective Utilization of Spectrum (31 May, 2005)'.

FIGURE 2.1-1

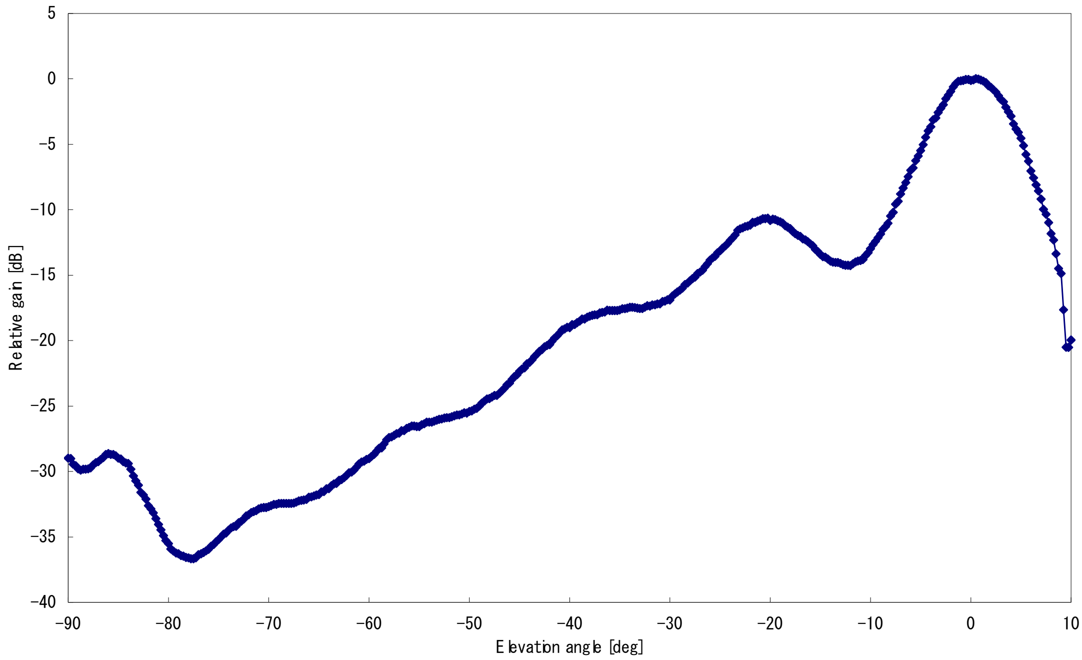
Transmitting/receiving antenna pattern of LTE base station (horizontal plane)[1]



1 Figure 3.2-1 of Report ’Committee on Effective Utilization of Spectrum (21 December, 2006)’.

FIGURE 2.1-2

Transmission/reception antenna pattern of LTE base station (vertical)[1]



1 Figure 3.2-2 of Report 'Committee on Effective Utilization of Spectrum (21 December, 2006)'.

TABLE 2.1-3

Transmission/reception filter characteristics of LTE base station and land mobile relay station[1]

Separation frequency from passing band end (MHz)	Out-of-band attenuation (dB)		
	Filter (a) 1.7 liter (0.65 dB[2])	Filter (b) 1.9 liter (0.9 dB[2])	Filter (c) 2.2 liter (1.1 dB[2])
0	0.7	0.9	1.1
1	0.9	1.2	1.5
2	5.0	12.0	15.0
2.9	21.2	33.6	43.8
3	23.0	36.0	47.0
4	23.5	36.5	48.0
5	24.0	37.0	49.0
6	25.8	40.0	52.8
7	27.6	43.0	56.6
8	29.4	46.0	60.4
9	31.2	49.0	64.2
10	33.0	52.0	68.0
11	35.0	54.4	70.8
12	37.0	56.8	73.6
13	39.0	59.2	76.4

TABLE 2.1-3 (*end*)

Separation frequency from passing band end (MHz)	Out-of-band attenuation (dB)		
	Filter (a) 1.7 liter (0.65 dB[2])	**Filter (b) 1.9 liter (0.9 dB[2])**	**Filter (c) 2.2 liter (1.1 dB[2])**
14	41.0	61.6	79.2
15	43.0	64.0	82.0
16	44.4	66.2	84.4
17	45.8	68.4	86.8
18	47.2	70.6	89.2
19	48.6	72.8	91.6
20	50.0	75.0	94.0
21	51.2	76.4	95.8
22	52.4	77.8	97.6
23	53.6	79.2	99.4
24	54.8	80.6	101.2
25	56.0	82.0	103.0
26	57.0	83.1	104.4
27	57.9	84.2	105.7
28	58.9	85.4	107.1
29	59.8	86.5	108.4
30	60.8	87.6	109.8
37.5	68.0	96.0	120.0
50	77.0	107.0	

[1] Table 3.2-3 of Report 'Committee on Effective Utilization of Spectrum (21 December, 2006)'.

[2] Insertion loss.

In the interference study, one antenna transmission is considered to be a base station. Also, in the case of multiple antenna transmission, it is presumed that the total transmission power is the same as that for one antenna transmission, and adjacent channel leak power used for compatibility study is a value relative to transmission power. Therefore, the study result is the same as that of one antenna transmission.

On the other hand, in the worst case, spurious emission above 10 MHz from the channel end may increase several times as much as one antenna transmission. However, introduction of filter can improve the situation.

2.2 Technical parameters of mobile station

(1) Characteristics of transmission and reception

The transmission and reception characteristics of mobile station used for the interference study are shown in Tables 2.2-1 and 2.2-2.

TABLE 2.2-1

LTE mobile station (information related to transmission side)

	LTE mobile station
Transmission frequency band	700 MHz
Antenna power	23 dBm[2]
Antenna gain	0 dBi[3]
Feeder loss	0 dB[3]
Antenna pattern characteristics (horizontal)	omni-directional
Antenna pattern characteristics (vertical)	omni-directional
Transmitting antenna height	1.5 m[3]
Band width (BWChannel)	5, 10, 15, 20 MHz
Adjacent channel leak power[1]	High value of the following value or –50 dBm/3.84 MHz –33 dBc (BWChannel/2+2.5 MHz separation)[2] –36 dBc (BWChannel/2+7.5 MHz separation)[2]
Spurious emission (30 MHz-1 GHz) (1 GHz-12.75 GHz) (1884.5-1919.6 MHz)	–36 dBm/100 kHz –30 dBm/MHz –41 dBm/300 kHz Table 2.2-3
Intermodulation distortion	Not specified
Spectrum mask characteristics	Fig. 2.2-1[2]
Transmission and reception filter characteristics	–
Other losses	8 dB (Body absorption loss)[3]

1 3GPP TS36 104 v8.3.0 (2008-9).

2 3GPP TS36 101 v8.3.0 (2008-9).

3 Report 'Committee on Effective Utilization of Spectrum (31 May, 2005)'.

TABLE 2.2-2

LTE base station/mobile station (information related to reception side)

	LTE mobile station
Reception frequency	700 MHz
Allowable interference power	–110.8 dBm/MHz (*I*/*N*= –6 dB)
Allowable desensitization power	–56 dBm[1] (BWChannel/2+7.5 MHz separation) –44 dBm[1] (BWChannel/2+12.5 MHz separation)
Receiving antenna gain	0 dBi
Power feeding loss	0 dB
Transmitting antenna height	1.5 m[2]
Other losses	8 dB (Body absorption loss)

1 3GPP TS36 101 v8.3.0 (2008-9).

2 Report 'Committee on Effective Utilization of Spectrum (31 May, 2005)'.

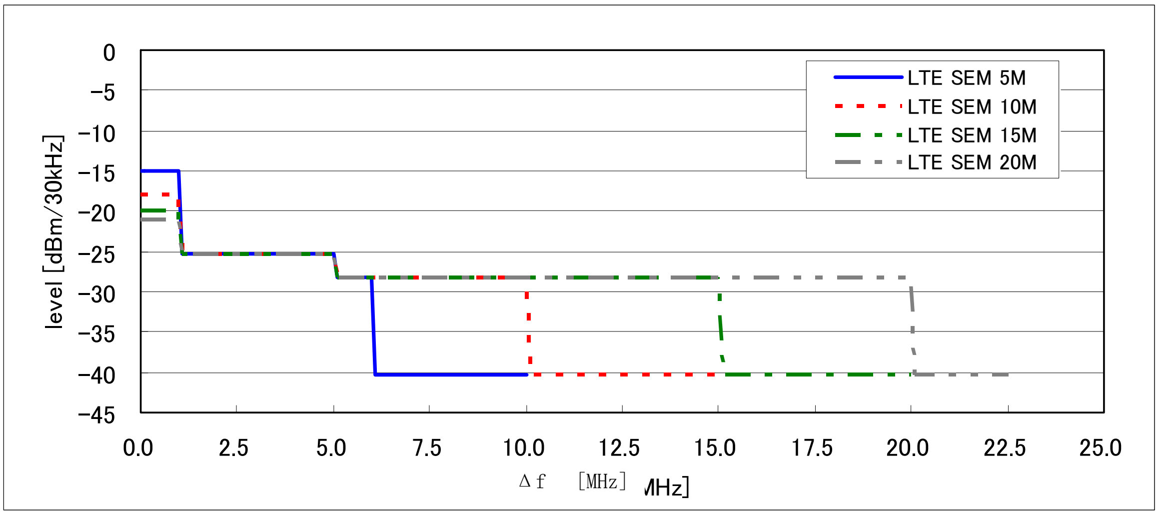
TABLE 2.2-3

Regulations related to mobile station spurious emission

Frequency range	**Allowable value**	**Reference band width**
Reception band of 800 MHz band/860 MHz or higher, 895 MHz or lower	–40 dBm	1 MHz
Reception band with 1.5 GHz band/1 475.9MHz or higher, 1 510.9 MHz or lower	–50 dBm	1 MHz
Reception band with 1.7 GHz band/1 844.9MHz or higher, 1 879.9 MHz or lower	–50 dBm	1 MHz
PHS band/1 884.5 MHz or higher, 1 919.6 MHz or lower	–41 dBm	300 kHz
Reception band with 2 GHz band/2 110 MHz or higher, 2 170 MHz or lower	–50 dBm	1 MHz

FIGURE 2.2-1

Spectrum emission mask characteristics of LTE mobile station



Δ_f (MHz)	Channel width				Measurement band width
	5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	
±0-1	–15	–18	–20	–21	30 kHz
±1-2.5	–10	–10	–10	–10	1 MHz
±2.5-5	–10	–10	–10	–10	1 MHz
±5-6	–13	–13	–13	–13	1 MHz
±6-10	–25	–13	–13	–13	1 MHz
±10-15		–25	–13	–13	1 MHz
±15-20			–25	–13	1 MHz
±20-25				–25	1 MHz

(2) Parameters of probabilistic study

The cumulative probability of transmission power of a mobile station used in a probabilistic study is shown in Fig. 2.2-2 and an example of transmission power distribution in the case of an LTE channel width being 20 MHz is shown in Fig. 2.2-3.

It is assumed that the average traffic density is 40.62 erl/MHz/km^2 (without voice activation) and the evaluation range is 100 m in radius. erl (erlang) is a unit of the amount of data flowing over the network. One erl corresponds to the amount of data that occupies one line for one hour.

FIGURE 2.2-2

Cumulative probability of transmission power of LTE mobile station

(Cell radius 750 m, LTE mobile station indoor installation model)

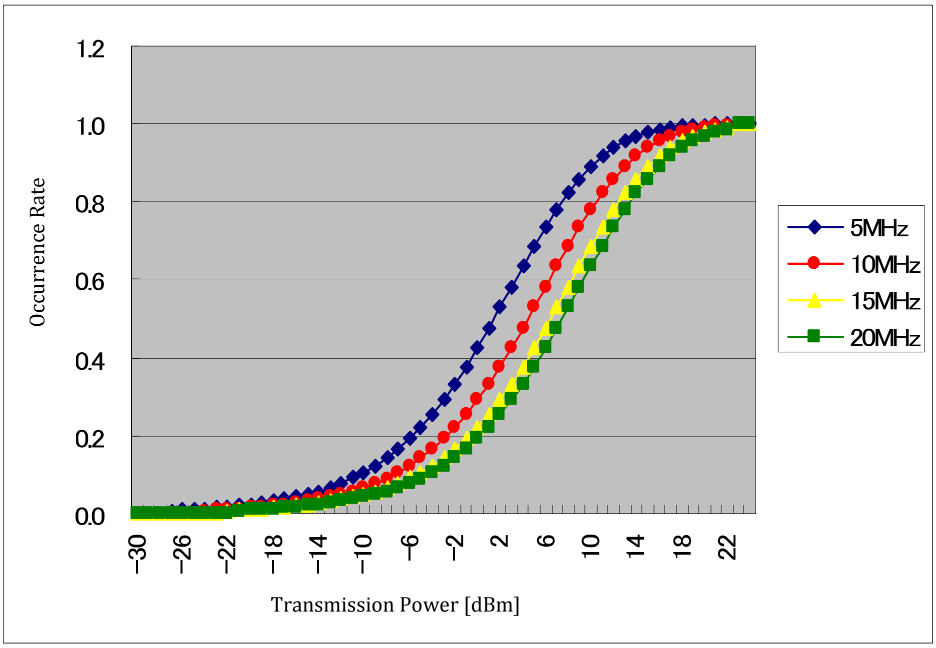
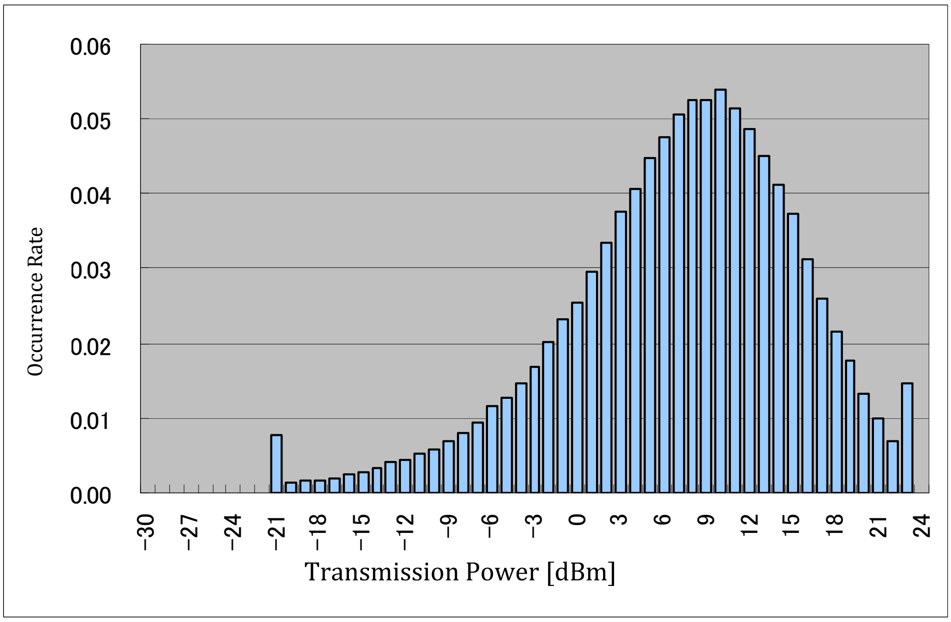


FIGURE 2.2-3

Transmission power distribution of LTE mobile station (operation example of LTE channel width of 20 MHz)

(Cell radius 750 m, LTE mobile station indoor installation model)



2.3 Technical parameters of land mobile relay station

(1) Transmission and reception characteristics

Tables 2.3-1 and 2.3-2 show transmission and reception characteristics of land mobile relay stations for interference studies.

TABLE 2.3-1

Land mobile relay stations (information related to transmission side)

	Land mobile station device at other end	Base station device at other end
Transmission frequency band	700 MHz	700 MHz
Maximum transmission power	For outdoor areas 38 dBm (Fig. 2.3-7) For indoor areas 26 dBm (Fig. 2.3-7)	For outdoor areas 23 dBm (Fig. 2.3-8) For indoor areas 20.4 dBm (Fig. 2.3-8)
Transmission antenna gain	For outdoor areas 11 dBi For indoor areas 0 dBi	For outdoor areas 13 dBi For indoor areas 7 dBi
Transmission feeder loss	For outdoor areas 8 dB For indoor areas 0 dB (integral type) 10 dB (separate type)	For outdoor areas 8 dB For indoor areas 0 dB (integral type) 10 dB (separate type)
Antenna directional characteristics (horizontal)	For outdoor areas Fig. 2.3-1 For indoor areas Omni-directional	For outdoor areas Fig. 2.3-3 For indoor areas Fig. 2.3-4
Antenna directional characteristics (vertical)	For outdoor areas Fig. 2.3-2 For indoor areas Omni-directional	For outdoor areas Fig. 2.3-5 For indoor areas Fig. 2.3-6
Transmission antenna height	For outdoor areas 15 m For indoor areas 2 m (integral type) 3 m (separate type)	For outdoor areas 15 m For indoor areas 2 m (integral type) 10 m (separate type)
Adjacent channel leak power	2.5 MHz away from transmission frequency band end (Excluding transmission frequency band) –44.2 dBc/3.84 MHz or lower, or +2.8 dBm/3.84 MHz or lower 7.5 MHz away from transmission frequency band end (Excluding transmission frequency band) –44.2 dBc/3.84 MHz or lower, or +2.8 dBm/3.84 MHz or lower	2.5 MHz away from transmission frequency band end (Excluding transmission frequency band) –32.2 dBc/3.84 MHz or lower 7.5 MHz away from transmission frequency band end (Excluding transmission frequency band) –35.2 dBc/3.84 MHz or lower

TABLE 2.3-1 (*end*)

	Land mobile station device at other end	Base station device at other end
Spurious emission*	30 MHz-1 GHz (10 MHz or higher away from transmission frequency band end (Excluding transmission frequency band)): –13 dBm/100 kHz or lower	30 MHz-1 GHz (10 MHz or higher away from transmission frequency band end (Excluding transmission frequency band)): –26 dBm/100 kHz or lower
Out-of-band gain	200 kHz away from band end: 60 dB 1 MHz away from band end: 45 dB 10 MHz away from band end: 35 dB	200 kHz away from band end: 60 dB 1 MHz away from band end: 45 dB 10 MHz away from band end: 35 dB

*NOTE – Only characteristics required for interference study are described.

TABLE 2.3-2

Land mobile relay stations (information related to reception side)

	Land mobile station device at other end	Base station device at other end
Reception frequency band	700 MHz	700 MHz
Maximum transmission power	In-band –118.9 dBm/MHz Out-of-band –44 dBm	In-band –110.9 dBm/MHz Out-of-band –56 dBm (5 MHz separation) –44 dBm (10 MHz separation)
Reception antenna gain	For outdoor areas 11 dBi For indoor areas 0 dBi	For outdoor areas 13 dBi For indoor areas 7 dBi
Reception feeder loss	For outdoor areas 8 dB For indoor areas 0 dB (integral type) 10 dB (separate type)	For outdoor areas 8 dB For indoor areas 0 dB (integral type) 10 dB (separate type)
Antenna directional characteristics (horizontal)	For outdoor areas Fig. 2.3-1 For indoor areas Omni-directional	For outdoor areas Fig. 2.3-3 For indoor areas Fig. 2.3-4
Antenna directional characteristics (vertical)	For outdoor areas Fig. 2.3-2 For indoor areas Omni-directional	For outdoor areas Fig. 2.3-5 For indoor areas Fig. 2.3-6
Reception antenna height	For outdoor areas 15 m For indoor areas 2 m (integral type) 3 m (separate type)	For outdoor areas 15 m For indoor areas 2 m (integral type) 10 m (separate type)

FIGURE 2.3-1

Land mobile relay stations (for outdoor areas) land mobile station device at other end

Antenna directional characteristics (horizontal)

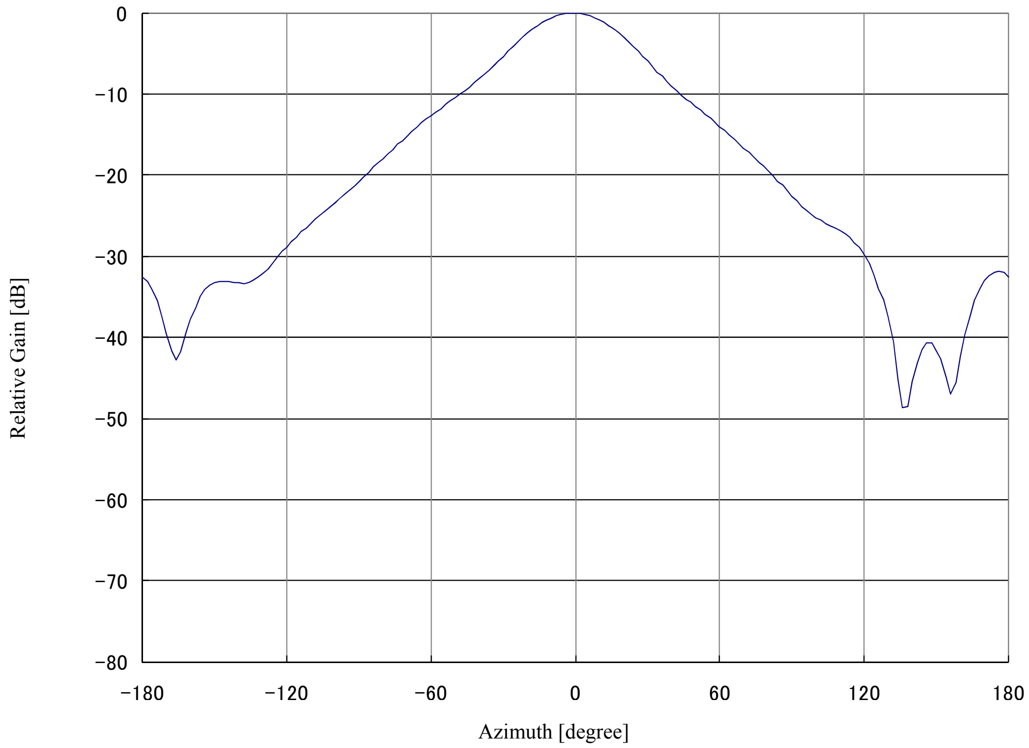


FIGURE 2.3-2

Land mobile relay stations (for outdoor areas) land mobile station device at other end

Antenna directional characteristics (vertical)

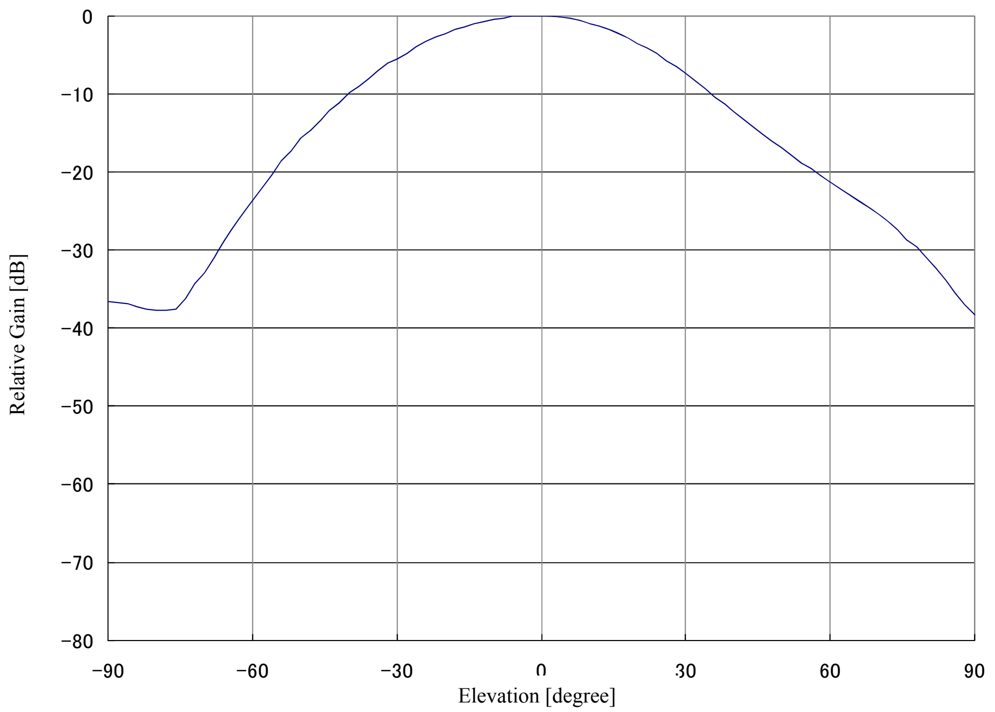


FIGURE 2.3-3

Land mobile relay stations (for outdoor areas) base station device at other end

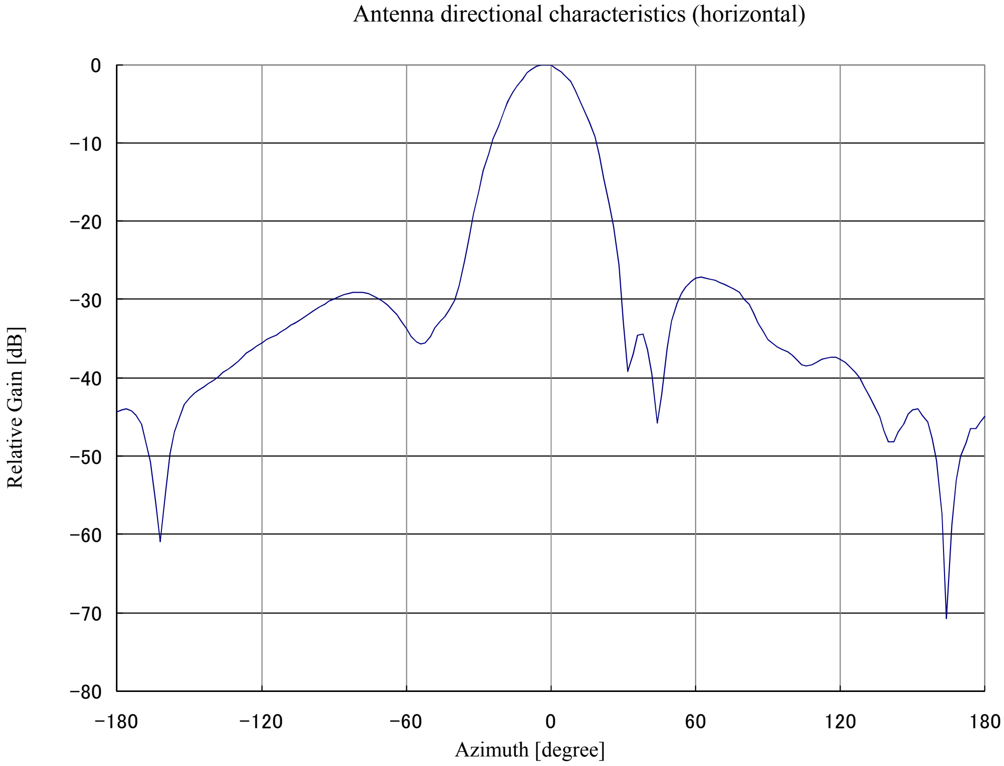


FIGURE 2.3-4

Land mobile relay stations (for indoor areas) base station device at other end

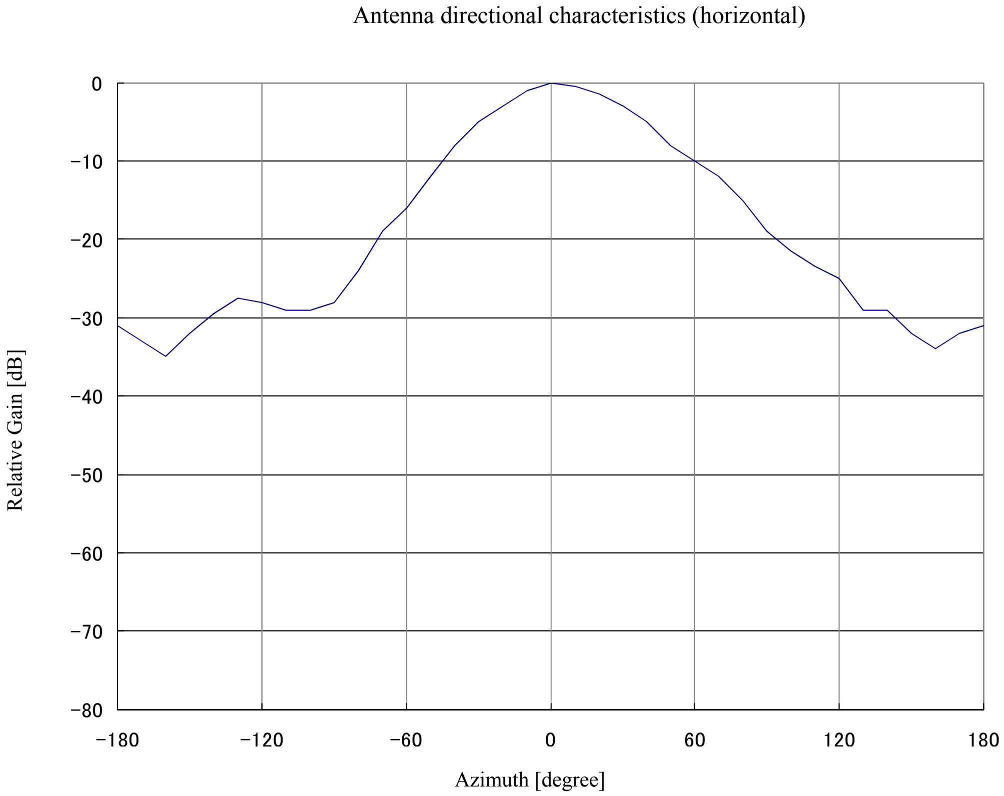


FIGURE 2.3-5

Land mobile relay stations (for outdoor areas) base station device at other end

Antenna directional characteristics (vertical)

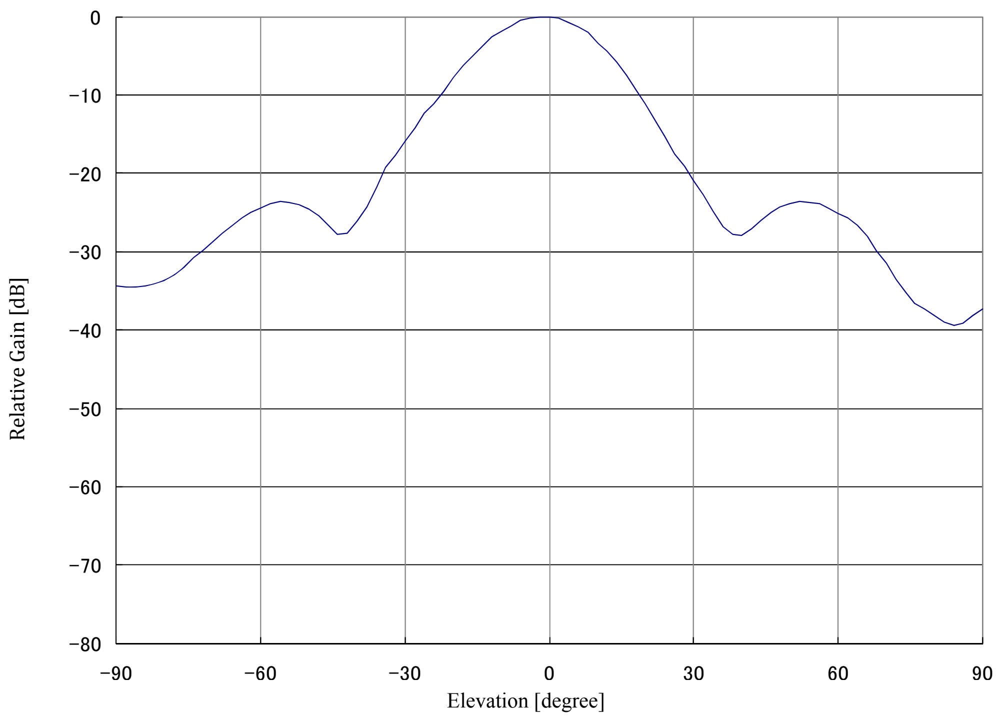
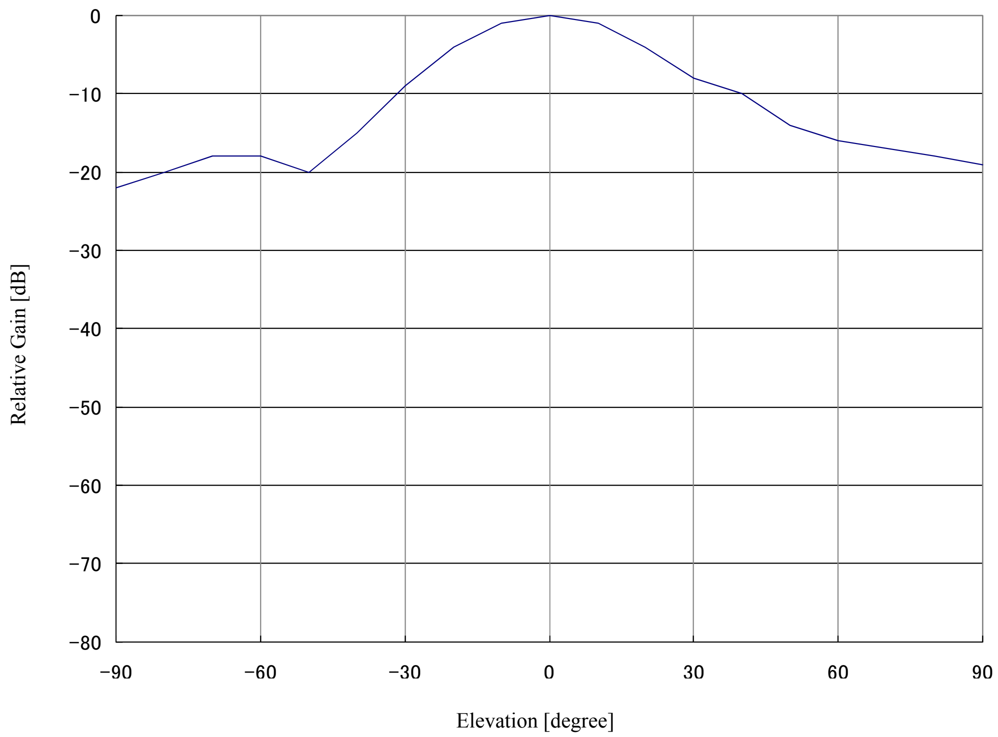


FIGURE 2.3-6

Land mobile relay stations (for indoor areas) base station device at other end

Antenna directional characteristics (vertical)



(2) Parameters for probabilistic study

For the number of land mobile relay stations operating per 1 km^2, one terminal is assumed for outdoors and seven terminals are assumed for indoors in a 2 GHz band land mobile relay station number density (in Tokyo) of 7.4 terminals/km^2 as of June 2010. The interference amount which becomes 97% cumulatively in the ascending order is calculated on the number of terminals by Monte-Carlo simulation. Figures 2.3-7 and 2.3-8 show the transmission power cumulative probability of a land mobile relay station which is used for probabilistic study.

FIGURE 2.3-7

Transmission power distribution (land mobile station device at other end transmission)

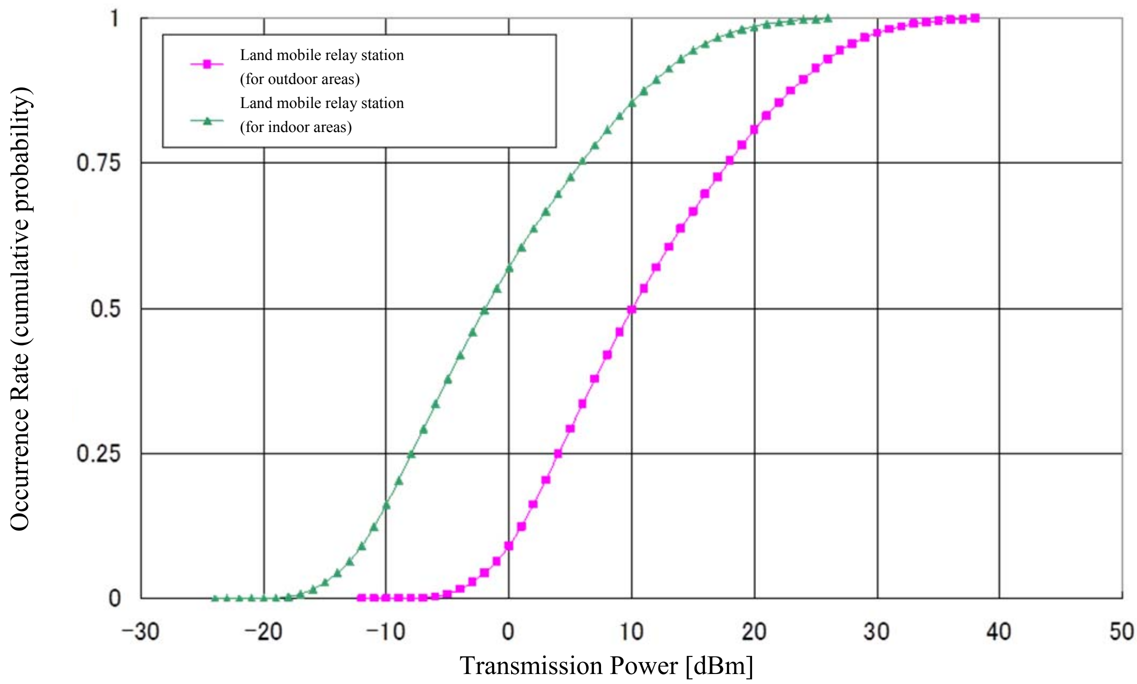
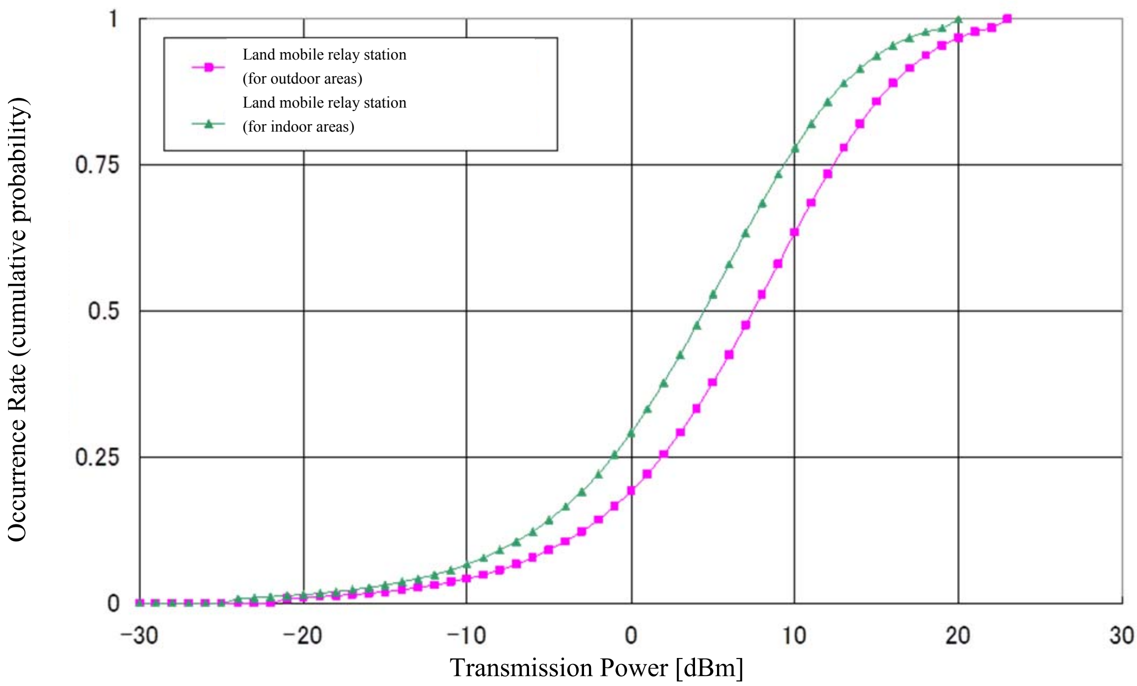


FIGURE 2.3-8

Transmission power distribution (base station device at other end transmission)



2.4 Technical parameters of small-powered repeater

(1) Transmission and reception characteristics

Tables 2.4-1 and 2.4-2 show transmission and reception characteristics of small-powered repeater for the interference study.

TABLE 2.4-1

Small-powered repeater (information related to transmission side)

	Land mobile station device at other end	Base station device at other end
Transmission frequency band	700 MHz	700 MHz
Maximum transmission power	24 dBm Fig. 2.4-3	16 dBm Fig. 2.4-4
Transmission antenna gain	0 dBi	9 dBi
Transmission feeder loss	0 dB	0 dB (integral type) 12 dB (separate type)
Antenna directional characteristics (horizontal)	Omni-directional	Fig. 2.4-1
Antenna directional characteristics (vertical)	Omni-directional	Fig. 2.4-2

TABLE 2.4-1 (*end*)

	Land mobile station device at other end	**Base station device at other end**
Transmission antenna height	2 m	2 m (integral type) 5 m (separate type)
Adjacent channel leak power	2.5 MHz away from transmission frequency band end (Excluding transmission frequency band) –3 dBm/MHz or lower 7.5 MHz away from transmission frequency band end (Excluding transmission frequency band) –3 dBm/MHz or lower	2.5 MHz away from transmission frequency band end (Excluding transmission frequency band) –32.2 dBc/3.84 MHz or lower 7.5 MHz away from transmission frequency band end (Excluding transmission frequency band) –35.2 dBc/3.84 MHz or lower
Spurious emission	30 MHz-1GHz (10 MHz or higher away from transmission frequency band end (Excluding transmission frequency band)): –13 dBm/100 kHz or lower	30 MHz-1GHz (10 MHz or higher away from transmission frequency band end (Excluding transmission frequency band)): –26 dBm/100 kHz or lower
Out-of-band gain	5 MHz away from band end: 35 dB 40 MHz away from band end: 0 dB	5 MHz away from band end: 35 dB 40 MHz away from band end: 0 dB

TABLE 2.4-2

Small-powered repeater (information related to reception side)

	Land mobile station device at other end	**Base station device at other end**
Reception frequency band	700 MHz	700 MHz
Maximum transmission power	In-band –118.9 dBm/MHz Out-of-band –44 dBm	In-band –110.9 dBm/MHz Out-of-band –56 dBm (5 MHz separation) –44 dBm (10 MHz separation)
Reception antenna gain	0 dBi	9 dBi
Reception feeder loss	0 dB	0 dB (integral type) 12 dB (separate type)
Antenna directional characteristics (horizontal)	Omni-directional	Fig. 2.4-1
Antenna directional characteristics (vertical)	Omni-directional	Fig. 2.4-2
Reception antenna height	2 m	2 m (integral type) 5 m (separate type)

FIGURE 2.4-1

Small-powered repeater base station device at other end antenna directional characteristics (horizontal)

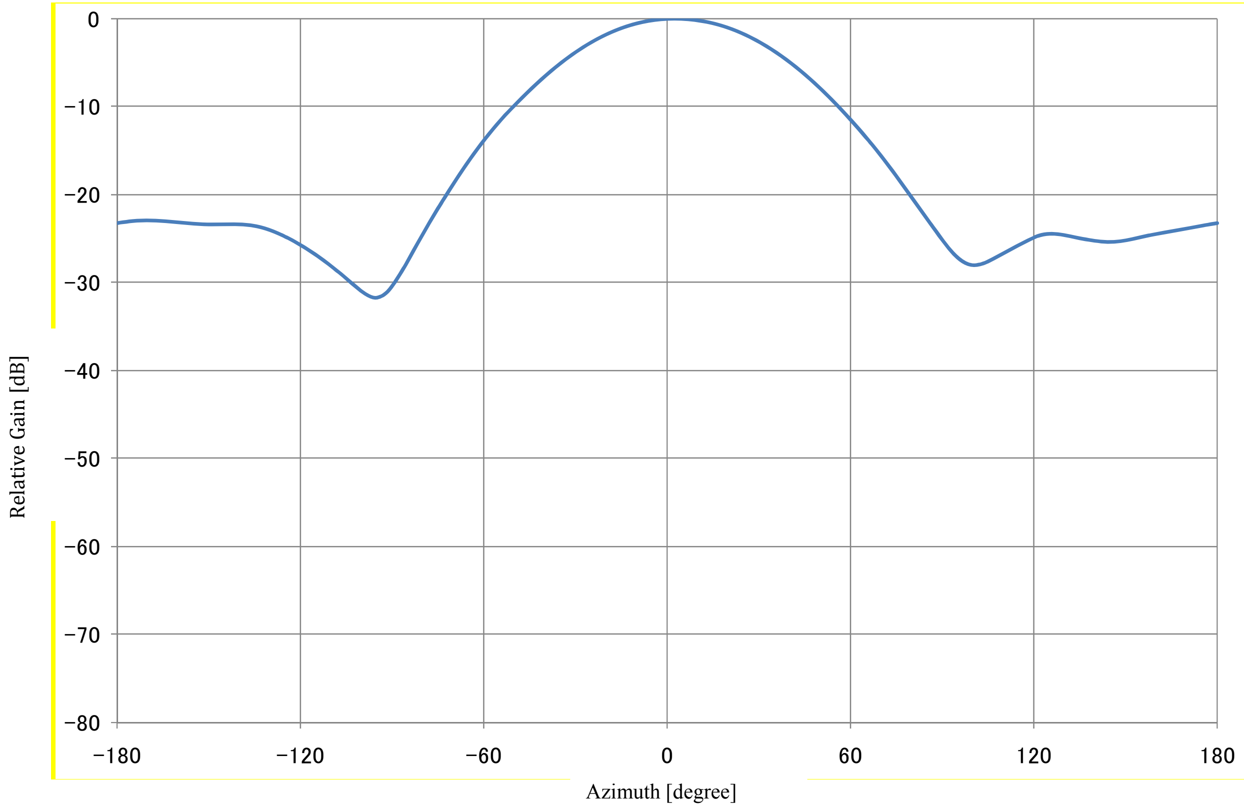
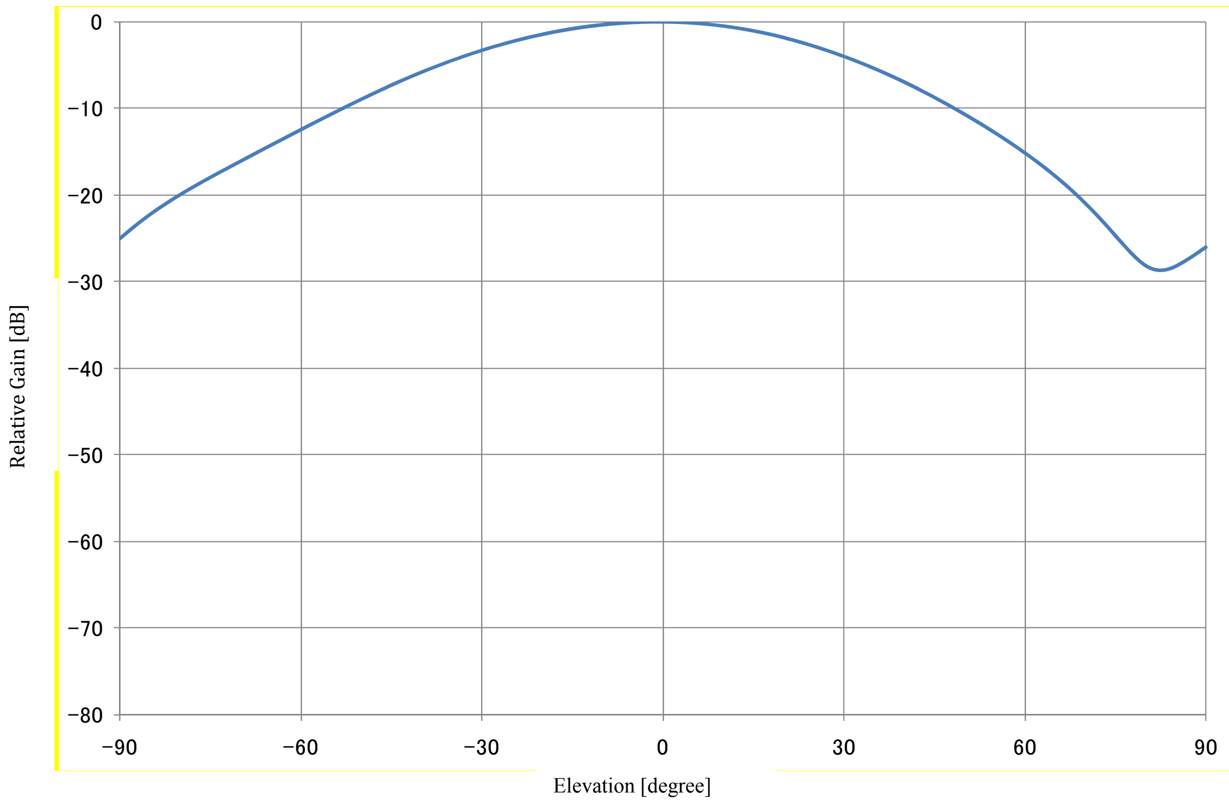


FIGURE 2.4-2

Small-powered repeater base station device at other end antenna directional characteristics (vertical)



(2) Parameters of probabilistic study

It is assumed that 5% of average traffic density (203.1 erl/carrier) is transmitted through small-powered repeater, and ten small-powered repeaters are determined to operate per 1 km^2. The interference amount which becomes 97% cumulatively in ascending order is calculated on this number of terminals by Monte-Carlo simulation. Figures 2.4-3 and 2.4-4 show the transmission power cumulative probability of small-powered repeater which is used for probabilistic study.

FIGURE 2.4-3

Transmission output distribution (land mobile station facing device transmission)

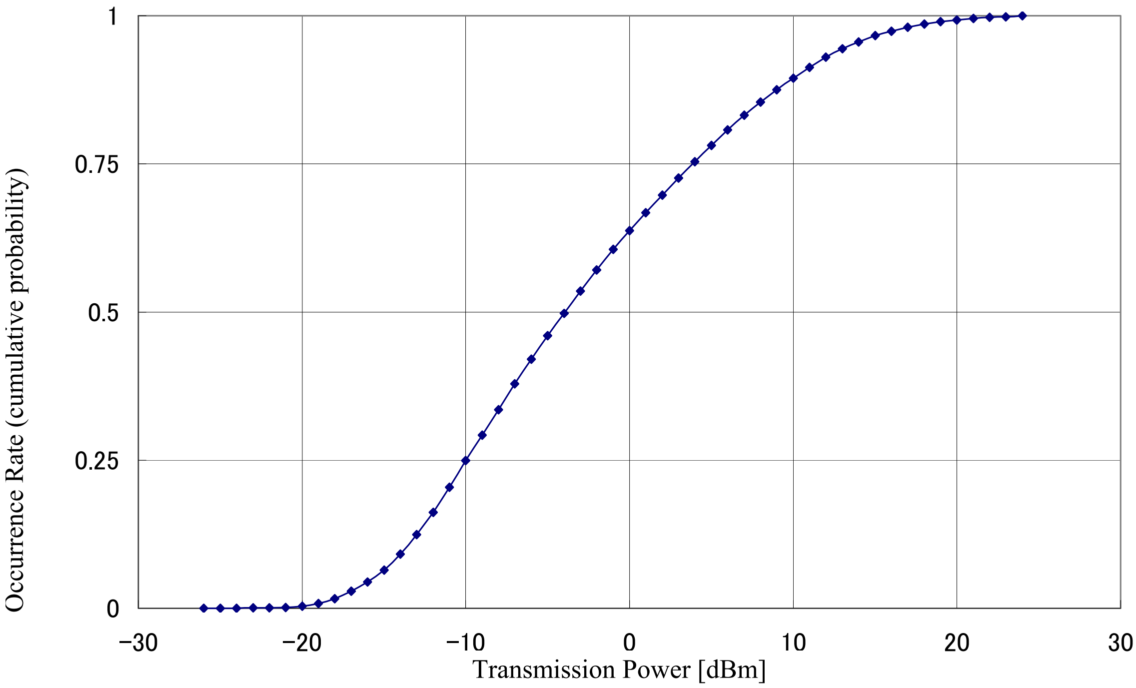
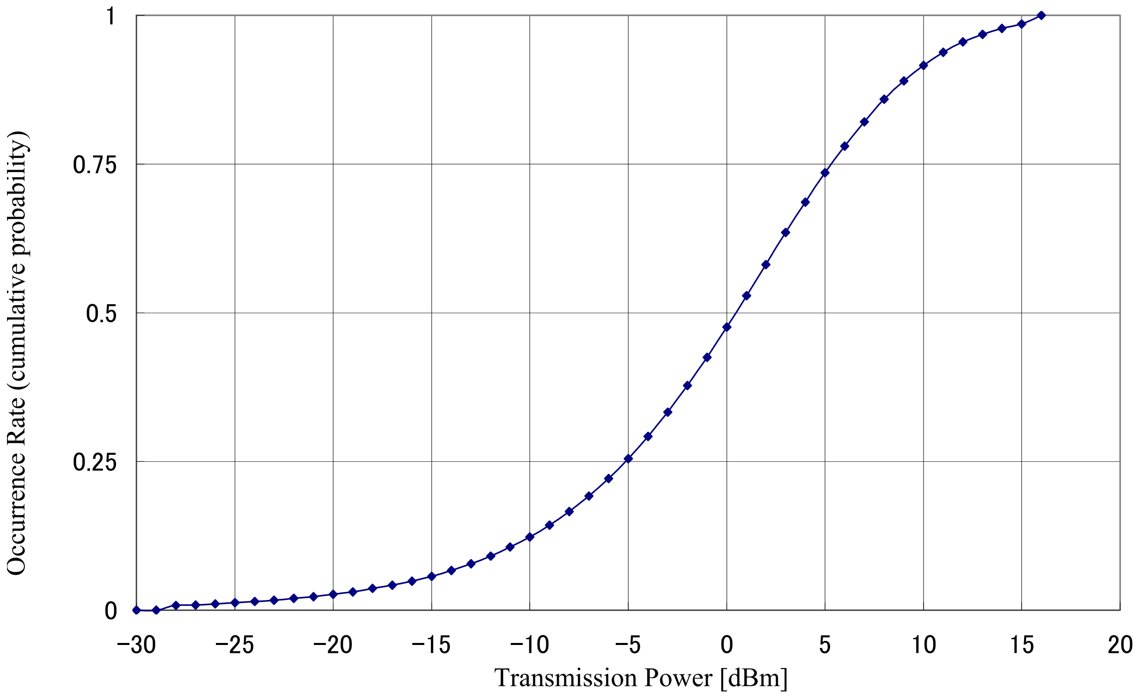


FIGURE 2.4-4

Transmission output distribution (base station device at other end transmission)



3 Technical analysis of interference between ISDB-T and IMT in the 700 MHz band

3.1 Combined study on interference

Table 3.1-1 shows systems subjected to study on interference on the part of DTTB and Table 3.1-2 shows systems subjected to study on interference on the part of cellular telephone systems. In addition, Table 3.1-3 shows combined study on interference with DTTB.

TABLE 3.1-1

Systems subjected to study on interference on part of DTTB

DTTB Reception	[1]	Yagi antenna with no LNA for home TV (10 m H)
	[2]	Yagi antenna with LNA for home TV (10 m H) (with no saturation)
	[3]	Simple antenna with no LNA for home TV (5 m H)
	[4]	Simple antenna with a LNA for home TV (5 m H) (with no saturation)
	[5]	Simple indoor antenna with no LNA for home TV (1 m H)
	[6]	Simple indoor antenna with a LNA for home TV (1 m H) (with no saturation)
	[7]	Yagi antenna with a LNA for home TV (10 m H) (with saturation)
	[8]	Simple antenna with a LNA for home TV (5 m H) (with saturation)
	[9]	Portable terminal (outdoors) (1.5 m H)
	[10]	Portable terminal (indoors) (1.5 m H)
	[11]	Mobile terminal (bus) (3 m H)
	[12]	Mobile terminal (private vehicle) (1.5 m H)
	[13]	Large relay station (reception) (5 m H)
	[14]	Small-powered station (reception) (5 m H)
	[15]	Community reception (with saturation)
DTTB Transmission	1	Parent station (transmission) (100 m H)
	2	Parent station (transmission) (20 m H)
	3	Large relay station (transmission) (20 m H)
	4	Small-powered station (transmission) (10 m H)

TABLE 3.1-2

Systems subjected to study on interference on cellular phones

IMT Downlink	I-a	Base station
	I-b	Small-powered repeater (integral type)
	I-c	Small-powered repeater (separate type)
	I-d	Land mobile relay station (for outdoor areas)
	I-e	Land mobile relay station (for indoor areas, integral type)
	I-f	Land mobile relay station (for indoor areas, separate type)
IMT Uplink	II-a	Mobile station
	II-b	Small-powered repeater (integral type)
	II-c	Small-powered repeater (separate type)
	II-d	Land mobile relay station (for outdoor areas)
	II-e	Land mobile relay station (for indoor areas, integral type)
	II-f	Land mobile relay station (for indoor areas, separate type)

TABLE 3.1-3

Combined study on interference between DTTB and IMT

			Giving interference		
			DTTB (transmission)	**IMT (transmission)**	
			1 to 4	**IMT downlink I-a to f**	**IMT uplink II-a to f**
Received interference	DTTB (reception)	[1] to [15]		Study implementation	Study implementation
	IMT (reception)	IMT downlink I-a to f	Study implementation		
		IMT uplink II-a to f	Study implementation		

3.2 Interference from DTTB into IMT

3.2.1 Study on guardband of 0 MHz

Table 3.2.1-1 shows simulation results of interference from DTTB to IMT by a one-to-one counter model in a guardband of 0 MHz.

Table 3.2.1-2 shows the relationship between the required guardband and required separation distance in the interference model that has the maximum required improvement. In the following tables showing result of study on interference, positive values indicate required improvements by mitigation techniques. For the IMT base station reception, land mobile relay station reception, or small-powered repeater reception, it is expected to allow for an improvement of approximately tens of dB for required improvement in Table 3.2.1-1 by adjusting the antenna position in consideration of the DTTB transmission station location.

TABLE 3.2.1-1

Results of study on interference (DTTB → IMT)

Required improvement (dB) when GB = 0 MHz (Propagation model: Free space)				Interference from DTTB (transmission)											
				1 Parent station (transmission) (100 m H)			2 Parent station (transmission) (20 m H)			3 Large relay station (transmission) (20 m H)			4 Small-powered station (transmission) (10 m H)		
				Horizontal separation distance (m)*	Required improvement of in-band interference (dB)	Required improvement of out-of-band interference (dB)	Horizontal separation distance (m)*	Required improvement of in-band interference (dB)	Required improvement of out-of-band interference (dB)	Horizontal separation distance (m)*	Required improvement of in-band interference (dB)	Required improvement of out-of-band interference (dB)	Horizontal separation distance (m)*	Required improvement of in-band interference (dB)	Required improvement of out-of-band interference (dB)
Received interference (reception)	IMT uplink reception	I-a	Base station	6.8	35.7	17.2	147	71.3	52.8	147	53.5	35	207	39.8	4.3
		I-b	Small-powered repeater (integral type)	20	46.7	29.3	20	58.1	40.7	20	40.3	22.9	20	40.3	5.8
		I-c	Small-powered repeater (separate type)	20	46.7	29.3	20	58.1	40.7	20	40.3	22.9	20	40.3	5.8
		I-d	Land mobile relay station (for outdoor areas)	680	52	34.6	40	76.6	59.2	40	58.8	41.4	20	53.5	19.1
		I-e	Land mobile relay station (for indoor areas, integral type)	20	46.7	29.3	20	58.1	40.7	20	40.3	22.9	20	40.3	5.8
		I-f	Land mobile relay station (for indoor areas, separate type)	20	36.8	19.4	109	43.3	25.9	108	25.6	8.2	20	30.6	–3.8
	IMT downlink reception	II-a	Mobile station	193	32.2	34.9	36.3	48.5	51.2	36.3	30.7	33.4	8.5	36.4	22.1
		II-b	Small-powered repeater (integral type)	180	37.9	40.4	33	52.6	55.2	150	35.6	38.2	20	39.2	24.7
		II-c	Small-powered repeater (separate type)	640	37.2	39.8	100	53.2	55.8	100	35.4	38	20	39.2	24.8
		II-d	Land mobile relay station (for outdoor areas)	680	44.8	47.4	45	69.1	71.7	45	51.4	53.9	20	44.8	30.4
		II-e	Land mobile relay station (for indoor areas, integral type)	280	32.6	35.1	44	47.3	49.8	125	33.7	36.3	25	34.7	20.3
		II-f	Land mobile relay station (for indoor areas, separate type)	690	37.4	39.9	75	56.5	59.1	80	38.8	41.4	20	40.9	26.5

* Horizontal separation distance used in interference calculation.

TABLE 3.2.1-2

Relationship between required guardband and required separation distance in DTTB parent station (20 m) ⇒ IMT uplink/downlink

		Horizontal separation distance used in interference calculation	Guardband	5 MHz	10 MHz	20 MHz	30 MHz
IMT downlink (IMT mobile station reception)	IMT mobile station reception	36.3 m	Required improvement of in-band interference	13.5 dB	3.5 dB	–16.5 dB	–
			Required improvement of out-of-band interference	51.2 dB	39.2 dB	24.2 dB*	9.2 dB*
			Horizontal separation distance which has negative required improvement	58 km	15 km	2.7 km	470 m
	IMT land mobile relay station (for outdoor areas) reception	45 m	Required improvement of in-band interference	34.1 dB	24.1 dB	4.1 dB	–15.9 dB
			Required improvement of out-of-band interference	22.7 dB	3.7 dB	–22.3 dB	–
			Horizontal separation distance which has negative required improvement	3.2 km	1 km	100 m	–
	IMT small-powered repeater (separate type) reception	100 m	Required improvement of in-band interference	18.2 dB	8.2 dB	–11.8 dB	–
			Required improvement of out-of-band interference	55.8 dB	4.8 dB	–4.2 dB	–
			Horizontal separation distance which has negative required improvement	104 km	410 m	–	–
IMT uplink (IMT base station reception)	IMT base station reception	147 m	Required improvement of in-band interference	36.3 dB	26.3 dB	6.3 dB	–13.7 dB
			Required improvement of out-of-band interference	3.8 dB	–15.2 dB	–	–
			Horizontal separation distance which has negative required improvement	6 km	2.3 km	352 m	–
	IMT land mobile relay station (for outdoor areas) reception	40 m	Required improvement of in-band interference	41.6 dB	31.6 dB	11.6 dB	–8.4 dB
			Required improvement of out-of-band interference	10.2 dB	–8.8 dB	–	–
			Horizontal separation distance which has negative required improvement	6.9 km	2.1 km	200 m	–
	IMT small-powered repeater(separate type/ integral type) reception	20 m	Required improvement of in-band interference	23.1 dB	13.1 dB	–6.9 dB	–
			Required improvement of out-of-band interference	40.7 dB	–10.3 dB	–	–
			Horizontal separation distance which has negative required improvement	11 km	460 m	–	–

* Considering actual value of a duplexer.

3.2.2 Consideration of minimum guardband

(1) In-band interference from DTTB to IMT

In the study on in-band interference from DTTB to IMT, it is verified that characteristics improvements can be expected by transmit filter replacement, when the interfering side is the DTTB parent station or large relay station. In addition, the improvement from the DTTB parent station to the IMT base station (uplink reception) is obtained to be approximately –30 dB to –80 dB when the guardband is 5 MHz to 30 MHz. In this study, feasibility of the transmit filter is verified to obtain the required improvements for compatibility.

A) In-band interference from DTTB parent station to IMT base station (uplink reception)

In Table 3.2.1-1 in-band interference from the DTTB parent station to the IMT base station (uplink reception), the required improvement is 71.3 dB (the height of the antenna of the DTTB parent station is 20 m and the horizontal separation distance to the IMT base station is 147 m) when the guardband is 0 MHz.

In order to verify the feasibility of the transmit filter in the above conditions, multiple examples of the transmit filter (filters that have the attenuation pole at 5 MHz, 10 MHz, and 15 MHz where the tilt of the filter attenuation band is different for each of low attenuation, intermediate attenuation, and high attenuation) are designed and the feasibility is additionally studied in consideration of the measured values using the actual equipment of the filter.

Table 3.2.2-1 shows designed filter attenuation characteristics.

TABLE 3.2.2-1

Designed filter attenuation characteristics (DTTB parent station)

Attenuation characteristics	Attenuation pole	Frequency (separation)					
		715 MHz (+5 MHz)	720 MHz (+10 MHz)	725 MHz (+15 MHz)	730 MHz (+20 MHz)	735 MHz (+25 MHz)	740 MHz (+30 MHz)
Low attenuation (4-stage)	5 MHz	–16.8 dB	–17.7 dB	–21.6 dB	–25.3 dB	–28.5 dB	–31.3 dB
	10 MHz	–8.1 dB	–34.6 dB	–34.6 dB	–36.0 dB	–38.3 dB	–40.6 dB
	15 MHz	–7.0 dB	–29.6 dB	–47.6 dB	–47.6 dB	–47.9 dB	–49.4 dB
Intermediate attenuation (6-stage)	5 MHz	–38.7 dB	–50.6 dB	–60.5 dB	–68.8 dB	–75.5 dB	–81.3 dB
	10 MHz	–30.8 dB	–71.7 dB	–73.2 dB	–79.3 dB	–85.1 dB	–90.4 dB
	15 MHz	–29.4 dB	–62.7 dB	–91.2 dB	–91.4 dB	–94.9 dB	–99.4 dB
High attenuation (8-stage)	5 MHz	–62.1 dB	–83.7 dB	–99.5 dB	–112.3 dB	–122.5 dB	–131.4 dB
	10 MHz	–54.0 dB	–108.3 dB	–112.6 dB	–123.0 dB	–132.3 dB	–140.6 dB
	15 MHz	–52.7 dB	–95.7 dB	–132.7 dB	–134.9 dB	–141.9 dB	–149.4 dB

* For the attenuation pole frequency, approximate values interpolated are used.

Table 3.2.2-2 shows the required improvement study results when filters shown in Table 3.2.2-1 are inserted into the transmitter output of the DTTB parent station.

TABLE 3.2.2-2

Required improvement when designed filter is inserted

(DTTB parent station)

Required improvement	Attenuation pole	Frequency (separation)					
		715 MHz (+5 MHz)	**720 MHz (+10 MHz)**	**725 MHz (+15 MHz)**	**730 MHz (+20 MHz)**	**735 MHz (+25 MHz)**	**740 MHz (+30 MHz)**
Low attenuation (4-stage)	5 MHz	54.5 dB	53.6 dB	49.7 dB	46.0 dB	42.8 dB	40.0 dB
	10 MHz	63.2 dB	36.7 dB	36.7 dB	35.3 dB	33.0 dB	30.7 dB
	15 MHz	64.3 dB	41.7 dB	23.7 dB	23.7 dB	23.4 dB	21.9 dB
Intermediate attenuation (6-stage)	5 MHz	32.6 dB	20.7 dB	10.8 dB	2.5 dB	–4.2 dB	–10.0 dB
	10 MHz	40.5 dB	–0.4 dB	–1.9 dB	–8.0 dB	–13.8 dB	–19.1 dB
	15 MHz	41.9 dB	8.6 dB	–19.9 dB	–20.1 dB	–23.6 dB	–28.1 dB
High attenuation (8-stage)	5 MHz	9.2 dB	–12.4 dB	–28.2 dB	–41.0 dB	–51.2 dB	–60.1 dB
	10 MHz	17.3 dB	–37.0 dB	–41.3 dB	–51.7 dB	–61.0 dB	–69.3 dB
	15 MHz	18.6 dB	–24.4 dB	–61.4 dB	–63.6 dB	–70.6 dB	–78.1 dB
Ref.		36.3 dB	26.3 dB	–	6.3 dB	–	–

NOTE 1 – Negative required improvements are parts where it is compatible at separation frequencies in the table.

NOTE 2 – Positive required improvements are parts where it is required to additionally study compatibility conditions in consideration of parameters such as the horizontal separation distance.

NOTE 3 – Numerical values in the line of "(Ref.)" in the above table are the required improvement values at each separation frequency. They are referred to in order to evaluate the required guardband for the required improvement of 71.3 dB in a guardband of 0 MHz, when obtaining the required guardband for reception in-band interference from a DTTB parent station to an IMT base station (uplink reception) in A) above.

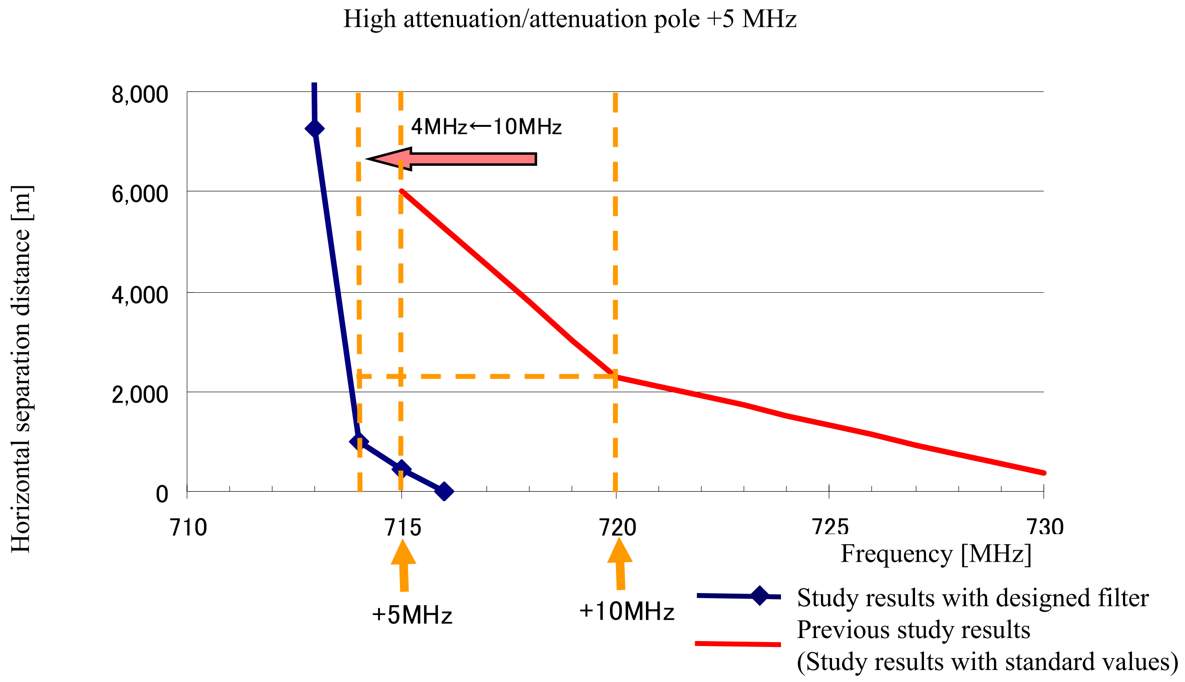
In addition, the horizontal separation distance that realizes this required improvement is calculated per 1 MHz using the models of the vertical-directional attenuation of the antenna and radio wave propagation loss in free space to study the relationship between the horizontal separation distance and separation frequency that realizes the required improvement per filter.

As a result, it is verified that the filter of the high attenuation and attenuation pole +5 MHz type are the conditions to realize the negative required improvement with less separation frequency. Figure 3.2.2-1 shows the relationship between the horizontal separation distance and separation frequency when this filter is used.

FIGURE 3.2.2-1

Conditions of high attenuation/attenuation pole +5 MHz type

(DTTB parent station)



B) In-band interference from DTTB large relay station to IMT base station (uplink reception)

In the study on in-band interference from a DTTB large relay station to a IMT base station (uplink reception) in § 3.2.1, the required improvement is 53.5 dB (the height of the antenna of the DTTB parent station is 20 m and the horizontal separation distance to the IMT base station is 147 m) when the guardband is 0 MHz.

In order to verify the feasibility of the transmit filter in the above conditions, multiple examples of the transmit filter (filters that have the attenuation pole at 5 MHz and 10 MHz where the tilt of the filter attenuation band is different for each of low attenuation, intermediate attenuation, and high attenuation) are designed and the feasibility is additionally studied in consideration of the measured values using the actual filter.

Table 3.2.2-3 shows designed filter attenuation characteristics.

TABLE 3.2.2-3

Designed filter attenuation characteristics

(DTTB large relay station)

Attenuation characteristics	Attenuation pole	Frequency (separation)					
		715 MHz (+5 MHz)	720 MHz (+10 MHz)	725 MHz (+15 MHz)	730 MHz (+20 MHz)	735 MHz (+25 MHz)	740 MHz (+30 MHz)
Low attenuation	5 MHz	–31.8 dB	–33.8 dB	–37.5 dB	–41.1 dB	–44.2 dB	–46.9 dB
	10 MHz	–27.3 dB	–45.0 dB	–56.5 dB	–65.1 dB	–72.0 dB	–77.6 dB
Intermediate attenuation	5 MHz	–46.1 dB	–58.4 dB	–68.2 dB	–76.1 dB	–82.8 dB	–88.2 dB
	10 MHz	–36.5 dB	–59.1 dB	–73.5 dB	–84.2 dB	–92.9 dB	–99.9 dB
High attenuation	5 MHz	–64.8 dB	–74.0 dB	–74.1 dB	–76.0 dB	–78.3 dB	–80.5 dB
	10 MHz	–40.6 dB	–83.3 dB	–90.2 dB	–98.1 dB	–98.1 dB	–98.1 dB

* For the attenuation pole frequency, approximate values interpolated are used.

Table 3.2.2-4 shows the required improvement study results when filters shown in Table 3.2.2-3 are inserted into the transmitter output of the DTTB large relay station.

TABLE 3.2.2-4

Required improvement when designed filter is inserted

(DTTB large relay station)

Required improvement	Attenuation pole	Frequency (separation)					
		715 MHz (+5 MHz)	720 MHz (+10 MHz)	725 MHz (+15 MHz)	730 MHz (+20 MHz)	735 MHz (+25 MHz)	740 MHz (+30 MHz)
Low attenuation	5 MHz	21.7 dB	19.8 dB	16.0 dB	12.4 dB	9.3 dB	6.6 dB
	10 MHz	26.3 dB	8.5 dB	–3.0 dB	–11.6 dB	–18.5 dB	–24.1 dB
Intermediate attenuation	5 MHz	7.4 dB	–4.9 dB	–14.7 dB	–22.6 dB	–29.3 dB	–34.7 dB
	10 MHz	17.0 dB	–5.6 dB	–20.0 dB	–30.7 dB	–39.4 dB	–46.4 dB
High attenuation	5 MHz	–11.3 dB	–20.5 dB	–20.6 dB	–22.5 dB	–24.8 dB	–27.0 dB
	10 MHz	12.9 dB	–29.8 dB	–36.7 dB	–44.6 dB	–44.6 dB	–44.6 dB
Ref.		18.5 dB	8.5 dB	–	–	–	–

NOTE 1 – Negative required improvements are parts where it is compatible at separation frequencies in the table.

NOTE 2 – Positive required improvements are parts where it is required to additionally study compatibility conditions in consideration of parameters such as the horizontal separation distance.

NOTE 3 – Numerical values of "Ref" in the above table are obtained as follows: In order to evaluate the similar required improvement in the case of the large relay station in B) above for the required improvement at each separation frequency in the required guardband study on in-band interference from the parent station (20 m) to the IMT base station in Table 3.2.1-1, the difference of the required improvement between the cases of A) and B) in a guardband of 0 MHz (17.8 dB = 71.3 dB-53.5 dB) is corrected to obtain the required improvement at each separation frequency in the case of B).

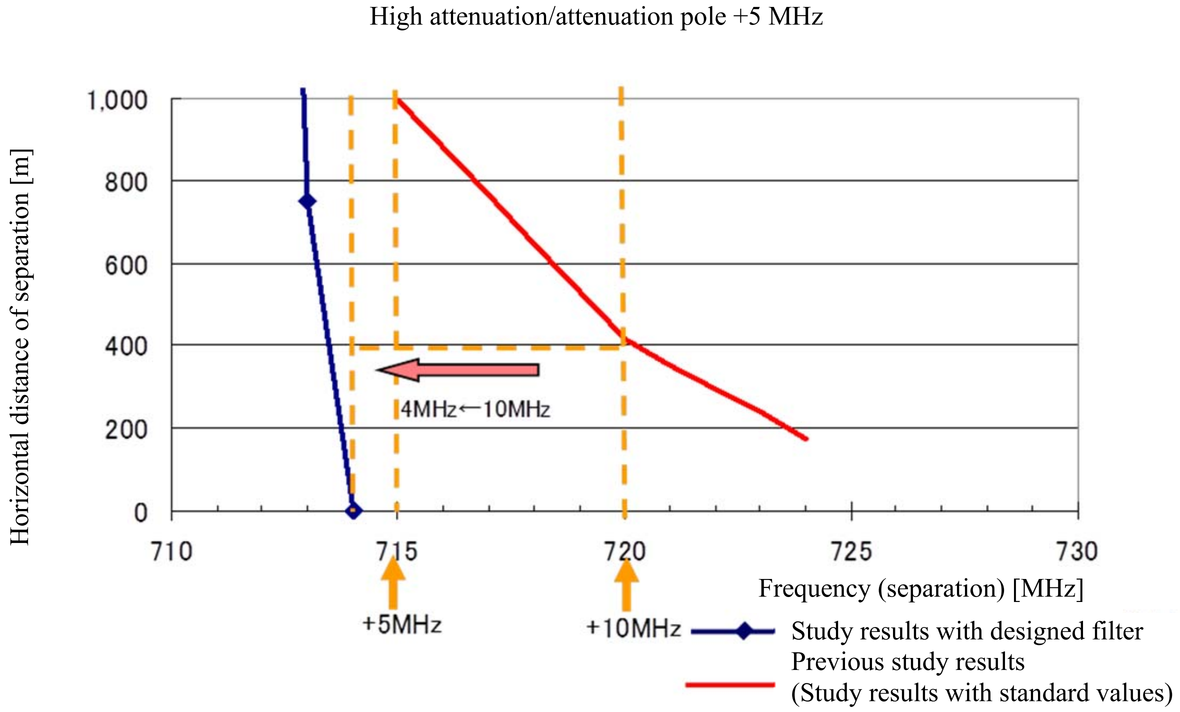
The same calculation as A) above is performed to study the relationship between the horizontal separation distance and separation frequency that realizes the required improvement per filter.

As a result, it is verified that the filter of the high attenuation and attenuation pole +5 MHz type are the conditions to realize the negative required improvement with less separation frequency. Figure 3.2.2-2 shows the relationship between the horizontal separation distance and separation frequency when this filter is used.

FIGURE 3.2.2-2

Conditions of high attenuation/attenuation pole +5 MHz type

(DTTB large relay station)



C) Summary of study results on in-band interference from DTTB to IMT

With the above study, using the feasible filter makes the required improvement a negative value by applying a certain separation frequency to the guardband by the attenuation characteristics.

It is also possible that providing a fixed horizontal separation distance between the broadcast station and IMT base station makes the guardband narrower.

In the study results of the feasible filter studied this time, it is compatible when the minimum guardband is 4 MHz (horizontal separation distance: 2.3 km) or 6 MHz (horizontal separation distance: 0 m) in the case of the DTTB parent station. With regard to the DTTB large relay station, it is also compatible at 3 MHz (horizontal separation distance: 1 km) and 4 MHz (horizontal separation distance: 0 m) that is the same as the DTTB parent station.

(2) Out-of-band interference from DTTB to IMT

With regard to out-of-band interference from the DTTB to IMT (downlink reception), it is compatible in the minimum guardband of 30 MHz in the case of interference from the DTTB to the IMT mobile station (downlink reception).

With regard to out-of-band interference from the DTTB to IMT (uplink reception), it is compatible in the same guardband of 4 MHz (horizontal separation distance: 2.3 km) or 6 MHz (horizontal separation distance: 0 m), which is the same as the guardband of in-band interference from the DTTB parent station to the IMT base station (downlink reception), by securing a fixed separation distance and adjustment of the installation position by a cellular phone agency.

3.3 Interference from IMT downlink into DTTB

3.3.1 Study on guardband of 0 MHz

Table 3.3.1-1 shows simulation results by a one-to-one counter model in a guardband of 0 MHz. In considering measures, DTTB reception is divided into the three cases of home TV (models [1] to [8] and [15]; see also Table 3.1-1), mobile terminal TV(models [9] to [12]), and DTTB relay station(models [13] and [14]).

TABLE 3.3.1-1

Results of study on interference (IMT downlink → DTTB)

Required improvement (dB) when GB = 0 MHz (Propagation model: Free space)		Interference: IMT downlink transmission																							
		I-a: IMT base station				I-b: IMT small-powered repeater (integral type)				I-c: IMT small-powered repeater (separate type)				I-d: IMT land mobile relay station (for outdoor areas)				I-e: IMT land mobile relay station (for indoor areas, integral type)				I-f: IMT land mobile relay station (for indoor areas, separate type)			
		Horizontal separation distance (m)*	Required improvement (dB)			Horizontal separation distance (m)*	Required improvement (dB)			Horizontal separation distance (m)*	Required improvement (dB)			Horizontal separation distance (m)*	Required improvement (dB)			Horizontal separation distance (m)*	Required improvement (dB)			Horizontal separation distance (m)*	Required improvement (dB)		
			In-band inter-ference	Out-of-band inter-ference	Image inter-ference		In-band inter-ference	Out-of-band inter-ference	Image inter-ference		In-band inter-ference	Out-of-band inter-ference	Image inter-ference		In-band inter-ference	Out-of-band inter-ference	Image inter-ference		In-band inter-ference	Out-of-band inter-ference	Image inter-ference		In-band inter-ference	Out-of-band inter-ference	Image inter-ference
Received interference DTTB reception	(1) Home TV Yagi ANT w/o LNA (10 m H)	214	46.2	35.7	22.2	21	48.8	8	1.7	21	48.8	8	1.7	19	64	37.2	30.9	25	48.7	9.9	3.6	23	39.8	1	–5.3
	(2) Home TV Yagi ANT w/ LNA (10 m H) (w/o saturation)	214	49.9	39.7	26.2	21	52.5	12	5.7	21	52.5	12	5.7	19	67.7	41.2	34.9	25	52.4	13.9	7.6	23	43.5	5	–1.3
	(3) Home TV simple ANT w/o LNA (5 m H)	241	44.5	17.8	4.3	4	61.6	4.6	–1.7	4	61.6	4.6	–1.7	25	59.6	16.6	10.3	4	61.6	6.6	0.3	3	55	0	–6.3
	(4) Home TV simple ANT w/ LNA (5 m H) (w/o saturation)	241	48.2	27.8	14.3	4	65.3	14.6	8.3	4	65.3	14.6	8.3	25	63.3	26.6	20.3	4	65.3	16.6	10.3	3	58.7	10	3.7
	(5) Home TV simple indoor ANT w/o LNA (1 m H)	269	33.6	6.8	–6.7	2	80.3	23.3	17	2	80.3	23.3	17	35	46.7	3.7	–2.6	2	80.3	25.3	19	3	65	10	3.7
	(6) Home TV simple ANT w/ LNA (1 m H) (w/o saturation)	269	37.3	16.8	3.3	2	84	33.3	27	2	84	33.3	27	35	50.4	13.7	7.4	2	84	35.3	29	3	68.7	20	13.7
	(7) Home TV Yagi ANT w/ LNA (10 m H) (w/ saturation)	214	52.9	32	–	21	55.5	4.3	–	21	55.5	4.3	–	19	70.7	33.5	–	25	55.4	6.2	–	23	46.5	–2.7	–
	(8) Home TV simple ANT w/ LNA (5 m H) (w/ saturation)	241	49.2	28.3	–	4	66.3	15.1	–	4	66.3	15.1	–	25	64.3	27.1	–	4	66.3	17.1	–	3	59.7	10.5	–
	(9) Mobile terminal (outdoors) (1.5 m H)	72	36	25.4	11.9	3	61.7	20.9	14.6	3	61.7	20.9	14.6	30	50.6	23.8	17.5	3	61.7	22.9	16.6	3	50.8	12.1	5.7
	(10) Mobile terminal (indoors)	72	26	15.4	1.9	0.5	84.4	43.6	37.2	0.5	84.4	43.6	37.2	30	40.6	13.8	7.5	0.5	84.3	45.6	39.2	0.5	67.3	28.6	22.2
	(11) Mobile terminal (bus) (3 m H)	72	26.1	15.5	2	3	61.4	20.6	14.2	3	61.4	20.6	14.2	28	51.6	24.8	18.5	3	61.3	22.6	16.2	3	51.8	13	6.7
	(12) Mobile terminal (private vehicle) (1.5 m H)	72	26	15.4	1.9	3	61.7	20.9	14.6	3	61.7	20.9	14.6	30	50.6	23.8	17.5	3	61.7	22.9	16.6	3	50.8	12.1	5.7
	(13) Large relay station (reception) (5 m H)	249	65.1	39.5	28	20	73.6	17.8	13.4	20	73.6	17.8	13.4	58	76.5	34.8	30.4	20	73.5	19.8	15.4	20	64.6	10.8	6.5
	(14) Small-powered station (reception) (5 m H)	241	53.4	28.8	17.3	20	62.2	7.4	3.1	20	62.2	7.4	3.1	25	69	28.3	23.9	20	62.2	9.4	5.1	20	52.3	–0.4	–4.8
	(15) Community reception (w/ saturation)	3	35.9	14.9	–	–	–	–	–	–	–	–	–	3	39.8	2.6	–	–	–	–	–	–	–	–	–

* Horizontal separation distance used in interference calculation.

3.3.2 Study on guardband of 60 MHz

An additional study is performed considering that the guardband between the IMT downlink band and DTTB band is 60 MHz or more since it is indicated as the basic concept that the frequency for the base station shall be 770 MHz or more in the basic principle of frequency reorganization in a band of 700 MHz.

The study on guardband of 0 MHz is performed assuming that the IMT downlink is used after frequency repacking for TV broadcasts at 770 MHz or less that is the TV broadcast band. This study is made on the precondition that no attenuation due to a receiver filter included in a DTTB receiver or LNA is expected.

In this study, verification is performed including the one for receiver filter characteristics using actual equipment of the DTTB receiver and LNA where the IMT downlink is used at the band of more than 770 MHz that is out of the TV broadcast band. Based on these results, the required improvement in each model is studied and considered.

With regard to in-band interference from the IMT downlink, in the study of § 3.3.1, the maximum required improvement of mobile terminal TV reception (models [9] to [12]; see also Table 3.1-1) from interference of IMT land mobile relay station in a guardband of 0 MHz is 84.3 dB (indoor area integral type → model [10]). However, the attenuation of 84.4 dB can be expected and the required improvement becomes negative by making the guard band 16 MHz and through the application of the transmit filter (c) shown in Fig. 2.1-3 to the IMT land mobile relay station that is the interfering side. With regard to in-band interference from the IMT downlink, it is possible to be compatible when a guardband of 16 MHz is provided at maximum through addition of the transmit filter to the IMT base station or IMT land mobile relay station that is the interfering side, consideration of actual values regarding spurious characteristics of the IMT small-powered repeater, and adjustment of the antenna installation direction and installation position, etc.

As the precondition of additional study, it is determined that no additional study is performed following the previous study details regarding in-band interference from the IMT downlink in consideration that the guardband between the IMT downlink band and DTTB band is 60 MHz or more.

As an index for out-of-band interference, a video failure limit value is used in the additional study. This is the value obtained by measuring the level that can detect the failure on a TV screen by inputting only IMT signals into a DTTB receiver or LNA in a laboratory. Therefore, it is necessary to pay attention so that no margin is included for interference or field strength change in the actual field and that the Quasi Error Free (QEF) conditions, the original terrestrial digital-broadcasting quality standards, are not met.

(1) Additional study on out-of-band interference from IMT downlink to DTTB

A) Additional study on out-of-band interference from IMT downlink to DTTB receiver

With regard to the models [1] to [6] and [9] to [12], an experiment is performed to verify the effects of out-of-band interference on DTTB receivers.

In the experiment, 25 models of DTTB receivers are used. The desired DTTB signal (signal level: –77 dBm to –40 dBm/6 MHz) and the worst signal generated by a signal generator (SG) as the IMT downlink signal (15 MHz × 2 [773 MHz to 803 MHz]) are input to those receivers to check the IMT downlink input level when the effects of interference are detected to obtain the desired signal to undesired signal ratio (D/U ratio) for the DTTB signal input level. Ch. 49, which is assumed to be affected greater than ch. 52, was determined as the DTTB channel for measurement in consideration of the effects of image interference. Detailed measurements are performed for all

25 models. The presence or absence of the effects of interference is visually checked for 20 seconds.

Figure 3.3.2-1 shows measurement results by model in ch. 49 and Table 3.3.2-1 shows the results of the model that indicated the worst characteristics by DTTB signal input level.

FIGURE 3.3.2-1

Experiment results by model on out-of-band interference from

IMT downlink to DTTB receiver (channel 49)

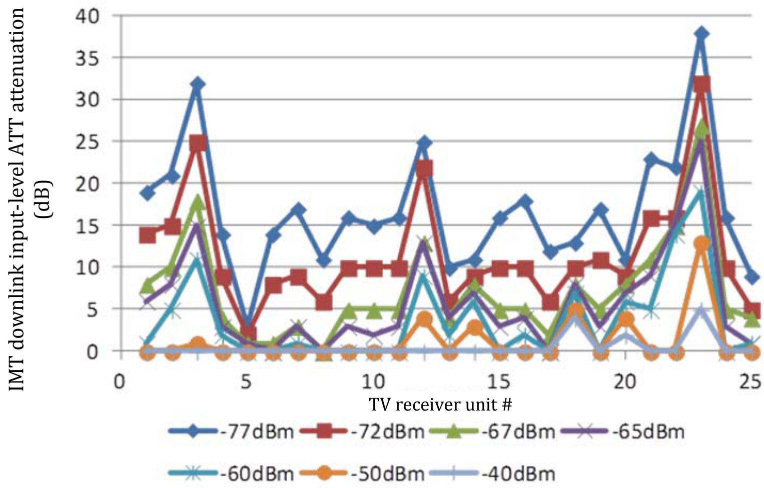


TABLE 3.3.2-1

Experiment results of out-of-band interference

from IMT downlink to DTTB receiver (worst values)

DTTB CH	49						
(a) DTTB signal input level (dBm/6 MHz)	–77	–72	–67	–65	–60	–50	–40
(b) Attenuation worst value (dB]	38	32	27	25	19	13	5
(Ref.) Attenuation median value (dB)	16	10	5	4	2	0	0
(c) IMT downlink signal input level to DTTB (0 dBm – (b)) (dBm)*	–38	–32	–27	–25	–19	–13	–5
D/U ratio (dB) ((a)-(c))	–39	–40	–40	–40	–41	–37	–35

* IMT downlink input level when ATT = 0 dB: 0 dBm.

It is found that the worst value of the D/U ratio is –35 dB when the DTTB signal input level is –40 dBm/6 MHz. It is also found that there is a difference of 5 dB between the worst value and median value of the 25 models for the IMT downlink level with the effects of interference detected.

The DTTB signal input level assumed in the DTTB receiver antenna outdoor installation model [1] or portable/mobile receiving models [9] to [12], which are typical receiving forms, is –73 dBm/6 MHz. From the experiment results, it is found that the IMT downlink signal input level has a difference of 22 dB between the worst value and median value of the 25 models when the DTTB signal input level is –72 dBm/6 MHz.

With regard to the models that indicated the worst value and median value out of the 25 models, measurement channels are further added to perform measurements in each case of DTTB signal input levels: –77 dBm/6 MHz, –65 dBm/6 MHz, and –40 dBm/6 MHz. Table 3.3.2-2 shows the IMT downlink signal input levels that are the video failure limit values by DTTB signal input level for each DTTB channel obtained from measurement results.

TABLE 3.3.2-2

IMT downlink signal input levels having video failure limit values

in models that indicate the worst and median values

	DTTB signal input level (dBm/ 6 MHz)	ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
IMT downlink signal input level (dBm) (median value)	–77.0	–3	–3	–2	–13	–16	–17	–20	–22	–18	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	–65.0	–1	–1	(0)	–1	–3	–5	–7	–9	–5	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	–40.0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
IMT downlink signal input level (dBm) (worst value)	–77.0	–7	–9	–9	–38	–43	–42	–42	–42	–38	–7	–6	–2	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	–65.0	–4	–5	–5	–25	–30	–29	–29	–29	–25	–2	–2	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	–40.0	(0)	(0)	(0)	–6	–10	–9	–9	–9	–5	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

* (0) indicates the case where no video failure is observed at the IMT maximum input level of 0 dBm in measurement.

B) Additional study on out-of-band interference from IMT downlink to LNA

With regard to the models [7], [8], and [15], an experiment is performed to verify the effects of out-of-band interference on LNA.

In the experiment, 11 models of LNA are used. The desired DTTB signal (1 signal), DTTB dummy signal (7 signals), which are 8 signals in total, and the worst signal generated by a signal generator (SG) as the IMT downlink signal (15 MHz × 2 [773 MHz to 803 MHz]) are input to those LNA. The IMT downlink signal input levels are attenuated with an attenuator by DTTB signal input level to check the IMT downlink signal input levels at which there are no effects on DTTB receivers. As DTTB channels for measurements, two channels: ch. 52, which is assumed to be most affected, and ch. 46, which is assumed to be significantly affected by the intermodulation by the IMT uplink signal and IMT downlink signal, are used. Detailed measurements are performed for all 11 models. The presence or absence of the effects of interference is visually checked for 20 seconds.

Figure 3.3.2-2 shows measurement results by model and Table 3.3.2-3 shows the results of the model indicating the worst characteristics by DTTB signal input level for each DTTB measurement channel.

FIGURE 3.3.2-2

Experiment results by model on out-of-band interference

from IMT downlink to LNA

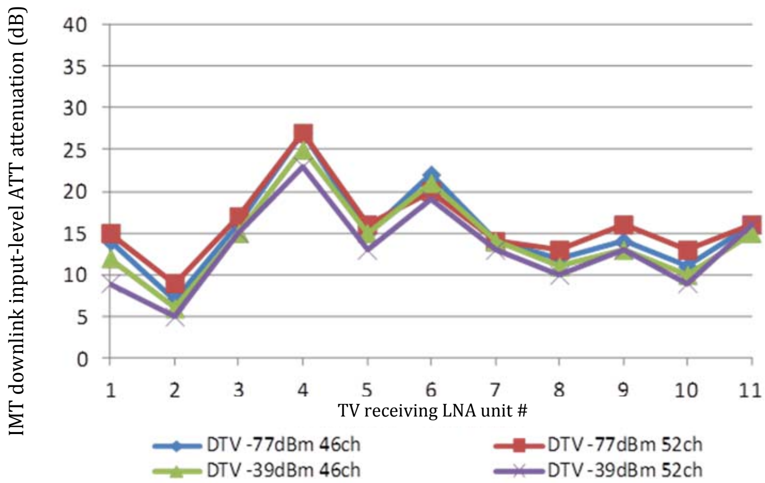


TABLE 3.3.2-3

Results of out-of-band interference experiment

from IMT downlink to LNA (worst values)

DTTB CH	46		52	
DTTB signal input level (dBm/6 MHz)	–77	–39	–77	–39
(a) ATT attenuation (dB)	27	25	27	23
(Ref.) ATT attenuation median value (dB)	14	14	16	13
IMT downlink signal input level (dBm) (–5 dBm-(a))*	–32	–30	–32	–28

* IMT downlink input level when ATT = 0 dB: –5 dBm.

From the experiment results, the following is found regarding ch. 52, which is assumed to be most affected: when the DTTB signal input level is –77 dBm/6 MHz, effects on the LNA that has the lowest proof stress are detected when the IMT downlink signal is input at –32 dBm or more. It is also found that there is a difference of 11 dB between the worst value and median value of the 11 models used in the experiment.

With regard to the models that indicated the worst value and median value out of all 11 models, measurement channels are further added to perform measurements in each case of DTTB signal input levels: –77 dBm/6 MHz, –65 dBm/6 MHz, and –40 dBm/6 MHz. Table 3.3.2-4 shows the IMT downlink signal input levels that are the video failure limit values by DTTB signal input level for each DTTB channel obtained from measurement results.

TABLE 3.3.2-4

IMT downlink signal input levels having video failure limit values

in models that indicate the worst and median values

	DTTB signal input level (dBm/ 6 MHz)	ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
IMT downlink signal input level (dBm) (median value)	–77.0	–14	–14	–14	–14	–14	–14	–14	–14	–14	–14	–14	–14	–14	–14	–14	–14	–14	–14	–14
	–65.0	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17
	–40.0	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17	–17
IMT downlink signal input level (dBm) (worst value)	–77.0	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32
	–65.0	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32
	–40.0	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32	–32

C) Recalculation of required improvement in out-of-band interference

Tables 3.3.2-5 to 2-28 show the required improvement for video failure limit values by DTTB channel and by DTTB signal input level, regarding the models indicating the worst value and median values out of DTTB receivers and LNA.

As an index for out-of-band interference, a video failure limit value is used in these tables. This is the value obtained by measuring the level that can detect the failure on a DTTB screen by inputting only IMT signals into a DTTB receiver or LNA in a laboratory. Therefore, it is necessary to pay attention so that no margin is included for interference or field strength change in the actual field and that the quasi error free (QEF) conditions, the original terrestrial digital-broadcasting quality standards, are not met.

The required improvement is calculated by subtracting the IMT downlink signal input level that is the video failure limit value in Table 3.3.2-2 and Table 3.3.2-4 from the maximum IMT input level assumed for each model.

With regard to the cases where the DTTB signal input level is –77 dBm/6 MHz and –65 dBm/6 MHz, the required improvement shall not be calculated for models [2], [3], [4], [5], and [6]. Models [2], [4], and [6] that include a LNA (no saturation) are provided assuming the case where –40 dBm/6 MHz is given as a result of amplification of the DTTB signal by 38 dB by the LNA. Therefore, they become the models with a weak field strength area of the DTTB assumed in reality and are summarized as a separate table from other models.

TABLE 3.3.2-5

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT base station) → DTTB (–77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	214	35.7	59.3	–10.3	Median	–7.3	–7.3	–8.3	2.7	5.7	6.7	9.7	11.7	7.7	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)
						Worst	–3.3	–1.3	–1.3	27.7	32.7	31.7	31.7	31.7	27.7	–3.3	–4.3	–8.3	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/ saturation)	214	32	56.3	–7.3	Median	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
						Worst	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7
	[8] Home TV simple ANT w/LNA (5 m H) (w/ saturation)	241	28.3	60	–11	Median	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
						Worst	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
	[15] Community reception (w/saturation)	3	14.9	73.4	–24.4	Median	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4	–10.4
						Worst	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	72	25.4	69.6	–20.6	Median	–17.6	–17.6	–18.6	–7.6	–4.6	–3.6	–0.6	1.4	–2.6	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)
						Worst	–13.6	–11.6	–11.6	17.4	22.4	21.4	21.4	21.4	17.4	–13.6	–14.6	–18.6	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)
	[10] Portable terminal (indoors)	72	15.4	79.6	–30.6	Median	–27.6	–27.6	–28.6	–17.6	–14.6	–13.6	–10.6	–8.6	–12.6	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)
						Worst	–23.6	–21.6	–21.6	7.4	12.4	11.4	11.4	11.4	7.4	–23.6	–24.6	–28.6	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)
	[11] Mobile terminal (bus) (3 m H)	72	15.5	79.5	–30.5	Median	–27.5	–27.5	–28.5	–17.5	–14.5	–13.5	–10.5	–8.5	–12.5	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)
						Worst	–23.5	–21.5	–21.5	7.5	12.5	11.5	11.5	11.5	7.5	–23.5	–24.5	–28.5	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)
	[12] Mobile terminal (private vehicle) (1.5 m H)	72	15.4	79.6	–30.6	Median	–27.6	–27.6	–28.6	–17.6	–14.6	–13.6	–10.6	–8.6	–12.6	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)
						Worst	–23.6	–21.6	–21.6	7.4	12.4	11.4	11.4	11.4	7.4	–23.6	–24.6	–28.6	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-6

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT base station) → DTTB (–65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	214	35.7	59.3	–10.3	Median	–9.3	–9.3	(–10.3)	–9.3	–7.3	–5.3	–3.3	–1.3	–5.3	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)
						Worst	–6.3	–5.3	–5.3	14.7	19.7	18.7	18.7	18.7	14.7	–8.3	–8.3	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	214	32	56.3	–7.3	Median	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
						Worst	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	241	28.3	60	–11	Median	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
						Worst	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
	[15] Community reception (w/saturation)	3	14.9	73.4	–24.4	Median	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4
						Worst	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	72	25.4	69.6	–20.6	Median	–19.6	–19.6	(–20.6)	–19.6	–17.6	–15.6	–13.6	–11.6	–15.6	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)
						Worst	–16.6	–15.6	–15.6	4.4	9.4	8.4	8.4	8.4	4.4	–18.6	–18.6	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)
	[10] Portable terminal (indoors)	72	15.4	79.6	–30.6	Median	–29.6	–29.6	(–30.6)	–29.6	–27.6	–25.6	–23.6	–21.6	–25.6	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)
						Worst	–26.6	–25.6	–25.6	–5.6	–0.6	–1.6	–1.6	–1.6	–5.6	–28.6	–28.6	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)
	[11] Mobile terminal (bus) (3 m H)	72	15.5	79.5	–30.5	Median	–29.5	–29.5	(–30.5)	–29.5	–27.5	–25.5	–23.5	–21.5	–25.5	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)
						Worst	–26.5	–25.5	–25.5	–5.5	–0.5	–1.5	–1.5	–1.5	–5.5	–28.5	–28.5	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)
	[12] Mobile terminal (private vehicle) (1.5 m H)	72	15.4	79.6	–30.6	Median	–29.6	–29.6	(–30.6)	–29.6	–27.6	–25.6	–23.6	–21.6	–25.6	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)
						Worst	–26.6	–25.6	–25.6	–5.6	–0.6	–1.6	–1.6	–1.6	–5.6	–28.6	–28.6	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-7

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT base station)→ DTTB (–40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	214	35.7	59.3	–10.3	Median	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)
						Worst	(–10.3)	(–10.3)	(–10.3)	–4.3	–0.3	–1.3	–1.3	–1.3	–5.3	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)	(–10.3)
	[3] Home TV simple ANT w/o LNA (5 m H)	241	17.8	61	–12	Median	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)
						Worst	(–12.0)	(–12.0)	(–12.0)	–6.0	–2.0	–3.0	–3.0	–3.0	–7.0	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)	(–12.0)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	214	32	56.3	–7.3	Median	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
						Worst	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	241	28.3	60	–11	Median	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
						Worst	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
	[15] Community reception (w/saturation)	3	14.9	73.4	–24.4	Median	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4	–7.4
						Worst	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	269	6.8	72	–23	Median	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)
						Worst	(–23.0)	(–23.0)	(–23.0)	–17.0	–13.0	–14.0	–14.0	–14.0	–18.0	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)	(–23.0)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	72	25.4	69.6	–20.6	Median	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)
						Worst	(–20.6)	(–20.6)	(–20.6)	–14.6	–10.6	–11.6	–11.6	–11.6	–15.6	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)	(–20.6)
	[10] Portable terminal (indoors)	72	15.4	79.6	–30.6	Median	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)
						Worst	(–30.6)	(–30.6)	(–30.6)	–24.6	–20.6	–21.6	–21.6	–21.6	–25.6	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)
	[11] Mobile terminal (bus) (3 m H)	72	15.5	79.5	–30.5	Median	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)
						Worst	(–30.5)	(–30.5)	(–30.5)	–24.5	–20.5	–21.5	–21.5	–21.5	–25.5	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)
	[12] Mobile terminal (private vehicle) (1.5 m H)	72	15.4	79.6	–30.6	Median	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)
						Worst	(–30.6)	(–30.6)	(–30.6)	–24.6	–20.6	–21.6	–21.6	–21.6	–25.6	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)	(–30.6)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-8

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT base station) → DTTB (–40 dBm/6 MHz)
Models [2], [4], and [6] (DTTB weak field strength area)

		Horizontal distance of separation (m)	**Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)**	**Coupled amount (dB)**	**IMT maximum input level (dBm)**	**Median/ Worst**	**Required improvement for video failure limit value (GB = 63 MHz) (dB)**																		
							ch. 52	**ch. 51**	**ch. 50**	**ch. 49**	**ch. 48**	**ch. 47**	**ch. 46**	**ch. 45**	**ch. 44**	**ch. 43**	**ch. 42**	**ch. 41**	**ch. 36**	**ch. 29**	**ch. 27**	**ch. 26**	**ch. 19**	**ch. 15**	**ch. 13**
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	214	39.7	21.3	27.7	Median	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)
						Worst	(27.7)	(27.7)	(27.7)	33.7	37.7	36.7	36.7	36.7	32.7	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)	(27.7)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	241	27.8	23	26	Median	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)
						Worst	(26.0)	(26.0)	(26.0)	32.0	36.0	35.0	35.0	35.0	31.0	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)	(26.0)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	269	16.8	34	15	Median	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)
						Worst	(15.0)	(15.0)	(15.0)	21.0	25.0	24.0	24.0	24.0	20.0	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-9

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT small-powered repeater (integral type)) → DTTB (–77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	21	8	62	–38	Median	–35.0	–35.0	–36.0	–25.0	–22.0	–21.0	–18.0	–16.0	–20.0	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
						Worst	–31.0	–29.0	–29.0	0.0	5.0	4.0	4.0	4.0	0.0	–31.0	–32.0	–36.0	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	21	4.3	59	–35	Median	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0
						Worst	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	4	15.1	48.2	–24.2	Median	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2
						Worst	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	20.9	49.1	–25.1	Median	–22.1	–22.1	–23.1	–12.1	–9.1	–8.1	–5.1	–3.1	–7.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	–18.1	–16.1	–16.1	12.9	17.9	16.9	16.9	16.9	12.9	–18.1	–19.1	–23.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
	[10] Portable terminal (indoors)	0.5	43.6	26.4	–2.4	Median	0.6	0.6	–0.4	10.6	13.6	14.6	17.6	19.6	15.6	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
						Worst	4.6	6.6	6.6	35.6	40.6	39.6	39.6	39.6	35.6	4.6	3.6	–0.4	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
	[11] Mobile terminal (bus) (3 m H)	3	20.6	49.4	–25.4	Median	–22.4	–22.4	–23.4	–12.4	–9.4	–8.4	–5.4	–3.4	–7.4	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
						Worst	–18.4	–16.4	–16.4	12.6	17.6	16.6	16.6	16.6	12.6	–18.4	–19.4	–23.4	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	20.9	49.1	–25.1	Median	–22.1	–22.1	–23.1	–12.1	–9.1	–8.1	–5.1	–3.1	–7.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	–18.1	–16.1	–16.1	12.9	17.9	16.9	16.9	16.9	12.9	–18.1	–19.1	–23.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-10

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT small-powered repeater (integral type)) → DTTB (–65 dBm/6 MHz)

		Horizontal distance of separation (m)	**Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)**	**Coupled amount (dB)**	**IMT maximum input level (dBm)**	**Median/ Worst**	**Required improvement for video failure limit value (GB = 63 MHz) (dB)**																		
							ch. 52	**ch. 51**	**ch. 50**	**ch. 49**	**ch. 48**	**ch. 47**	**ch. 46**	**ch. 45**	**ch. 44**	**ch. 43**	**ch. 42**	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	21	8	62	–38	Median	–37.0	–37.0	(–38.0)	–37.0	–35.0	–33.0	–31.0	–29.0	–33.0	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
						Worst	–34.0	–33.0	–33.0	–13.0	–8.0	–9.0	–9.0	–9.0	–13.0	–36.0	–36.0	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	21	4.3	59	–35	Median	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0
						Worst	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	4	15.1	48.2	–24.2	Median	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2
						Worst	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	20.9	49.1	–25.1	Median	–24.1	–24.1	(–25.1)	–24.1	–22.1	–20.1	–18.1	–16.1	–20.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	–21.1	–20.1	–20.1	–0.1	4.9	3.9	3.9	3.9	–0.1	–23.1	–23.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
	[10] Portable terminal (indoors)	0.5	43.6	26.4	–2.4	Median	–1.4	–1.4	(–2.4)	–1.4	0.6	2.6	4.6	6.6	2.6	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
						Worst	1.6	2.6	2.6	22.6	27.6	26.6	26.6	26.6	22.6	–0.4	–0.4	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
	[11] Mobile terminal (bus) (3 m H)	3	20.6	49.4	–25.4	Median	–24.4	–24.4	(–25.4)	–24.4	–22.4	–20.4	–18.4	–16.4	–20.4	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
						Worst	–21.4	–20.4	–20.4	–0.4	4.6	3.6	3.6	3.6	–0.4	–23.4	–23.4	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	20.9	49.1	–25.1	Median	–24.1	–24.1	(–25.1)	–24.1	–22.1	–20.1	–18.1	–16.1	–20.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	–21.1	–20.1	–20.1	–0.1	4.9	3.9	3.9	3.9	–0.1	–23.1	–23.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-11

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT small-powered repeater (integral type)) → DTTB (–40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	21	8	62	–38	Median	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
						Worst	(–38.0)	(–38.0)	(–38.0)	–32.0	–28.0	–29.0	–29.0	–29.0	–33.0	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
	[3] Home TV simple ANT w/o LNA (5 m H)	4	4.6	49.2	–25.2	Median	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)
						Worst	(–25.2)	(–25.2)	(–25.2)	–19.2	–15.2	–16.2	–16.2	–16.2	–20.2	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	21	4.3	59	–35	Median	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0
						Worst	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	4	15.1	48.2	–24.2	Median	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2
						Worst	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	2	23.3	30.5	–6.5	Median	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)
						Worst	(–6.5)	(–6.5)	(–6.5)	–0.5	3.5	2.5	2.5	2.5	–1.5	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	20.9	49.1	–25.1	Median	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	(–25.1)	(–25.1)	(–25.1)	–19.1	–15.1	–16.1	–16.1	–16.1	–20.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
	[10] Portable terminal (indoors)	0.5	43.6	26.4	–2.4	Median	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
						Worst	(–2.4)	(–2.4)	(–2.4)	3.6	7.6	6.6	6.6	6.6	2.6	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
	[11] Mobile terminal (bus) (3 m H)	3	20.6	49.4	–25.4	Median	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
						Worst	(–25.4)	(–25.4)	(–25.4)	–19.4	–15.4	–16.4	–16.4	–16.4	–20.4	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	20.9	49.1	–25.1	Median	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	(–25.1)	(–25.1)	(–25.1)	–19.1	–15.1	–16.1	–16.1	–16.1	–20.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-12

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT small-powered repeater (integral type)) → DTTB (–40 dBm/6 MHz)
Models [2], [4], and [6] (DTTB weak field strength area)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	21	12	24	0	Median	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
						Worst	(0.0)	(0.0)	(0.0)	6.0	10.0	9.0	9.0	9.0	5.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	4	14.6	11.2	12.8	Median	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)
						Worst	(12.8)	(12.8)	(12.8)	18.8	22.8	21.8	21.8	21.8	17.8	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	2	33.3	–7.5	31.5	Median	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)
						Worst	(31.5)	(31.5)	(31.5)	37.5	41.5	40.5	40.5	40.5	36.5	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-13

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT small-powered repeater (separate type)) → DTTB (–77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	21	8	62	–38	Median	–35.0	–35.0	–36.0	–25.0	–22.0	–21.0	–18.0	–16.0	–20.0	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
						Worst	–31.0	–29.0	–29.0	0.0	5.0	4.0	4.0	4.0	0.0	–31.0	–32.0	–36.0	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	21	4.3	59	–35	Median	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0	–21.0
						Worst	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	4	15.1	48.2	–24.2	Median	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2	–10.2
						Worst	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	20.9	49.1	–25.1	Median	–22.1	–22.1	–23.1	–12.1	–9.1	–8.1	–5.1	–3.1	–7.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	–18.1	–16.1	–16.1	12.9	17.9	16.9	16.9	16.9	12.9	–18.1	–19.1	–23.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
	[10] Portable terminal (indoors)	0.5	43.6	26.4	–2.4	Median	0.6	0.6	–0.4	10.6	13.6	14.6	17.6	19.6	15.6	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
						Worst	4.6	6.6	6.6	35.6	40.6	39.6	39.6	39.6	35.6	4.6	3.6	–0.4	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
	[11] Mobile terminal (bus) (3 m H)	3	20.6	49.4	–25.4	Median	–22.4	–22.4	–23.4	–12.4	–9.4	–8.4	–5.4	–3.4	–7.4	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
						Worst	–18.4	–16.4	–16.4	12.6	17.6	16.6	16.6	16.6	12.6	–18.4	–19.4	–23.4	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	20.9	49.1	–25.1	Median	–22.1	–22.1	–23.1	–12.1	–9.1	–8.1	–5.1	–3.1	–7.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	–18.1	–16.1	–16.1	12.9	17.9	16.9	16.9	16.9	12.9	–18.1	–19.1	–23.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-14

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT small-powered repeater (separate type)) → DTTB (–65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	21	8	62	–38	Median	–37.0	–37.0	(–38.0)	–37.0	–35.0	–33.0	–31.0	–29.0	–33.0	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
						Worst	–34.0	–33.0	–33.0	–13.0	–8.0	–9.0	–9.0	–9.0	–13.0	–36.0	–36.0	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	21	4.3	59	–35	Median	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0
						Worst	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	4	15.1	48.2	–24.2	Median	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2
						Worst	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	20.9	49.1	–25.1	Median	–24.1	–24.1	(–25.1)	–24.1	–22.1	–20.1	–18.1	–16.1	–20.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	–21.1	–20.1	–20.1	–0.1	4.9	3.9	3.9	3.9	–0.1	–23.1	–23.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
	[10] Portable terminal (indoors)	0.5	43.6	26.4	–2.4	Median	–1.4	–1.4	(–2.4)	–1.4	0.6	2.6	4.6	6.6	2.6	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
						Worst	1.6	2.6	2.6	22.6	27.6	26.6	26.6	26.6	22.6	–0.4	–0.4	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
	[11] Mobile terminal (bus) (3 m H)	3	20.6	49.4	–25.4	Median	–24.4	–24.4	(–25.4)	–24.4	–22.4	–20.4	–18.4	–16.4	–20.4	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
						Worst	–21.4	–20.4	–20.4	–0.4	4.6	3.6	3.6	3.6	–0.4	–23.4	–23.4	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	20.9	49.1	–25.1	Median	–24.1	–24.1	(–25.1)	–24.1	–22.1	–20.1	–18.1	–16.1	–20.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	–21.1	–20.1	–20.1	–0.1	4.9	3.9	3.9	3.9	–0.1	–23.1	–23.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-15

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT small-powered repeater (separate type)) → DTTB (–40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	21	8	62	–38	Median	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
						Worst	(–38.0)	(–38.0)	(–38.0)	–32.0	–28.0	–29.0	–29.0	–29.0	–33.0	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)	(–38.0)
	[3] Home TV simple ANT w/o LNA (5 m H)	4	4.6	49.2	–25.2	Median	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)
						Worst	(–25.2)	(–25.2)	(–25.2)	–19.2	–15.2	–16.2	–16.2	–16.2	–20.2	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)	(–25.2)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	21	4.3	59	–35	Median	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0	–18.0
						Worst	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0	–3.0
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	4	15.1	48.2	–24.2	Median	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2	–7.2
						Worst	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	2	23.3	30.5	–6.5	Median	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)
						Worst	(–6.5)	(–6.5)	(–6.5)	–0.5	3.5	2.5	2.5	2.5	–1.5	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)	(–6.5)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	20.9	49.1	–25.1	Median	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	(–25.1)	(–25.1)	(–25.1)	–19.1	–15.1	–16.1	–16.1	–16.1	–20.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
	[10] Portable terminal (indoors)	0.5	43.6	26.4	–2.4	Median	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
						Worst	(–2.4)	(–2.4)	(–2.4)	3.6	7.6	6.6	6.6	6.6	2.6	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)	(–2.4)
	[11] Mobile terminal (bus) (3 m H)	3	20.6	49.4	–25.4	Median	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
						Worst	(–25.4)	(–25.4)	(–25.4)	–19.4	–15.4	–16.4	–16.4	–16.4	–20.4	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)	(–25.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	20.9	49.1	–25.1	Median	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)
						Worst	(–25.1)	(–25.1)	(–25.1)	–19.1	–15.1	–16.1	–16.1	–16.1	–20.1	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)	(–25.1)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-16

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT small-powered repeater (separate type)) → DTTB (–40 dBm/6 MHz)
Models [2], [4], and [6] (DTTB weak field strength area)

		Horizontal distance of separation (m)	**Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)**	**Coupled amount (dB)**	**IMT maximum input level (dBm)**	**Median/ Worst**	**Required improvement for video failure limit value (GB = 63 MHz) (dB)**																		
							ch. 52	**ch. 51**	**ch. 50**	**ch. 49**	**ch. 48**	**ch. 47**	**ch. 46**	**ch. 45**	**ch. 44**	**ch. 43**	**ch. 42**	**ch. 41**	**ch. 36**	**ch. 29**	**ch. 27**	**ch. 26**	**ch. 19**	**ch. 15**	**ch. 13**
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	21	12	24	0	Median	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
						Worst	(0.0)	(0.0)	(0.0)	6.0	10.0	9.0	9.0	9.0	5.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	4	14.6	11.2	12.8	Median	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)
						Worst	(12.8)	(12.8)	(12.8)	18.8	22.8	21.8	21.8	21.8	17.8	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)	(12.8)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	2	33.3	–7.5	31.5	Median	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)
						Worst	(31.5)	(31.5)	(31.5)	37.5	41.5	40.5	40.5	40.5	36.5	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)	(31.5)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-17

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (for outdoor areas)) → DTTB (–77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	19	37.2	46.8	–8.8	Median	–5.8	–5.8	–6.8	4.2	7.2	8.2	11.2	13.2	9.2	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)
						Worst	–1.8	0.2	0.2	29.2	34.2	33.2	33.2	33.2	29.2	–1.8	–2.8	–6.8	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	19	33.5	43.8	–5.8	Median	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
						Worst	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	25	27.1	50.2	–12.2	Median	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
						Worst	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
	[15] Community reception (w/saturation)	3	2.6	74.7	–36.7	Median	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7	–22.7
						Worst	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	30	23.8	60.2	–22.2	Median	–19.2	–19.2	–20.2	–9.2	–6.2	–5.2	–2.2	–0.2	–4.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
						Worst	–15.2	–13.2	–13.2	15.8	20.8	19.8	19.8	19.8	15.8	–15.2	–16.2	–20.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
	[10] Portable terminal (indoors)	30	13.8	70.2	–32.2	Median	–29.2	–29.2	–30.2	–19.2	–16.2	–15.2	–12.2	–10.2	–14.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
						Worst	–25.2	–23.2	–23.2	5.8	10.8	9.8	9.8	9.8	5.8	–25.2	–26.2	–30.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
	[11] Mobile terminal (bus) (3 m H)	28	24.8	59.2	–21.2	Median	–18.2	–18.2	–19.2	–8.2	–5.2	–4.2	–1.2	0.8	–3.2	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)
						Worst	–14.2	–12.2	–12.2	16.8	21.8	20.8	20.8	20.8	16.8	–14.2	–15.2	–19.2	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)
	[12] Mobile terminal (private vehicle) (1.5 m H)	30	23.8	60.2	–22.2	Median	–19.2	–19.2	–20.2	–9.2	–6.2	–5.2	–2.2	–0.2	–4.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
						Worst	–15.2	–13.2	–13.2	15.8	20.8	19.8	19.8	19.8	15.8	–15.2	–16.2	–20.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-18

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (for outdoor areas)) → DTTB (–65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	19	37.2	46.8	–8.8	Median	–7.8	–7.8	(–8.8)	–7.8	–5.8	–3.8	–1.8	0.2	–3.8	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)
						Worst	–4.8	–3.8	–3.8	16.2	21.2	20.2	20.2	20.2	16.2	–6.8	–6.8	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	19	33.5	43.8	–5.8	Median	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
						Worst	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	25	27.1	50.2	–12.2	Median	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
						Worst	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
	[15] Community reception (w/saturation)	3	2.6	74.7	–36.7	Median	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7
						Worst	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	30	23.8	60.2	–22.2	Median	–21.2	–21.2	(–22.2)	–21.2	–19.2	–17.2	–15.2	–13.2	–17.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
						Worst	–18.2	–17.2	–17.2	2.8	7.8	6.8	6.8	6.8	2.8	–20.2	–20.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
	[10] Portable terminal (indoors)	30	13.8	70.2	–32.2	Median	–31.2	–31.2	(–32.2)	–31.2	–29.2	–27.2	–25.2	–23.2	–27.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
						Worst	–28.2	–27.2	–27.2	–7.2	–2.2	–3.2	–3.2	–3.2	–7.2	–30.2	–30.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
	[11] Mobile terminal (bus) (3 m H)	28	24.8	59.2	–21.2	Median	–20.2	–20.2	(–21.2)	–20.2	–18.2	–16.2	–14.2	–12.2	–16.2	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)
						Worst	–17.2	–16.2	–16.2	3.8	8.8	7.8	7.8	7.8	3.8	–19.2	–19.2	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)
	[12] Mobile terminal (private vehicle) (1.5 m H)	30	23.8	60.2	–22.2	Median	–21.2	–21.2	(–22.2)	–21.2	–19.2	–17.2	–15.2	–13.2	–17.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
						Worst	–18.2	–17.2	–17.2	2.8	7.8	6.8	6.8	6.8	2.8	–20.2	–20.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-19

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (for outdoor areas)) → DTTB (–40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	19	37.2	46.8	–8.8	Median	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)
						Worst	(–8.8)	(–8.8)	(–8.8)	–2.8	1.2	0.2	0.2	0.2	–3.8	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)	(–8.8)
	[3] Home TV simple ANT w/o LNA (5 m H)	25	16.6	51.2	–13.2	Median	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)
						Worst	(–13.2)	(–13.2)	(–13.2)	–7.2	–3.2	–4.2	–4.2	–4.2	–8.2	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)	(–13.2)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	19	33.5	43.8	–5.8	Median	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
						Worst	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	25	27.1	50.2	–12.2	Median	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
						Worst	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
	[15] Community reception (w/saturation)	3	2.6	74.7	–36.7	Median	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7	–19.7
						Worst	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7	–4.7
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	35	3.7	64.1	–26.1	Median	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)
						Worst	(–26.1)	(–26.1)	(–26.1)	–20.1	–16.1	–17.1	–17.1	–17.1	–21.1	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)	(–26.1)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	30	23.8	60.2	–22.2	Median	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
						Worst	(–22.2)	(–22.2)	(–22.2)	–16.2	–12.2	–13.2	–13.2	–13.2	–17.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
	[10] Portable terminal (indoors)	30	13.8	70.2	–32.2	Median	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
						Worst	(–32.2)	(–32.2)	(–32.2)	–26.2	–22.2	–23.2	–23.2	–23.2	–27.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
	[11] Mobile terminal (bus) (3 m H)	28	24.8	59.2	–21.2	Median	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)
						Worst	(–21.2)	(–21.2)	(–21.2)	–15.2	–11.2	–12.2	–12.2	–12.2	–16.2	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)	(–21.2)
	[12] Mobile terminal (private vehicle) (1.5 m H)	30	23.8	60.2	–22.2	Median	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
						Worst	(–22.2)	(–22.2)	(–22.2)	–16.2	–12.2	–13.2	–13.2	–13.2	–17.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-20

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (for outdoor areas)) → DTTB (–40 dBm/6 MHz)
Models [2], [4], and [6] (DTTB weak field strength area)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	19	41.2	8.8	29.2	Median	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)
						Worst	(29.2)	(29.2)	(29.2)	35.2	39.2	38.2	38.2	38.2	34.2	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)	(29.2)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	25	26.6	13.2	24.8	Median	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)
						Worst	(24.8)	(24.8)	(24.8)	30.8	34.8	33.8	33.8	33.8	29.8	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)	(24.8)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	35	13.7	26.1	11.9	Median	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)
						Worst	(11.9)	(11.9)	(11.9)	17.9	21.9	20.9	20.9	20.9	16.9	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)	(11.9)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-21

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (indoor area integral type)) → DTTB (–77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	25	9.9	62.1	–36.1	Median	–33.1	–33.1	–34.1	–23.1	–20.1	–19.1	–16.1	–14.1	–18.1	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)
						Worst	–29.1	–27.1	–27.1	1.9	6.9	5.9	5.9	5.9	1.9	–29.1	–30.1	–34.1	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	25	6.2	59.1	–33.1	Median	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1	–19.1
						Worst	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	4	17.1	48.2	–22.2	Median	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2
						Worst	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	22.9	49.1	–23.1	Median	–20.1	–20.1	–21.1	–10.1	–7.1	–6.1	–3.1	–1.1	–5.1	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)
						Worst	–16.1	–14.1	–14.1	14.9	19.9	18.9	18.9	18.9	14.9	–16.1	–17.1	–21.1	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)
	[10] Portable terminal (indoors)	0.5	45.6	26.4	–0.4	Median	2.6	2.6	1.6	12.6	15.6	16.6	19.6	21.6	17.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	6.6	8.6	8.6	37.6	42.6	41.6	41.6	41.6	37.6	6.6	5.6	1.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
	[11] Mobile terminal (bus) (3 m H)	3	22.6	49.4	–23.4	Median	–20.4	–20.4	–21.4	–10.4	–7.4	–6.4	–3.4	–1.4	–5.4	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)
						Worst	–16.4	–14.4	–14.4	14.6	19.6	18.6	18.6	18.6	14.6	–16.4	–17.4	–21.4	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	22.9	49.1	–23.1	Median	–20.1	–20.1	–21.1	–10.1	–7.1	–6.1	–3.1	–1.1	–5.1	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)
						Worst	–16.1	–14.1	–14.1	14.9	19.9	18.9	18.9	18.9	14.9	–16.1	–17.1	–21.1	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-22

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (indoor area integral type)) → DTTB (–65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	25	9.9	62.1	–36.1	Median	–35.1	–35.1	(–36.1)	–35.1	–33.1	–31.1	–29.1	–27.1	–31.1	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)
						Worst	–32.1	–31.1	–31.1	–11.1	–6.1	–7.1	–7.1	–7.1	–11.1	–34.1	–34.1	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	25	6.2	59.1	–33.1	Median	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1
						Worst	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	4	17.1	48.2	–22.2	Median	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2
						Worst	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	22.9	49.1	–23.1	Median	–22.1	–22.1	(–23.1)	–22.1	–20.1	–18.1	–16.1	–14.1	–18.1	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)
						Worst	–19.1	–18.1	–18.1	1.9	6.9	5.9	5.9	5.9	1.9	–21.1	–21.1	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)
	[10] Portable terminal (indoors)	0.5	45.6	26.4	–0.4	Median	0.6	0.6	(–0.4)	0.6	2.6	4.6	6.6	8.6	4.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	3.6	4.6	4.6	24.6	29.6	28.6	28.6	28.6	24.6	1.6	1.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
	[11] Mobile terminal (bus) (3 m H)	3	22.6	49.4	–23.4	Median	–22.4	–22.4	(–23.4)	–22.4	–20.4	–18.4	–16.4	–14.4	–18.4	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)
						Worst	–19.4	–18.4	–18.4	1.6	6.6	5.6	5.6	5.6	1.6	–21.4	–21.4	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	22.9	49.1	–23.1	Median	–22.1	–22.1	(–23.1)	–22.1	–20.1	–18.1	–16.1	–14.1	–18.1	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)
						Worst	–19.1	–18.1	–18.1	1.9	6.9	5.9	5.9	5.9	1.9	–21.1	–21.1	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-23

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (indoor area integral type)) → DTTB (–40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	25	9.9	62.1	–36.1	Median	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)
						Worst	(–36.1)	(–36.1)	(–36.1)	–30.1	–26.1	–27.1	–27.1	–27.1	–31.1	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)	(–36.1)
	[3] Home TV simple ANT w/o LNA (5 m H)	4	6.6	49.2	–23.2	Median	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)
						Worst	(–23.2)	(–23.2)	(–23.2)	–17.2	–13.2	–14.2	–14.2	–14.2	–18.2	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)	(–23.2)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	25	6.2	59.1	–33.1	Median	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1	–16.1
						Worst	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation	4	17.1	48.2	–22.2	Median	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2	–5.2
						Worst	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	2	25.3	30.5	–4.5	Median	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)
						Worst	(–4.5)	(–4.5)	(–4.5)	1.5	5.5	4.5	4.5	4.5	0.5	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)	(–4.5)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	22.9	49.1	–23.1	Median	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)
						Worst	(–23.1)	(–23.1)	(–23.1)	–17.1	–13.1	–14.1	–14.1	–14.1	–18.1	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)
	[10] Portable terminal (indoors)	0.5	45.6	26.4	–0.4	Median	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	(–0.4)	(–0.4)	(–0.4)	5.6	9.6	8.6	8.6	8.6	4.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
	[11] Mobile terminal (bus) (3 m H)	3	22.6	49.4	–23.4	Median	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)
						Worst	(–23.4)	(–23.4)	(–23.4)	–17.4	–13.4	–14.4	–14.4	–14.4	–18.4	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)	(–23.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	22.9	49.1	–23.1	Median	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)
						Worst	(–23.1)	(–23.1)	(–23.1)	–17.1	–13.1	–14.1	–14.1	–14.1	–18.1	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)	(–23.1)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-24

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (indoor area integral type)) → DTTB (–40 dBm/6 MHz)
Models [2], [4], and [6] (DTTB weak field strength area)

		Horizontal distance of separation (m)	**Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)**	**Coupled amount (dB)**	**IMT maximum input level (dBm)**	**Median/ Worst**	**Required improvement for video failure limit value (GB = 63 MHz) (dB)**																		
							ch. 52	**ch. 51**	**ch. 50**	**ch. 49**	**ch. 48**	**ch. 47**	**ch. 46**	**ch. 45**	**ch. 44**	**ch. 43**	**ch. 42**	**ch. 41**	**ch. 36**	**ch. 29**	**ch. 27**	**ch. 26**	**ch. 19**	**ch. 15**	**ch. 13**
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	25	13.9	24.1	1.9	Median	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)
						Worst	(1.9)	(1.9)	(1.9)	7.9	11.9	10.9	10.9	10.9	6.9	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)	(1.9)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	4	16.6	11.2	14.8	Median	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)
						Worst	(14.8)	(14.8)	(14.8)	20.8	24.8	23.8	23.8	23.8	19.8	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)	(14.8)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	2	35.3	–7.5	33.5	Median	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)
						Worst	(33.5)	(33.5)	(33.5)	39.5	43.5	42.5	42.5	42.5	38.5	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-25

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (indoor area separate type)) → DTTB (–77 dBm/6 MHz))

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT/o LNA (10 m H)	23	1	71	–45	Median	–42.0	–42.0	–43.0	–32.0	–29.0	–28.0	–25.0	–23.0	–27.0	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)
						Worst	–38.0	–36.0	–36.0	–7.0	–2.0	–3.0	–3.0	–3.0	–7.0	–38.0	–39.0	–43.0	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	23	–2.7	68	–42	Median	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0	–28.0
						Worst	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	3	10.5	54.8	–28.8	Median	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8	–14.8
						Worst	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	12.1	59.9	–33.9	Median	–30.9	–30.9	–31.9	–20.9	–17.9	–16.9	–13.9	–11.9	–15.9	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)
						Worst	–26.9	–24.9	–24.9	4.1	9.1	8.1	8.1	8.1	4.1	–26.9	–27.9	–31.9	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)
	[10] Portable terminal (indoors)	0.5	28.6	43.4	–17.4	Median	–14.4	–14.4	–15.4	–4.4	–1.4	–0.4	2.6	4.6	0.6	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)
						Worst	–10.4	–8.4	–8.4	20.6	25.6	24.6	24.6	24.6	20.6	–10.4	–11.4	–15.4	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)
	[11] Mobile terminal (bus) (3 m H)	3	13	59	–33	Median	–30.0	–30.0	–31.0	–20.0	–17.0	–16.0	–13.0	–11.0	–15.0	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)
						Worst	–26.0	–24.0	–24.0	5.0	10.0	9.0	9.0	9.0	5.0	–26.0	–27.0	–31.0	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	12.1	59.9	–33.9	Median	–30.9	–30.9	–31.9	–20.9	–17.9	–16.9	–13.9	–11.9	–15.9	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)
						Worst	–26.9	–24.9	–24.9	4.1	9.1	8.1	8.1	8.1	4.1	–26.9	–27.9	–31.9	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-26

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (indoor area separate type)) → DTTB (–65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	23	1	71	–45	Median	–44.0	–44.0	(–45.0)	–44.0	–42.0	–40.0	–38.0	–36.0	–40.0	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)
						Worst	–41.0	–40.0	–40.0	–20.0	–15.0	–16.0	–16.0	–16.0	–20.0	–43.0	–43.0	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	23	–2.7	68	–42	Median	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0
						Worst	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	3	10.5	54.8	–28.8	Median	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8
						Worst	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	12.1	59.9	–33.9	Median	–32.9	–32.9	(–33.9)	–32.9	–30.9	–28.9	–26.9	–24.9	–28.9	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)
						Worst	–29.9	–28.9	–28.9	–8.9	–3.9	–4.9	–4.9	–4.9	–8.9	–31.9	–31.9	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)
	[10] Portable terminal (indoors)	0.5	28.6	43.4	–17.4	Median	–16.4	–16.4	(–17.4)	–16.4	–14.4	–12.4	–10.4	–8.4	–12.4	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)
						Worst	–13.4	–12.4	–12.4	7.6	12.6	11.6	11.6	11.6	7.6	–15.4	–15.4	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)
	[11] Mobile terminal (bus) (3 m H)	3	13	59	–33	Median	–32.0	–32.0	(–33.0)	–32.0	–30.0	–28.0	–26.0	–24.0	–28.0	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)
						Worst	–29.0	–28.0	–28.0	–8.0	–3.0	–4.0	–4.0	–4.0	–8.0	–31.0	–31.0	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	12.1	59.9	–33.9	Median	–32.9	–32.9	(–33.9)	–32.9	–30.9	–28.9	–26.9	–24.9	–28.9	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)
						Worst	–29.9	–28.9	–28.9	–8.9	–3.9	–4.9	–4.9	–4.9	–8.9	–31.9	–31.9	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-27

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (indoor area separate type)) → DTTB (–40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	23	1	71	–45	Median	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)
						Worst	(–45.0)	(–45.0)	(–45.0)	–39.0	–35.0	–36.0	–36.0	–36.0	–40.0	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)	(–45.0)
	[3] Home TV simple ANT w/o LNA (5 m H)	3	0	55.8	–29.8	Median	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)
						Worst	(–29.8)	(–29.8)	(–29.8)	–23.8	–19.8	–20.8	–20.8	–20.8	–24.8	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)	(–29.8)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	23	–2.7	68	–42	Median	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0	–25.0
						Worst	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0	–10.0
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	3	10.5	54.8	–28.8	Median	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8	–11.8
						Worst	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	3	10	45.8	–19.8	Median	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)
						Worst	(–19.8)	(–19.8)	(–19.8)	–13.8	–9.8	–10.8	–10.8	–10.8	–14.8	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)	(–19.8)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	12.1	59.9	–33.9	Median	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)
						Worst	(–33.9)	(–33.9)	(–33.9)	–27.9	–23.9	–24.9	–24.9	–24.9	–28.9	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)
	[10] Portable terminal (indoors)	0.5	28.6	43.4	–17.4	Median	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)
						Worst	(–17.4)	(–17.4)	(–17.4)	–11.4	–7.4	–8.4	–8.4	–8.4	–12.4	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)
	[11] Mobile terminal (bus) (3 m H)	3	13	59	–33	Median	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)
						Worst	(–33.0)	(–33.0)	(–33.0)	–27.0	–23.0	–24.0	–24.0	–24.0	–28.0	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)	(–33.0)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	12.1	59.9	–33.9	Median	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)
						Worst	(–33.9)	(–33.9)	(–33.9)	–27.9	–23.9	–24.9	–24.9	–24.9	–28.9	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)	(–33.9)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.3.2-28

Required improvement for video failure limit value in out-of-band interference

IMT downlink (IMT land mobile relay station (indoor area separate type)) → DTTB (–40 dBm/6 MHz)
Models [2], [4], and [6] (DTTB weak field strength area)

		Horizontal distance of separation (m)	**Required improvement in Table 3.3.1-1 (GB = 0 MHz) (dB)**	**Coupled amount (dB)**	**IMT maximum input level (dBm)**	**Median/ Worst**	**Required improvement for video failure limit value (GB = 63 MHz) (dB)**																		
							ch. 52	**ch. 51**	**ch. 50**	**ch. 49**	**ch. 48**	**ch. 47**	**ch. 46**	**ch. 45**	**ch. 44**	**ch. 43**	**ch. 42**	**ch. 41**	**ch. 36**	**ch. 29**	**ch. 27**	**ch. 26**	**ch. 19**	**ch. 15**	**ch. 13**
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	23	5	33	–7	Median	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)
						Worst	(–7.0)	(–7.0)	(–7.0)	–1.0	3.0	2.0	2.0	2.0	–2.0	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)	(–7.0)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	3	10	17.8	8.2	Median	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)
						Worst	(8.2)	(8.2)	(8.2)	14.2	18.2	17.2	17.2	17.2	13.2	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)	(8.2)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	3	20	7.8	18.2	Median	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)
						Worst	(18.2)	(18.2)	(18.2)	24.2	28.2	27.2	27.2	27.2	23.2	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)	(18.2)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

D) Consideration of out-of-band interference from IMT downlink (base station transmission) to DTTB

(a) TV receiver antenna outdoor-installation models (models [1] to [4], [7], [8], and [15])

The maximum required improvement for the video failure limit value in model [2] (with a weak DTTB field strength area assumed) is 37.7 dB (worst characteristics model) when the DTTB signal input level is –40 dBm/6 MHz (after LNA) and the measurement channel is ch. 48. With regard to the model [2], the required improvement is calculated on the precondition that the IMT signal is linearly amplified by the LNA. When the rated output of the LNA is considered, it is assumed that LNA saturation actually occurs.

As measures, receiver filter addition to the DTTB receiving systems (receiver filter addition in front of the LNA input to avoid LNA saturation, and receiver filter addition between the LNA and DTTB receiver to avoid the desensitization of the DTTB receiver), an improvement in vertical pattern by replacement with high-performance receiver antenna, gain adjustment, and insertion of an attenuator (when the antenna has a LNA), etc., can be considered. However, study, cost, adjustment method, etc., should be separately considered before actually taking measures. When it is assumed that the DTTB signal input level of the TV receiver antenna is 10-dB larger than the assumption of this model, it is assumed that losses due to receiver cable or signal branching or the like are further secured by approximately 10 dB than this model (worst case) in average common households. In this case, the IMT input level becomes smaller by 10 dB while the DTTB signal input level to the DTTB receiver stays at –40 dBm/6 MHz. Therefore, it is assumed that the required improvement above becomes smaller by that amount.

Table 3.3.2-29 shows the study results on the feasible performance of the receiver filter to be added to the DTTB receiving systems at a practical cost and size. With the above taken into consideration, it is assumed that the required improvement for the video failure limit value is made negative by taking various measures when the guardband is 60 MHz or more.

TABLE 3.3.2-29

Receiver filter performance values assumed to be feasible*

Guardband	8 MHz	20 MHz	40 MHz	60 MHz
Frequency	718 MHz	730 MHz	750 MHz	770 MHz
Attenuation	10 dB	30 dB	30 dB	30 dB

* The reception level decreases due to insertion loss. Especially for ch. 52, insertion loss is approximately 4 dB and thereby a receiving failure may occur in weak field strength. Appropriate measures such as installing a high performance roof top antenna or an LNA may be required.

(b) TV receiver antenna indoor installation model (models [5] and [6])

The maximum required improvement for the video failure limit value in model [6] (with a weak DTTB field strength area assumed) is 25 dB (worst characteristics model) when the DTTB signal input level is –40 dBm/6 MHz (after LNA) and the measurement channel is ch. 48. With regard to the model [6], the required improvement is calculated on the precondition that the IMT signal is linearly amplified by the LNA. When the rated output of the LNA is considered, it is assumed that LNA saturation actually occurs.

As measures, receiver filter addition to the DTTB receiving systems, an improvement in vertical pattern by replacement with high-performance receiver antenna, gain adjustment, and insertion of an attenuator (when the antenna has a LNA), etc., can be considered. However, study, cost, adjustment method, etc., should be separately considered before actually taking measures.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. With the above taken into consideration, it is assumed that the required improvement for the video failure limit value is made negative by taking various measures when the guardband is 60 MHz or more.

(c) Portable/mobile TV receiving model (models [9] to [12])

The maximum required improvement for the video failure limit value in out-of-band interference is 22.4 dB when the DTTB signal input level is –77 dBm/6 MHz, the measurement channel is ch. 48, and the model is [9] (worst characteristics model). As measures in portable/mobile terminal TV receiving models, receiver filter addition can be considered for model [11] (bus) and model [12] (private vehicle). However, a further detailed study is required on whether or not the manufacture of the filter that provides the required attenuation is possible at a practical installable size and cost (depending on the guardband) and whether or not the filter is additionally installable in actual buses or private vehicles. With regard to portable/mobile TV reception, TV reception while moving is the major use form. In consideration of the location probability and hour rate for the separation distance set in the interference study, it is assumed that problems that actually occur are less than DTTB reception in common households.

For each model, the worst case of the separation distance, which minimizes the coupling loss between the interfering side and interference receiving side is set. In addition, the extent of effects of interference depends on the model. Considering these in addition to the study in (a) to (c) above, it is necessary to pay attention so that the required improvement for the video failure limit value shown in Tables 3.3.2-5 to 2-28 does not always apply to all the DTTB receivers or LNA corresponding to each model.

It is therefore required to take measures based on the proliferation of DTTB receivers and LNA in the future.

E) Consideration of out-of-band interference from IMT downlink (small-powered repeater land mobile station device at other end transmission) to DTTB

(a) TV receiver antenna outdoor installation model (models [1] to [4], [7], [8], and [15])

The maximum required improvement for the video failure limit value in model [4] (with a weak DTTB field strength area assumed) is 22.8 dB (worst characteristics model) when the DTTB signal input level is –40 dBm/6 MHz (after LNA) and the measurement channel is ch. 48.

With regard to the model [4], the required improvement is calculated on the precondition that the IMT signal is linearly amplified by the LNA. When the rated output of the LNA is considered, it is assumed that LNA saturation actually occurs.

As measures, receiver filter addition to the DTTB receiving systems, an improvement in vertical pattern by replacement with high-performance receiver antenna, gain adjustment, and insertion of an attenuator (when the antenna has a LNA), etc., can be considered. However, study, cost, adjustment method, etc., should be separately considered before actually taking measures. When it is assumed that the DTTB signal input level of the TV receiver antenna is 10-dB larger than the assumption of this model, it is assumed that losses due to receiver cable or signal branching or the like are further secured by approximately 10 dB than this model (worst case) in average common households. In this case, the IMT input level becomes smaller by 10 dB while the DTTB signal input level to the DTTB receiver stays at –40 dBm/6 MHz. Therefore, it is assumed that the required improvement above becomes smaller by that amount.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. With the above taken into consideration, it is assumed that the required improvement for the video failure limit value is made negative by taking various measures when the guardband is 60 MHz or more.

(b) TV receiver antenna indoor installation model (models [5] and [6])

The maximum required improvement for the video failure limit value in model [6] (with a weak DTTB field strength area assumed) is 41.5 dB (worst characteristics model) when the DTTB signal input level is –40 dBm/6 MHz (after LNA) and the measurement channel is ch. 48. With regard to the model [6], the required improvement is calculated on the precondition that the IMT signal is linearly amplified by the LNA. When the rated output of the LNA is considered, it is assumed that LNA saturation actually occurs.

As measures, receiver filter addition to the DTTB receiving systems (receiver filter addition in front of the LNA input to avoid LNA saturation, and receiver filter addition between the LNA and DTTB receiver to avoid the desensitization of the DTTB receiver), an improvement in vertical pattern by replacement with high-performance receiver antenna, gain adjustment, and insertion of an attenuator (when the antenna has a LNA), etc., can be considered. However, study, cost, adjustment method, etc., should be separately considered before actually taking measures.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. With the above taken into consideration, it is assumed that the required improvement for the video failure limit value is made negative by taking various measures when the guardband is 60 MHz or more.

(c) Portable/mobile TV receiving model (models [9] to [12])

The maximum required improvement for the video failure limit value in out-of-band interference is 40.6 dB when the DTTB signal input level is –77 dBm/6 MHz, the measurement channel is ch. 48, and the model is [10] (worst characteristics model). As measures in portable/mobile terminal TV receiving models, receiver filter addition can be considered for model [11] (bus) and model [12] (private vehicle). However, a further detailed study is required on whether or not the manufacture of the filter that provides the required attenuation is possible at a practical installable size and cost (depending on the guardband) and whether or not the filter is additionally installable in actual buses or private vehicles. With regard to portable/mobile TV reception, TV reception while moving is the major use form. In consideration of the location probability and hour rate for the separation distance set in the interference study, it is assumed that problems that actually occur are less than DTTB reception in common households.

For each model, the worst case of the separation distance, which minimizes the coupling loss between the interfering side and interference receiving side is set. In addition, the extent of effects of interference depends on the model. Considering these in addition to the study in (a) to (c) above, it is necessary to pay attention so that the required improvement for the video failure limit value shown in Tables 3.3.2-5 to 2-28 does not always apply to all the DTTB receivers or LNA corresponding to each model.

It is therefore required to take measures based on the proliferation of DTTB receivers and LNA in the future.

F) Consideration of out-of-band interference from IMT downlink (land mobile station device at other end transmission of land mobile relay station) to DTTB

(a) TV receiver antenna outdoor installation model (models [1] to [4], [7], [8], and [15])

The maximum required improvement for the video failure limit value in model [2] (with a weak DTTB field strength area assumed) is 39.2 dB (worst characteristics model) when the DTTB signal input level is –40 dBm/6 MHz (after LNA), the measurement channel is ch. 48, and the interfering system is the IMT land mobile relay station (for outdoor areas). With regard to the model [2], the required improvement is calculated on the precondition that the IMT signal is linearly amplified by the LNA. When the rated output of the LNA is considered, it is assumed that LNA saturation actually occurs.

As measures, receiver filter addition to the DTTB receiving systems (receiver filter addition in front of the LNA input to avoid LNA saturation, and receiver filter addition to between the LNA and DTTB receiver to avoid the desensitization of the DTTB receiver), an improvement in vertical pattern by replacement with high-performance receiver antenna, gain adjustment, and insertion of an attenuator (when the antenna has a LNA), etc., can be considered. However, study, cost, adjustment method, etc., should be separately considered before actually taking measures. When it is assumed that the DTTB signal input level of the TV receiver antenna is 10-dB larger than the assumption of this model, it is assumed that losses due to receiver cable or signal branching or the like are further secured by approximately 10 dB than this model (worst case) in average common households. In this case, the IMT input level becomes smaller by 10 dB while the DTTB signal input level to the DTTB receiver stays at –40 dBm/6 MHz. Therefore, it is assumed that the required improvement above becomes smaller by that amount.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. With the above taken into consideration, it is assumed that the required improvement for the video failure limit value is made negative by taking various measures when the guardband is 60 MHz or more.

(b) TV receiver antenna indoor installation model (models [5] and [6])

The maximum required improvement for the video failure limit value in model [6] (with a weak DTTB field strength area assumed) is 43.5 dB (worst characteristics model) when the DTTB signal input level is –40 dBm/6 MHz (after LNA), the measurement channel is ch. 48, and the interfering system is the IMT land mobile relay station (outdoor area integral type). With regard to the model [6], the required improvement is calculated on the precondition that the IMT signal is linearly amplified by the LNA. When the rated output of the LNA is considered, it is assumed that LNA saturation actually occurs.

As measures, receiver filter addition to the DTTB receiving systems (receiver filter addition in front of the LNA input to avoid LNA saturation, and receiver filter addition to between the LNA and DTTB receiver to avoid the desensitization of the DTTB receiver), an improvement in vertical pattern by replacement with high-performance receiver antenna, gain adjustment, and insertion of an attenuator (when the antenna has a LNA), etc., can be considered. However, study, cost, adjustment method, etc., should be separately considered before actually taking measures.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. With the above taken into consideration, it is assumed that the required improvement for the video failure limit value is made negative by taking various measures when the guardband is 60 MHz or more.

(c) Portable/mobile TV receiving model (models [9] to [12])

The maximum required improvement for the video failure limit value in out-of-band interference is 42.6 dB when the DTTB signal input level is –77 dBm/6 MHz, the measurement channel is ch. 48, and interference is from the IMT land mobile relay station (indoor area integral type) to model [10] (worst characteristics model). As measures in portable/mobile terminal TV receiving systems, receiver filter addition can be considered for model [11] (bus) and model [12] (private vehicle). However, a further detailed study is required on whether or not the manufacture of the filter that provides the required attenuation is possible at a practical installable size and cost (depending on the guardband) and whether or not the filter is additionally installable in actual buses or private vehicles. With regard to portable/mobile TV reception, TV reception while moving is the major use form. In consideration of the location probability and hour rate for the separation distance set in the interference study, it is assumed that problems that actually occur are less than DTTB reception in common households.

For each model, the worst case of the separation distance, which minimizes the coupling loss between the interfering side and interference receiving side is set. In addition, the extent of effects of interference depends on the model. Considering these in addition to the study in (a) to (c) above, it is necessary to pay attention so that the required improvement for the video failure limit value shown in Tables 3.3.2-5 to 2-28 does not always apply to all the DTTB receivers or LNA corresponding to each model.

It is therefore required to take measures based on the proliferation of DTTB receivers and LNA in the future.

3.4 Interference from IMT uplink into ISDB-T

3.4.1 Study on guardband of 0 MHz

Table 3.4.1-1 shows simulation results with one-to-one counter models in a guardband of 0 MHz. To consider countermeasures, DTTB reception is divided into three types of reception: home TV(Models [1] to [8], [15]; see also Table 3.1-1), mobile terminal TV(Models [9] to [12]) and DTTB relay station(Models [13], [14]).

TABLE 3.4.1-1

Results of study on interference (IMT to DTTB)

Required improvement (dB) when GB = 0 MHz (Propagation model: Free space)		Giving interference IMT uplink transmission																							
		II-a IMT mobile station				II-b IMT small-powered repeater (Integral type)				II-c IMT small-powered repeater (Separate type)				II-d IMT land mobile station (For outdoor area)				II-e IMT land mobile station (Integral type for outdoor area)				II-f IMT land mobile station (Separate type for outdoor area)			
		Horizontal separation distance (m)*	Required improvement (dB)			Horizontal separation distance (m)*	Required improvement (dB)			Horizontal separation distance (m)*	Required improvement (dB)			Horizontal separation distance (m)*	Required improvement (dB)			Horizontal separation distance (m)*	Required improvement (dB)			Horizontal separation distance (m)*	Required improvement (dB)		
			In-band interference	Out-of-band interference	Image interference		In-band interference	Out-of-band interference	Image interference		In-band interference	Out-of-band interference	Image interference		In-band interference	Out-of-band interference	Image interference		In-band interference	Out-of-band interference	Image interference		In-band interference	Out-of-band interference	Image interference
Giving interference DTTB reception	[1] Home TV Yagi ANT w/LNA (10 m H)	22	54.4	9.3	1.8	25	37.3	7.5	1.2	19	39.2	9.4	3.1	22	51.5	21.7	15.4	30	38.4	8.7	2.3	7	55.5	25.8	19.4
	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	22	58.1	13.3	5.8	25	41	11.5	5.2	19	42.9	13.4	7.1	22	55.2	25.7	19.4	30	42.1	12.7	6.3	7	59.2	29.8	23.4
	[3] Home TV simple ANT w/o LNA (5 m H)	3	60.9	–0.4	–7.9	7	47.6	1.7	–4.7	3	57.6	11.6	5.3	45	45.6	–0.4	–6.7	9	47.7	1.7	–4.6	15	43.3	–2.7	–9
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	3	64.6	9.6	2.1	7	51.3	11.7	5.3	3	61.3	21.6	15.3	45	49.3	9.6	3.3	9	51.4	11.7	5.4	15	47	7.3	1
	[5] Home TV simple indoor ANT w/o LNA (1 m H)	0.7	79.3	18	10.5	2	67.7	21.7	15.4	10	33.6	–12.4	–18.7	50	32.4	–13.6	–19.9	3	67.2	21.3	14.9	29	28.2	–17.8	–24.1
	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	0.7	83	28	20.5	2	73.4	33.7	27.4	10	37.3	–2.4	–8.7	50	36.1	–3.6	–9.9	3	70.9	31.3	24.9	29	31.9	–7.8	–14.1
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	22	61.1	–3.4	–	25	44	–5.2	–	19	45.9	–3.3	–	22	58.2	9	–	30	45.1	–4	–	7	62.2	13.1	–
	[8] Home TV simple ANT w/LNA (5 m H) (Saturated)	3	65.6	1.1	–	7	52.3	3.2	–	3	62.3	13.1	–	45	50.3	1.1	–	9	52.4	3.2	–	15	48	–1.2	–
	[9] Portable terminal (Outdoors) (1.5 m H)	0.5	82.7	37.6	30.1	3	51.4	21.6	15.3	6	39.1	9.3	3	51	35.6	5.8	–0.5	3	53.2	23.4	17.1	25	31.8	2	–4.3
	[10] Portable terminal (Indoors)	0.5	82.7	37.6	30.1	1	67.8	38	31.7	6	29.1	–0.7	–7	51	25.6	–4.2	–10.5	1	65.7	35.9	29.6	25	21.8	–8	–14.3
	[11] Mobile terminal (Bus) (3 m H)	0.5	72.7	27.6	20.1	3	49.8	20.1	13.7	3	44	14.2	7.9	51	36.7	6.9	0.6	3	50.3	20.6	14.2	20	33.5	3.7	–2.6
	[12] Mobile terminal (Private vehicle) (1.5 m H)	0.5	82.7	37.6	30.1	3	51.4	21.6	15.3	6	39.1	9.3	3	51	35.6	5.8	–0.5	3	53.2	23.4	17.1	25	31.8	2	–4.3
	[13] Large relay station (Reception) (5 m H)	0.5	88.7	28.6	23.1	20	63.1	18.4	14	20	64.3	19.5	15.2	58	65.2	20.4	16.1	20	65.2	20.5	16.1	29	61.4	16.6	12.3
	[14] Ultra low power station (Reception) (5 m H)	8.7	70.7	11.6	6.1	20	51.8	8	3.7	20	50.4	6.6	2.3	44	55	11.2	6.9	20	53.9	10.1	5.8	20	52.2	8.4	4.1
	[15] Common antenna reception (w/saturation)	0.5	27.2	–37.3	–	–	–	–	–	–	–	–	–	3	19.7	–29.4	–	–	–	–	–	3	19.1	–30	–

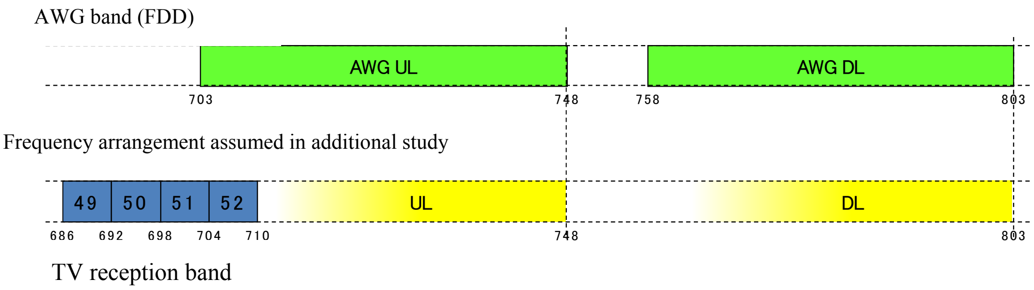
* Horizontal separation distance used in interference calculation.

3.4.2 Study on minimum guardband

In the case of 8 MHz which is a minimum one as an actual guard band is mainly considered as a case where upper end of the frequency of the AWG band FDD proposal is used as a base point based on the fact that the DTTB band is 710 MHz in Japan, upper end of uplink frequency band of the AWG band FDD proposal is 748 MHz, and IMT operation band is set in a step of 5 MHz between 5 to 20 MHz.

FIGURE 3.4.2-1

Relationship between frequency arrangement and AWG band (FDD) assumed in additional study



For the additional study, in view of considering the influence of more realistic interference, in-band interference, out-of-band interference and image interference from IMT uplink to DTTB are verified using DTTB receiver and LNA for TV reception, and actual devices for IMT mobile station corresponding to 700 MHz band, and required improvements in each model are considered and examined based on the results.

Furthermore, a guideline is set for protection criteria for broadcasts in the Recommendation ITU-R BT.1895 – Protection criteria for terrestrial broadcasting systems.

This Recommendation specifies that the total interference amounts which a reception system of broadcast receives from all emissions of which frequencies are not allocated in the broadcast band according to Radio Regulations shall not exceed 1% ($I/N = -20$ dB) of reception system noise, and all interference amounts which reception system of broadcast receives from all radio emissions of which frequencies for primary service are allocated in the same frequency band as broadcast band according to the Radio Regulations shall not exceed 10% ($I/N = -10$ dB) of reception system noise. It is further specified that interference amounts exceeding these values shall be individually considered if necessary.

According to this regulation, $I/N = -10$ dB which has been considered before establishment of Recommendation ITU-R BT.1895 was temporarily set individual consideration, required GB and required separation distance are considered, and at the same time, measurement experiments are conducted for an IMT uplink signal input level which became an video failure limit value through DTTB receiver and a LNA, then the allowable interference amounts is considered.

In addition, video failure limit value is a value obtained by inputting only a IMT signal to DTTB receiver and LNA in a laboratory and measuring the level on which failure can be actually detected on television screen. For this reason, it is necessary to pay attention to the facts that the value does not completely include a margin for interference obstruction and variation in field strength in an actual field, and does not meet QEF condition which is an original terrestrial digital quality standard.

(1) Additional study related to in-band interference from IMT uplink to DTTB

A) Additional study related to in-band interference from IMT mobile station to DTTB receiver

For models [1] to [12], and [15] (see also Table 3.1-1), experiments are conducted to confirm influence by in-band interference to DTTB receiver from IMT mobile station. In addition, in view of conducting more realistic study for spurious characteristics of an IMT mobile station, it has been determined to conduct experiments using a duplexer which is trial-produced corresponding to the 700 MHz band IMT mobile station transmission band (718 to 748 MHz) conceived of in Japan with an eye on the AWG band FDD proposal, and a duplexer used for according to 700 MHz band IMT mobile station (3GPP Band12, transmission band is 698 to 716 MHz) commercially available in the USA.

In the experiments, DTTB desired wave (–77 dBm/6 MHz) and IMT uplink signal (resource block number: 1 and 75) generated by an actual device are inputted to 25 DTTB receiver models in an experiment system which simulated models [9], [10] and [12] of which coupling losses between the IMT mobile station and DTTB receiver, and power of the IMT uplink signal is attenuated until no influence by interference occurred for each DTTB measurement channel, then required improvement for the video failure limit value in those models are defined. In addition, confirmation in presence of influence by interference is visually confirmed for 20 seconds.

(a) Experiment results with trial duplexer and required improvement for video failure limit values

As a result of all models, it is confirmed for the models [9], [10] and [12] that, when the guard width is 8 MHz, there is no influence by in-band interference for channels of ch. 50 or less. Furthermore, as a result of models showing the worst characteristics, the maximum value of the required improvement for the video failure limit value is 10 dB for ch. 51, and 15 dB for ch. 52, and both are the results when the number of the IMT uplink transmission resource blocks is 75. Furthermore, the unnecessary emission input level of the IMT mobile station at this time is –101 dBm/6 MHz, and the median value of the required improvement for the video failure limit value of 25 models for ch. 52 is 10 dB. The measurement results for each model are shown in Fig. 3.4.2-2, and the results of confirming the spurious actual values of the IMT mobile station with the trial duplexers are shown in Table 3.4.2-1, however, it is confirmed that the required improvement for the video failure limit value varies by approximately 5 dB for ch. 52 and 51 depending on the models.

FIGURE 3.4.2-2

Experimental results with trial duplexers for each model

(When guardband is 8 MHz, and number of resource blocks is 75)

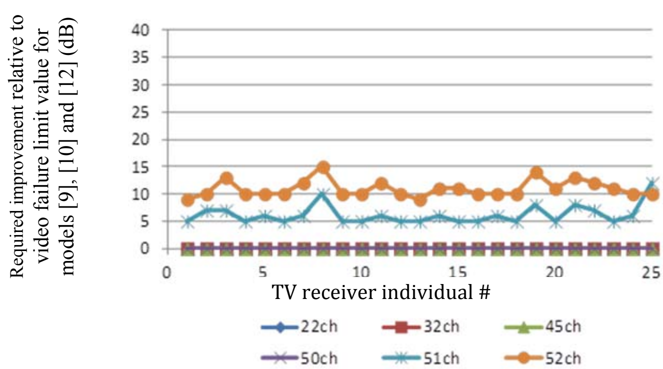


TABLE 3.4.2-1

IMT mobile station spurious actual values by trial duplexers

	IMT mobile station spurious actual values by trial duplexers (dBm/6 MHz)
ch. 52	–55.6
ch. 51	–60.3
ch. 50	–65.6
ch. 49 or less	–72.2

Required improvement for a video failure limit value is considered based on the above results. Difference in coupling loss from the other models is reflected based on the results of the DTTB receiver which showed the worst characteristics in the models [9], [10] and [12], then required improvements for video failure limit values of all models are calculated for ch. 52, 51 and 50. In addition, difference in attenuation of spurious actual value is reflected for channels of ch. 49 or less using ch. 50 as a base point, and then required improvements for a video failure limit value are calculated.

In order to compare with the results in the studies of § 3.4.1, required improvements for interference allowable level based on I/N = –10 dB are calculated respectively when unnecessary emission of a LET mobile station in ch. 52 is –34 dBm/MHz (specified value of AWG) and when actual value by the trial duplexer is reflected.

Required improvements for each model and for each DTTB channel are shown in Table 3.4.2-2. For the models [9], [10] and [12] which are simulated by the experiment system, in ch. 52, the required improvement for interference allowable level based on I/N = –10d is 19 dB, the required improvement for the video failure limit value is 15 dB (C/I = 24 dB) on the model of the worst characteristics, and the median value of 25 models is 10 dB (C/I = 19 dB). Furthermore, the worst value of the interference allowable level based on I/N = –10 dB is 19.3 dB on the model [6].

TABLE 3.4.2-2

Required improvement of in-band interference by trial duplexer

IMT Mobile station to DTTB receiver Required improvement of in-band interference						Table 3.4.1-1	Additional study result								
			Guardband			GB = 0 MHz	GB = 8 MHz								
			IMT mobile station unnecessary emission			Specified value 0.3 dBm/MHz	Specified value of AWG –34 dBm/MHz (–25.2 dBm/6 MHz)	Trial duplexer actual value –63.4 dBm/MHz (–55.6 dBm/6 MHz)	Trial duplexer actual value –68.1 dBm/MHz (–60.3 dBm/6 MHz)	Trial duplexer actual value –73.4 dBm/MHz (–65.6 dBm/6 MHz)	Trial duplexer actual value –80.0 dBm/MHz (–72.2 dBm/6 MHz)	Trial duplexer actual value			
			DTTB interference allowable level			Simulation value (I/N = –10 dB)	Simulation value (I/N = –10 dB)					Video failure limit value			
			Coupling loss (dB)	Difference in coupling loss on [9] [10] [12] (dB)	Horizontal separation distance (m)*	Required improvement for interference allowable level of I/N = –10 dB (dB)	Required improvement for interference allowable level of I/N = –10 dB (dB)					Required improvement for video failure limit value (dB)			
						ch. 52	ch. 52	ch. 52	ch. 51	ch. 50	ch. 49 less	ch. 52	ch. 51	ch. 50	ch. 49 less
Interfered DTTB reception	Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	59.7	28.3	22	54.4	20.1	–9.3	–14	–19.3	–25.9	–13.3	–18.3	–28.3	–34.9
		[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	59.7	28.3	22	58.1	23.8	–5.6	–10.3	–15.6	–22.2	–13.3	–18.3	–28.3	–34.9
		[3] Home TV simple ANT w/o LNA (5 m H)	53.2	21.8	3	60.9	26.6	–2.8	–7.5	–12.8	–19.4	–6.8	–11.8	–21.8	–28.4
		[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	53.2	21.8	3	64.6	30.3	0.9	–3.8	–9.1	–15.7	–6.8	–11.8	–21.8	–28.4
		[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	56.7	25.3	22	61.1	27.3	–2.1	–6.8	–12.1	–18.7	–10.3	–15.3	–25.3	–31.9
		[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	52.2	20.8	3	65.6	31.3	1.9	–2.8	–8.1	–14.7	–5.8	–10.8	–20.8	–27.4
		[15] Community reception (w/saturation)	90.6	59.2	0.5	27.2	–7.1	–36.5	–41.2	–46.5	–53.1	–44.2	–49.2	–59.2	–65.8
	Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	34.8	3.4	0.7	79.3	45	15.6	10.9	5.6	–1	11.6	6.6	–3.4	–10
		[6] Home TV simple ANT w/LNA (1 m H) (w/o saturation)	34.8	3.4	0.7	83	48.7	19.3	14.6	9.3	2.7	11.6	6.6	–3.4	–10
	Portable/ mobile	[9] Mobile terminal (outdoors) (1.5 m H)	31.4	0	0.5	82.7	48.4	19	14.3	9	2.4	15	10	0	-6.6
		[10] Mobile Terminal (indoors)	31.4	0	0.5	82.7	48.4	19	14.3	9	2.4	15	10	0	-6.6
		[11] Mobile terminal (bus) (3 m H)	41.4	10	0.5	72.7	38.4	9	4.3	–1	–7.6	5	0	–10	–16.6
		[12] Mobile terminal (private vehicle) (1.5 m H)	31.4	0	0.5	82.7	48.4	19	14.3	9	2.4	15	10	0	–6.6

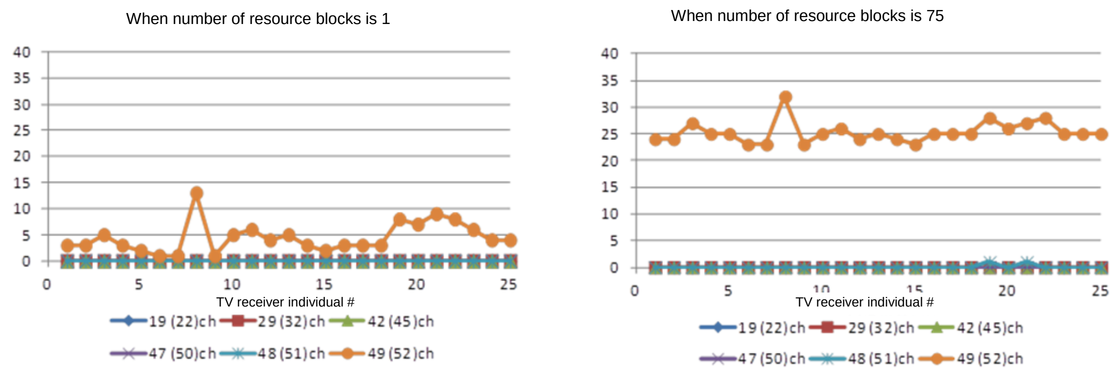
* Horizontal separation distance used in interference calculation.

(b) Experimental results by duplexer for 3GPP Band12 and required improvement for a video failure limit value

As a result of all models, it is confirmed that there is no influence by in-band interference for channels of ch. 51 or less on the models [9], [10] and [12]. In addition, as a result of models showing the worst characteristics, the maximum value of the required improvement for the video failure limit value in ch. 52 is 32 dB when the number of the IMT uplink transmission resource blocks is 75, and it is found that the unnecessary emission input level of the IMT mobile station at this time is –101 dBm/6 MHz. Furthermore, for the required improvement for the video failure limit value in ch. 52, the median value of 25 models is 25 dB. The measurement results for each model are shown in Fig. 3.4.2-3, however, it is confirmed that the required improvement for the video failure limit value varies by approximately 10 dB depending on the models when the number of resource blocks is 75 for ch. 52.

FIGURE 3.4.2-3

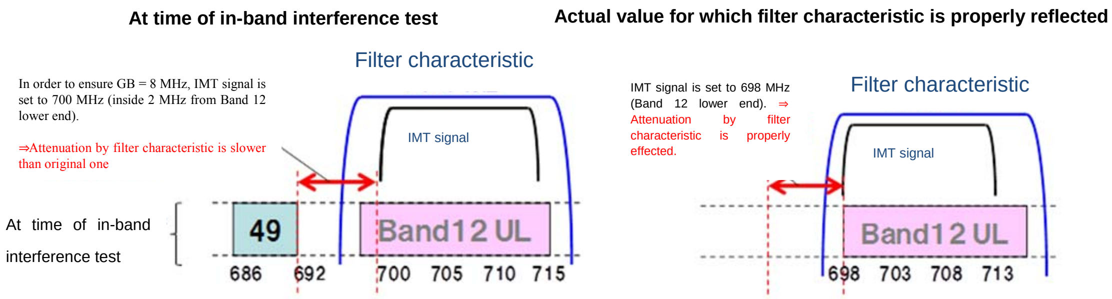
Experimental results for each model by duplexer for 3GPP Band12



Furthermore, in order to simulate situations of guardband 8 MHz in the experiments, as shown in Fig. 3.4.2-4, the carrier of uplink 15 MHz width is generated to 700 to 715 MHs inside of 2 MHz in comparison with the uplink transmission band (698 to 716 MHz) of 3GPP Band12.

FIGURE 3.4.2-4

Concept of actual value for which filter characteristics is properly reflected



Therefore, in order to properly reflect the filter characteristic of 3GPP Band12, it is necessary to measure spurious actual value when a carrier of 15 MHz width of 3GPP Band12 is generated to 698 to 713 MHz and properly correct the required improvement for a video failure limit value obtained in the experiment results on the models [9], [10], and [12]. Table 3.4.2-3 shows measurement results of spurious actual values and correction results of required improvements for a video failure limit value for properly reflecting filter characteristics on the experiment results of the previously described models [9], [10], and [12].

TABLE 3.4.2-3

Spurious actual value by 3GPP Band12 duplexer + PA and required improvement correction for a video failure limit value

	Spurious value by 3GPP Band12 duplexer + PA		**Required improvement for video failure limit value on models [9] [10] [12]**		
	(a) **At time of in-band interference test (700 to 715 MHz transmission) (dBm/6 MHz)**	**(b)** **Actual value on which filter characteristics is properly reflected (698 to 713 MHz transmission) (dBm/6 MHz)**	**(c)** **Measurement result required improvement (GB = 8 MHz) (dB)**	**(d)** **Corrected value ((b)-(a)) (dB)**	**(e)** **Required improvement after correction ((c) + (d)) (dB)**
Mask specified value	–5.2	–5.2			
ch. 52	–38.4	–52.9	32	–14.5	17.5
ch. 51	–66.3	–65.1	0	+1.2	1.2
ch. 50	–69.6	–70.4	0	–0.8	–0.8
ch. 49 or less	–72.0	–72.2	0	*	*

* In the case of channel of ch. 49 or less, actual value improvement of 1.8 dB of (b) from ch. 50 to ch. 49 is corrected for required improvement (e) of –0.8 dB after correction on ch. 50, and –2.6 dB is required improvement after correction.

3GPP Band12 does not have any special provision to protect broadcast bands, and the spectrum mask specified value in a guardband 8 MHz is –13 dBm/MHz (–5.2 dBm/6 MHz), however, it is confirmed that –52.9 dBm/6 MHz can be attained if a filter characteristics is properly reflected. For filters which will be manufactured with –34 dBm/MHz which is a broadcast band protection provision in AWG in the future taken in account, it is estimated that at least an actual value equal to this can be ensured.

Based on required improvement for video failure limit values after correction on the models [9], [10] and [12], a difference in coupling loss from the other models is reflected and required improvements for video failure limit values of all models on ch. 52 are calculated. Furthermore, in order to compare with the results of the studies in § 3.4.1, required improvements for interference allowable level based on I/N = –10 dB are calculated respectively when unnecessary emission from an IMT mobile station is assumed to be –34 dBm/MHz (specified value of AWG) for ch. 52 and when the actual value by duplexer for 3GPP Band1 is reflected.

Table 3.4.2-4 shows required improvement for each model and for each channel. For models [9], [10] and [12] which are simulated by the experiment system, required improvement for the interference allowable level based on I/N = –10 dB is 21.7 dB, required improvement for the video failure limit value is 17.5 dB (C/I = 24 dB) on the model with the worst characteristics and the median value of 25 models is 10.5 dB (measured value 25 dB – improvement of filter characteristics is 14.5 dB) (C/I = 17d). In addition, the worst value of the interference allowable level based on I/N = –10 dB is 22 dB on the model [6].

TABLE 3.4.2-4

Required improvement of in-band interference by duplexer for 3GPP Band 12

IMT mobile station to DTTB receiver Required improvement of in-band interference						Previous study results	Additional study result								
			Guardband			GB = 0 MHz	GB = 8 MHz								
			IMT mobile station unnecessary emission			Specified value 0.3 dBm/MHz	Specified value of AWG –34 dBm/MHz (–25.2 dBm/ 6 MHz)	Actual value of duplexer for 3GPP Band12: –60.7 dBm/ MHz (–52.9 dBm/ 6 MHz)	Actual value of duplexer for 3GPP Band12: –72.9 dBm/MHz (–65.1 dBm/ 6 MHz)	Actual value of duplexer for 3GPP Band12: –78.2 dBm/MHz (–70.4 dBm/ 6 MHz)	Actual value of duplexer for 3GPP Band12: –80.0 dBm/ MHz (–72.2 dBm/ 6 MHz)	Actual value of duplexer for 3GPP Band12			
			DTTB interference allowable level			Simulation value (I/N = –10 dB)	Simulation value (I/N = –10 dB)					Video failure limit value			
			Coupling loss (dB)	Difference in coupling loss on [9] [10] [12] (dB)	Horizontal separation distance (m)*	Required improvement for interference allowable level of I/N = –10 dB (dB)	Required improvement for interference allowable level of I/N = –10 dB (dB)					Required improvement for video failure limit value (dB)			
						ch. 52	ch. 52	ch. 52	ch. 51	ch. 50	ch. 49 less	ch. 52	ch. 51	ch. 50	ch. 49 less
Giving interference DTTB reception	Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	59.7	28.3	22	54.4	20.1	–6.6	–18.8	–24.1	–25.9	–10.8	–27.1	–29.1	–30.9
		[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	59.7	28.3	22	58.1	23.8	–2.9	–15.1	–20.4	–22.2	–10.8	–27.1	–29.1	–30.9
		[3] Home TV simple ANT w/o LNA (5 m H)	53.2	21.8	3	60.9	26.6	–0.1	–12.3	–17.6	–19.4	–4.3	–20.6	–22.6	–24.4
		[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	53.2	21.8	3	64.6	30.3	3.6	–8.6	–13.9	–15.7	–4.3	–20.6	–22.6	–24.4
		[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	56.7	25.3	22	61.1	27.3	0.1	–12.1	–17.4	–19.2	–7.8	–24.1	–26.1	–27.9
		[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	52.2	20.8	3	65.6	31.3	4.6	–7.6	–12.9	–14.7	–3.3	–19.6	–21.6	–23.4
		[15] Community reception (w/saturation)	90.6	59.2	0.5	27.2	–7.1	–33.8	–46	–51.3	–53.1	–41.7	–58	–60	–61.8
	Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	34.8	3.4	0.7	79.3	45	18.3	6.1	0.8	–1	14.1	–2.2	–4.2	–6
		[6] Home TV simple ANT w/LNA (1 m H) (w/o saturation)	34.8	3.4	0.7	83	48.7	22	9.8	4.5	2.7	14.1	–2.2	–4.2	–6
	Portable/mobile	[9] Mobile terminal (outdoors) (1.5 m H)	31.4	0	0.5	82.7	48.4	21.7	9.5	4.2	2.4	17.5	1.2	–0.8	–2.6
		[10] Mobile terminal (indoors)	31.4	0	0.5	82.7	48.4	21.7	9.5	4.2	2.4	17.5	1.2	–0.8	–2.6
		[11] Mobile terminal (bus) (3 m H)	41.4	10	0.5	72.7	38.4	11.7	–0.5	–5.8	–7.6	7.5	–8.8	–10.8	–12.6
		[12] Mobile terminal (private vehicle) (1.5 m H)	31.4	0	0.5	82.7	48.4	21.7	9.5	4.2	2.4	17.5	1.2	–0.8	–2.6

* Horizontal separation distance used in interference calculation.

(c) Consideration related to actual device which is used for experiment

The trial duplexer which is used for the experiment corresponded to the 700 MHz band IMT mobile station transmission band (718 to 748 MHz) and is trial-produced under the conditions that the duplexer ensures attenuation for ch. 52 at a maximum and can be mass-produced based on the existing manufacturing technology. On the other hand, the duplexer for 3GPP Band12 (transmission band is 698 to 716 MHz) offers results being mounted on the 700 MHz band IMT mobile station which is commercially available in the USA.

According to the measurement results, on ch. 51 and 50, the actual value by the trial-produced duplexer is found to have slightly deteriorated characteristics in comparison with the actual value by the duplexer for 3GPP Band12, however, it is considered that the generally equivalent actual value is ensured, Furthermore, the causes of deterioration of the characteristics on ch. 51 and 50 are estimated to be that this duplexer is designed so that attenuation on ch. 52 is prioritized as a condition at the trial stage, and this duplexer is the first trial one while the characteristics are enhanced through some trials in normal design.

According to the facts that an unnecessary emission actual values from the IMT mobile stations by the both duplexers are generally equivalent, these actual values are practical ones, and if the trial duplexer is IMT mobile station corresponding to the actual 700 MHz band, it is estimated that actual value same as that of 3GPP Band12 is ensured. In addition, it is also considered to be appropriate that unnecessary emission actual values from the IMT mobile station by two types of duplexers obtained in this experiment are used for compatibility consideration.

(d) Consideration related to required improvement

According to the results in Table 3.4.2-2 and Table 3.4.2-4, when the unnecessary emission actual value from IMT mobile station, the required improvements for interference allowable level based on $I/N = -10$ dB for TV receiver antenna outdoor installation model of the most general reception form are reduced on ch. 51 or less on the trial duplexer and the duplexer for 3GPP Band12. Even on ch. 52, the required improvement is reduced on the models [1], [2] and [7] of which the TV receiver antenna is 10 m high and the model [3] for the trial duplexer, and the required improvements are reduced on the models [1], [2] and [3] even for the duplexer for 3GPP Band12.

Furthermore, the required improvements for a video failure limit value are reduced on all channels on the TV receiver antenna outdoor installation model for both of the trial duplexer and the duplexer for 3GPP Band12, additionally, it has been found that a certain margin can be ensured.

On the TV antenna indoor installation model (Models [5] and [6]) and portable mobile TV reception models (Models [9] to [12]), the required improvements for interference allowable level based on $I/N = -10$ dB are often increased on ch. 52 to 49 or less for both of the trial duplexer and the duplexer for 3GPP Band12, on the other hand, it is found that the required improvements for a video failure limit value are reduced on ch. 50 or less on all models. On these models, when separation distance between the DTTB reception and the IMT mobile station are often 0.5 m and 0.7 m and the separation distance for indoor propagation is set to approximately 1 to 2 m, further attenuation of approximately 10 dB can be taken into account. Additionally, if use form to carry out TV reception while moving is a main feature for DTTB receiver such as a portable terminal, bus and private vehicle, it is predicted that substantial interference influence will become smaller in comparison with DTTB reception in a general home, etc., if place ratio and time ratio which are separation distance discussed in the interference consideration are taken into account.

Additionally, if the following elements are taken into account on all of the models [1] to [12] and [15], it is estimated that the influence by interference become smaller.

– The required improvement for the video failure limit value in the additionally considered result is caused by models showing the worst characteristics among 25 models of the DTTB receiver, and varies for every model.
– Each model sets separation distance of the worst case which minimizes coupling loss with IMT mobile station, DTTB receiver and LNA.
– Transmission power of IMT mobile station is properly controlled for power to reduce battery consumption depending on the distance between the base station and the mobile station, and the mobile station is often operated at a power lower than the maximum value.

Even if the interference influence would be generated by in-band interference from an IMT mobile station, the following countermeasures are also considered.

– In areas where transmission power from an IMT mobile station becomes higher, area situation can be improved and transmission power from IMT mobile station can be reduced by installing an IMT relay station.

Additionally, for DTTB relay station reception models of the models [13] and [14], verification has not been made with an actual machine of DTTB relay station reception, however, a case where spurious actual value of an IMT mobile station is examined. In the studies of section 3.4.1, the maximum value for the interference allowable level based on $I/N = -10$ dB in the guardband 0 MHz is improvement 88.7 dB on the model [13], however, when 8 MHz is assumed as the guardband, the required improvement becomes 27.7 dB if –52.9 dBm/6 MHz (–60.7 dBm/MHz) is taken into account as an actual value of unnecessary emission by the duplexer for 3GPP Band12. The required separation distance becomes 240 m if the required improvement is reduced by ensuring the separation distance.

The model [13] is a case where a large relay station reception antenna and IMT mobile station are close to each other in a horizontal separation distance of 0.5 m, and this assumes utilization of a cellular phone by related personnel entering in a facility of a large relay station such as DTTB maintenance personnel. As measures, it is considered to ensure attenuation of directionality and ensuring separation distance by adjustment of reception antenna installation place and replacement of a reception antenna or the like, depending on the installation situation of an actual large relay station reception antenna. Furthermore, in view of actual operation, it is considered to use the IMT mobile station corresponding to other frequency bands in the large relay station, it is considered that mutual operations can be allowed while influence by interference is avoided by totally taking these measures and the above elements into account similar to the other models.

B) Additional study related to in-band interference from IMT uplink (small-powered repeater base station facing device transmission) to DTTB

According to Table 3.4.1-1, maximum value of required improvement for interference allowable antenna based on $I/N = -10$ dB is 62.3 dB (separate type to model [8]) on the TV receiver antenna outdoor installation models (Models [1] to [4], [7], [8] and [15]) at a guardband of 0 MHz, maximum value of required improvement for interference allowable antenna based on $I/N = -10$ dB is 73.4 dB (integral type to model [6]) on the TV receiver antenna outdoor installation models (Models [5] and [6]), maximum value of required improvement for interference allowable antenna based on $I/N = -10$ dB is 67.8 dB (integral type to model [10]) on the portable mobile TV receiver antenna models (Models [9] to [12]), and maximum value of required improvement for interference allowable antenna based on $I/N = -10$ dB is 64.3 dB (separate type to model [13]) on the DTTB relay station reception (Models [13] and [14]).

If spurious characteristics of an IMT small-powered repeater are taken into account, improvement of 40 to 60 dB for the standard value is expected only if a guardband of 8 MHz is ensured.

Because an IMT small-powered repeater uplink transmission antenna is installed toward the outdoor direction, a certain improvement can be expected by adjusting installation direction and installation position for indoor TV receiver antenna or TV receiver antenna in the visible neighboring range of approximately 10 m. In addition, a certain improvement can also be made by changing the device type from integral type to separate type on TV antenna indoor installation model (Models [5] and [6]).

C) Additional study related to in-band interference from IMT uplink (land mobile station device at other end transmission) to DTTB

(a) TV receiver antenna outdoor installation models (Models [1] to [4], [7], [8] and [15])

In the studies of section 3.4.1, maximum value of required improvement for interference allowable level based on I/N = –10 dB in guardband of 0 MHz is 62.2 dB (separate type for indoor areas to model [7]), however, if the guard band is set to 9 MHz, attenuation of 64.2 dB is expected and the required improvement is reduced by applying the transmission filter (c) in Fig. 2.1-3 to IMT land mobile station which is the giving interference side. In addition, when the guardband is 8 MHz, attenuation of 60.4 dB is expected and the required improvement becomes 1.8 dB by applying the transmission filter (c) in Fig. 2.1-3, however, a certain improvement can be expected by adjusting the installation direction and installation position of the antenna.

(b) TV receiver antenna indoor installation model (Models [5] and [6])

In the studies of section 3.4.1, maximum value of required improvement for interference allowable level based on I/N = –10 dB in a guardband of 0 MHz is 70.9 dB (integral type for indoor areas to model [6]), however, if the guard band is set to 12 MHz, attenuation of 73.6 dB is expected and the required improvement is reduced by applying the transmission filter (c) in Fig. 2.1-3 to an IMT land mobile station which is the giving interference side. In addition, when the guardband is 8 MHz, attenuation of 60.4 dB is expected and the required improvement becomes 10.5 dB by applying the transmission filter (c) in Fig. 2.1-3, however, a certain improvement can be expected by adjusting the installation direction and installation position of the antenna.

(c) Portable mobile TV reception (Models [9] to [12])

Maximum value of required improvement for interference allowable level based on I/N = –10 dB in guardband 0 of MHz is 65.7 dB (integral type for indoor areas to model [10]), however, if the guard band is set to 10 MHz, attenuation of 68 dB is expected and the required improvement is reduced by applying the transmission filter (c) in Fig. 2.1-3 to an IMT land mobile station which is the giving interference side. In addition, when the guardband is 8 MHz, attenuation of 60.4 dB is expected and the required improvement becomes 5.3 dB by applying the transmission filter (c) in Fig. 2.1-3. Furthermore, use form to carry out DTTB reception while moving is a main feature for portable mobile TV reception and it is predicted that the number of substantially occurring problems is smaller in comparison with DTTB reception in general homes, etc., if the place ratio and time ratio which are separation distance discussed in the interference consideration are taken into account.

(d) DTTB relay station reception (Models [13], [14])

Maximum value of required improvement for interference allowable level based on I/N = –10 dB in guardband of 0 MHz is 65.2 dB (integral type for outdoor areas/indoor areas to model [13]), however, if the guard band is set to 10 MHz, attenuation of 68 dB is expected and the required improvement is reduced by applying the transmission filter (c) in Fig. 2.1-3 to IMT land mobile station which is the giving interference side.

In addition, if the guard band is 8 MHz, attenuation of 60.4 dB is expected and the required improvement for the interference allowable level becomes 4.8 dB, however, a certain improvement can be expected by adjusting the installation direction and installation position of the antenna.

(2) Additional study related to out-of-band/image interference from IMT uplink to DTTB

A) Additional study related to out-of-band interference from IMT uplink to DTTB receiver

Experiments to confirm influence to DTTB receiver by out-of-band are conducted on models [1] to [6] and [9] to [12].

In the experiments, IMT uplink signal generated by DTTB desired value and SG is inputted to 25 models of the DTTB receiver, and D/U ratio for IMT uplink input level and DTTB signal input level are derived for every setting of DTTB measurement channel, IMT uplink signal band width and IMT uplink signal continuity when influence by interference is confirmed. In addition, the DTTB signal input level is set to –65 dBm/6 MHz which is assumed to have a large influence in view of automatic gain control in the DTTB receiver, and whether it is influenced by interference or not is visually confirmed for 20 seconds.

Measurement results for each model are shown in Fig. 3.4.2-5, and results of the model which showed the worst characteristics are shown in Table 3.4.2-5.

FIGURE 3.4.2-5

Experiment results for each model related to out-of-band interference from IMT uplink to DTTB receiver

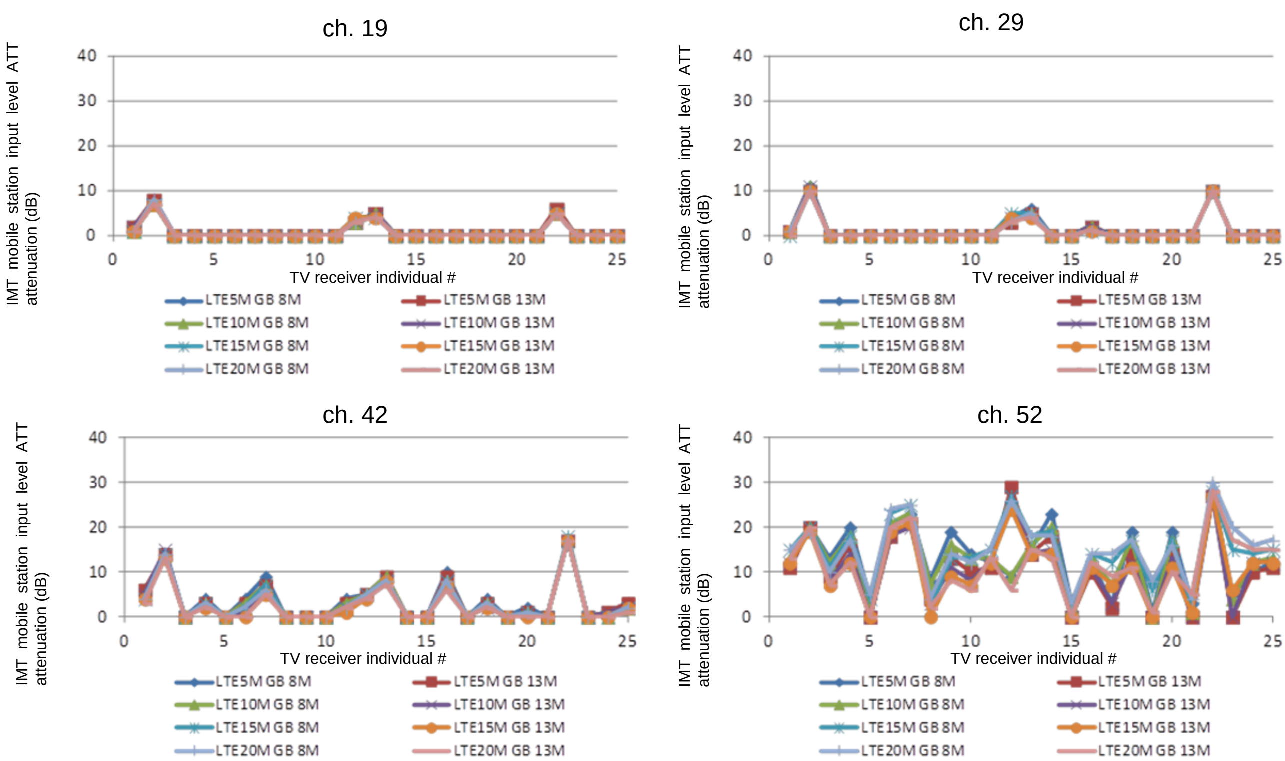


TABLE 3.4.2-5

Experimental results of out-of-band interference from IMT uplink to DTTB receiver (worst value)

DTTB ch	**19**	**29**	**42**	**52**
IMT uplink signal band width	5, 10, 15, 20 MHz	5, 10, 15, 20 MHz	5, 10, 15, 20 MHz	5, 10, 15, 20 MHz
(a) DTTB signal input level (dBm/6 MHz)	–65	–65	–65	–65
IMT uplink signal continuity (Duty)[1]	Burst (10%)[2]	Burst (10%)[2]	Burst (10%)[2]	Burst (10%)[2]
(b) ATT Attenuation (dB)	8	11	18	30
(Reference) Median value of ATT attenuation (dB)	0	0	2	16
(c) IMT uplink signal input level to DTTB (–8 dBm – (b)) (dBm)[3]	–16	–19	–26	–38
D/U ratio (dB) ((a) – (c))	–49	–46	–39	–27

1 Measurements are made with continuous wave (Duty100%), and burst wave (three cases of Duty 50%, 20% and 10%).

2 Burst wave signal period at Duty10%: 10 msec.

3 IMT uplink input level in case of ATT = 0 dB: –8 dBm.

All DTTB measurement channels had the worst results when an IMT uplink signal continuity had a burst wave with a duty ratio of 10%. This shows that DTTB receiver is subject to significant influences of desensitization due to bursty of an IMT uplink signal.

Furthermore, the worst value of the D/U ratio in the above experiment when the DTTB signal input level is set to –65 dBm/6 MHz is –27 dB at the time of ch. 52 measurement.

At ch. 52 which has the most significant influence, variation for each model is large, and it is found that the difference between the worst value and the median value of 25 models is 14 dB for an IMT uplink signal input level if the guardband is 8 MHz and the IMT channel width is 20 MHz.

In addition, improvement in D/U ratio is seen in the lower measurement and it is found that the D/U ratio tended to improve by 12 dB for ch. 42 for the result for ch. 52, by 19 dB for ch. 29 and by 22 dB for ch. 19 respectively.

For the models which showed the worst value and showed the median value among 25 models, the measurement channels are further added, and measurements are made respectively when the DTTB signal input level is –77 dBm/6 MHz, –65 dBm/6 MHz, and –40 dBm/6 MHz. Table 3.4.2-6 shows an IMT uplink signal input level which becomes a video failure limit value for each DTTB channel and each DTTB signal input level obtained from the measurement results.

TABLE 3.4.2-6

IMT uplink signal input level which becomes a video failure limit value in models which showed the worst value and in models which showed median value

	DTTB signal input level (dBm/ 6 MHz)	ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
IMT uplink signal input level (dBm) (median value)	–77.0	–27	–19	–16	–11	–15	–14	–13	–12	–11	–10	–9	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)
	–65.0	–24	–17	–14	–11	–13	–13	–12	–11	–10	–9	–10	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)
	–40.0	–13	–10	–10	–9	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)
IMT uplink signal input level (dBm) (worst value)	–77.0	–38	–35	–33	–33	–31	–30	–29	–28	–27	–27	–27	–25	–23	–19	–18	–17	–14	–13	–12
	–65.0	–38	–33	–33	–32	–30	–29	–28	–27	–26	–26	–26	–24	–22	–19	–16	–16	–16	–11	–11
	–40.0	–13	–12	–10	–9	–12	–12	–11	–10	–9	–9	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)	(–8)

* (–8) shows cases where no image failure is observed even at IMT maximum input level –8 dBm for measurement.

B) Additional study related to out-of-band interference from IMT uplink to LNA

Experiments to confirm influence by interference to LNA are conducted on the models [7], [8] and [15].

In the experiments, a total of 8 waves of DTTB desired wave (1 wave) and DTTB dummy signal (7 waves), and ELT uplink signal generated by SG are inputted to 11 models of LNA, and IMT uplink signal input level to be inputted to DTTB is attenuated for each measurement channel and each DTTB signal input level by an attenuator, then input power for IMT uplink signal where there is no influence on DTTB is derived. DTTB channels to be measured are a total of 2 channels of ch. 52 which is close to the IMT downlink signal and predicted to have the most significant influence by interference, and ch. 46 which is predicted to have significant influence by intermodulation by an IMT uplink signal and IMT downlink signal, and all 11 models are measured in detail on these 2 channels. In addition, whether it is influenced by interference or not is visually confirmed for 20 seconds.

Fig. 3.4.2-6 shows the measurement results for each model, and Table 3.4.2-7 shows the results of the models which showed the worst characteristic for each DTTB channel and each DTTB signal input level.

FIGURE 3.4.2-6

Experiment result for each model related to out-of-band interference from IMT uplink to LNA

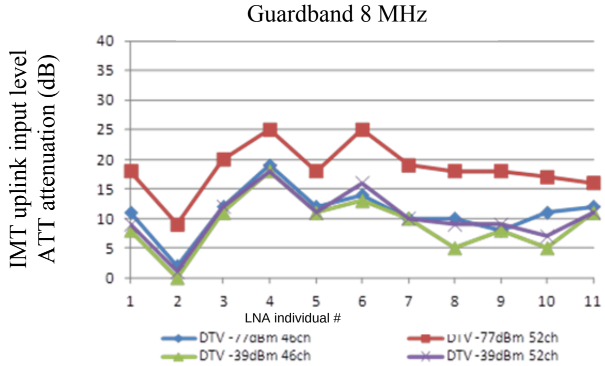


TABLE 3.4.2-7

Experimental results for each model related to out-of-band interference from IMT uplink to LNA

DTTB ch	46		52	
DTTB signal input level (dBm/6 MHz)	–77	–39	–77	–39
(a) ATT Attenuation (dB)	19	18	25	24
(Reference) Median value of ATT attenuation (dB)	11	10	18	10
IMT uplink signal input level (dBm) (–10 dBm-(a))*	–29	–28	–35	–34

* IMT downlink input level in the case of ATT = 0 dB: –10 dBm.

According to the experimental results, influence by interference is respectively confirmed in a LNA with the smallest strength when an IMT uplink signal is inputted in –35 dBm in the case that the measurement channel is ch. 52, and when the IMT uplink signal is inputted in –29 dBm in the case that the measurement channel is ch. 46.

In addition, on ch. 52 which had the most significant influence, when the DTTB desired wave level is –77 dBm/6 MHz, the difference between the worst value of 11 models and the median value is 7 dB for the IMT uplink signal input level.

In addition, for the models which showed the worst values and models which showed median values, measurement channels are further added, and measurements are made respectively when the DTTB signal input level is –77 dBm/6 MHz, –65 dBm/6 MHz, and –40 dBm/6 MHz. Table 3.4.2-8 shows an IMT uplink input level which becomes a video failure limit value for each DTTB channel and each DTTB signal input level obtained from the measurement results.

TABLE 3.4.2-8

IMT uplink signal level which becomes a video failure limit value in models which showed the worst value and models which showed median value

	DTTB signal input level (dBm/ 6 MHz)	ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
IMT uplink signal input level (dBm) (median value)	–77.0	–28	–26	–24	–23	–22	–22	–22	–21	–21	–21	–21	–21	–21	–21	–21	–21	–21	–21	–21
	–65.0	–26	–23	–23	–21	–20	–20	–19	–20	–20	–20	–20	–20	–20	–23	–20	–20	–24	–20	–20
	–40.0	–21	–20	–19	–19	–19	–19	–17	–19	–19	–20	–20	–20	–20	–23	–20	–20	–24	–20	–20
IMT uplink signal input level (dBm) (worst value)	–77.0	–35	–29	–29	–28	–27	–28	–29	–27	–27	–27	–27	–27	–27	–27	–27	–27	–27	–27	–27
	–65.0	–30	–28	–27	–27	–26	–27	–26	–27	–26	–27	–27	–26	–27	–26	–26	–26	–26	–26	–27
	–40.0	–27	–27	–27	–26	–26	–26	–25	–26	–26	–26	–26	–26	–26	–25	–26	–26	–27	–26	–26

C) Image interference from IMT uplink to DTTB receiver

Experiments to confirm influence by image interference to DTTB receiver are conducted on the models [1] to [6] and [9] to [12].

In the experiments, DTTB desired wave, and IMT uplink signal generated by SG are inputted to 25 models of DTTB receiver, and D/U ratio to IMT uplink signal input level and DTTB signal input level when influence by interference is confirmed is derived for each setting of DTTB measurement channel, IMT uplink signal band width and IMT uplink signal continuity. In addition, whether it is influenced by interference or not is visually confirmed for 20 seconds. The measurement channels are ch. 15 and 36 which are predicted to have a large influence by image interference.

Figure 3.4.2-7 shows the measurement results for each model, and it is found that a difference in presence or absence of influence is clear for each model. Table 3.4.2-9 shows the results of models which showed the worst characteristics for each measured DTTB channel.

FIGURE 3.4.2-7

Experiment results related to image interference from IMT uplink for each model to DTTB receiver

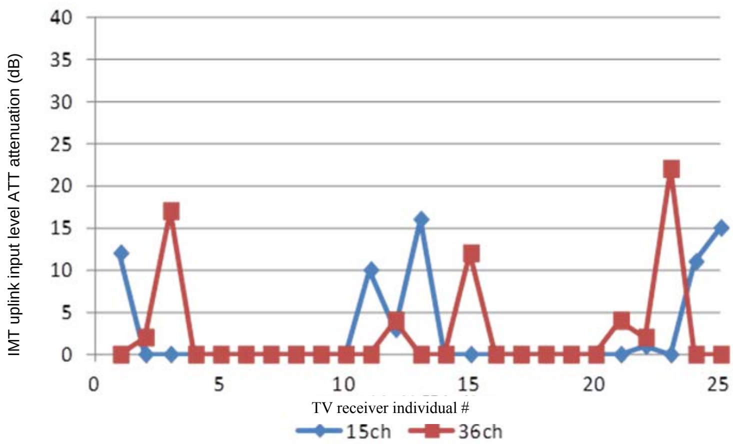


TABLE 3.4.2-9

Experiment results of image interference from IMT uplink to DTTB receiver

DTTB ch	**15**	**36**
(a) DTTB signal input level (dBm/6 MHz)	–65	–65
(b) ATT attenuation (dB)	16	22
(c) Input level to DTTB –8 dBm – (b) (dBm)	–24	–30
D/U ratio (dB) ((a) – (c))	–41	–35

D) Additional study related to required improvement of out-of-band/image interference from IMT uplink

Tables 3.4.2-10 to 33 show required improvement for a video failure limit value for each DTTB channel and each DTTB signal input level for models which showed the worst value and models which showed median value among the DTTB receiver and LNA on out-of-band interference. In addition, Table 3.4.2-34 shows required improvement for a video failure limit value for each DTTB channel for the models which showed the worst characteristic on image interference. In addition, these tables use a video failure limit value as an index for out-of-band interference. This Table shows values obtained by inputting only an IMT signal to DTTB receiver and LNA in a laboratory and measuring a level where a failure can actually be detected on a television screen. For this reason, it is necessary to pay attention to the fact that the value does not completely include a margin for interference obstruction and variation in field strength in an actual field, and does not meet the QEF condition which is an original terrestrial digital quality standard.

Out-of-band required improvement is calculated by deducting the IMT uplink signal input level which becomes a video failure limit value shown in Table 3.4.2-6 and Table 3.4.2-8 from the IMT maximum input level assumed for each model. The required improvement for image interference is similarly calculated by deducting input power (IMT uplink signal input level which becomes a video failure limit value) to (c) DTTB shown in Table 3.4.2-9 from IMT maximum input level assumed for each model.

Furthermore, when the DTTB signal input level is –77 dBm/6 MHz and –65 dBm/6 MHz, required improvements for the models [2], [3], [4], [5] and [6] are not calculated on out-of-band interference. In addition, if the DTTB signal input level is –40 dBm/6 MHz, the models of [2], [4] and [6] with LNA (w/o saturation) assume cases where DTTB signals are amplified by 38 dB by a LNA and, as a result, amplified to –40 dBm/6 MHz, therefore, it is actually a model which assumes weak field strength area, then is summarized in the other table from the other models. In addition, for image interference, experiments when the DTTB signal input level is –65 dBm/6 MHz are conducted and no event occurred on the LNA saturation models, therefore, it is determined that required improvement is not calculated for the models [2], [3], [4], [5], [6], [7], [8] and [15].

TABLE 3.4.2-10

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT mobile station to DTTB (DTTB signal: –77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	22	9.3	59.7	–36.7	Median	–9.7	–17.7	–20.7	–25.7	–21.7	–22.7	–23.7	–24.7	–25.7	–26.7	–27.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
						Worst	1.3	–1.7	–3.7	–3.7	–5.7	–6.7	–7.7	–8.7	–9.7	–9.7	–9.7	–11.7	–13.7	–17.7	–18.7	–19.7	–22.7	–23.7	–24.7
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	22	–3.4	56.7	–33.7	Median	–5.7	–7.7	–9.7	–10.7	–11.7	–11.7	–11.7	–12.7	–12.7	–12.7	–12.7	–12.7	–12.7	–12.7	–12.7	–12.7	–12.7	–12.7	–12.7
						Worst	1.3	–4.7	–4.7	–5.7	–6.7	–5.7	–4.7	–6.7	–6.7	–6.7	–6.7	–6.7	–6.7	–6.7	–6.7	–6.7	–6.7	–6.7	–6.7
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	3	1.1	52.2	–29.2	Median	–1.2	–3.2	–5.2	–6.2	–7.2	–7.2	–7.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2
						Worst	5.8	–0.2	–0.2	–1.2	–2.2	–1.2	–0.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2
	[15] Community reception (w/saturation)	0.5	–37.3	90.6	–67.6	Median	–39.6	–41.6	–43.6	–44.6	–45.6	–45.6	–45.6	–46.6	–46.6	–46.6	–46.6	–46.6	–46.6	–46.6	–46.6	–46.6	–46.6	–46.6	–46.6
						Worst	–32.6	–38.6	–38.6	–39.6	–40.6	–39.6	–38.6	–40.6	–40.6	–40.6	–40.6	–40.6	–40.6	–40.6	–40.6	–40.6	–40.6	–40.6	–40.6
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	0.5	37.6	31.4	–8.4	Median	18.6	10.6	7.6	2.6	6.6	5.6	4.6	3.6	2.6	1.6	0.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	29.6	26.6	24.6	24.6	22.6	21.6	20.6	19.6	18.6	18.6	18.6	16.6	14.6	10.6	9.6	8.6	5.6	4.6	3.6
	[10] Portable terminal (indoors)	0.5	37.6	31.4	–8.4	Median	18.6	10.6	7.6	2.6	6.6	5.6	4.6	3.6	2.6	1.6	0.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	29.6	26.6	24.6	24.6	22.6	21.6	20.6	19.6	18.6	18.6	18.6	16.6	14.6	10.6	9.6	8.6	5.6	4.6	3.6
	[11] Mobile terminal (bus) (3 m H)	0.5	27.6	41.4	–18.4	Median	8.6	0.6	–2.4	–7.4	–3.4	–4.4	–5.4	–6.4	–7.4	–8.4	–9.4	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)
						Worst	19.6	16.6	14.6	14.6	12.6	11.6	10.6	9.6	8.6	8.6	8.6	6.6	4.6	0.6	–0.4	–1.4	–4.4	–5.4	–6.4
	[12] Mobile terminal (private vehicle) (1.5 m H)	0.5	37.6	31.4	–8.4	Median	18.6	10.6	7.6	2.6	6.6	5.6	4.6	3.6	2.6	1.6	0.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	29.6	26.6	24.6	24.6	22.6	21.6	20.6	19.6	18.6	18.6	18.6	16.6	14.6	10.6	9.6	8.6	5.6	4.6	3.6

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-11

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT mobile station to DTTB (TV signal: –65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	22	9.3	59.7	–36.7	Median	–12.7	–19.7	–22.7	–25.7	–23.7	–23.7	–24.7	–25.7	–26.7	–27.7	–26.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
						Worst	1.3	–3.7	–3.7	–4.7	–6.7	–7.7	–8.7	–9.7	–10.7	–10.7	–10.7	–12.7	–14.7	–17.7	–20.7	–20.7	–20.7	–25.7	–25.7
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	22	–3.4	56.7	–33.7	Median	–7.7	–10.7	–10.7	–12.7	–13.7	–13.7	–14.7	–13.7	–13.7	–13.7	–13.7	–13.7	–13.7	–10.7	–13.7	–13.7	–9.7	–13.7	–13.7
						Worst	–3.7	–5.7	–6.7	–6.7	–7.7	–6.7	–7.7	–6.7	–7.7	–6.7	–6.7	–7.7	–6.7	–7.7	–7.7	–7.7	–7.7	–7.7	–6.7
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	3	1.1	52.2	–29.2	Median	–3.2	–6.2	–6.2	–8.2	–9.2	–9.2	–10.2	–9.2	–9.2	–9.2	–9.2	–9.2	–9.2	–6.2	–9.2	–9.2	–5.2	–9.2	–9.2
						Worst	0.8	–1.2	–2.2	–2.2	–3.2	–2.2	–3.2	–2.2	–3.2	–2.2	–2.2	–3.2	–2.2	–3.2	–3.2	–3.2	–3.2	–3.2	–2.2
	[15] Community reception (w/saturation)	0.5	–37.3	90.6	–67.6	Median	–41.6	–44.6	–44.6	–46.6	–47.6	–47.6	–48.6	–47.6	–47.6	–47.6	–47.6	–47.6	–47.6	–44.6	–47.6	–47.6	–43.6	–47.6	–47.6
						Worst	–37.6	–39.6	–40.6	–40.6	–41.6	–40.6	–41.6	–40.6	–41.6	–40.6	–40.6	–41.6	–40.6	–41.6	–41.6	–41.6	–41.6	–41.6	–40.6
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	0.5	37.6	31.4	–8.4	Median	15.6	8.6	5.6	2.6	4.6	4.6	3.6	2.6	1.6	0.6	1.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	29.6	24.6	24.6	23.6	21.6	20.6	19.6	18.6	17.6	17.6	17.6	15.6	13.6	10.6	7.6	7.6	7.6	2.6	2.6
	[10] Portable terminal (indoors)	0.5	37.6	31.4	–8.4	Median	15.6	8.6	5.6	2.6	4.6	4.6	3.6	2.6	1.6	0.6	1.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	29.6	24.6	24.6	23.6	21.6	20.6	19.6	18.6	17.6	17.6	17.6	15.6	13.6	10.6	7.6	7.6	7.6	2.6	2.6
	[11] Mobile terminal (bus) (3 m H)	0.5	27.6	41.4	–18.4	Median	5.6	–1.4	–4.4	–7.4	–5.4	–5.4	–6.4	–7.4	–8.4	–9.4	–8.4	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)
						Worst	19.6	14.6	14.6	13.6	11.6	10.6	9.6	8.6	7.6	7.6	7.6	5.6	3.6	0.6	–2.4	–2.4	–2.4	–7.4	–7.4
	[12] Mobile terminal (private vehicle) (1.5 m H)	0.5	37.6	31.4	–8.4	Median	15.6	8.6	5.6	2.6	4.6	4.6	3.6	2.6	1.6	0.6	1.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	29.6	24.6	24.6	23.6	21.6	20.6	19.6	18.6	17.6	17.6	17.6	15.6	13.6	10.6	7.6	7.6	7.6	2.6	2.6

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-12

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT mobile station to DTTB (DTTB signal: –40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	22	9.3	59.7	–36.7	Median	–23.7	–26.7	–26.7	–27.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
						Worst	–23.7	–24.7	–26.7	–27.7	–24.7	–24.7	–25.7	–26.7	–27.7	–27.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
	[3] Home TV simple ANT w/o LNA (5 m H)	3	–0.4	53.2	–30.2	Median	–17.2	–20.2	–20.2	–21.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
						Worst	–17.2	–18.2	–20.2	–21.2	–18.2	–18.2	–19.2	–20.2	–21.2	–21.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	22	–3.4	56.7	–33.7	Median	–12.7	–13.7	–14.7	–14.7	–14.7	–14.7	–16.7	–14.7	–14.7	–13.7	–13.7	–13.7	–13.7	–10.7	–13.7	–13.7	–9.7	–13.7	–13.7
						Worst	–6.7	–6.7	–6.7	–7.7	–7.7	–7.7	–8.7	–7.7	–7.7	–7.7	–7.7	–7.7	–7.7	–8.7	–7.7	–7.7	–6.7	–7.7	–7.7
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	3	1.1	52.2	–29.2	Median	–8.2	–9.2	–10.2	–10.2	–10.2	–10.2	–12.2	–10.2	–10.2	–9.2	–9.2	–9.2	–9.2	–6.2	–9.2	–9.2	–5.2	–9.2	–9.2
						Worst	–2.2	–2.2	–2.2	–3.2	–3.2	–3.2	–4.2	–3.2	–3.2	–3.2	–3.2	–3.2	–3.2	–4.2	–3.2	–3.2	–2.2	–3.2	–3.2
	[15] Community reception (w/saturation)	0.5	–37.3	90.6	–67.6	Median	–46.6	–47.6	–48.6	–48.6	–48.6	–48.6	–50.6	–48.6	–48.6	–47.6	–47.6	–47.6	–47.6	–44.6	–47.6	–47.6	–43.6	–47.6	–47.6
						Worst	–40.6	–40.6	–40.6	–41.6	–41.6	–41.6	–42.6	–41.6	–41.6	–41.6	–41.6	–41.6	–41.6	–42.6	–41.6	–41.6	–40.6	–41.6	–41.6
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	0.7	18	34.8	–11.8	Median	1.2	–1.8	–1.8	–2.8	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)
						Worst	1.2	0.2	–1.8	–2.8	0.2	0.2	–0.8	–1.8	–2.8	–2.8	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)	(–3.8)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	0.5	37.6	31.4	–8.4	Median	4.6	1.6	1.6	0.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	4.6	3.6	1.6	0.6	3.6	3.6	2.6	1.6	0.6	0.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
	[10] Portable terminal (indoors)	0.5	37.6	31.4	–8.4	Median	4.6	1.6	1.6	0.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	4.6	3.6	1.6	0.6	3.6	3.6	2.6	1.6	0.6	0.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
	[11] Mobile terminal (bus) (3 m H)	0.5	27.6	41.4	–18.4	Median	–5.4	–8.4	–8.4	–9.4	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)
						Worst	–5.4	–6.4	–8.4	–9.4	–6.4	–6.4	–7.4	–8.4	–9.4	–9.4	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)	(–10.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	0.5	37.6	31.4	–8.4	Median	4.6	1.6	1.6	0.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)
						Worst	4.6	3.6	1.6	0.6	3.6	3.6	2.6	1.6	0.6	0.6	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)	(–0.4)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-13

Required improvement for video failure limit value for out-of-band interference

IMT uplink IMT mobile station to DTTB (DTTB signal: –40 dBm/6 MHz)
Models [2], [4] and [6] (Weak field strength for DTTB)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	22	13.3	21.7	1.3	Median	14.3	11.3	11.3	10.3	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)
						Worst	14.3	13.3	11.3	10.3	13.3	13.3	12.3	11.3	10.3	10.3	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)	(9.3)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	3	9.6	15.2	7.8	Median	20.8	17.8	17.8	16.8	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)
						Worst	20.8	19.8	17.8	16.8	19.8	19.8	18.8	17.8	16.8	16.8	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	0.7	28	–3.2	26.2	Median	39.2	36.2	36.2	35.2	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)
						Worst	39.2	38.2	36.2	35.2	38.2	38.2	37.2	36.2	35.2	35.2	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)	(34.2)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-14

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT small-powered repeater (integral type) to DTTB (DTTB signal: –77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	25	7.5	54.5	–38.5	Median	–11.5	–19.5	–22.5	–27.5	–23.5	–24.5	–25.5	–26.5	–27.5	–28.5	–29.5	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)
						Worst	–0.5	–3.5	–5.5	–5.5	–7.5	–8.5	–9.5	–10.5	–11.5	–11.5	–11.5	–13.5	–15.5	–19.5	–20.5	–21.5	–24.5	–25.5	–26.5
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	25	–5.2	51.5	–35.5	Median	–7.5	–9.5	–11.5	–12.5	–13.5	–13.5	–13.5	–14.5	–14.5	–14.5	–14.5	–14.5	–14.5	–14.5	–14.5	–14.5	–14.5	–14.5	–14.5
						Worst	–0.5	–6.5	–6.5	–7.5	–8.5	–7.5	–6.5	–8.5	–8.5	–8.5	–8.5	–8.5	–8.5	–8.5	–8.5	–8.5	–8.5	–8.5	–8.5
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	7	3.2	43.1	–27.1	Median	0.9	–1.1	–3.1	–4.1	–5.1	–5.1	–5.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1
						Worst	7.9	1.9	1.9	0.9	–0.1	0.9	1.9	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	21.6	40.4	–24.4	Median	2.6	–5.4	–8.4	–13.4	–9.4	–10.4	–11.4	–12.4	–13.4	–14.4	–15.4	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)
						Worst	13.6	10.6	8.6	8.6	6.6	5.6	4.6	3.6	2.6	2.6	2.6	0.6	–1.4	–5.4	–6.4	–7.4	–10.4	–11.4	–12.4
	[10] Portable terminal (indoors)	1	38	24	–8	Median	19.0	11.0	8.0	3.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0								
						Worst	30.0	27.0	25.0	25.0	23.0	22.0	21.0	20.0	19.0	19.0	19.0	17.0	15.0	11.0	10.0	9.0	6.0	5.0	4.0
	[11] Mobile terminal (bus) (3 m H)	3	20.1	41.9	–25.9	Median	1.1	–6.9	–9.9	–14.9	–10.9	–11.9	–12.9	–13.9	–14.9	–15.9	–16.9	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)
						Worst	12.1	9.1	7.1	7.1	5.1	4.1	3.1	2.1	1.1	1.1	1.1	–0.9	–2.9	–6.9	–7.9	–8.9	–11.9	–12.9	–13.9
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	21.6	40.4	–24.4	Median	2.6	–5.4	–8.4	–13.4	–9.4	–10.4	–11.4	–12.4	–13.4	–14.4	–15.4	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)
						Worst	13.6	10.6	8.6	8.6	6.6	5.6	4.6	3.6	2.6	2.6	2.6	0.6	–1.4	–5.4	–6.4	–7.4	–10.4	–11.4	–12.4

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-15

Required improvement for video failure limit value for out-of-band interference

IMT uplink IMT small-powered repeater (integral type) to DTTB (TV signal: –65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	25	7.5	54.5	–38.5	Median	–14.5	–21.5	–24.5	–27.5	–25.5	–25.5	–26.5	–27.5	–28.5	–29.5	–28.5	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)
						Worst	–0.5	–5.5	–5.5	–6.5	–8.5	–9.5	–10.5	–11.5	–12.5	–12.5	–12.5	–14.5	–16.5	–19.5	–22.5	–22.5	–22.5	–27.5	–27.5
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	25	–5.2	51.5	–35.5	Median	–9.5	–12.5	–12.5	–14.5	–15.5	–15.5	–16.5	–15.5	–15.5	–15.5	–15.5	–15.5	–15.5	–12.5	–15.5	–15.5	–11.5	–15.5	–15.5
						Worst	–5.5	–7.5	–8.5	–8.5	–9.5	–8.5	–9.5	–8.5	–9.5	–8.5	–8.5	–9.5	–8.5	–9.5	–9.5	–9.5	–9.5	–9.5	–8.5
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	7	3.2	43.1	–27.1	Median	–1.1	–4.1	–4.1	–6.1	–7.1	–7.1	–8.1	–7.1	–7.1	–7.1	–7.1	–7.1	–7.1	–4.1	–7.1	–7.1	–3.1	–7.1	–7.1
						Worst	2.9	0.9	–0.1	–0.1	–1.1	–0.1	–1.1	–0.1	–1.1	–0.1	–0.1	–1.1	–0.1	–1.1	–1.1	–1.1	–1.1	–1.1	–0.1
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	21.6	40.4	–24.4	Median	–0.4	–7.4	–10.4	–13.4	–11.4	–11.4	–12.4	–13.4	–14.4	–15.4	–14.4	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)
						Worst	13.6	8.6	8.6	7.6	5.6	4.6	3.6	2.6	1.6	1.6	1.6	–0.4	–2.4	–5.4	–8.4	–8.4	–8.4	–13.4	–13.4
	[10] Portable terminal (indoors)	1	38	24	–8	Median	16.0	9.0	6.0	3.0	5.0	5.0	4.0	3.0	2.0	1.0	2.0								
						Worst	30.0	25.0	25.0	24.0	22.0	21.0	20.0	19.0	18.0	18.0	18.0	16.0	14.0	11.0	8.0	8.0	8.0	3.0	3.0
	[11] Mobile terminal (bus) (3 m H)	3	20.1	41.9	–25.9	Median	–1.9	–8.9	–11.9	–14.9	–12.9	–12.9	–13.9	–14.9	–15.9	–16.9	–15.9	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)
						Worst	12.1	7.1	7.1	6.1	4.1	3.1	2.1	1.1	0.1	0.1	0.1	–1.9	–3.9	–6.9	–9.9	–9.9	–9.9	–14.9	–14.9
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	21.6	40.4	–24.4	Median	–0.4	–7.4	–10.4	–13.4	–11.4	–11.4	–12.4	–13.4	–14.4	–15.4	–14.4	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)
						Worst	13.6	8.6	8.6	7.6	5.6	4.6	3.6	2.6	1.6	1.6	1.6	–0.4	–2.4	–5.4	–8.4	–8.4	–8.4	–13.4	–13.4

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-16

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT small-powered repeater (integral type) to DTTB (DTTB signal: –40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	25	7.5	54.5	–38.5	Median	–25.5	–28.5	–28.5	–29.5	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)
						Worst	–25.5	–26.5	–28.5	–29.5	–26.5	–26.5	–27.5	–28.5	–29.5	–29.5	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)	(–30.5)
	[3] Home TV simple ANT w/o LNA (5 m H)	7	1.7	44.1	–28.1	Median	–15.1	–18.1	–18.1	–19.1	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)
						Worst	–15.1	–16.1	–18.1	–19.1	–16.1	–16.1	–17.1	–18.1	–19.1	–19.1	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	25	–5.2	51.5	–35.5	Median	–14.5	–15.5	–16.5	–16.5	–16.5	–16.5	–18.5	–16.5	–16.5	–15.5	–15.5	–15.5	–15.5	–12.5	–15.5	–15.5	–11.5	–15.5	–15.5
						Worst	–8.5	–8.5	–8.5	–9.5	–9.5	–9.5	–10.5	–9.5	–9.5	–9.5	–9.5	–9.5	–9.5	–10.5	–9.5	–9.5	–8.5	–9.5	–9.5
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	7	3.2	43.1	–27.1	Median	–6.1	–7.1	–8.1	–8.1	–8.1	–8.1	–10.1	–8.1	–8.1	–7.1	–7.1	–7.1	–7.1	–4.1	–7.1	–7.1	–3.1	–7.1	–7.1
						Worst	–0.1	–0.1	–0.1	–1.1	–1.1	–1.1	–2.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–2.1	–1.1	–1.1	–0.1	–1.1	–1.1
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	2	21.7	24.1	–8.1	Median	4.9	1.9	1.9	0.9	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)
						Worst	4.9	3.9	1.9	0.9	3.9	3.9	2.9	1.9	0.9	0.9	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)	(–0.1)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	21.6	40.4	–24.4	Median	–11.4	–14.4	–14.4	–15.4	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)
						Worst	–11.4	–12.4	–14.4	–15.4	–12.4	–12.4	–13.4	–14.4	–15.4	–15.4	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)
	[10] Portable terminal (indoors)	1	38	24	–8	Median	5.0	2.0	2.0	1.0															
						Worst	5.0	4.0	2.0	1.0	4.0	4.0	3.0	2.0	1.0	1.0									
	[11] Mobile terminal (bus) (3 m H)	3	20.1	41.9	–25.9	Median	–12.9	–15.9	–15.9	–16.9	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)
						Worst	–12.9	–13.9	–15.9	–16.9	–13.9	–13.9	–14.9	–15.9	–16.9	–16.9	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)	(–17.9)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	21.6	40.4	–24.4	Median	–11.4	–14.4	–14.4	–15.4	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)
						Worst	–11.4	–12.4	–14.4	–15.4	–12.4	–12.4	–13.4	–14.4	–15.4	–15.4	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)	(–16.4)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-17

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT small-powered repeater (integral type) to DTTB (DTTB signal: –40 dBm/6 MHz)
Models [2], [4] and [6] (Weak field strength for DTTB)

		Horizontal distance of separation (m)	**Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)**	**Coupled amount (dB)**	**IMT maximum input level (dBm)**	**Median/ Worst**	**Required improvement for video failure limit value (GB = 8 MHz) (dB)**																		
							ch. 52	**ch. 51**	**ch. 50**	**ch. 49**	**ch. 48**	**ch. 47**	**ch. 46**	**ch. 45**	**ch. 44**	**ch. 43**	**ch. 42**	**ch. 41**	**ch. 36**	**ch. 29**	**ch. 27**	**ch. 26**	**ch. 19**	**ch. 15**	**ch. 13**
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	25	11.5	16.5	–0.5	Median	12.5	9.5	9.5	8.5	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)
						Worst	12.5	11.5	9.5	8.5	11.5	11.5	10.5	9.5	8.5	8.5	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)	(7.5)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	7	11.7	6.1	9.9	Median	22.9	19.9	19.9	18.9	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)
						Worst	22.9	21.9	19.9	18.9	21.9	21.9	20.9	19.9	18.9	18.9	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	2	33.7	–15.9	31.9	Median	44.9	41.9	41.9	40.9	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)
						Worst	44.9	43.9	41.9	40.9	43.9	43.9	42.9	41.9	40.9	40.9	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)	(39.9)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-18

Required improvement in video failure limit value for out-of-band interference

IMT uplink IMT small-powered repeater (separate type) to DTTB (DTTB signal: –77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	19	9.4	52.6	–36.6	Median	–9.6	–17.6	–20.6	–25.6	–21.6	–22.6	–23.6	–24.6	–25.6	–26.6	–27.6	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)
						Worst	1.4	–1.6	–3.6	–3.6	–5.6	–6.6	–7.6	–8.6	–9.6	–9.6	–9.6	–11.6	–13.6	–17.6	–18.6	–19.6	–22.6	–23.6	–24.6
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	19	–3.3	49.6	–33.6	Median	–5.6	–7.6	–9.6	–10.6	–11.6	–11.6	–11.6	–12.6	–12.6	–12.6	–12.6	–12.6	–12.6	–12.6	–12.6	–12.6	–12.6	–12.6	–12.6
						Worst	1.4	–4.6	–4.6	–5.6	–6.6	–5.6	–4.6	–6.6	–6.6	–6.6	–6.6	–6.6	–6.6	–6.6	–6.6	–6.6	–6.6	–6.6	–6.6
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	3	13.1	33.2	–17.2	Median	10.8	8.8	6.8	5.8	4.8	4.8	4.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
						Worst	17.8	11.8	11.8	10.8	9.8	10.8	11.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	6	9.3	52.7	–36.7	Median	–9.7	–17.7	–20.7	–25.7	–21.7	–22.7	–23.7	–24.7	–25.7	–26.7	–27.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
						Worst	1.3	–1.7	–3.7	–3.7	–5.7	–6.7	–7.7	–8.7	–9.7	–9.7	–9.7	–11.7	–13.7	–17.7	–18.7	–19.7	–22.7	–23.7	–24.7
	[10] Portable terminal (indoors)	6	–0.7	62.7	–46.7	Median	–19.7	–27.7	–30.7	–35.7	–31.7	–32.7	–33.7	–34.7	–35.7	–36.7	–37.7	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)
						Worst	–8.7	–11.7	–13.7	–13.7	–15.7	–16.7	–17.7	–18.7	–19.7	–19.7	–19.7	–21.7	–23.7	–27.7	–28.7	–29.7	–32.7	–33.7	–34.7
	[11] Mobile terminal (bus) (3 m H)	3	14.2	47.8	–31.8	Median	–4.8	–12.8	–15.8	–20.8	–16.8	–17.8	–18.8	–19.8	–20.8	–21.8	–22.8	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)
						Worst	6.2	3.2	1.2	1.2	–0.8	–1.8	–2.8	–3.8	–4.8	–4.8	–4.8	–6.8	–8.8	–12.8	–13.8	–14.8	–17.8	–18.8	–19.8
	[12] Mobile terminal (private vehicle) (1.5 m H)	6	9.3	52.7	–36.7	Median	–9.7	–17.7	–20.7	–25.7	–21.7	–22.7	–23.7	–24.7	–25.7	–26.7	–27.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
						Worst	1.3	–1.7	–3.7	–3.7	–5.7	–6.7	–7.7	–8.7	–9.7	–9.7	–9.7	–11.7	–13.7	–17.7	–18.7	–19.7	–22.7	–23.7	–24.7

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-19

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT small-powered repeater (separate type) to DTTB (DTTB signal: –65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	19	9.4	52.6	–36.6	Median	–12.6	–19.6	–22.6	–25.6	–23.6	–23.6	–24.6	–25.6	–26.6	–27.6	–26.6	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)
						Worst	1.4	–3.6	–3.6	–4.6	–6.6	–7.6	–8.6	–9.6	–10.6	–10.6	–10.6	–12.6	–14.6	–17.6	–20.6	–20.6	–20.6	–25.6	–25.6
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	19	–3.3	49.6	–33.6	Median	–7.6	–10.6	–10.6	–12.6	–13.6	–13.6	–14.6	–13.6	–13.6	–13.6	–13.6	–13.6	–13.6	–10.6	–13.6	–13.6	–9.6	–13.6	–13.6
						Worst	–3.6	–5.6	–6.6	–6.6	–7.6	–6.6	–7.6	–6.6	–7.6	–6.6	–6.6	–7.6	–6.6	–7.6	–7.6	–7.6	–7.6	–7.6	–6.6
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	3	13.1	33.2	–17.2	Median	8.8	5.8	5.8	3.8	2.8	2.8	1.8	2.8	2.8	2.8	2.8	2.8	2.8	5.8	2.8	2.8	6.8	2.8	2.8
						Worst	12.8	10.8	9.8	9.8	8.8	9.8	8.8	9.8	8.8	9.8	9.8	8.8	9.8	8.8	8.8	8.8	8.8	8.8	9.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	6	9.3	52.7	–36.7	Median	–12.7	–19.7	–22.7	–25.7	–23.7	–23.7	–24.7	–25.7	–26.7	–27.7	–26.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
						Worst	1.3	–3.7	–3.7	–4.7	–6.7	–7.7	–8.7	–9.7	–10.7	–10.7	–10.7	–12.7	–14.7	–17.7	–20.7	–20.7	–20.7	–25.7	–25.7
	[10] Portable terminal (indoors)	6	–0.7	62.7	–46.7	Median	–22.7	–29.7	–32.7	–35.7	–33.7	–33.7	–34.7	–35.7	–36.7	–37.7	–36.7	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)
						Worst	–8.7	–13.7	–13.7	–14.7	–16.7	–17.7	–18.7	–19.7	–20.7	–20.7	–20.7	–22.7	–24.7	–27.7	–30.7	–30.7	–30.7	–35.7	–35.7
	[11] Mobile terminal (bus) (3 m H)	3	14.2	47.8	–31.8	Median	–7.8	–14.8	–17.8	–20.8	–18.8	–18.8	–19.8	–20.8	–21.8	–22.8	–21.8	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)
						Worst	6.2	1.2	1.2	0.2	–1.8	–2.8	–3.8	–4.8	–5.8	–5.8	–5.8	–7.8	–9.8	–12.8	–15.8	–15.8	–15.8	–20.8	–20.8
	[12] Mobile terminal (private vehicle) (1.5 m H)	6	9.3	52.7	–36.7	Median	–12.7	–19.7	–22.7	–25.7	–23.7	–23.7	–24.7	–25.7	–26.7	–27.7	–26.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
						Worst	1.3	–3.7	–3.7	–4.7	–6.7	–7.7	–8.7	–9.7	–10.7	–10.7	–10.7	–12.7	–14.7	–17.7	–20.7	–20.7	–20.7	–25.7	–25.7

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-20

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT small-powered repeater (separate type) to DTTB (DTTB signal: –40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	19	9.4	52.6	–36.6	Median	–23.6	–26.6	–26.6	–27.6	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)
						Worst	–23.6	–24.6	–26.6	–27.6	–24.6	–24.6	–25.6	–26.6	–27.6	–27.6	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)	(–28.6)
	[3] Home TV simple ANT w/o LNA (5 m H)	3	11.6	34.2	–18.2	Median	–5.2	–8.2	–8.2	–9.2	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)
						Worst	–5.2	–6.2	–8.2	–9.2	–6.2	–6.2	–7.2	–8.2	–9.2	–9.2	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)	(–10.2)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	19	–3.3	49.6	–33.6	Median	–12.6	–13.6	–14.6	–14.6	–14.6	–14.6	–16.6	–14.6	–14.6	–13.6	–13.6	–13.6	–13.6	–10.6	–13.6	–13.6	–9.6	–13.6	–13.6
						Worst	–6.6	–6.6	–6.6	–7.6	–7.6	–7.6	–8.6	–7.6	–7.6	–7.6	–7.6	–7.6	–7.6	–8.6	–7.6	–7.6	–6.6	–7.6	–7.6
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	3	13.1	33.2	–17.2	Median	3.8	2.8	1.8	1.8	1.8	1.8	–0.2	1.8	1.8	2.8	2.8	2.8	2.8	5.8	2.8	2.8	6.8	2.8	2.8
						Worst	9.8	9.8	9.8	8.8	8.8	8.8	7.8	8.8	8.8	8.8	8.8	8.8	8.8	7.8	8.8	8.8	9.8	8.8	8.8
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	10	–12.4	58.2	–42.2	Median	–29.2	–32.2	–32.2	–33.2	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)
						Worst	–29.2	–30.2	–32.2	–33.2	–30.2	–30.2	–31.2	–32.2	–33.2	–33.2	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)	(–34.2)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	6	9.3	52.7	–36.7	Median	–23.7	–26.7	–26.7	–27.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
						Worst	–23.7	–24.7	–26.7	–27.7	–24.7	–24.7	–25.7	–26.7	–27.7	–27.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
	[10] Portable terminal (indoors)	6	–0.7	62.7	–46.7	Median	–33.7	–36.7	–36.7	–37.7	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)
						Worst	–33.7	–34.7	–36.7	–37.7	–34.7	–34.7	–35.7	–36.7	–37.7	–37.7	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)	(–38.7)
	[11] Mobile terminal (bus) (3 m H)	3	14.2	47.8	–31.8	Median	–18.8	–21.8	–21.8	–22.8	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)
						Worst	–18.8	–19.8	–21.8	–22.8	–19.8	–19.8	–20.8	–21.8	–22.8	–22.8	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)	(–23.8)
	[12] Mobile terminal (private vehicle) (1.5 m H)	6	9.3	52.7	–36.7	Median	–23.7	–26.7	–26.7	–27.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)
						Worst	–23.7	–24.7	–26.7	–27.7	–24.7	–24.7	–25.7	–26.7	–27.7	–27.7	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)	(–28.7)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-21

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT small-powered repeater (separate type) to DTTB (DTTB signal: –40 dBm/6 MHz)
Models [2], [4] and [6] (Weak field strength for DTTB)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	19	13.4	14.6	1.4	Median	14.4	11.4	11.4	10.4	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)
						Worst	14.4	13.4	11.4	10.4	13.4	13.4	12.4	11.4	10.4	10.4	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)	(9.4)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	3	21.6	–3.8	19.8	Median	32.8	29.8	29.8	28.8	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)
						Worst	32.8	31.8	29.8	28.8	31.8	31.8	30.8	29.8	28.8	28.8	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)	(27.8)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	10	–2.4	20.2	–4.2	Median	8.8	5.8	5.8	4.8	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)
						Worst	8.8	7.8	5.8	4.8	7.8	7.8	6.8	5.8	4.8	4.8	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)	(3.8)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-22

Required improvement for video failure limit value for out-of-band interference

IMT uplink IMT land mobile station (for outdoor area) to DTTB (DTTB signal: –77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	22	21.7	47.3	–24.3	Median	2.7	–5.3	–8.3	–13.3	–9.3	–10.3	–11.3	–12.3	–13.3	–14.3	–15.3	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)
						Worst	13.7	10.7	8.7	8.7	6.7	5.7	4.7	3.7	2.7	2.7	2.7	0.7	–1.3	–5.3	–6.3	–7.3	–10.3	–11.3	–12.3
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	22	9	44.3	–21.3	Median	6.7	4.7	2.7	1.7	0.7	0.7	0.7	–0.3	–0.3	–0.3	–0.3	–0.3	–0.3	–0.3	–0.3	–0.3	–0.3	–0.3	–0.3
						Worst	13.7	7.7	7.7	6.7	5.7	6.7	7.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	45	1.1	52.2	–29.2	Median	–1.2	–3.2	–5.2	–6.2	–7.2	–7.2	–7.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2	–8.2
						Worst	5.8	–0.2	–0.2	–1.2	–2.2	–1.2	–0.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2	–2.2
	[15] Community reception (w/saturation)	3	–29.4	82.7	–59.7	Median	–31.7	–33.7	–35.7	–36.7	–37.7	–37.7	–37.7	–38.7	–38.7	–38.7	–38.7	–38.7	–38.7	–38.7	–38.7	–38.7	–38.7	–38.7	–38.7
						Worst	–24.7	–30.7	–30.7	–31.7	–32.7	–31.7	–30.7	–32.7	–32.7	–32.7	–32.7	–32.7	–32.7	–32.7	–32.7	–32.7	–32.7	–32.7	–32.7
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	51	5.8	63.2	–40.2	Median	–13.2	–21.2	–24.2	–29.2	–25.2	–26.2	–27.2	–28.2	–29.2	–30.2	–31.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
						Worst	–2.2	–5.2	–7.2	–7.2	–9.2	–10.2	–11.2	–12.2	–13.2	–13.2	–13.2	–15.2	–17.2	–21.2	–22.2	–23.2	–26.2	–27.2	–28.2
	[10] Portable terminal (indoors)	51	–4.2	73.2	–50.2	Median	–23.2	–31.2	–34.2	–39.2	–35.2	–36.2	–37.2	–38.2	–39.2	–40.2	–41.2	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)
						Worst	–12.2	–15.2	–17.2	–17.2	–19.2	–20.2	–21.2	–22.2	–23.2	–23.2	–23.2	–25.2	–27.2	–31.2	–32.2	–33.2	–36.2	–37.2	–38.2
	[11] Mobile terminal (bus) (3 m H)	51	6.9	62.1	–39.1	Median	–12.1	–20.1	–23.1	–28.1	–24.1	–25.1	–26.1	–27.1	–28.1	–29.1	–30.1	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)
						Worst	–1.1	–4.1	–6.1	–6.1	–8.1	–9.1	–10.1	–11.1	–12.1	–12.1	–12.1	–14.1	–16.1	–20.1	–21.1	–22.1	–25.1	–26.1	–27.1
	[12] Mobile terminal (private vehicle) (1.5 m H)	51	5.8	63.2	–40.2	Median	–13.2	–21.2	–24.2	–29.2	–25.2	–26.2	–27.2	–28.2	–29.2	–30.2	–31.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
						Worst	–2.2	–5.2	–7.2	–7.2	–9.2	–10.2	–11.2	–12.2	–13.2	–13.2	–13.2	–15.2	–17.2	–21.2	–22.2	–23.2	–26.2	–27.2	–28.2

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-23

Required improvement for video failure limit value for out-of-band interference

IMT uplink IMT land mobile station (for outdoor area) to DTTB (DTTB signal: –65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	22	21.7	47.3	–24.3	Median	–0.3	–7.3	–10.3	–13.3	–11.3	–11.3	–12.3	–13.3	–14.3	–15.3	–14.3	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)
						Worst	13.7	8.7	8.7	7.7	5.7	4.7	3.7	2.7	1.7	1.7	1.7	–0.3	–2.3	–5.3	–8.3	–8.3	–8.3	–13.3	–13.3
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	22	9	44.3	–21.3	Median	4.7	1.7	1.7	–0.3	–1.3	–1.3	–2.3	–1.3	–1.3	–1.3	–1.3	–1.3	–1.3	1.7	–1.3	–1.3	2.7	–1.3	–1.3
						Worst	8.7	6.7	5.7	5.7	4.7	5.7	4.7	5.7	4.7	5.7	5.7	4.7	5.7	4.7	4.7	4.7	4.7	4.7	5.7
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	45	1.1	52.2	–29.2	Median	–3.2	–6.2	–6.2	–8.2	–9.2	–9.2	–10.2	–9.2	–9.2	–9.2	–9.2	–9.2	–9.2	–6.2	–9.2	–9.2	–5.2	–9.2	–9.2
						Worst	0.8	–1.2	–2.2	–2.2	–3.2	–2.2	–3.2	–2.2	–3.2	–2.2	–2.2	–3.2	–2.2	–3.2	–3.2	–3.2	–3.2	–3.2	–2.2
	[15] Community reception (w/saturation)	3	–29.4	82.7	–59.7	Median	–33.7	–36.7	–36.7	–38.7	–39.7	–39.7	–40.7	–39.7	–39.7	–39.7	–39.7	–39.7	–39.7	–36.7	–39.7	–39.7	–35.7	–39.7	–39.7
						Worst	–29.7	–31.7	–32.7	–32.7	–33.7	–32.7	–33.7	–32.7	–33.7	–32.7	–32.7	–33.7	–32.7	–33.7	–33.7	–33.7	–33.7	–33.7	–32.7
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	51	5.8	63.2	–40.2	Median	–16.2	–23.2	–26.2	–29.2	–27.2	–27.2	–28.2	–29.2	–30.2	–31.2	–30.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
						Worst	–2.2	–7.2	–7.2	–8.2	–10.2	–11.2	–12.2	–13.2	–14.2	–14.2	–14.2	–16.2	–18.2	–21.2	–24.2	–24.2	–24.2	–29.2	–29.2
	[10] Portable terminal (indoors)	51	–4.2	73.2	–50.2	Median	–26.2	–33.2	–36.2	–39.2	–37.2	–37.2	–38.2	–39.2	–40.2	–41.2	–40.2	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)
						Worst	–12.2	–17.2	–17.2	–18.2	–20.2	–21.2	–22.2	–23.2	–24.2	–24.2	–24.2	–26.2	–28.2	–31.2	–34.2	–34.2	–34.2	–39.2	–39.2
	[11] Mobile terminal (bus) (3 m H)	51	6.9	62.1	–39.1	Median	–15.1	–22.1	–25.1	–28.1	–26.1	–26.1	–27.1	–28.1	–29.1	–30.1	–29.1	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)
						Worst	–1.1	–6.1	–6.1	–7.1	–9.1	–10.1	–11.1	–12.1	–13.1	–13.1	–13.1	–15.1	–17.1	–20.1	–23.1	–23.1	–23.1	–28.1	–28.1
	[12] Mobile terminal (private vehicle) (1.5 m H)	51	5.8	63.2	–40.2	Median	–16.2	–23.2	–26.2	–29.2	–27.2	–27.2	–28.2	–29.2	–30.2	–31.2	–30.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
						Worst	–2.2	–7.2	–7.2	–8.2	–10.2	–11.2	–12.2	–13.2	–14.2	–14.2	–14.2	–16.2	–18.2	–21.2	–24.2	–24.2	–24.2	–29.2	–29.2

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-24

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT land mobile station (for outdoor area) to DTTB (DTTB signal: –40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	22	21.7	47.3	–24.3	Median	–11.3	–14.3	–14.3	–15.3	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)
						Worst	–11.3	–12.3	–14.3	–15.3	–12.3	–12.3	–13.3	–14.3	–15.3	–15.3	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)	(–16.3)
	[3] Home TV simple ANT w/o LNA (5 m H)	45	–0.4	53.2	–30.2	Median	–17.2	–20.2	–20.2	–21.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
						Worst	–17.2	–18.2	–20.2	–21.2	–18.2	–18.2	–19.2	–20.2	–21.2	–21.2	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)	(–22.2)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	22	9	44.3	–21.3	Median	–0.3	–1.3	–2.3	–2.3	–2.3	–2.3	–4.3	–2.3	–2.3	–1.3	–1.3	–1.3	–1.3	1.7	–1.3	–1.3	2.7	–1.3	–1.3
						Worst	5.7	5.7	5.7	4.7	4.7	4.7	3.7	4.7	4.7	4.7	4.7	4.7	4.7	3.7	4.7	4.7	5.7	4.7	4.7
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	45	1.1	52.2	–29.2	Median	–8.2	–9.2	–10.2	–10.2	–10.2	–10.2	–12.2	–10.2	–10.2	–9.2	–9.2	–9.2	–9.2	–6.2	–9.2	–9.2	–5.2	–9.2	–9.2
						Worst	–2.2	–2.2	–2.2	–3.2	–3.2	–3.2	–4.2	–3.2	–3.2	–3.2	–3.2	–3.2	–3.2	–4.2	–3.2	–3.2	–2.2	–3.2	–3.2
	[15] Community reception (w/saturation)	3	–29.4	82.7	–59.7	Median	–38.7	–39.7	–40.7	–40.7	–40.7	–40.7	–42.7	–40.7	–40.7	–39.7	–39.7	–39.7	–39.7	–36.7	–39.7	–39.7	–35.7	–39.7	–39.7
						Worst	–32.7	–32.7	–32.7	–33.7	–33.7	–33.7	–34.7	–33.7	–33.7	–33.7	–33.7	–33.7	–33.7	–34.7	–33.7	–33.7	–32.7	–33.7	–33.7
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	50	–13.6	66.4	–43.4	Median	–30.4	–33.4	–33.4	–34.4	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)
						Worst	–30.4	–31.4	–33.4	–34.4	–31.4	–31.4	–32.4	–33.4	–34.4	–34.4	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)	(–35.4)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	51	5.8	63.2	–40.2	Median	–27.2	–30.2	–30.2	–31.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
						Worst	–27.2	–28.2	–30.2	–31.2	–28.2	–28.2	–29.2	–30.2	–31.2	–31.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
	[10] Portable terminal (indoors)	51	–4.2	73.2	–50.2	Median	–37.2	–40.2	–40.2	–41.2	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)
						Worst	–37.2	–38.2	–40.2	–41.2	–38.2	–38.2	–39.2	–40.2	–41.2	–41.2	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)	(–42.2)
	[11] Mobile terminal (bus) (3 m H)	51	6.9	62.1	–39.1	Median	–26.1	–29.1	–29.1	–30.1	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)
						Worst	–26.1	–27.1	–29.1	–30.1	–27.1	–27.1	–28.1	–29.1	–30.1	–30.1	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)	(–31.1)
	[12] Mobile terminal (private vehicle) (1.5 m H)	51	5.8	63.2	–40.2	Median	–27.2	–30.2	–30.2	–31.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)
						Worst	–27.2	–28.2	–30.2	–31.2	–28.2	–28.2	–29.2	–30.2	–31.2	–31.2	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)	(–32.2)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-25

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT land mobile station (for outdoor area) to DTTB (DTTB signal: –40 dBm/6 MHz)
Models [2], [4] and [6] (Weal field strength for DTTB)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	22	25.7	9.3	13.7	Median	26.7	23.7	23.7	22.7	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)
						Worst	26.7	25.7	23.7	22.7	25.7	25.7	24.7	23.7	22.7	22.7	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)	(21.7)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	45	9.6	15.2	7.8	Median	20.8	17.8	17.8	16.8	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)
						Worst	20.8	19.8	17.8	16.8	19.8	19.8	18.8	17.8	16.8	16.8	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)	(15.8)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	50	–3.6	28.4	–5.4	Median	7.6	4.6	4.6	3.6	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)
						Worst	7.6	6.6	4.6	3.6	6.6	6.6	5.6	4.6	3.6	3.6	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)	(2.6)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-26

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT land mobile station (Integral type for outdoor area) to DTTB (DTTB signal: –77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoor	[1] Home TV Yagi ANT w/o LNA (10 m H)	30	8.7	57.7	–37.3	Median	–10.3	–18.3	–21.3	–26.3	–22.3	–23.3	–24.3	–25.3	–26.3	–27.3	–28.3	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)
						Worst	0.7	–2.3	–4.3	–4.3	–6.3	–7.3	–8.3	–9.3	–10.3	–10.3	–10.3	–12.3	–14.3	–18.3	–19.3	–20.3	–23.3	–24.3	–25.3
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	30	–4	54.7	–34.3	Median	–6.3	–8.3	–10.3	–11.3	–12.3	–12.3	–12.3	–13.3	–13.3	–13.3	–13.3	–13.3	–13.3	–13.3	–13.3	–13.3	–13.3	–13.3	–13.3
						Worst	0.7	–5.3	–5.3	–6.3	–7.3	–6.3	–5.3	–7.3	–7.3	–7.3	–7.3	–7.3	–7.3	–7.3	–7.3	–7.3	–7.3	–7.3	–7.3
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	9	3.2	47.5	–27.1	Median	0.9	–1.1	–3.1	–4.1	–5.1	–5.1	–5.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1	–6.1
						Worst	7.9	1.9	1.9	0.9	–0.1	0.9	1.9	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	23.4	43	–22.6	Median	4.4	–3.6	–6.6	–11.6	–7.6	–8.6	–9.6	–10.6	–11.6	–12.6	–13.6	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)
						Worst	15.4	12.4	10.4	10.4	8.4	7.4	6.4	5.4	4.4	4.4	4.4	2.4	0.4	–3.6	–4.6	–5.6	–8.6	–9.6	–10.6
	[10] Portable terminal (indoors)	1	35.9	30.5	–10.1	Median	16.9	8.9	5.9	0.9	4.9	3.9	2.9	1.9	0.9	–0.1	–1.1	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)
						Worst	27.9	24.9	22.9	22.9	20.9	19.9	18.9	17.9	16.9	16.9	16.9	14.9	12.9	8.9	7.9	6.9	3.9	2.9	1.9
	[11] Mobile terminal (bus) (3 m H)	3	20.6	45.8	–25.4	Median	1.6	–6.4	–9.4	–14.4	–10.4	–11.4	–12.4	–13.4	–14.4	–15.4	–16.4	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)
						Worst	12.6	9.6	7.6	7.6	5.6	4.6	3.6	2.6	1.6	1.6	1.6	–0.4	–2.4	–6.4	–7.4	–8.4	–11.4	–12.4	–13.4
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	23.4	43	–22.6	Median	4.4	–3.6	–6.6	–11.6	–7.6	–8.6	–9.6	–10.6	–11.6	–12.6	–13.6	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)
						Worst	15.4	12.4	10.4	10.4	8.4	7.4	6.4	5.4	4.4	4.4	4.4	2.4	0.4	–3.6	–4.6	–5.6	–8.6	–9.6	–10.6

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-27

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT land mobile station (Integral type for outdoor area) to DTTB (DTTB signal: –65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoor	[1] Home TV Yagi ANT w/o LNA (10 m H)	30	8.7	57.7	–37.3	Median	–13.3	–20.3	–23.3	–26.3	–24.3	–24.3	–25.3	–26.3	–27.3	–28.3	–27.3	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)
						Worst	0.7	–4.3	–4.3	–5.3	–7.3	–8.3	–9.3	–10.3	–11.3	–11.3	–11.3	–13.3	–15.3	–18.3	–21.3	–21.3	–21.3	–26.3	–26.3
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	30	–4	54.7	–34.3	Median	–8.3	–11.3	–11.3	–13.3	–14.3	–14.3	–15.3	–14.3	–14.3	–14.3	–14.3	–14.3	–14.3	–11.3	–14.3	–14.3	–10.3	–14.3	–14.3
						Worst	–4.3	–6.3	–7.3	–7.3	–8.3	–7.3	–8.3	–7.3	–8.3	–7.3	–7.3	–8.3	–7.3	–8.3	–8.3	–8.3	–8.3	–8.3	–7.3
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	9	3.2	47.5	–27.1	Median	–1.1	–4.1	–4.1	–6.1	–7.1	–7.1	–8.1	–7.1	–7.1	–7.1	–7.1	–7.1	–7.1	–4.1	–7.1	–7.1	–3.1	–7.1	–7.1
						Worst	2.9	0.9	–0.1	–0.1	–1.1	–0.1	–1.1	–0.1	–1.1	–0.1	–0.1	–1.1	–0.1	–1.1	–1.1	–1.1	–1.1	–1.1	–0.1
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	23.4	43	–22.6	Median	1.4	–5.6	–8.6	–11.6	–9.6	–9.6	–10.6	–11.6	–12.6	–13.6	–12.6	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)
						Worst	15.4	10.4	10.4	9.4	7.4	6.4	5.4	4.4	3.4	3.4	3.4	1.4	–0.6	–3.6	–6.6	–6.6	–6.6	–11.6	–11.6
	[10] Portable terminal (indoors)	1	35.9	30.5	–10.1	Median	13.9	6.9	3.9	0.9	2.9	2.9	1.9	0.9	–0.1	–1.1	–0.1	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)
						Worst	27.9	22.9	22.9	21.9	19.9	18.9	17.9	16.9	15.9	15.9	15.9	13.9	11.9	8.9	5.9	5.9	5.9	0.9	0.9
	[11] Mobile terminal (bus) (3 m H)	3	20.6	45.8	–25.4	Median	–1.4	–8.4	–11.4	–14.4	–12.4	–12.4	–13.4	–14.4	–15.4	–16.4	–15.4	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)
						Worst	12.6	7.6	7.6	6.6	4.6	3.6	2.6	1.6	0.6	0.6	0.6	–1.4	–3.4	–6.4	–9.4	–9.4	–9.4	–14.4	–14.4
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	23.4	43	–22.6	Median	1.4	–5.6	–8.6	–11.6	–9.6	–9.6	–10.6	–11.6	–12.6	–13.6	–12.6	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)
						Worst	15.4	10.4	10.4	9.4	7.4	6.4	5.4	4.4	3.4	3.4	3.4	1.4	–0.6	–3.6	–6.6	–6.6	–6.6	–11.6	–11.6

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-28

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT land mobile station (Integral type for outdoor area) to DTTB (DTTB signal: –40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	30	8.7	57.7	–37.3	Median	–24.3	–27.3	–27.3	–28.3	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)
						Worst	–24.3	–25.3	–27.3	–28.3	–25.3	–25.3	–26.3	–27.3	–28.3	–28.3	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)	(–29.3)
	[3] Home TV simple ANT w/o LNA (5 m H)	9	1.7	48.5	–28.1	Median	–15.1	–18.1	–18.1	–19.1	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)
						Worst	–15.1	–16.1	–18.1	–19.1	–16.1	–16.1	–17.1	–18.1	–19.1	–19.1	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)	(–20.1)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	30	–4	54.7	–34.3	Median	–13.3	–14.3	–15.3	–15.3	–15.3	–15.3	–17.3	–15.3	–15.3	–14.3	–14.3	–14.3	–14.3	–11.3	–14.3	–14.3	–10.3	–14.3	–14.3
						Worst	–7.3	–7.3	–7.3	–8.3	–8.3	–8.3	–9.3	–8.3	–8.3	–8.3	–8.3	–8.3	–8.3	–9.3	–8.3	–8.3	–7.3	–8.3	–8.3
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	9	3.2	47.5	–27.1	Median	–6.1	–7.1	–8.1	–8.1	–8.1	–8.1	–10.1	–8.1	–8.1	–7.1	–7.1	–7.1	–7.1	–4.1	–7.1	–7.1	–3.1	–7.1	–7.1
						Worst	–0.1	–0.1	–0.1	–1.1	–1.1	–1.1	–2.1	–1.1	–1.1	–1.1	–1.1	–1.1	–1.1	–2.1	–1.1	–1.1	–0.1	–1.1	–1.1
	[15] Community reception (w/saturation)	–	–	–	–	Median	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
						Worst	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	3	21.3	28.9	–8.5	Median	4.5	1.5	1.5	0.5	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)
						Worst	4.5	3.5	1.5	0.5	3.5	3.5	2.5	1.5	0.5	0.5	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)	(–0.5)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	3	23.4	43	–22.6	Median	–9.6	–12.6	–12.6	–13.6	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)
						Worst	–9.6	–10.6	–12.6	–13.6	–10.6	–10.6	–11.6	–12.6	–13.6	–13.6	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)
	[10] Portable terminal (indoors)	1	35.9	30.5	–10.1	Median	2.9	–0.1	–0.1	–1.1	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)
						Worst	2.9	1.9	–0.1	–1.1	1.9	1.9	0.9	–0.1	–1.1	–1.1	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)	(–2.1)
	[11] Mobile terminal (bus) (3 m H)	3	20.6	45.8	–25.4	Median	–12.4	–15.4	–15.4	–16.4	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)
						Worst	–12.4	–13.4	–15.4	–16.4	–13.4	–13.4	–14.4	–15.4	–16.4	–16.4	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)	(–17.4)
	[12] Mobile terminal (private vehicle) (1.5 m H)	3	23.4	43	–22.6	Median	–9.6	–12.6	–12.6	–13.6	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)
						Worst	–9.6	–10.6	–12.6	–13.6	–10.6	–10.6	–11.6	–12.6	–13.6	–13.6	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)	(–14.6)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-29

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT land mobile station (Integral type for outdoor area) to DTTB (DTTB signal: –40 dBm/6 MHz)
Models [2], [4] and [6] (Weak field strength for DTTB)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	30	12.7	19.7	0.7	Median	13.7	10.7	10.7	9.7	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)
						Worst	13.7	12.7	10.7	9.7	12.7	12.7	11.7	10.7	9.7	9.7	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)	(8.7)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	9	11.7	10.5	9.9	Median	22.9	19.9	19.9	18.9	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)
						Worst	22.9	21.9	19.9	18.9	21.9	21.9	20.9	19.9	18.9	18.9	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	3	31.3	–9.1	29.5	Median	42.5	39.5	39.5	38.5	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)
						Worst	42.5	41.5	39.5	38.5	41.5	41.5	40.5	39.5	38.5	38.5	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)	(37.5)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-30

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT land mobile station (Separate type for outdoor area) to DTTB (DTTB signal: –77 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoor	[1] Home TV Yagi ANT w/o LNA (10 m H)	7	25.8	40.6	–20.2	Median	6.8	–1.2	–4.2	–9.2	–5.2	–6.2	–7.2	–8.2	–9.2	–10.2	–11.2	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)
						Worst	17.8	14.8	12.8	12.8	10.8	9.8	8.8	7.8	6.8	6.8	6.8	4.8	2.8	–1.2	–2.2	–3.2	–6.2	–7.2	–8.2
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	7	13.1	37.6	–17.2	Median	10.8	8.8	6.8	5.8	4.8	4.8	4.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
						Worst	17.8	11.8	11.8	10.8	9.8	10.8	11.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	15	–1.2	51.9	–31.5	Median	–3.5	–5.5	–7.5	–8.5	–9.5	–9.5	–9.5	–10.5	–10.5	–10.5	–10.5	–10.5	–10.5	–10.5	–10.5	–10.5	–10.5	–10.5	–10.5
						Worst	3.5	–2.5	–2.5	–3.5	–4.5	–3.5	–2.5	–4.5	–4.5	–4.5	–4.5	–4.5	–4.5	–4.5	–4.5	–4.5	–4.5	–4.5	–4.5
	[15] Community reception (w/saturation)	3	–30	80.7	–60.3	Median	–32.3	–34.3	–36.3	–37.3	–38.3	–38.3	–38.3	–39.3	–39.3	–39.3	–39.3	–39.3	–39.3	–39.3	–39.3	–39.3	–39.3	–39.3	–39.3
						Worst	–25.3	–31.3	–31.3	–32.3	–33.3	–32.3	–31.3	–33.3	–33.3	–33.3	–33.3	–33.3	–33.3	–33.3	–33.3	–33.3	–33.3	–33.3	–33.3
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	25	2	64.4	–44	Median	–17.0	–25.0	–28.0	–33.0	–29.0	–30.0	–31.0	–32.0	–33.0	–34.0	–35.0	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)
						Worst	–6.0	–9.0	–11.0	–11.0	–13.0	–14.0	–15.0	–16.0	–17.0	–17.0	–17.0	–19.0	–21.0	–25.0	–26.0	–27.0	–30.0	–31.0	–32.0
	[10] Portable terminal (indoors)	25	–8	74.4	–54	Median	–27.0	–35.0	–38.0	–43.0	–39.0	–40.0	–41.0	–42.0	–43.0	–44.0	–45.0	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)
						Worst	–16.0	–19.0	–21.0	–21.0	–23.0	–24.0	–25.0	–26.0	–27.0	–27.0	–27.0	–29.0	–31.0	–35.0	–36.0	–37.0	–40.0	–41.0	–42.0
	[11] Mobile terminal (bus) (3 m H)	20	3.7	62.7	–42.3	Median	–15.3	–23.3	–26.3	–31.3	–27.3	–28.3	–29.3	–30.3	–31.3	–32.3	–33.3	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)
						Worst	–4.3	–7.3	–9.3	–9.3	–11.3	–12.3	–13.3	–14.3	–15.3	–15.3	–15.3	–17.3	–19.3	–23.3	–24.3	–25.3	–28.3	–29.3	–30.3
	[12] Mobile terminal (private vehicle) (1.5 m H)	25	2	64.4	–44	Median	–17.0	–25.0	–28.0	–33.0	–29.0	–30.0	–31.0	–32.0	–33.0	–34.0	–35.0	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)
						Worst	–6.0	–9.0	–11.0	–11.0	–13.0	–14.0	–15.0	–16.0	–17.0	–17.0	–17.0	–19.0	–21.0	–25.0	–26.0	–27.0	–30.0	–31.0	–32.0

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-31

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT land mobile station (Separate type for outdoor area) to DTTB (DTTB signal: –65 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoor	[1] Home TV Yagi ANT w/o LNA (10 m H)	7	25.8	40.6	–20.2	Median	3.8	–3.2	–6.2	–9.2	–7.2	–7.2	–8.2	–9.2	–10.2	–11.2	–10.2	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)
						Worst	17.8	12.8	12.8	11.8	9.8	8.8	7.8	6.8	5.8	5.8	5.8	3.8	1.8	–1.2	–4.2	–4.2	–4.2	–9.2	–9.2
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	7	13.1	37.6	–17.2	Median	8.8	5.8	5.8	3.8	2.8	2.8	1.8	2.8	2.8	2.8	2.8	2.8	2.8	5.8	2.8	2.8	6.8	2.8	2.8
						Worst	12.8	10.8	9.8	9.8	8.8	9.8	8.8	9.8	8.8	9.8	9.8	8.8	9.8	8.8	8.8	8.8	8.8	8.8	9.8
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	15	–1.2	51.9	–31.5	Median	–5.5	–8.5	–8.5	–10.5	–11.5	–11.5	–12.5	–11.5	–11.5	–11.5	–11.5	–11.5	–11.5	–8.5	–11.5	–11.5	–7.5	–11.5	–11.5
						Worst	–1.5	–3.5	–4.5	–4.5	–5.5	–4.5	–5.5	–4.5	–5.5	–4.5	–4.5	–5.5	–4.5	–5.5	–5.5	–5.5	–5.5	–5.5	–4.5
	[15] Community reception (w/saturation)	3	–30	80.7	–60.3	Median	–34.3	–37.3	–37.3	–39.3	–40.3	–40.3	–41.3	–40.3	–40.3	–40.3	–40.3	–40.3	–40.3	–37.3	–40.3	–40.3	–36.3	–40.3	–40.3
						Worst	–30.3	–32.3	–33.3	–33.3	–34.3	–33.3	–34.3	–33.3	–34.3	–33.3	–33.3	–34.3	–33.3	–34.3	–34.3	–34.3	–34.3	–34.3	–33.3
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	25	2	64.4	–44	Median	–20.0	–27.0	–30.0	–33.0	–31.0	–31.0	–32.0	–33.0	–34.0	–35.0	–34.0	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)
						Worst	–6.0	–11.0	–11.0	–12.0	–14.0	–15.0	–16.0	–17.0	–18.0	–18.0	–18.0	–20.0	–22.0	–25.0	–28.0	–28.0	–28.0	–33.0	–33.0
	[10] Portable terminal (indoors)	25	–8	74.4	–54	Median	–30.0	–37.0	–40.0	–43.0	–41.0	–41.0	–42.0	–43.0	–44.0	–45.0	–44.0	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)
						Worst	–16.0	–21.0	–21.0	–22.0	–24.0	–25.0	–26.0	–27.0	–28.0	–28.0	–28.0	–30.0	–32.0	–35.0	–38.0	–38.0	–38.0	–43.0	–43.0
	[11] Mobile terminal (bus) (3 m H)	20	3.7	62.7	–42.3	Median	–18.3	–25.3	–28.3	–31.3	–29.3	–29.3	–30.3	–31.3	–32.3	–33.3	–32.3	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)
						Worst	–4.3	–9.3	–9.3	–10.3	–12.3	–13.3	–14.3	–15.3	–16.3	–16.3	–16.3	–18.3	–20.3	–23.3	–26.3	–26.3	–26.3	–31.3	–31.3
	[12] Mobile terminal (private vehicle) (1.5 m H)	25	2	64.4	–44	Median	–20.0	–27.0	–30.0	–33.0	–31.0	–31.0	–32.0	–33.0	–34.0	–35.0	–34.0	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)
						Worst	–6.0	–11.0	–11.0	–12.0	–14.0	–15.0	–16.0	–17.0	–18.0	–18.0	–18.0	–20.0	–22.0	–25.0	–28.0	–28.0	–28.0	–33.0	–33.0

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-32

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT land mobile station (Separate type for outdoor area) to DTTB (DTTB signal: –40 dBm/6 MHz)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 63 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	7	25.8	40.6	–20.2	Median	–7.2	–10.2	–10.2	–11.2	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)
						Worst	–7.2	–8.2	–10.2	–11.2	–8.2	–8.2	–9.2	–10.2	–11.2	–11.2	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)	(–12.2)
	[3] Home TV simple ANT w/o LNA (5 m H)	15	–2.7	52.9	–32.5	Median	–19.5	–22.5	–22.5	–23.5	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)
						Worst	–19.5	–20.5	–22.5	–23.5	–20.5	–20.5	–21.5	–22.5	–23.5	–23.5	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)	(–24.5)
	[7] Home TV Yagi ANT w/LNA (10 m H) (w/saturation)	7	13.1	37.6	–17.2	Median	3.8	2.8	1.8	1.8	1.8	1.8	–0.2	1.8	1.8	2.8	2.8	2.8	2.8	5.8	2.8	2.8	6.8	2.8	2.8
						Worst	9.8	9.8	9.8	8.8	8.8	8.8	7.8	8.8	8.8	8.8	8.8	8.8	8.8	7.8	8.8	8.8	9.8	8.8	8.8
	[8] Home TV simple ANT w/LNA (5 m H) (w/saturation)	15	–1.2	51.9	–31.5	Median	–10.5	–11.5	–12.5	–12.5	–12.5	–12.5	–14.5	–12.5	–12.5	–11.5	–11.5	–11.5	–11.5	–8.5	–11.5	–11.5	–7.5	–11.5	–11.5
						Worst	–4.5	–4.5	–4.5	–5.5	–5.5	–5.5	–6.5	–5.5	–5.5	–5.5	–5.5	–5.5	–5.5	–6.5	–5.5	–5.5	–4.5	–5.5	–5.5
	[15] Community reception (w/saturation)	3	–30	80.7	–60.3	Median	–39.3	–40.3	–41.3	–41.3	–41.3	–41.3	–43.3	–41.3	–41.3	–40.3	–40.3	–40.3	–40.3	–37.3	–40.3	–40.3	–36.3	–40.3	–40.3
						Worst	–33.3	–33.3	–33.3	–34.3	–34.3	–34.3	–35.3	–34.3	–34.3	–34.3	–34.3	–34.3	–34.3	–35.3	–34.3	–34.3	–33.3	–34.3	–34.3
Indoors	[5] Home TV simple indoor ANT w/o LNA (1 m H)	29	–17.8	68	–47.6	Median	–34.6	–37.6	–37.6	–38.6	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)
						Worst	–34.6	–35.6	–37.6	–38.6	–35.6	–35.6	–36.6	–37.6	–38.6	–38.6	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)	(–39.6)
Portable/mobile	[9] Portable terminal (outdoors) (1.5 m H)	25	2	64.4	–44	Median	–31.0	–34.0	–34.0	–35.0	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)
						Worst	–31.0	–32.0	–34.0	–35.0	–32.0	–32.0	–33.0	–34.0	–35.0	–35.0	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)
	[10] Portable terminal (indoors)	25	–8	74.4	–54	Median	–41.0	–44.0	–44.0	–45.0	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)
						Worst	–41.0	–42.0	–44.0	–45.0	–42.0	–42.0	–43.0	–44.0	–45.0	–45.0	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)	(–46.0)
	[11] Mobile terminal (bus) (3 m H)	20	3.7	62.7	–42.3	Median	–29.3	–32.3	–32.3	–33.3	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)
						Worst	–29.3	–30.3	–32.3	–33.3	–30.3	–30.3	–31.3	–32.3	–33.3	–33.3	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)	(–34.3)
	[12] Mobile terminal (private vehicle) (1.5 m H)	25	2	64.4	–44	Median	–31.0	–34.0	–34.0	–35.0	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)
						Worst	–31.0	–32.0	–34.0	–35.0	–32.0	–32.0	–33.0	–34.0	–35.0	–35.0	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)	(–36.0)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-33

Required improvement for video failure limit value in out-of-band interference

IMT uplink IMT land mobile station (Separate type for outdoor area) to DTTB (DTTB signal: –40 dBm/6 MHz)
Models [2], [4] and [6] (Weak field strength for DTTB)

		Horizontal distance of separation (m)	Required improvement in Table 3.4.1-1 (GB = 0 MHz) (dB)	Coupled amount (dB)	IMT maximum input level (dBm)	Median/ Worst	Required improvement for video failure limit value (GB = 8 MHz) (dB)																		
							ch. 52	ch. 51	ch. 50	ch. 49	ch. 48	ch. 47	ch. 46	ch. 45	ch. 44	ch. 43	ch. 42	ch. 41	ch. 36	ch. 29	ch. 27	ch. 26	ch. 19	ch. 15	ch. 13
Outdoors	[2] Home TV Yagi ANT w/LNA (10 m H) (w/o saturation)	7	29.8	2.6	17.8	Median	30.8	27.8	27.8	26.8	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)
						Worst	30.8	29.8	27.8	26.8	29.8	29.8	28.8	27.8	26.8	26.8	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)	(25.8)
	[4] Home TV simple ANT w/LNA (5 m H) (w/o saturation)	15	7.3	14.9	5.5	Median	18.5	15.5	15.5	14.5	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)
						Worst	18.5	17.5	15.5	14.5	17.5	17.5	16.5	15.5	14.5	14.5	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)	(13.5)
Indoors	[6] Home TV simple indoor ANT w/LNA (1 m H) (w/o saturation)	29	–7.8	30	–9.6	Median	3.4	0.4	0.4	–0.6	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)
						Worst	3.4	2.4	0.4	–0.6	2.4	2.4	1.4	0.4	–0.6	–0.6	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)	(–1.6)

* Numerical values in parentheses indicate that the required improvement is less than the relevant numerical value.

TABLE 3.4.2-34

Required improvement of image interference

IMT uplink to DTTB (DTTB signal: –65 dBm/6 MHz)

IMT uplink to DTTB receiver			Giving interference IMT uplink transmission																														
			II – a					II – b					II – c					II – d					II – e					II – f				
			IMT mobile station					IMT small-powered repeater (integral type)					IMT small-powered repeater (separate type)					IMT land mobile station (For outdoor area)					IMT land mobile station (Integral type for outdoor area)					IMT land mobile station (Separate type for outdoor area)				
			Horizontal separation distance (m)	IMT max. input level (dBm)	Required improvement for video failure limit value (dB)			Horizontal separation distance (m)	IMT max. input level (dBm)	Required improvement for video failure limit value (dB)			Horizontal separation distance (m)	IMT max. input level (dBm)	Required improvement for video failure limit value (dB)			Horizontal separation distance (m)	IMT max. input level (dBm)	Required improvement for video failure limit value (dB)			Horizontal separation distance (m)	IMT max. input level (dBm)	Required improvement for video failure limit value (dB)			Horizontal separation distance (m)	IMT max. input level (dBm)	Required improvement for video failure limit value (dB)		
					Previous study	Additional study result				Previous study	Additional study result				Previous study	Additional study result				Previous study	Additional study result				Previous study	Additional study result				Previous study	Additional study result	
						ch. 36	ch. 15				ch. 36	ch. 15				ch. 36	ch. 15				ch. 36	ch. 15				ch. 36	ch. 15				ch. 36	ch. 15
Giving interference DTTB reception	Outdoors	[1] Home TV Yagi ANT w/o LNA (10 m H)	22	–37	1.8	–6.7	–13	25	–39	1.2	–8.5	–15	19	–37	3.1	–6.6	–13	22	–24	15.4	5.7	–0.3	30	–37	2.3	–7.3	–13	7	–20	19.4	9.8	3.8
	Portable mobile	[9] Portable terminal (Outdoors) (1.5 m H)	0.5	–8.4	30.1	21.6	15.6	3	–24	15.3	5.6	–0.4	6	–37	3	–6.7	–13	51	–40	–0.5	–10	–16	3	–23	17.1	7.4	1.4	25	–44	–4.3	–14	–20
		[10] Portable terminal (Indoors)	0.5	–8.4	30.1	21.6	15.6	1	–8	31.7	22	16	6	–47	–7	–17	–23	51	–50	–11	–20	–26	1	–10	29.6	19.9	13.9	25	–54	–14	–24	–30
		[11] Mobile terminal (Bus) (3 m H)	0.5	–18	20.1	11.6	5.6	3	–26	13.7	4.1	–1.9	3	–32	7.9	–1.8	–7.8	51	–39	0.6	–9.1	–15	3	–25	14.2	4.6	–1.4	20	–42	–2.6	–12	–18
		[12] Mobile terminal (Private vehicle) (1.5 m H)	0.5	–8.4	30.1	21.6	15.6	3	–24	15.3	5.6	–0.4	6	–37	3	–6.7	–13	51	–40	–0.5	–10	–16	3	–23	17.1	7.4	1.4	25	–44	–4.3	–14	–20

E) Consideration related to out-of-band/image interference from IMT uplink (mobile station transmission) to DTTB

(a) TV receiver antenna outdoor installation models (Models [1] to [4], [7], [8] and [15])

Maximum value of required improvement for a video failure limit value for out-of-band interference is –40 dBm/6 MHz (after LNA) on DTTB signal input level on the model [4] which assumes a weak field strength area of DTTB, and 20.8 dB (worst characteristics model and median characteristics model) when the measurement channel is ch. 52. In addition, for the model [4], the required improvement is calculated on the assumption that IMT signal is linearly amplified by a LNA, and it is estimated that the LNA is actually saturated in light of LNA rated output. And, for image interference, the required improvement is reduced on the model [1] when DTTB signal level is –65 dBm/6 MHz, and when the measurement channels are ch. 36 and 15.

As countermeasures, it is considered to add a receiver filter to a DTTB receiving system (to add a receiver filter before LNA input to avoid LNA saturation, and further add a receiver filter between the LNA and DTTB receiver to avoid desensitization of the DTTB receiver), enhance vertical plane directionality by replacement to high performance receiver antenna, adjust the gain and insert an attenuator (when LNA is equipped). However, to take countermeasures, further consideration should be made in detail regarding a study, cost and adjustment method, etc. Considering a case that DTTB signal input level on TV receiver antenna is 10 dB larger than assumed for this model, it is predicted that approximately an additional 10 dB of loss by receiving cable and signal branch, etc., is ensured in an average general home in comparison with this model (worst case), and in this case, DTTB signal input level into DTTB receiver remains at –40 dBm/6 MHz and IMT input level decreases by 10 dB and it is estimated that the above required improvement also decreases accordingly.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. In light of the above, if the guard band is set to 8 MHz or higher, it is estimated that the required improvement relative for a video failure limit value becomes very small by taking various countermeasures.

(b) TV receiver antenna indoor installation model (Models [5], [6])

Maximum value of required improvement for a video failure limit value for out-of-band interference is –40 dBm/6 MHz (after LNA) on DTTB signal input level on the model [6] which assumes a weak field strength area of DTTB, and 39.2 dB (worst characteristics model and median characteristics model) when the measurement channel is ch. 52. In addition, for the model [6], the required improvement is calculated on the assumption that an IMT signal is linearly amplified by a LNA, and it is estimated that the LNA is actually saturated in light of LNA rated output.

In addition, this model assumes that a TV receiver antenna is installed indoors, and user of IMT mobile station and DTTB audience are in the same room. In comparison with an outdoor TV antenna installation model, it is easy to grasp a cause when influence by interference occurs on DTTB receiver and it is possible for a TV mobile station user to take action such as keeping away from DTTB receiver while using. Furthermore, in these models, separation distance between DTTB receiver and IMT mobile station is 0.7 m, and attenuation of approximately 10 dB can be further taken into account by ensuring that the separation distance is approximately 1 to 2 m for indoor propagation.

As countermeasures, it is considered to add a receiver filter to a DTTB receiving system (to add a receiver filter before LNA input to avoid LNA saturation, and further add a receiver filter between the LNA and DTTB receiver to avoid desensitization of the DTTB receiver), enhance vertical plane directionality by replacement to high performance receiver antenna, adjust the gain and insert an attenuator (when LNA is equipped). However, to take countermeasures, further consideration should be made in detail regarding a study, cost and adjustment method, etc.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. In light of the above, if the guard band is set to 8 MHz or higher, it is estimated that the required improvement for a video failure limit value becomes smaller by taking various countermeasures.

(c) Portable mobile TV reception model (Models [9] to [12])

Maximum value of required improvement for a video failure limit value is respectively –77 dBm/6 MHz and –65 dBm/6 MHz on DTTB signal input level for out-of-band interference, 29.6 dB (worst characteristics model) on models [9], [10] and [12] when the measurement channel is ch. 52, and maximum value of required improvement for a video failure limit value for image interference is 21.6 dB (worst characteristics model) on models [9], [10] and [12] when the measurement channel is ch. 36. As countermeasures for portable mobile terminal DTTB reception model, addition of a receiver filter is considered for the models [11] (bus) and [12] (private vehicle). It is necessary to consider in detail whether it is possible to manufacture a filter ensuring the required attenuation (depending on guardband) at a practical installable size and cost, and it is possible to additionally install on actual buses or private vehicles. Furthermore, use form to carry out DTTB reception while moving is a main feature for portable mobile TV reception, and it is predicted that the number of substantially occurring problems is smaller in comparison with DTTB reception in a general home, etc., if the place ratio and time ratio which are separation distance discussed in the interference consideration are taken into account.

(d) DTTB relay station reception (Models [13], [14])

Maximum value of required improvement for out-of-band interference in the studies of section 3.4.1 is improvement 28.6 dB (out-of-band interference) on the model [13]. In addition, if the required improvement is reduced only by ensuring separation distance, the required separation distance is 240 m. As countermeasures, it is estimated that mutual operation becomes possible while avoiding influence by interference, as a countermeasure, by ensuring separation distance (example: improvement of approximately 12 dB by ensuring approximately 20 m), adjusting in advance based on actual broadcast station installation environment if necessary when setting peripheral installation places of large relay stations, and ultra low power stations to IMT area, and totally considering countermeasures such as insertion of a receiver filter for a DTTB relay station reception system.

Furthermore, in addition to the studies in the above (a) to (d), for transmission power of an IMT mobile station, power is properly controlled on the actual operation depending on the distance between base station and mobile station in order to reduce battery consumption, and if the IMT terminal transmission power distribution assuming outdoor use is calculated in an urban area where the distance between the base stations is approximately 500 m, the average transmission power (accumulated probability 50% value). In this way, it is considered that transmission power of the IMT mobile station is often operated with power significantly below the maximum value, then some extent of improvement for out-of-band interference and image interference can be expected to be taken into account as an interference reduction element, however, it has to be recognized that some required improvement remains depending on the cases and may become a problem.

If it is taken into account that the worst case of separation distance where coupling loss is minimized on the giving interference side and given interference side is set on each model and extent of influence by interference depends on models, it has to be recognized that the required improvements for a video failure limit value shown in Table 3.4.2-10 to 34 are not always applied to all of the DTTB receiver and LNA associated with each model.

It is necessary to take countermeasures in the future while paying attention to disseminating the status of DTTB receiver and LNA.

F) Consideration related to out-of-band/image interference from IMT uplink (small-powered repeater base station facing device transmission) to DTTB

(a) TV receiver antenna outdoor installation models (Models [1] to [4], [7], [8] and [15])

Maximum value of required improvement for a video failure limit value for out-of-band interference is –40 dBm/6 MHz (after LNA) on DTTB signal input level on the model [4] which assumes a weak field strength area of a DTTB, and 32.8 dB (worst characteristics model and median characteristics model) when the measurement channel is ch. 52 and the interference system is a small-powered repeater (separate type). In addition, for the model [4], the required improvement is calculated on the assumption that an IMT signal is linearly amplified by a LNA, and it is estimated that the LNA is actually saturated in light of LNA rated output. And, for image interference, the required improvement is reduced on the model [1] when a DTTB signal level is –65 dBm/6 MHz, and when the measurement channels are ch. 36 and 15.

Because an uplink transmission antenna for IMT small-powered repeater is usually installed toward the outdoor direction, a certain improvement can be expected by adjusting the installation direction and installation position for the uplink transmission antenna of IMT small-powered repeater as countermeasures for a TV receiver antenna in neighborhood in a visible range of approximately 10 m (as an example, directionality attenuation in case of azimuth of 90° is approximately 25 dB: see Fig. 2.4-1). In addition, as other countermeasures, it is considered to add a receiver filter to a DTTB receiving system (to add a receiver filter before LNA input to avoid LNA saturation, and further add receiver filter between the LNA and DTTB receiver to avoid desensitization of the DTTB receiver), enhance vertical plane directionality by replacement to high performance receiver antenna, adjust the gain and insert an attenuator (when LNA is equipped). However, to take countermeasures, further consideration should be made in detail regarding a study, cost and adjustment method etc. Considering a case that a DTTB signal input level on a TV receiver antenna is 10 dB larger than assumed on this model, it is predicted that approximately an additional 10 dB of loss by receiving cable and signal branch, etc., is ensured in an average general home in comparison with this model (worst case), and in this case, DTTB signal input level into DTTB receiver remains to be –40 dBm/6 MHz and IMT input level decreases by 10 dB and it is estimated that the above required improvement also decreases accordingly.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. In light of the above, if the guard band is set to 8 MHz or higher, it is estimated that the required improvement for a video failure limit value becomes very small by taking various countermeasures.

(b) TV receiver antenna indoor installation model (Models [5] and [6])

Maximum value of required improvement for a video failure limit value for out-of-band interference is –40 dBm/6 MHz (after LNA) on DTTB signal input level on the model [6] which assumes a weak field strength area of DTTB, and 44.9 dB (worst characteristics model and median characteristics model) when the measurement channel is ch. 52 and the interference system is a small-powered repeater (separate type). In addition, for the model [6], the required improvement is calculated on the assumption that IMT signal is linearly amplified by a LNA, and it is estimated that the LNA is actually saturated in light of LNA rated output.

Because an uplink transmission antenna for IMT small-powered repeater is usually installed toward the outdoor direction, a certain improvement can be expected by adjusting the installation direction and installation position for the uplink transmission antenna of IMT small-powered repeater as countermeasures for an indoor TV receiver antenna (as an example, directionality attenuation in case of azimuth of 90° is approximately 25 dB: see Fig. 2.4-1). Furthermore, a certain improvement of approximately 10 dB by wall attenuation can also be expected by changing the equipment type from integral type to separate type. In addition, as other countermeasures, it is considered to add a receiver filter to DTTB receiving system (to add a receiver filter before LNA input to avoid LNA saturation, and further add a receiver filter between the LNA and a DTTB receiver to avoid desensitization of the DTTB receiver), enhance vertical plane directionality by replacement to high performance receiver antenna, adjust the gain and insert an attenuator (when LNA is equipped). However, to take countermeasures, further consideration should be made in detail regarding a study, cost and adjustment method, etc.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. In light of the above, if the guard band is set to 8 MHz or higher, it is estimated that the required improvement for a video failure limit value is reduced by taking various countermeasures.

(c) Portable mobile TV reception model (Models [9] to [12])

Maximum value of required improvement for a video failure limit value is respectively –77 dBm/6 MHz and –65 dBm/6 MHz on DTTB signal input level for out-of-band interference, 30 dB (worst characteristics model) on integral type to models [10] when the measurement channel is ch. 52, and maximum value of required improvement for a video failure limit value for image interference is 22 dB for worst characteristics model on integral type to models [10] when the measurement channel is ch. 36. As countermeasures for portable mobile terminal TV reception model, addition of a receiver filter is considered on the models [11] (bus) and [12] (private vehicle). It is necessary to consider in detail whether it is possible to manufacture a filter ensuring the required attenuation (depending on guardband) at a practical installable size and cost, and it is possible to additionally install on actual buses or private vehicles. Furthermore, use form to carry out DTTB reception while moving is a main feature for portable mobile TV reception, and it is predicted that the number of substantially occurring problems is smaller in comparison with DTTB reception in a general home, etc., if the place ratio and time ratio which are separation distance discussed in the interference consideration are taken into account.

(d) DTTB station relay station reception (Models [13], [14])

Maximum value of required improvement for out-of-band interference in the studies of section 3.4.1 is improvement 19.5 dB (out-of-band interference) on separate type to the model [13] (large relay station), however, it is estimated that mutual operation becomes possible while avoiding influence by interference by totally considering countermeasures such as adjustment of antenna installation position and the installation direction of IMT small-powered repeater and ensuring separation distance and insertion of a receiver filter into DTTB reception system in consideration of installation place and installation environment of actual IMT small-powered repeater, large relay station, and ultra low power station and through advance adjustment. In addition, if the required improvement is reduced only by ensuring separation distance, the required separation distance is approximately 220 m.

In addition to the above studies, for uplink direction of small-powered repeater, there exists a mobile station in the following area, and radio waves amplified with those signals are transmitted from the base station facing device, and the transmitted power is operated with power significantly lower than the maximum transmission output of the base station facing device based on the transmission power control at the mobile station. For this reason, some improvement for out-of-band interference and image interference can be estimated to be taken into account as an interference reduction element, however, it also has to be recognized that required improvement remains depending on the case and may become a problem.

If it is taken into account that the worst case of separation distance where coupling loss is minimized on the giving interference side and given interference side is set on each model and extent of influence by interference depends on models, it has to be recognized that the required improvements for a video failure limit value shown in Tables 3.4.2-10 to 34 are not always applied to all of DTTB receivers and LNA associated with each model.

It is necessary to take countermeasures in the future while paying attention to disseminating status of DTTB receivers and LNA.

G) Consideration related to out-of-band/image interference from IMT uplink (land mobile station device at other end transmission) to DTTB

(a) TV receiver antenna outdoor installation models (Models [1] to [4], [7], [8] and [15])

Maximum value of required improvement for a video failure limit value for out-of-band interference is –40 dBm/6 MHz (after LNA) on DTTB signal input level on the model [2] which assumes a weak field strength area of DTTB, and 30.8 dB (worst characteristics model and median characteristics model) when the measurement channel is ch. 52 and the interference system is a separate type for indoor areas. In addition, for the model [2], the required improvement is calculated on the assumption that an IMT signal is linearly amplified by a LNA, and it is estimated that the LNA is actually saturated in light of LNA rated output. And maximum value of required improvement for a video failure limit value for image interference is 9.8 dB (worst characteristics model) on separate type for indoor areas to model [1] when the measurement channel is ch. 36.

Because uplink transmission antenna for land mobile station (separate type for outdoor area) is usually installed toward the outdoor direction, a certain improvement can be expected by adjusting the installation direction and installation position for an uplink transmission antenna for land mobile station (separate type for outdoor area) as countermeasures for TV receiver antenna in neighborhood in a visible range of approximately 10 m (as an example, directionality attenuation in the case of azimuth of 90° is approximately 20 dB: see Fig. 2.3-4). In addition, as other countermeasures, it is considered to add a receiver filter to DTTB receiving system (to add a receiver filter before the LNA input to avoid LNA saturation, and further add a receiver filter between the LNA and DTTB receiver to avoid desensitization of the DTTB receiver), enhance vertical plane directionality by replacement to high performance receiver antenna, adjust the gain and insert an attenuator (when a LNA is equipped). However, to take countermeasures, further consideration should be made in detail regarding a study, cost and adjustment method, etc.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. In light of the above, if the guard band is set to 8 MHz or higher, it is estimated that the required improvement for a video failure limit value is reduced by taking various countermeasures.

(b) TV receiver antenna indoor installation model (Models [5], [6])

Maximum value of required improvement for a video failure limit value for out-of-band interference is –40 dBm/6 MHz (after LNA) on DTTB signal input level on the model [6] which assumes a weak field strength area of DTTB, and 42.5 dB (worst characteristics model and median characteristics model) when the measurement channel is ch. 52 and the interference system is an integral type for indoor areas. In addition, for the model [6], the required improvement is calculated on the assumption that an IMT signal is linearly amplified by a LNA, and it is estimated that the LNA is actually saturated in light of a LNA rated output.

Because an uplink transmission antenna for land mobile station is usually installed toward the outdoor direction, a certain improvement can be expected by adjusting the installation direction and installation position for an uplink transmission antenna of a land mobile station as countermeasures for an indoor TV receiver antenna (as an example, directionality attenuation in the case of azimuth of 90° is approximately 20 dB: see Fig. 2.3-4). Furthermore, a certain improvement of approximately 10 dB by wall attenuation can also be expected by changing the equipment type from integral type to separate type. In addition, as the other countermeasures, it is considered to add a receiver filter to DTTB receiving system (to add a receiver filter before LNA input to avoid LNA saturation, and further add receiver filter between the LNA and DTTB receiver to avoid desensitization of the DTTB receiver), enhance vertical plane directionality by replacement to high performance reception antenna, adjust the gain and insert an attenuator (when LNA is equipped).

However, to take countermeasures, further consideration should be made in detail about study, cost and adjustment method, etc.

The performance of the receiver filter added to DTTB receiving system is shown in Table 3.3.2-29. In light of the above, if the guard band is set to 8 MHz or higher, it is estimated that the required improvement for a video failure limit value is reduced by taking various countermeasures.

(c) Portable mobile TV reception model (Models [9] to [12])

Maximum value of required improvement for a video failure limit value is respectively –77 dBm/ 6 MHz and –65 dBm/6 MHz on DTTB signal input level for out-of-band interference, 27.9 dB (worst characteristics model) on integral type indoor areas to models [10] (indoor portable terminal) when the measurement channel is ch. 52, and maximum value of required improvement for a video failure limit value for image interference is 19.9 dB for worst characteristics model on integral type for indoor areas to models [10] when the measurement channel is ch. 36. As countermeasures for portable mobile terminal TV reception model, addition of a receiver filter is considered on the models [11] (bus) and [12] (private vehicle). It is necessary to consider in detail whether it is possible to manufacture a filter ensuring the required attenuation (depending on guardband) at practical installable size and cost size and cost, and it is possible to additionally install on actual buses or private vehicles. Furthermore, use form to carry out DTTB reception while moving is a main feature for portable mobile TV reception, and it is predicted that the number of substantially occurring problems is smaller in comparison with DTTB reception in a general home, etc., if the place ratio and time ratio which are separation distance discussed in the interference consideration are taken in account.

(d) DTTB station relay station reception (Models [13] and [14])

Maximum value of required improvement in the studies of section 3.4.1 is improvement 20.5 dB (out-of-band interference) on integral type indoor areas to the model [13] (large relay station), however, it is estimated that mutual operation becomes possible while avoiding influence by interference by totally considering countermeasures such as adjustment of antenna installation position and installation direction of IMT land mobile station and ensuring separation distance and insertion of a receiver filter into DTTB reception system in consideration of installation place and installation environment of actual IMT land mobile station, large relay station, and ultra low power station and through advance adjustment. In addition, if the required improvement is reduced only by ensuring separation distance, the required separation distance is approximately 320 m.

Furthermore, in addition to the studies in the above (a) to (d), for uplink direction of land mobile station, there exists a mobile station in the following area, and radio waves amplified with those signals are transmitted from the base station facing device only during communication, and the transmitted power is operated with power significantly lower than the maximum transmission output of the base station facing device based on the transmission power control at the mobile station. For this reason, some improvement for out-of-band interference and image interference can be estimated to be taken into account as an interference reduction element, however, it also has to be recognized that required improvement remains depending on the case and may become a problem.

If it is taken into account that the worst case of separation distance where coupling loss is minimized on the giving interference side and given interference side is set on each model and extent of influence by interference depends on models, it has to be recognized that the required improvements for a video failure limit value shown in Table 3.4.2-10 to 34 are not always applied to all of DTTB receiver and LNA associated with each model.

It is necessary to take countermeasures in the future while paying attention to disseminating the status of DTTB receiver and LNA.

4 Summary of consideration results for interference between ISDB-T and IMT in the 700 MHz band

Table 4-1 shows the minimum guardband and those conditions as a summary of consideration results for interference with DTTB.

TABLE 4-1

Summary of consideration results for interference between ISDB-T and IMT in the 700 MHz band

		Giving interference		
		DTTB (transmission)	**IMT downlink (IMT base station transmission)**	**IMT uplink (IMT mobile station transmission)**
Received interference	DTTB (reception)		Minimum guardband 60 MHz[1]	Minimum guardband 8 MHz[1]
	IMT downlink (IMT mobile station reception)	Minimum guardband 30 MHz (Horizontal separation distance 470 m) or minimum guardband 60 MHz (Horizontal separation distance 0 m)[2]		
	IMT uplink (IMT base station reception)	Minimum guardband 4 MHz (Horizontal separation distance 2.3 km) or minimum guardband 6 MHz (Horizontal separation distance 0 m)[2]		

[1] Taking appropriate mitigation techniques such as inserting proper filters into DTTB receiving system and replacing to high performance receiving antennas are also required.

[2] Taking appropriate mitigation techniques such as inserting proper filters into DTTB transmitters are also required.

Up to this point, interference has been considered based on each model, and countermeasures when influence by interference occurs have been considered. Extent of influence by interference to DTTB from IMT depends on the characteristics of DTTB receiver and LNA. Representative models which are generally and widely used and considered appropriate as evaluation targets are selected from commercially available DTTB receiver and LNA, and experiments are conducted, then reasonable countermeasure proposals are derived based on the performance measurement results. It is necessary to notice that the results of each experiment in these studies are not results of studies conducted for all models of DTTB receiver and LNA.

A) Countermeasures related to giving interference from IMT to DTTB

For interference from IMT to DTTB, demonstration experiments shows that minimum guardband in the parent station is 6 MHz when horizontal separation distance is not limited, and it is 4 MHz when horizontal separation distance of 2.3 km is ensured. In this study, a case where filters are added to DTTB station is considered, however, in order to minimize the influence on DTTB in operation, it is important to make a total judgment including installation environment or the like. In the demonstration experiments, transmitters for the actual DTTB are trial-produced in addition to the verification of filter performance. As a result, it is confirmed that the actual value for unnecessary emission is reduced depending on the frequency detuning in comparison with the standard value. It is inappropriate to conduct quantitative evaluations from only measurement results according to the specific DTTB transmitters, however, when actual value of unnecessary emission from DTTB stations and conditions of horizontal separation distance from the IMT base station can be taken into account by making adjustments between parties interested, it is confirmed that there is a possibility that the above guard band can be realized not only by a method to further add filters in addition to filters which are installed in DTTB transmitters, but also by replacing the installed filters in DTTB transmitters or ensuring the horizontal separation distance.

B) Countermeasures related to giving interference from IMT to DTTB

(a) Countermeasures related to in-band interference from IMT to DTTB

If there occurs any influence by in-band interference from IMT to DTTB, it is considered to add transmission filters (excluding small-powered repeater), adjust antenna installation position and installation direction for base station, land mobile station and small-powered repeater which mobile-service provider installs and controls.

In addition, for in-band interference from an IMT mobile station, the required improvement for the interference allowable level of $I/N = –10$ dB is reduced on ch. 51 or lower on all of 7 models for outdoor reception if unnecessary emission by the trial duplexer is taken into account in TV receiver antenna outdoor installation models (7 models for outdoor reception) of the most common reception form, and is reduced even on ch. 52 on more than half the models including 3 models (models [1], [2] and [7]; see also Table 3.1-1) of reception antenna height 10 m. Furthermore, the required improvement for a video failure limit value is reduced on all channels lower than ch. 52 on TV receiving antenna outdoor installation model, and it is found that a certain margin can be further ensured.

If it is taken into consideration that spurious actual value of the IMT mobile station, actual value of interference endurance for DTTB receiver and transmission power for IMT mobile station are often operated at a power lower than the maximum value, influence by interference is predicted to be small in the case that TV receiving antenna of the most common reception form is installed outdoors, however, when any interference occurs as transmitted output from an IMT mobile station becomes high, countermeasures such as improvement in area status by installation of IMT relay station and reduction in transmission power of IMT mobile station are suggested.

(b) Countermeasures related to out-of-band interference from IMT to DTTB

Because the existing DTTB receiver and LNA are designed so as to receive a band from 710 to 770 MHz of the TV broadcast band before repacking, out-of-band interference is generated by receiving main wave emitted from a new system as an interference wave when the new system is introduced into a band of 710 MHz or higher. As short-term countermeasures, addition of a receiver filter to DTTB receiving system, enhancement of perpendicular directionality by replacement to high performance reception antenna, gain adjustment and insertion of attenuator (when a LNA is equipped) or the like are suggested.

In addition, as long-term countermeasures, DTTB receiver and LNA should be manufactured to avoid influence by out-of-band interference from a new system using a band of 710 MHz or higher.