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

Technical Framework Development 700 MHz Spectrum Licence Band

## TLG-Discussion Paper No. 2 Design Requirements for the Technical Framework Determination of Unacceptable Interference / System Models / Propagation Models / Levels of Protection / Device Boundary Criterion

Document Release Information

|  |  |  |
| --- | --- | --- |
| **Version** | **Date Released** | **Remarks** |
| 1 | 2 December 2011 | Initial Release |
| 2 | 16 February 2012 | Updated as a result of responses to version 1 |
| Final | 5 March 2012 | Finalised as a result of responses to version 2 |

## 1 Background

This discussion paper deals with the parts of the technical framework that appear in the section 145 Determination of unacceptable interference. Section 145 of the *Radiocommunications Act 1992 (*the Act*)*, is located in Part 3.5 ofthe Act*.* This Part of the Act deals with the registration of radiocommunications licences, and the details that must be recorded in the register of radiocommunications licenses (RRL) for the authorisation of the use of a radiocommunications transmitter.

Section 145 of the Act authorises the Australian Communications and Media Authority (ACMA) to refuse registration of a transmitter for operation under a spectrum licence if the ACMA is satisfied that the operation of the transmitter could cause unacceptable interference to the licensed operation of other radiocommunications devices. Sub section 4 of section 145 of the Act states that the ACMA may determine, by written instrument, what are unacceptable levels of interference for the purposes of refusing to register devices under a spectrum licence. The *Radiocommunications (Unacceptable Levels of Interference -700 MHz Band) Determination*, made under section 145, is that written instrument.

The section 145 determination is used by the ACMA to set out device registration requirements. These typically include a requirement that the operation of a transmitter must not result in a breach of a core condition of the licence relating to maximum permitted levels of radio emissions outside the frequency band of the licence or the geographic area of the licence and that the device boundary of a registered transmitter - calculated using a device boundary criterion - must lie within the geographic boundary of the licence.

The section 145 determination can also be used to reinforce arrangements that permit the operation of low power mobile devices such as hand held devices or low power indoor fixed devices without registration[[1]](#footnote-1) by declaring them not to cause unacceptable interference if they comply with specific conditions. The section 145 determination is also used to set out arrangements for group registration of similar transmitters. Group registration and arrangements for low power devices reduce costs and records management requirements.

## 2 Introduction

This discussion paper looks in detail at the following items of the technical framework that are used to develop the section 145 determination;

* system models;
* propagation modelling;
* level of protection;
* device boundary criteria; and
* other device registration arrangements.

Each of these items will be considered by examining overseas arrangements, arrangements in other spectrum licensed bands and the proposed arrangements to support Wireless Access Services under the 700 MHz technical framework. An outline of the reasoning leading to selection of the proposed models and requirements has been provided for information. Note that this paper deals primarily with co-channel or co-frequency issues.

This is a discussion paper and the views and suggestions of the members of the technical liaison group are sought as to the relevance and suitability of the proposed models and requirements.

## 3 System Models

System models are used to simplify the analysis of the technical framework with regard to the reference technologies. The reference technologies are identified in the *700 MHz TLG Discussion Paper No. 1* and are shown in .

|  |  |
| --- | --- |
| Table 1 Reference technologies | |
| **Reference technology** | **Applicable standards and reports** |
| UMTS  (UTRA, WCDMA, HSPA, HSPA+) | ITU-R Report M.2039-2, 3GPP TS 25.101, 3GPP TS 25.104, 3GPP TS 24.942, ECC Report 82, ECC Report 96 |
| LTE  (E-UTRA, LTE-Advanced) | ITU-R Report M.2039-2, 3GPP TS 36.101, 3GPP TS 36.104, 3GPP TS 36.942 |
|  | |

The development of the system models does not exclude the use of other technologies under the licence. The system models for the deployment are simply a tool for the development of the framework.

### 3.1 Mobile Systems

Typical mobile systems are characterised by the use of omni-directional (base) transmitter/receiver sites (30 - 60 metre antenna height) communicating with omni-directional user equipment (UE) devices at 1.5 metre antenna height. Systems requirements typically do not permit co-channel cells to operate without geographic separation unless synchronisation or other interference management arrangements are agreed between the licensees.

The dominant interference mode for FDD systems is high site to low site because of the uplink and downlink frequency separation arrangements.

### 3.2 Proposed system models

As indicated in the *700 MHz TLG Discussion Paper No. 1* it is proposed to optimise the framework for FDD services as the indications from industry are that there is a preference in Australia for paired channels (FDD) while the likelihood for a requirement for TDD services is low. It should be noted that there are flexibilities within the framework that would allow for the deployment of TDD services if desired.

The proposed system model parameters are derived from the reference technologies in for the base station transmitter (), base station receiver (), UE transmitter () and UE receiver ().

|  |  |  |
| --- | --- | --- |
| Table 2 Base station transmitter | | |
| **Parameter** | **UMTS** | **LTE** |
| Height above ground level | 30 m | 30 m |
| Transmitter power | 43 dBm/3.84 MHz | 43 dBm/4.515 MHz |
| 21.9 dBm/30 kHz | 21.2 dBm/30 kHz |
| Antenna gain (including losses) | 15 dBi | 15 dBi |
| EIRP | 58 dBm/3.84 MHz | 58 dBm/4.515 MHz |
| 36.9 dBm/30 kHz | 36.2 dBm/30 kHz |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| Table 3 Base station receiver | | |
| **Parameter** | **UMTS** | **LTE** |
| Antenna gain (including losses) | 15 dBi | 15 dBi |
| Noise figure (F) | 5 dB | 5 dB |
| Noise floor (kTBF) | -103dBm/3.84 MHz | -102dBm/4.515 MHz |
|  | | |

|  |  |  |
| --- | --- | --- |
| Table 4 UE transmitter | | |
| **Parameter** | **UMTS** | **LTE** |
| Height above ground level | 1.5 m | 1.5 m |
| UE maximum power | 24 dBm/3.84 MHz | 23 dBm/4.515 MHz |
| 2.9 dBm/30kHz | 1.2 dBm/30kHz |
| Antenna Gain (includes losses) | 0 dBi | 0 dBi |
| EIRP | 24 dBm/3.84 MHz | 23 dBm/4.515 MHz |
| 2.9 dBm/30kHz | 1.2 dBm/30kHz |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| Table 5 UE receiver | | |
| **Parameter** | **UMTS** | **LTE** |
| Antenna gain (including losses) | 0 dBi | 0 dBi |
| Noise figure (F) | 9 dB | 9 dB |
| Noise floor(kTBF) | -99.1 dBm/3.84 MHz | -98.4 dBm/4.515 MHz |
|  |  |  |

## 4. Propagation Modelling

The propagation model chosen for the technical framework appears in the section 145 determination as part of the device boundary criterion. The propagation model selected for the technical framework needs to be:

* suitable for FDD systems (e.g. antenna height range);
* a generic model that does not require detailed information on terrain or land usage;
* not too complex and can be easily repeated with certainty; and
* suitable for use in the 700 MHz band.

The propagation model selected here does not need to be suitable for the detailed planning of services, and licensees are free to use any model for their own planning needs. The selected propagation model will be the basis of the device boundary criterion on which the ACMA may decide to reject the registration of a transmitter to be operated under the spectrum licence.

### 4.1 Propagation modelling used overseas

The propagation modelling in CEPT Report 30 (where the European framework was developed) uses the ITU-R JTG 5-6 propagation model. The ITU-R JTG5-6 model is based on three propagation models: free space for distance below 40 m; a modified Hata model for distances from 0.04 to 0.1 km and ITU-R Recommendation P.1546[[2]](#footnote-2) for distances greater than 1 km. Distances between 0.1 km and 1 km are based on a blending of the results for the upper and lower distances using both models. Details of these models can be found in ITU-R Report SM.2028-1.

### 4.2 Proposed propagation model

There are a range of available propagation models that could be implemented in the section 145 determination and the device boundary criterion including: ITU-R JTG 5-6, ITU-R P.1546, ITU-R P.526, ITU-R P.452 or ITU-R Report SM.2028 and ERC Report 68 Annex B.a.1. Each has its advantages or disadvantages and these must be considered when planning to implement one or the other in the section 145.

The proposed propagation model is based on the modified-Hata model as detailed in ITU-R Report SM.2028 and *ERC Report 68 (Feb 2000) part b) of Appendix 1 to Annex 2: (Reference (3)) : Propagation model*.

This model has been chosen in preference to others because it is easier to implement and describe in the section 145 determination and it aligns well with the ITU-R JTG 5-6 model and ITU-R P.1546 under certain conditions. The P.526 and P.452 models have been excluded because they require additional terrain and clutter detail which cannot be made, or isn’t readily, available at all locations where the 700 MHz spectrum licence has been declared.

It is proposed to implement the suburban variant of the modified-Hata model because it offers a reasonable compromise between urban and open area models and better reflects that geographic boundaries are typically located outside metropolitan and/or highly populated areas.

The modified-Hata model is recommended for antenna height up to 200 metres and distances up to 100 kilometres, and provides acceptable results for antenna heights up to 500 metres.

## 5. Level of Protection

The level of protection (LOP) is the benchmark protection given to receivers from co-channel emissions from transmitters operating in adjacent geographic licence areas. This benchmark level is also necessary for the calculation of the device boundary criterion which is used to determine if a transmitter is likely to cause unacceptable interference prior to the ACMA registering a transmitter and therefore limits emissions over the geographic boundaries of the licence.

This LOP in the spectrum licence technical framework is typically based on factors including receiver sensitivity, system noise floors, protection ratios, margins and allowances. FDD system arrangements make the interference path a high site to low site on the downlink and a low site to high site propagation path on the uplink. This type of propagation path has higher losses compared to near free space high site to high site paths. This reduces the necessary separation distance from the interference source.

**The Protection This Level of Protection Does Not Provide**

It should be noted that this LOP does not directly apply to emissions from devices operating in adjacent frequencies in the same geographic area. The level of protection chosen in that instance should reflect those contained in the relevant radio advisory guidelines or any agreements reached between affected parties. For co-sited devices, licensees are required to take reasonable steps to work with the site manager or affected licensees to resolve any interference issues.

### 5.1 Levels of protection overseas

CEPT Report 30 does not make reference to a specific protection level within its studies, instead referring to methods found in previous studies (CEPT Report 119, ECC Report 131) and to the GE06 Agreement trigger field strengths. The one of most relevance to the level of protection used in the Australian spectrum licensing is the maximum interference power density at the receiver of ‑115 dBm/ MHz[[3]](#footnote-3). ECC Report 131 extends the BEM model to terminal stations using two terminal station interference protection levels:

‑105 dBm/ MHz for 3 dB noise floor increase and -111 dBm/ MHz for 1 dB noise floor increase.

### 5.2 Proposed Level of Protection

The LOP is a compromise between the level of emissions over the geographic boundary of the licence and the anticipated protection requirements of receivers. The LOP must be met at or within the geographic boundary of the licence following the device boundary criterion methodology of the section 145 determination.

The method chosen to determine the LOP for the 700 MHz band is based on the reference sensitivity level of an LTE UE in the 700 MHz band. This method is chosen in preference to the traditional noise floor plus interference-to-noise margin (I/N) of -6dB resulting in a 1dB increase in noise floor because this method is the most restrictive and does not allow deployment as close to the geographic boundary.

Current 36-series 3GPP standards do not currently specify the Australian 700 MHz band allocation as an E-UTRA operating band; however, a number of adjacent or partially overlapping bands have been specified including bands 12, 13 and 14 which cover the frequency range 698 MHz to 798 MHz.

The calculated reference sensitivity for a QPSK rate 1/3 channel consisting of 25 allocated resource blocks is -96.4 dBm/4.515 MHz, which closely matches that specified in 36.101 of -97 dBm/4.515 MHz or -118.8 dBm/30 kHz[[4]](#footnote-4) for those adjacent or partially overlapping bands specified in the 36-series 3GPP standards. The reason for calculating rather than using the reference sensitivity from the 36 series standard is because the bands only partially overlap rather than being those in the Australian context. It has been assumed that a 2 dB implementation margin has been included in the calculation of reference sensitivity based on the formula for reference sensitivity[[5]](#footnote-5) of:



The reference sensitivity requires a necessary signal-to-noise plus interference ratio (SNIR) to maintain a suitable bit error rate. For LTE, using QPSK rate 1/3, the required SNIR is found to be 0 dB for a bit-error rate of 0.00239

In order to determine the minimum required signal level at a UE, it is necessary to consider a fade margin as a result of area coverage and consideration of body loss. Typical outdoor mobile coverage probability for a single cell case is 95%; under a multi-cell environment with coverage overlap, the actual coverage requirement of an individual cell can be smaller.

Estimation of the area coverage probability for the single-cell case is given by the following equation[[6]](#footnote-6):



where:





Assuming a path-loss exponent () of 3.5 (represents typical terrain features and is typical of the modified-Hata model) and a standard deviation () of 7 dB, results in a fading margin () of 7.0 dB for a single-cell area coverage probability of 95%.







The allowed propagation loss is calculated and includes the slow fading margin for calculation of the BS to UE separation. A slow fade margin is not included in calculation of the BS to the geographic boundary which effectively adds in more conservatism – hence increasing the setback distance from a boundary, but also means additional protection to the UE in the adjacent geographic area and vice versa.

Body loss is set to 0 dB to account for non handheld devices, such as USB modems, which result in a larger cell radius which is considered the worst case.

Using these parameters, the link budget in can be derived. The case demonstrated is for a 5 MHz allocated channel utilising all 25 resource blocks for a single user and a cyclic prefix of 6.

|  |  |  |
| --- | --- | --- |
| Table 6 BS-to-UE link budget | | |
| **Allocated bandwidth** | 5 MHz |  |
| **Resource blocks (RB)** | 25 |  |
| **Sub-carriers (SC)** | 300 | 12 sub-carriers per resource block |
| **Occupied bandwidth (OB)** | 4.515 MHz | RB \* 180 kHz + 15 kHz |
| **Cyclic prefix (CP)** | 6 | symbols per slot (a slot is half a sub frame) |
| **OFDMA symbols per sub frame (OS)** | 12 | CP / 0.5 |
| **Modulation symbol rate** | 3.6 Msps | (SC \* OS / 0.001) / 1e6 |
| **OFDM symbols for control channels (CC)** | 3 | including PDCCH, PBCH, PHICH, PCFICH, etc |
|  |  |  |
| **Modulation** | QPSK |  |
| **Symbols (sym)** | 4 | QPSK = 4, 16QAM = 16, 64QAM = 64 |
| **Code rate (rate)** | 1/3 |  |
| **SNIR** | 0 dB |  |
| **Implementation margin (IM)** | 2 dB |  |
|  |  |  |
| **UE noise figure (NF)** | 9 dB | 36.101 |
| **Reference sensitivity (refsens)** | -96.43 dBm/4.515 MHz |  |
| **N** | -98.43 dBm/4.515 MHz |  |
| **I (or LOP)** | -100.76 dBm/4.515 MHz |  |
|  |  |  |
| **Required area probability** | 95 % |  |
| **Fade margin** | 7 dB | path exponent = 3.5, stdev = 7 dB |
| **Body loss** | 0 dB |  |
|  |  |  |
| **Throughput (TP)** | 0.40 bps/Hz |  |
| **Data rate (DR)** | 1800.00 kbps |  |
| **Eb/No** | 6.00 |  |
| **Bit-error rate (BER)** | 0.00239 | BER curve[[7]](#footnote-7) for QPSK in AWGN |
|  | | |

results in a level of protection of -100.76 dBm/4.515 MHz or

-122.54 dBm/30 kHz at the UE.

Analysis of the calculated level of protection allows us to define the system model for coexistence across the licence boundary given in . Comparison between urban and suburban modified-Hata is provided; however, the suburban model is recommended for the purposes of calculating the device boundary criterion in section 6.

|  |  |  |
| --- | --- | --- |
| Table 7 System model for co-existence across the licence boundary | | |
| Frequency | 758 MHz | |
| BS height | 30 m | |
| MS height | 1.5 m | |
| Model | **Urban modified-Hata** | **Suburban modified-Hata** |
| LTE BS EIRP | 36.2 dBm/30 kHz | |
| UE reference sensitivity (refsens) | -118.2 dBm/30 kHz | |
| Body Loss (Lb) | 0 dB | |
| Fade Margin (FM) | 7.0 dB | |
| Minimum required path loss =  EIRP – refsens – Lb - FM | 147.4 dB | |
| BS to UE separation | 4.5 km | 8.5 km |
| LOP at the boundary | -122.5 dBm/30 kHz | |
| Minimum required path loss =  EIRP – LOP – Lb | 158.7 dB | |
| BS to LOP boundary | 9.5 km | 17.5 km |
| UE to geographic boundary | 5 km | 9.0 km |
|  | | |

The level of protection as calculated in is the interference level allowed at the UE as a result of the SNIR. In the analysis of the system model in , the level of protection is actually specified at the geographic boundary; as a result, the level of interference from is not at the UE but the boundary which for the suburban case if 9 kilometres further from the UE as shown in .

|  |
| --- |
| Figure 1 System model for co-existence across the licence boundary |
| 8.5 km  9 km  9 km  Geographic boundary  UE boundary  LOP boundary  17.5 km |
|  |

By halving the UE to geographic boundary distance on both sides of the boundary the value of the LOP is now applicable at the location of the UE receiver rather than at the boundary which is how it was specified in for a SNIR of 0 dB. As a result, the reduction in path loss needs to be added to the LOP calculated. A reduction in distance from 17.5 to 13.0 kilometres is a reduction in path loss of 4.5 dB. Adding this to the LOP of -122.5 dBm/30 kHz results in the proposed LOP for the 700 MHz band of -118 dBm/30 kHz.

Licensees need to be aware that by halving the distance on either side of the boundary to allow UEs to get closer to the boundary, that the likelihood of interference across the boundary is increased; but, this occurs for both parties and is equally likely. Licensees are encouraged to conduct their own network planning to determine the likelihood of interference to and from adjacent areas.

The ACMA consider the suburban propagation model is best suited to application in the 700 MHz band, noting that the geographic area boundaries are nominally located in regional or rural areas and as such, the increased clutter effects of the urban model may not be applicable.

## 6. Device Boundary Criterion

The device boundary of a transmitter, calculated using the device boundary criterion, must lie within the geographic boundary of the licence otherwise the transmitter may be declared under the section 145 determination to cause unacceptable interference. The device boundary aims to manage co-channel interference across the geographic boundary of the licence.

It does this by regulating the maximum radiated power level of transmitters located near the boundary of the licence. Alternatively it can be seen as a tool for calculating the necessary set back of transmitters from the boundary of the licence to prevent interference to receivers in the adjacent licence geographic area without the requirement for cooperation or agreement between the licensees.

The device boundary is drawn up by applying the device boundary criterion to the radio propagation paths along radials about the proposed transmitter site. The position of the device boundary is located where the value of the device boundary criterion diminishes to zero or first becomes a negative value.

The device boundary criterion is the difference between the horizontally radiated power of the transmitter including the level of measurement uncertainty and the modelled propagation loss of the path combined with the level of protection given to receivers in the geographically adjacent licence area.

### 6.1 Proposed Boundary Criterion

A new methodology has been proposed by the ACMA for the calculation of the device boundary and it is intended that this methodology be used in the 700 MHz band technical framework. The proposed methodology aims to improve the accuracy, reliability and ease of determining the device boundary. It also aims to provide a consistent methodology across all new and expiring spectrum licences.

The new device boundary criterion (DBC) is calculated along 360 radials (one degree spacing) with a step size of 500 metres. This is an increase in resolution over the device boundary criterion methodology currently employed in bands such as 800 MHz, 1800 MHz and 2 GHz. The increased resolution is intended to improve the accuracy of the DBC by taking better account of terrain elevations as well as facilitating deployment of devices closer to the boundary.

Further details of the proposed methodology can be found in the TLG Reference Paper *Proposed Device Boundary Criterion Methodology*.

Given the ACMA considers the suburban model in section 5.2 to be appropriate, the proposed level of protection of -118.0 dBm/30kHz specified at the device boundary is intended to provide adequate base station separation from the boundary to enable co-existence between adjacent area services while not placing overly restrictive constraints on transmitter deployment near the geographic boundary.

The modified-Hata propagation model in suburban mode from ERC Report 68 is specified for use in the DBC. The remaining components of the DBC are included in the TLG Reference Paper – *Proposed Device Boundary Criterion Methodology*.

Because the modified-Hata propagation model caters well for heights up to 200 metres, but not particularly for heights above 500 metres (where inverse height gain becomes apparent at separation distance greater than 50 kilometres), it is proposed to limit the maximum effective antenna height to 500 metres. A review of existing registrations in the ACMA database for 800 MHz and 1800 MHz spectrum licences showed that an effective antenna height of 500 metres is rarely achieved because most sites pass the DBC within 20 kilometres.

Given a maximum effective base station antenna height of 500 metres and UE station effective antenna height of 1.5 metres, the propagation model as described in section 4.2, the maximum out-of-area limit from *700 MHz TLG Discussion Paper No. 1* of 52 dBm/30kHz and the proposed level of protection in section 5.2, the maximum radial length achievable is 77 km. Devices located greater than 77 km from the boundary, will always pass the proposed DBC.

Therefore services located greater than 77 km from a geographical boundary are deemed to comply with the DBC, and are taken not to cause unacceptable interference.

**Proposed device boundary criterion (Schedule 2)**

**Part 3 Calculation of Propagation Loss**

1. In calculating *PL(lmn, Lnm)*:

|  |  |  |
| --- | --- | --- |
| *f* | : | centre frequency of transmitter (megahertz) |
| *hgr* | : | is the nominal receive antenna height above ground level being 1.5 metres |
|  | : | is the transmit effective antenna height (metres) as defined in Schedule 3. |
| *d(lmn, Lmn)* | : | is the distance in kilometres between the location of the transmitter, *(lt, Lt)*, and the mth increment on the nth radial *(lmn, Lmn).* |

if  < 1.5 metres, then = 1.5 metres; or

if  > 500 metres then = 500 metres.

2. The propagation loss for the mth increment on the nth radial is established as follows:

Step 1: Calculate the constants required







Step 2: Calculate the propagation loss for the mth increment on the nth radial



### 6.2 Proposed New Digital Elevation Model

The ACMA intends to transition from the Australian Geodetic Datum 1966 (AGD66) to the Geocentric Datum of Australia 1994 (GDA94).

This change in datum will also require the Digital Elevation Model (DEM) used in spectrum licensing to also be in GDA94. Currently effective antenna heights calculations are made using RadDEM, which is a 9-second DEM and is in the AGD66 format. It is intended to use a DEM already in GDA94 rather than convert RadDEM to GDA94. The likely DEM to be used is published by Geoscience Australia and is called GEODATA 9 Second Digital Elevation Model Version 3. For more information refer to the *TLG Reference Paper – GDA94 Adoption*.

## 7. Other Device Registration Arrangements

Other device registration arrangements typically:

* declare the use of low power transmitters within the licence area as not causing unacceptable interference;
* define a group of transmitters or receivers for group registration;
* simplify the registration requirements for devices located well away from the geographic boundary (greater than 77 km as proposed in section 6.1); and
* set out deployment constraints to encourage high site to low site frequency selection.

### 7.1 Proposed registration exemption requirements

The proposed registration arrangements to be added to the framework that would exempt certain devices from the registration requirements are similar to those found in other spectrum licence technical frameworks.

It is proposed that low power devices with an EIRP below a maximum limit that meet emission mask requirements of the licence, will be deemed as not causing unacceptable interference within the licence area and will be exempted from the need to register. This exemption is intended to include mobile transmitters, low powered indoor transmitters such as femtocells[[8]](#footnote-8) and leaky-feeder systems.

The proposed registration exempt EIRP limit for transmitters in the lower band (703-748 MHz) is the maximum LTE UE transmitter power of , resulting in the proposed EIRP limit of 23 dBm within the occupied bandwidth of the transmitter.

To facilitate greater flexibility in the upper band (758-803 MHz), the registration exempt limit is proposed to be 30 dBm within the occupied bandwidth of the transmitter. This allows some equipment operating in the upper band to deploy utilising additional operating power or additional antenna gain without requiring registration.

It should be noted that although low powered transmitters such as femtocells are exempt from the device registration requirements, it is the licensee’s responsibility to ensure that all devices operated under their spectrum licence comply with the conditions of the licence.

### 7.2 Definition of groups of transmitters and receivers

The section 145 determination may also set out the definition of a group of transmitters and a group of receivers for the purpose of simplifying registration of those devices. Group registrations are defined to allow devices located within 20 metres of the same central point with identical emission characteristics to register as a group of transmitters or receivers.

Unless exempted, transmitters must always be registered as either an individual transmitter or as part of a group of transmitters. If two or more transmitters are operated for the purpose of communicating with the same receiver or group of receivers then those transmitters may be treated as a group in order to simplify the registration process. A transmitter shall not belong to more than one group of transmitters.

Receiver registration is not mandatory, but may be registered as either an individual receiver or as part of a group of receivers. If two or more receivers are operated for the purposes of communicating with the same transmitter or group of transmitters then those receivers may be treated as a group in order to simplify the registration process. A receiver shall not belong to more than one group of receivers.

### 7.3 Simplified registration requirements

Because the suburban modified-Hata propagation model has specific attenuation limits for set distances, frequencies and heights, it is possible to specify a maximum distance from the geographic boundary at which a transmitter not exceeding the out-of-area emission limit and a base station effective antenna height limited to 500m will pass the device boundary criterion.

Therefore, based on the calculation in section 6.1, a transmitter located greater than 77 km along all radials from the geographic boundary, and meeting the deployment constraints of the section 145 determination, will not require calculation of the device boundary and are deemed to pass the device boundary criterion for the purpose of registration.

### 7.4 Proposed deployment constraints

To maintain the site sense applicable to FDD systems in the 700 MHz band, it is proposed to implement a maximum effective antenna height restriction of 10 metres in the lower segment (703-748 MHz). This forces a low site to high site interference path in the lower segment providing protection for high sited receivers operating in this segment.

1. The licence will contain a statutory condition exempting mobile and fixed indoor devices from device registration requirements, see subsection 69 (2) of *the Act*. However while not mandatory, registration could be desirable in some circumstances, and the section 145 determination arrangements ensure this is possible. [↑](#footnote-ref-1)
2. International Telecommunications Union Radiocommunications sector (ITU-R) Recommendation on Propagation (P) 1546 -3 “Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3000 MHz”, Geneva 2007. [↑](#footnote-ref-2)
3. CEPT Report 19 Annex IV section A4.2 pg 70. [↑](#footnote-ref-3)
4. In 36.101, only 16 resource blocks are allocated (the total available is 25), the reference sensitivity power is still over the entire potentially available resource blocks. Also, the reference sensitivity is specified at the antenna connector(s) of the UE. A gain of 0 dBi is assumed for each antenna port. [↑](#footnote-ref-4)
5. Sesia. S, Toufik. I, Baker. M, *LTE – The UMTS Long Term Evolution: From Theory to Practice*, John Wiley and Sons, 2011, pg. 479 [↑](#footnote-ref-5)
6. Mishra. A. R, *Advanced cellular network planning and optimisation: 2G/2.5G/3G – evolution to 4G*, John Wiley and Sons, 2007, pg. 48 [↑](#footnote-ref-6)
7. Haykin. S., Moher. M., *Introduction to Analog & Digital Communications – Second Edition*, John Wiley and Sons, 2007, pg. 419 [↑](#footnote-ref-7)
8. A femtocell is a fixed low power base station typically connected to the network via the customers broadband internet connection [↑](#footnote-ref-8)