# H:\AAA - daily web work\ACMA_Masthead__GREYSCALE_A4.jpg

Technical Framework Development700 MHz Spectrum Licence Band

## Radiocommunications Advisory Guidelines Methodology and parameters for the development of digital television coverage maps and exclusion zones

## Introduction

TLG Discussion Paper #3, identified two scenarios which required the management of interference to digital television (DTV) receivers, these were:

* DTV receivers operating below 694 MHz; and
* Incumbent DTV receivers operating in the 700 MHz band.

This paper provides details of the methodology and parameters that will be used to develop the maps to be published by the ACMA to assist spectrum licensees to comply with the conditions specified on their spectrum licences.

Both cases identified above and detailed in Sections 5.2 and 5.5 of TLG Discussion Paper #3 will require the production of maps depicting predicted DTV coverage areas.

### DTV Receivers below 694 MHz

As outlined in Section 5.2 of the TLG Discussion Paper #3, the ACMA will publish a series of maps showing predicted coverage from digital television transmitters to identify the areas where television channels 49, 50 and 51 are in use/planned and where the implementation of the –40 dBm/MHz limit[[1]](#footnote-1) is required in the range 673–694 MHz. In other areas, and in the same frequency range, an out-of-band limit of –34 dBm/MHz applies1.

The methodology and parameters for determining the DTV coverage areas are outlined in Section 2.

### Incumbent DTV Receivers operating in the 700 MHz Band

As outlined in Section 5.5 of the TLG Discussion Paper #3, potential interference from spectrum-licensed transmitters operating in the 700MHz band to incumbent DTV services would need to be mitigated until they are restacked to channels below 694 MHz. Where a DTV service continues to operate in the 694–820 MHz frequency range, deployment of spectrum licensed transmitters will be subject to exclusion zones around the DTV transmitter within which spectrum licensed transmitters cannot be deployed.

Exclusion zones are greater than the broadcast service coverage area, and their composition is explained in Section 3. It is important to note that a component of the exclusion zone also requires the definition of the coverage area for incumbent DTV services in the 700 MHz band, as detailed in Section 2. Again, the ACMA will publish a series of maps identifying these exclusion zones.

The buffer distance will be based on the largest separation distance required to manage *co-channel* interference between spectrum-licensed transmitters and DTV receivers. As LTE is considered the most likely technology to be deployed in the near future LTE parameters have been used to determine the separation criteria. LTE base stations parameters were used in the analysis as the higher EIRP and antenna heights compared with LTE user equipment (UE) would require larger geographical separation to mitigate interference to DTV receivers.

The methodology and parameters for determining the geographic separation requirement, and its application to define exclusion zones, is outlined in Section 3.

## Definition of DTV Coverage Areas

### 2.1 Prediction parameters

The following parameters will be used to determine the coverage areas used to generate maps defining areas where requirements specified by spectrum licence conditions must be met.

| **Table 2 Parameters used for the definition of DTV coverage areas** | | |
| --- | --- | --- |
| **Parameter** | **Value/Source** | |
| **For DTV services in 673–694 MHz** | **For incumbent DTV services in the 700 MHz Band** |
| DTV Services | Restacked TLAP services in Channels 49, 50, 51 | Operating services in Channels 52–69 |
| DTV Tx Coordinates | Planning Data coordinates | |
| DTV Tx Antenna Height | Planning Data antenna height | |
| DTV Tx Antenna Radiation Pattern/Envelope | Planning Data HRP envelope | |
| DTV Tx ERP | Max. of the ERPs in TLAP and Planning Data | Planning Data max. ERP for operating services |
| Minimum median field strength (@ 10m) at coverage edge to protect 80% of locations | 54 dBuV/m | |
| Propagation prediction model | CRC Predict[[2]](#footnote-2) | |
| Time percentage | 50% | |
| Location percentage | 50 %[[3]](#footnote-3) | |
| Digital elevation model | SRTM DEM (3 second resolution) | |
| Clutter data | Not included | |
| Out-of-licence area coverage | Only include locations within the intended licence area (i.e. out-of-area licence area reception will not be protected). | |
| Coverage area boundary | Coverage edge at minimum median field strength—unless a higher field strength (relative to the planning threshold for that band) is provided by another DTV service. i.e. a maximum server prediction analysis is used to determine the coverage area. | Coverage edge at minimum median field strength—unless Planning Data includes an Advisory Note (or similar) with another value (e.g. 67 dBµV/m). |
|  |  |  |

**NOTE**: For an explanation of Television Licence Area Plans (TLAPs) and the associated Planning Data, see Annex A.

## Geographical separation distance requirement: Incumbent DTV services in the 700 MHz band

### Protection criteria for DTV services

According to the procedures adopted for planning of digital terrestrial television broadcasting services in Australia, protection of DTV receivers is achieved by satisfying protection ratio requirements, for which the maximum permissible interfering field strength at the receiving antenna depends on the wanted field strength at the receiving antenna. In order to protect DTV receivers at the edge of coverage, the protection ratio must be satisfied for the minimum median field strength *Emed*. The calculation of *Emed* for Band V digital terrestrial television broadcasting (DTTB) services is documented in the *DTTB Planning Handbook*. The minimum median field strength at 10 m antenna height translates to the minimum field strength being received in at least 80% of locations for rural environments. Minimum field strengths (at 10 m antenna height) are higher for suburban and urban environments (mainly to account for losses attributed to lower antenna height and antenna gain), meaning that satisfying protection ratio requirements leads to smaller separation distances, and so the case of a rural environment has been adopted as a worst-case scenario. The receive antenna height of the victim DTV service is 10 m. This is aligned with the assumption of fixed reception using a directional receive antenna, on which planning of digital television broadcasting in Australia is based[[4]](#footnote-4).

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 3 Parameters for determining protection requirements (at the coverage edge) for DTV services in the digital dividend** | | | |
| **Parameter** | **Value** | | |
| **Unwanted signal entering DTV rx antenna main beam** | | **Unwanted signal entering rear of DTV rx antenna** |
| Receive antenna height (m) | 10 | | |
| Minimum median field strength (for 80% of loc.), *Emed* (dBµV/m) | 54 | | |
| Protection ratio (dB)  (for DVB-T 64QAM, CR=3/4) | 21 | | |
| PCF (dB) (for 80% of locations) = *Qi*(0.8) | 6.5 | | |
| *Daz* + *Dpol* (dB) [[5]](#footnote-5),[[6]](#footnote-6) | 3 | 16 | |
| Maximum interfering field strength, *Ei\_max*(dBµV/m) (rounded) | 30 dBµV/m | 43 dBµV/m | |
|  |  |  | |

### ”Back-of-antenna” Exclusion zone component

Spectrum licensed transmitters will only be allowed to be introduced into areas where they can operate co-channel with *any* DTV service in the 700 MHz band. This means that a spectrum licensed transmitter must be geographically separated from the edge of a DTV coverage area by a buffer distance such that no interference will be caused to receivers of that DTV service. If the spectrum licensed base station transmitter is situated some specified minimum distance from the edge of coverage, then the path to the nearest DTV receiving location will be perpendicular to the coverage edge, and hence into the rear4 of a DTV receiving antenna at that location (see Figure 1). In addition, if this minimum separation distance is satisfied at the edge of coverage, then there is an even greater distance to DTV receivers within the coverage area, and the geographic separation requirement is satisfied everywhere within the coverage area.

This situation suffices for DTV services with a large coverage area; however, for cases of DTV services with small coverage areas the critical separation distance may be dictated by unwanted signals entering the main beam of the DTV receive antenna as introduced in Section 3.3.

DTV tx station

DTV rx

SL BS

**DTV coverage area**

**Exclusion zone**

***Figure 1****—For any single DTV receiver at the edge of coverage, the nearest a co-channel LTE base station can be to it, while respecting the geographic separation requirement for all points around the DTV coverage edge, is for the LTE base station to be towards the rear of the DTV receive antenna, which is pointing towards the DTV transmitting station.*

### “Main-beam” exclusion zone component

If the geographic separation requirement for unwanted signals entering the back of the DTV receive antenna is satisfied at the edge of coverage, it is satisfied everywhere within the coverage area, as explained in Section 3.2. However, this is not the case for unwanted signals entering the main beam of the DTV receive antenna. This is because the main-beam separation decreases below the required level as the *receiving* location nears the DTV transmitter (i.e. further within the coverage area). Because assumptions cannot be made about the field strength within the coverage area, a conservative approach is taken such that the separation requirement must be satisfied everywhere within the coverage area, including at the DTV transmitter (see Figure 2).

DTV tx station

DTV rx

**DTV coverage area**

**Exclusion zone**

SL BS

(a)

SL BS

**Exclusion zone**

**DTV coverage area**

DTV tx station

DTV rx

(b)

***Figure 2****—Exclusion zone component for unwanted signals entering the main beam of a DTV receive antenna located (a) at the edge of coverage; and (b) within the coverage area.*

The final exclusion zone will be a combination of both the back-of-the-antenna and main-beam exclusion zones described above.

### Spectrum Licensed Base Station Parameters and Unwanted Signal Propagation

Table 4 lists the parameters adopted for the spectrum licensed base station transmitters.

|  |  |
| --- | --- |
| **Table 4 Base station parameters to determine geographic separation requirement** | |
| EIRP | 58 dBm[[7]](#footnote-7) |
| ERP = EIRP – 2.2 dBi | 25.8 dBW |
| Effective transmit antenna height | 150 m |
|  | |

To determine a generalised separation requirement from spectrum-licensed base station transmitters, the use of propagation models requiring the use of detailed terrain information, such as the diffraction-based propagation model CRC Predict, would not be appropriate. Given the large separation distances expected to result, the use of Recommendation ITU-R P.1546 is proposed[[8]](#footnote-8). ERC Report 68 (Report ITU-R SM.2028) states, in using the “Modified Hata” propagation model in that report, that “care should be taken when propagation distances are expected to be above 20 km”, and hence it is considered that the “Modified Hata” model is not appropriate to use in this situation.

Recommendation ITU-R P.1546 calculates field strength at distance *d* (km) depending on the *effective* antenna height *heff*, which is defined as the height of the transmitting antenna above the average height of the terrain between 3 km and 15 km from the transmitting antenna. The accepted value for the base station antenna height (above ground) is 30 m. This may constitute a correct *effective* antenna height for calculation of propagation over shorter distances over which terrain height may not vary significantly. However, over long distances, the effective antenna height is often considerably higher than the height of the antenna above the ground. Analysis of existing IMT base stations revealed that the effective antenna height for the majority of base stations did not exceed 150 m.

Only 1% time curves of Recommendation ITU-R P.1546 should be used for the calculation of interfering/unwanted signal field strengths[[9]](#footnote-9). Location variability has been taken into account in the minimum median field strength and PCF in Table 3, and should not also be incorporated in the use of the propagation model.

### Exclusion zones

Using the DTV protection requirements listed in Table 3, the base station parameters listed in Table 4, and the propagation model (and parameters) described in Section 3.4, the following geographic separation requirements have been developed.

|  |  |
| --- | --- |
| **Table 5**—**Geographic separation requirement required to not exceed the maximum permissible interfering signal field strengths in Table 3.** | |
| **Exclusion zone component** | **Geographic separation requirement** |
| Back of antenna | 43 km |
| Main beam | 79 km |
|  |  |

For the “back-of-antenna” component of the exclusion zone, it is proposed that the **geographic separation requirement of 43 km** be applied to the edge of the DTV coverage area, as the width of the buffer zone, as explained in Section 3.2.

For the “main-beam” component of the exclusion zone, it is proposed that the **geographic separation requirement of 79 km** be applied at the DTV transmitter site, as explained in Section 3.3.

The maps to be published for each incumbent DTV service in the 700 MHz Band, will be the total exclusion zone formed from the outer envelope of the overlay of both the corresponding “main-beam” and “back-of-antenna” exclusion zone components.

## Comment Period

The period for submission of comments on the proposals made in this paper closes 18th May 2012.

## ANNEX A

### Television Licence Area Plans

Television Licence area plans (TLAPs) are the long term planning instrument for television broadcasting services. TLAPs reflect the requirements of subsection 26(1B) of the *Broadcasting Services Act 1992* and come into effect after the end of a simulcast period, replacing the Licence Area Plans (LAPs) and Digital Channel Plans (DCPs).

TLAPs were designed to help define and delineate the restack of digital television channels. In general, TLAPs:

* specify the channels that are to be available in specified parts of a particular licence area to provide commercial television broadcasting services, national television broadcasting services and other television broadcasting services
* allot channels to particular providers of television broadcasting services
* determine the characteristics, including technical specifications, of broadcasting services that are to be available in particular areas of Australia with the use of the broadcasting service bands
* enable the ACMA to determine additional specifications and technical limitations, or to determine events or circumstances related to the use of a particular channel.

In order to maintain a simple and administratively efficient instrument, the key defining characteristics of the right to use the broadcasting spectrum were identified. The ‘characteristics’ and ‘technical specifications’ of the transmission of services proposed to be determined are the ‘maximum effective radiated power (ERP)’ and ‘polarisation’ of the transmission. These, characteristics, combined with the channel allotted, define the right to use the broadcasting spectrum in the manner planned.

### Planning data

Other information previously included in LAPs and DCPs, such as detailed site coordinates, and antenna pattern and height, are now included in separate planning data documents which are published with the TLAPs. Some of these matters will be dealt with by conditions imposed on the relevant apparatus licence under the *Radiocommunications Act 1992*. These planning data documents will be used by the ACMA in considering whether to issue or vary relevant transmitter licences, as operation of a transmitter in a way that is inconsistent with the planning data documents could lead to interference issues.

Previous [draft TLAPs](http://www.acma.gov.au/WEB/STANDARD/pc=PC_410169) released for comment and [final TLAPs](http://www.acma.gov.au/WEB/STANDARD/pc=PC_410167) issued by the ACMA, can be found on the ACMA website, along with the associated Planning Data.

1. Averaged over a 7 MHz channel. [↑](#footnote-ref-1)
2. ACMA engineers have used this propagation model to perform restack channel planning and to indicate coverage areas in data that DBCDE has used to generate the maps contained in the MySwitch tool (www.digitalready.gov.au). [↑](#footnote-ref-2)
3. In the calculation of median field strength. Correction factors to account for location variability have been taken into account to protect higher percentages of locations. [↑](#footnote-ref-3)
4. Because, in the assessment of co-channel interference to the coverage edge, both wanted and unwanted signals are transmitted from distant sources, it can be assumed that both would experience a similar amount of antenna height loss, when the receive antenna is not actually at 10 m. [↑](#footnote-ref-4)
5. As per Recommendation ITU-R BT.419, the “rear” of a UHF receive antenna has an azimuthal discrimination of 16 dB over the range of azimuths between 60º–300º. [↑](#footnote-ref-5)
6. When unwanted LTE BS signals enter the DTV receive antenna main beam, and they are slant (45º) polarised, there is a polarisation discrimination (*Dpol*) of 3 dB is assumed. [↑](#footnote-ref-6)
7. TLG Discussion Paper #2. [↑](#footnote-ref-7)
8. Without detailed terrain information, neither diffraction losses nor clearance angles can be calculated, which results in their being no difference between the path loss calculated with versions 1 through 4 of Recommendation ITU-R P.1546. [↑](#footnote-ref-8)
9. ITU-R Working Party 3K in its Liaison Statement to the JTG 5-6. [↑](#footnote-ref-9)