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2011

BBC

Research & Development

White Paper

WHP 223

April 2012

Protection of Broadcast Cells with Mixed Mode Reception using the Database Approach

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BRITISH BROADCASTING CORPORATION

White Paper WHP 223

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Abstract

A typical broadcast cell supports reception using a variety of reception modes, including fixed outdoor, portable outdoor and portable indoor. As signal strength increases towards the centre of the cell, reception on lower performance installations becomes possible and experience shows that such devices are widely used by consumers when reception conditions permit it.

ECC 159 showed that the protection of portable devices places significant restrictions on WSD EIRP which might prevent some applications. As a consequence, some regulators are considering protecting only fixed DTT reception. Any additional coverage margin provided by the broadcast network, which could support portable reception, is then made available to the white space device as an interference budget. This approach makes the assumption that the optimised 10m receive installations typically deployed at the edge of the broadcast cell will be universally installed throughout the cell and carries a significant risk that sub-optimum installations close to the centre of the cell may be significantly degraded by WSD deployment.

This document proposes an alternative approach where the protection geometry is varied within a coverage area to protect the expected modes of reception. The portable modes, which require the greatest restriction on the WSD EIRP, are applied only to areas where the signal strengths are sufficient to support them. Where mobile or nomadic portable reception is not expected or supported, the restrictions can be removed taking into account population data. Areas with no known population need not be restricted by the portable reference geometry, thus enabling higher power applications including access points or base stations on the edges of populated areas.

This document was originally published in 12th meeting of SE43 in Cambridge, December 2011 under the document number SE43 (11) 88.

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SE43(11)88

CEPT ECC
Electronic Communications Committee

12th meeting of SE43
Cambridge, 13 - 15 December 2011

Date issued:	9th December 2011
Source:	BBC
Subject:	Protection of Broadcast Cells with Mixed Mode Reception using the Database Approach

Summary:

A typical broadcast cell supports reception using a variety of reception modes, including fixed outdoor, portable outdoor and portable indoor. As signal strength increases towards the centre of the cell, reception on lower performance installations becomes possible and experience shows that such devices are widely used by consumers when reception conditions permit it.

ECC 159 showed that the protection of portable devices places significant restrictions on WSD EIRP which might prevent some applications. As a consequence, some regulators are considering protecting only fixed DTT reception. Any additional coverage margin provided by the broadcast network, which could support portable reception, is then made available to the white space device as an interference budget. This approach makes the assumption that the optimised 10m receive installations typically deployed at the edge of the broadcast cell will be universally installed throughout the cell and carries a significant risk that sub-optimum installations close to the centre of the cell may be significantly degraded by WSD deployment.

This document proposes an alternative approach where the protection geometry is varied within a coverage area to protect the expected modes of reception. The portable modes, which require the greatest restriction on the WSD EIRP are applied only to areas where the signal strengths are sufficient to support them. Where mobile or nomadic portable reception is not expected or supported, the restrictions can be removed taking into account population data. Areas with no known population need not be restricted by the portable reference geometry, thus enabling higher power applications including access points or base stations on the edges of populated areas.

Proposal: For consideration by SE43 and inclusion in the draft ECC Report on Geolocation Database techniques from SE43.

Background: SE43 has been tasked by WGSE to define technical and operational requirements for the operation of cognitive radio systems in the white spaces of the UHF broadcasting band (470-790 MHz) to ensure the protection of incumbent radio services/systems and investigate the consequential amount of spectrum potentially available as “white space”.

Contents

1 Introduction

The received field strength within a broadcast network varies with distance from the transmitter. A typical network is planned on a 100m grid and predictions are made for each 100x100m pixel. For pixels at the edge of the coverage, reception is only possible using high quality fixed installations. For planning purposes a 12dBi antenna is assumed, installed at a height of 10m above ground level. Pixels closer to the centre of the broadcast cell typically enjoy increased signal strength enabling reception on reduced performance installations. At higher field strengths, loft mounted and outdoor portable reception can be supported and as field strengths increase further, indoor reception on set top antennas or even USB tuners connected to laptop computers may also be possible. The different reception modes each require a different field strength and reference geometry to ensure protection from WSDs. Figure 1, below, illustrates how reception conditions are expected to vary in an idealised broadcast cell.

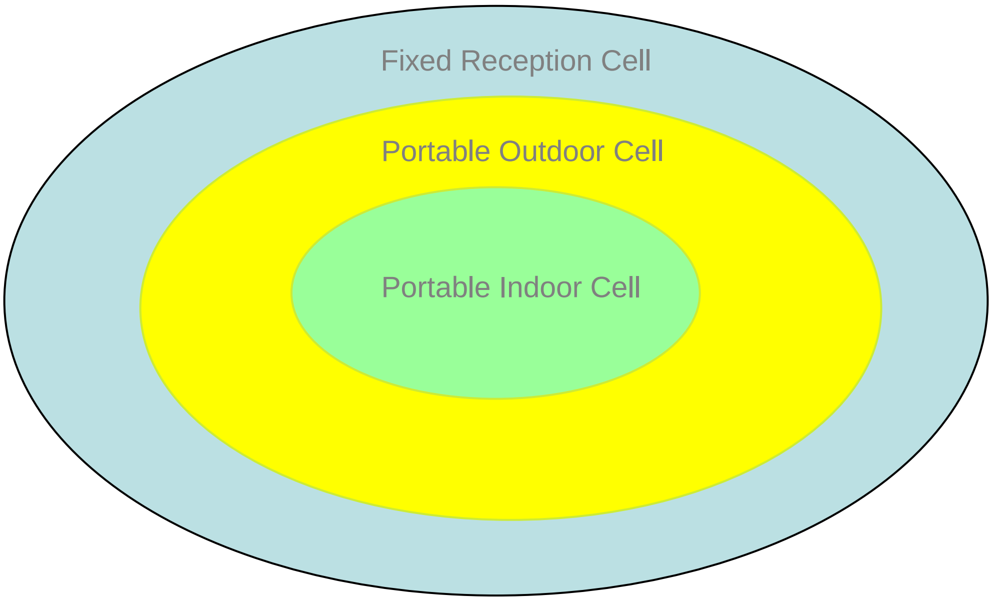

Figure 1: Reception modes within an idealised broadcast cell

Protection of portable reception is likely to be the most restrictive to the WSDs, and it is felt inappropriate to apply such restrictions in areas where this mode of reception cannot be supported. Mobile reception implies protection of all pixels where DTT reception might be possible, which could also prove restrictive, particularly for WSD base station applications. In practice portable reception on indoor antennas tends to be used for secondary sets, some primary sets where outdoor antennas are impractical or nomadic applications in populated areas. This suggests the protection restrictions could be lifted in unpopulated areas where there are no receivers requiring the necessary protection and this could be supported by the database approach.

1.1 Definition of DTT Reception Modes

The field strength requirements for the different reception modes within a mixed reception cell can be derived using the Geneva GE06 planning rules [1]. These have been enumerated in ECC 159 Table 1, however slight modifications are required for the mixed reception cell, as the same DTT mode will be used throughout the broadcast cell.

1.1.1 Fixed reception mode

A 10m height antenna is assumed for fixed reception as illustrated below:

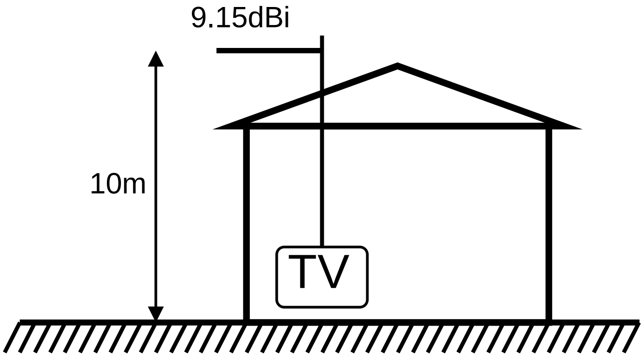

Figure 1. Fixed reception arrangement at 10m.

Reception is based on the following planning parameters:

Parameter	Symbol	Value	Units	Notes
Link BW	B	7.6	MHz	DVB-T, 8MHz channels
Receiver Noise Figure	NF	7	dB	Assumed tuner performance
Receiver Noise Floor	N	-98.17	dBm	kT, 290K
Cell Edge reliability	q	95.00%		% of locations to serve at pixel edge
Shadowing variance	s_{DTT}	5.5	dB	Intra pixel variance
Loss margin	ms_{DTT}	9.05	dB	Additional margin for q% locations
Min SNR	SNR_{min}	19.5	dB	GE06 A3.2: 64-QAM 2/3 mode, Ricean
Receiver implementation margin	IM_{margin}	1.5	dB	Departure from theoretical performance
Minimum DTT signal level	P_{min}	-77.2	dBm	Minimum power at tuner
Target DTT signal level	P_{target}	-69.6	dBm	Median power, with location margin
Frequency	F	650	MHz	
Antenna Gain	G_{ant}	9.15	dBi	Net gain including 3dB feeder loss

Table 1. Link budget for fixed reception at 10m

A median field of 56dBuV/m defines the 95% location probability contour. At this field strength, reception will be possible at 95% of locations within a pixel. In general, the fixed case defines the extent of the broadcaster's coverage, albeit the noise figure and antenna gain can be improved in some installations, enabling reception down to 50dBuV/m whilst still maintaining 95% location probability. There is also evidence that modern DTT receiver implementations can work down to much lower signal strengths than the figure of -77dBm used for the Geneva planning[1].

1.1.2 Portable Outdoor, 1.5m

At higher field strengths, portable outdoor reception at 1.5m will be possible.

[1] The minimum sensitivity requirement in the DTG D-book for the 64-QAM 2/3 mode is -78dBm. All receivers must meet or exceed this performance to comply with the conformance test. In practice, lab tests show this requirement is exceeded by typically 3dB.

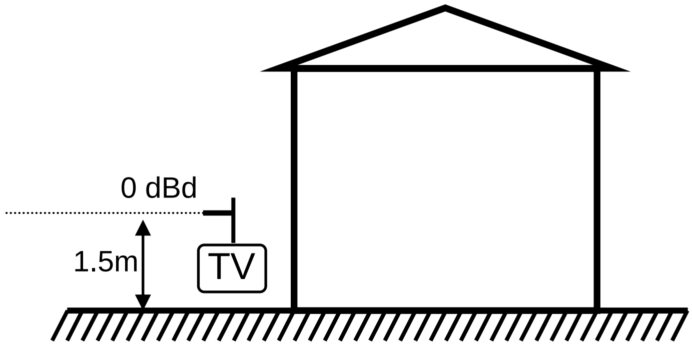

Figure 2. Portable reception arrangement at 1.5m.

Reception is based on the following planning parameters:

Parameter	Symbol	Value	Units	Notes
Link BW	B	7.6	MHz	DVB-T, 8MHz channels
Receiver Noise Figure	NF	7	dB	Assumed tuner performance
Receiver Noise Floor	N	-98.17	dBm	kT, 290K
Cell Edge reliability	q	70.00%		% of locations to serve at pixel edge
Shadowing variance	s_{DTT}	5.5	dB	Intra pixel variance
Loss margin	ms_{tot}	2.88	dB	Additional margin for q% locations
Min SNR	SNR_{min}	21.8	dB	GE06: 64-QAM 2/3 mode, Rayleigh channel
Receiver implementation margin	IM_{margin}	1.5	dB	Departure from theoretical performance
Minimum DTT signal level	P_{min}	-74.9	dBm	Minimum power at tuner
Target DTT signal level	P_{target}	-72.0	dBm	Median power, with location margin
Frequency	F	650	MHz	
Height Loss (10 - 1.5m)	$L_{10-1.5m}$	16	dB	GE06 Height loss: (10-1.5m)
Antenna Gain	G_{ant}	2.15	dBi	No feeder loss
Minimum Field strength at 10m	$E_{med,min}$	72.44	dBuV/m	
Target DTT Field strength (outdoor)	$E_{med,plan}$	75.32	dBuV/m	

Table 2. Link budget for portable reception at 1.5m

Portable outdoor reception is viable for 70% locations when the predicted field strength at 10m exceeds 75dBuV/m. This value includes the additional margins required to compensate for height loss, the lower gain antenna and the Rayleigh channel. In practice, active antennas with preamps are often deployed in these applications, giving a system noise figure improvement of 3dB and a corresponding improvement in sensitivity,

1.1.3 Portable Indoor, 4m

Reception using a portable indoor antenna is quite common in the UK, particularly on the first floor of houses for secondary sets. A typical indoor antenna has a gain of 0dBd and will be deployed approximately 4m above ground level, assuming a typical floor height of 2.35m.

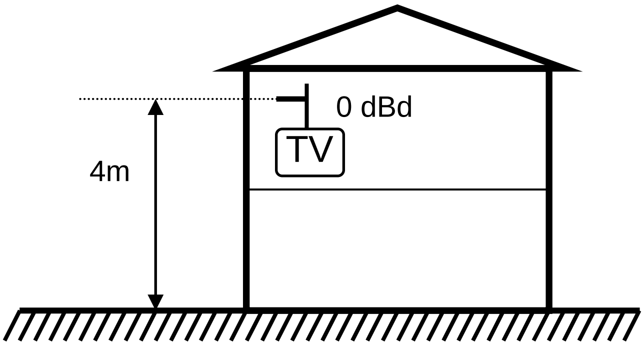

Figure 3. Indoor portable reception arrangement at 4m

Reception is based on the following planning parameters:

Parameter	Symbol	Value	Units	Notes
Link BW	B	7.6	MHz	DVB-T, 8MHz channels
Receiver Noise Figure	NF	7	dB	Assumed tuner performance
Receiver Noise Floor	N	-98.17	dBm	kT, 290K
Cell Edge reliability	q	70.00%		% of locations to serve at pixel edge
Shadowing variance	σ_{DTT}	5.5	dB	Intra pixel variance
Wall variance	σ_{BPL}	5.5	dB	Wall loss variance
Total Loss variance	σ_{tot}	7.78	dB	Total variance, wall + shadowing
Loss margin	$\mu\sigma_{tot}$	4.08	dB	Additional margin for q% locations
Min SNR	SNR_{min}	21.8	dB	For 64-QAM 2/3 mode, Rayleigh channel
Receiver implementation margin	IM_{margin}	1.5	dB	Departure from theoretical performance
Minimum DTT signal level	P_{min}	-74.9	dBm	Minimum power at tuner
Target DTT signal level	P_{target}	-70.8	dBm	Median power, with location margin
Frequency	F	650	MHz	
Wall loss	BPL	8	dB	GE06
Height Loss (10 - 4m)	L_{10-4m}	8.20	dB	ITU 1546
Antenna Gain	G_{ant}	2.15	dBi	No feeder loss
Minimum Field strength at 10m	$E_{med,min}$	72.64	dBuV/m	
Target DTT Field strength (outdoor)	$E_{med,plan}$	76.72	dBuV/m	

Table 3. Link budget for indoor portable reception at 4m

Reception is viable when the predicted field strength at 10m exceeds 77dBuV/m. This value includes the additional margins required to compensate for the height loss and the reduced performance indoor receiver using a set top antenna shielded by 1 wall. Note the table includes a location probability target of 70%, on the basis that marginal reception should be supported and protected from WSD. Active antennas, that improve the system noise figure, will improve the sensitivity,

1.1.4 Portable Indoor, 1.5m

Deep inside the broadcast cell, reception using a portable indoor antenna indoors on the ground floor may also be possible. A typical indoor antenna has a gain of 0dBd and will be deployed approximately 1.5m.

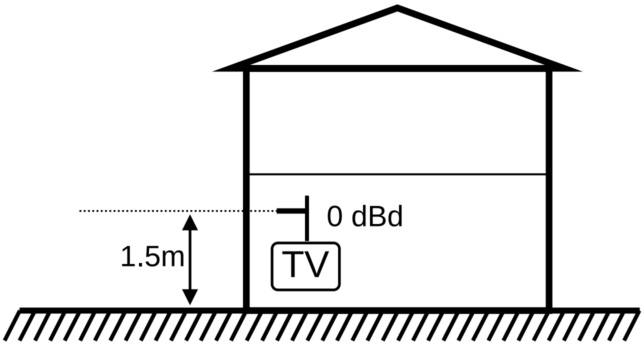

Figure 4. Indoor portable reception arrangement at 1.5m

Reception is based on the following planning parameters:

Parameter	Symbol	Value	Units	Notes
Link BW	B	7.6	MHz	DVB-T, 8MHz channels
Receiver Noise Figure	NF	7	dB	Assumed tuner performance, with preamp
Receiver Noise Floor	N	-98.17	dBm	kT, 290K
Cell Edge reliability	q	70.00%		% of locations to serve at pixel edge
Shadowing variance	s_{DTT}	5.5	dB	Intra pixel variance
Wall variance	s_{BPL}	5.5	dB	Wall loss variance
Total Loss variance	s_{tot}	7.78	dB	Total variance, wall + shadowing
Loss margin	ms_{tot}	4.08	dB	Additional margin for q% locations
Min SNR	SNR_{min}	21.8	dB	For 64-QAM 2/3 mode, Rayleigh channel
Receiver implementation margin	IM_{margin}	1.5	dB	Departure from theoretical performance
Minimum DTT signal level	P_{min}	-74.9	dBm	Minimum power at tuner
Target DTT signal level	P_{target}	-70.8	dBm	Median power, with location margin
Frequency	F	650	MHz	
Wall loss	BPL	8	dB	
Height Loss (10 - 1.5m)	$L_{10-1.5m}$	16.00	dB	GE06: (10-1.5m)
Antenna Gain	G_{ant}	2.15	dBi	No feeder loss
Minimum Field strength at 10m	$E_{med,min}$	80.44	dBuV/m	
Target DTT Field strength (outdoor)	$E_{med,plan}$	84.52	dBuV/m	

Table 4. Link budget for indoor portable reception at 1.5m.

A field strength of 84.5dBuV/m at 10m outdoors is required to enable reception at 1.5m indoors for 70% locations.

2 Protection of different reception modes

As shown in the preceding sections, the prediction for the field strength at 10m can be used to assess which modes of reception will be possible. Areas with good coverage margin will support reception on portable devices using set top antennas and the database could allow these to be protected in populated pixels when there is sufficient signal for this reception mode. Towards the edge of the coverage, only the fixed receiver installation requires protection,

2.1 Protection of the Fixed Reception Cell

The approach developed in ECC 159 is based on allowing a permitted degradation in the location probability for the broadcast service. The location probability is defined as the percentage of locations that will be able to receive the TV signal without impairment in a TV planning pixel.

In the absence of interference form the WSD, the location probability is given by

$$q_1 = \Pr\left\{ P_{\mathrm{S}} \geq P_{\mathrm{S,min}} + \sum_{i=1}^{K} r_{\mathrm{U},k} P_{\mathrm{U},k} \right\} = \Pr\{P_{\mathrm{S}} \geq U\}$$

where $\Pr\{A\}$ is the probability of event A, P_{S} is the received power of the wanted DTT signal, $P_{\mathrm{S,min}}$ is the DTT receiver's (noise-limited) reference sensitivity level, $P_{\mathrm{U},k}$ is the received power of the k^{th} unwanted DTT signal, and $r_{\mathrm{U},k}$ is DTT-to-DTT protection ratio for the k^{th} DTT interferer. Note all quantities are expressed in the linear domain (i.e. not dB).

In the presence of the WSD interferer the DTT location probability is degraded from q_1 to $q_2 = q_1 - \Delta q$. Assuming a coupling gain, G, the received WSD interferer power is then given by the product $G\,P^{\mathrm{WSD}}$. This can be expressed in the linear domain thus:

$$q_2 = \Pr\left\{ P_{\mathrm{S}} \geq P_{\mathrm{S,min}} + \sum_{i=1}^{K} r_{\mathrm{U},k} P_{\mathrm{U},k} + r(\Delta f)\, G\, P^{\mathrm{WSD}} \right\}$$

The approach of allowing a degradation Δq in the location probability defines the maximum nuisance power from the interfering WSD to be derived. Solving the equation for P^{WSD} requires either numerical approximations or a Monte Carlo simulation. A coverage degradation, Δq, of 1% corresponds to 1% of DTT users losing reception of DTT using the proportional counting method to assess interference impact.

The coupling gain G depends on the distance of the WSD to the victim DTT antenna and cannot be precisely known. Instead a reference geometry is used to define a 'typical worst case' and a propagation model is used to model the path from the WSD to the victim DTT antenna.

2.1.1 Reference Geometry for Fixed reception

To protect fixed WSD from a mobile WSD, the following reference geometry has been defined in ECC 159.

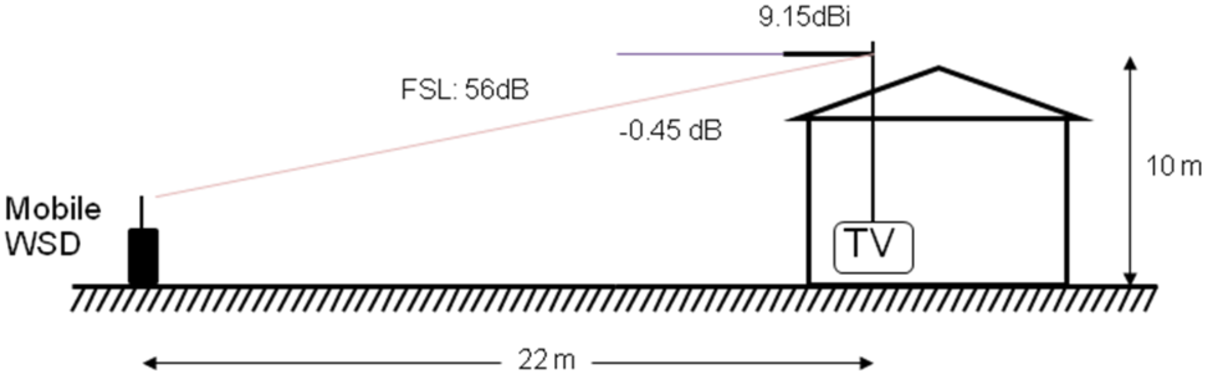

Figure 5. Reference geometry for fixed DTT reception with a portable WSD

The slant distance from the WSD at 1.5m to the victim DTT antenna is 23.6m. A standard GE06 fixed antenna with a net gain of 9.15dBi including 3dB feeder loss is assumed. An additional 3dB of polarization discrimination is assumed on the basis that the mobile WSD signal will not be aligned with the polarisation of the DTT antenna. In practice, the WSD is randomly orientated and could be aligned with the DTT antenna, but this is dealt with by modelling a statistical variation in the path loss between the WSD and the DTT antenna. A standard deviation of 3.5dB for the path is used, which is intended to also take account of possible constructive interference between the ground wave and the direct path to the DTT antenna. The minimum coupling loss between the WSD and the TV receiver is calculated to be 50.5dB at 650MHz.

2.1.2 WSD EIRP limits for a noise-limited DTT cell

The relationship between P^{WSD} and the predicted DTT signal strength at 10m is complex and depends upon the other interfering contributions from co-channel and adjacent channel DTT stations elsewhere in the DTT network. Where the contributions from other DTT stations can be neglected and the DTT coverage can be considered limited only by thermal noise, the EIRP restriction for the WSD can readily be calculated. Increased power may be possible for DTT networks limited by network interference, but this depends on the precise values of DTT interference and their associated standard deviation.

The EIRP restrictions are shown in Figure 6 below as a function of the chosen degradation in location probability, Δq. The precise values of EIRP are also a function of the DTT receiver performance characterised by the protection ratio for the WSD interference. A value of -40dB is used for computation of the graph, based on a typical value for a noise-like WSD interferer operating in the second adjacent channel to the wanted DTT signal. A co-channel protection ratio of 20dB is assumed, corresponding to the DVB-T 64-QAM 2/3 mode.

At the coverage edge, corresponding to a received signal of 56.2dBuV/m for a noise limited location probability of 95%, the maximum permitted power is 2.5dBm for 1% coverage degradation with the WSD at the reference geometry. A 15dB increase in DTT field strength enables a further 19dB increase in WSD power, to 21.5dBm. Restrictions for the 1st adjacent channel will be approximately 10dB lower, but will depend strongly upon the actual protection ratios for the DTT receiver, which should include corrections for the ACLR characteristics of the WSD.

For DTT field strengths above 71.2dBuV/m, the curves are approximately linear, with each dB of DTT coverage margin allowing a further 1dB in interference from the WSD. In this region, DTT reception will be dominated by WSD interference.

In practice, the receiver protection ratios will exhibit compression as a result of receiver saturation. For a receiver with an overload point of -20dBm, the WSD power would need to be restricted to 30.5dBm, assuming operation at the reference geometry with 50.5dB coupling loss to the victim

DTT. WSD powers of 1W (30dBm) and above are likely to result in receiver blocking for typical tuners, but the precise value is a function of the receiver type and the frequency offset from the wanted DTT signal.

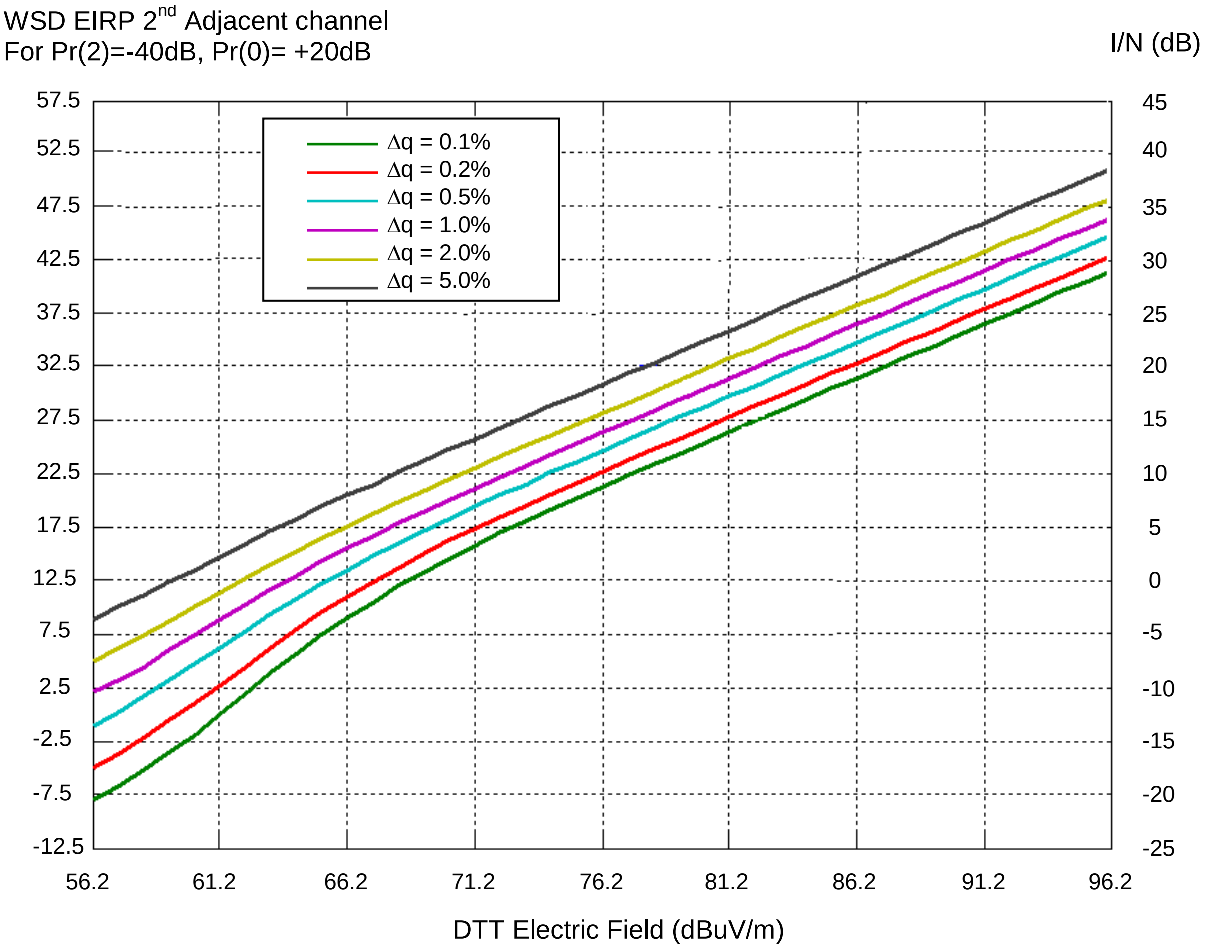

Figure 6. Typical WSD EIRP vs. DTT Field Strength for a given coverage degradation

2.2 Protection of Portable Reception

For the fixed reception case, the coverage margin was made available to the WSD as an interference budget. For portable reception, this is not appropriate as reception tends to be noise limited. Any coverage margin at a particular location tends to be consumed by increased choice in antenna location or operation of the receiver deeper indoors. It is thus advisable to protect the minimum signal strength at the receiver using an *I/N* approach in the same way as proposed by ECC159 for the protection of the mobile service. This will maintain optimum reception indoors and in fading environments, where the received field strength may readily drop to the minimum.

The interference from the WSD, weighted by the receiver ACS value should be positioned below the noise floor of the receiver to minimise loss of sensitivity. The precise value of *I/N*, ι in dB, will determine the loss in sensitivity, γ, and is given by the following equation:

$$\gamma = 10 \cdot \log_{10}(1 + 10^{\iota/10})$$

The behaviour of this function is shown in the graph below:

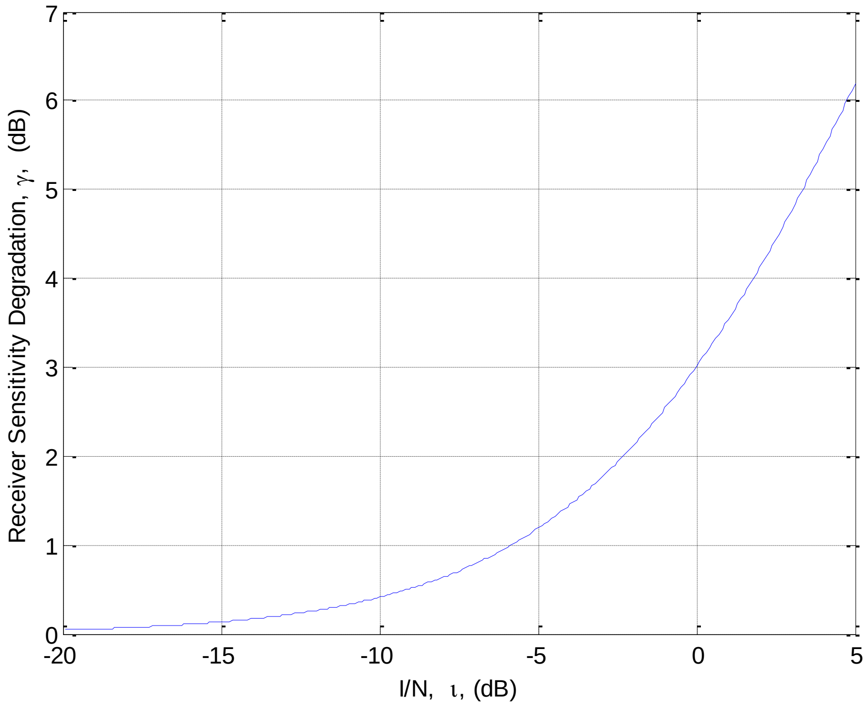

Figure 7. Degradation in receiver sensitivity as function of *I/N*

A sensitivity degradation, γ, of 1dB corresponds to an *I/N*, ι, of approximately -6dB. An *I/N* of 0dB implies a sensitivity degradation of 3dB.

Using this approach, the total interference power from the WSD, will be constrained so that

$$\frac{\sum_j G_j \cdot P_{WSD,j}(f) \cdot r(\Delta f)}{r(0)} \le \iota_{lin} k T_0 \cdot NF \cdot B$$

Where

G_j is the coupling gain between the j^{th} WSD and the victim DTT receiver.

$P_{WSD,j}$ is the EIRP from the j^{th} WSD at frequency f

$r(\Delta f)$ is the protection ratio for DTT receiver at frequency offset Δf

NF is the noise figure of the DTT receiver

B is the DTT receiver bandwidth

k is the Boltzmann constant

T_0 the noise temperature of the receiver, taken as 290K at UHF

ι_{lin} is the chosen value of *I/N* expressed in linear units

2.2.1 Reference Geometry for Outdoor Portable Protection

A suggested geometry for the protection of outdoor portable reception is shown below. The choice of separation between the WSD and the DTT antenna is a compromise. Short separations will imply the greatest restrictions on the WSD

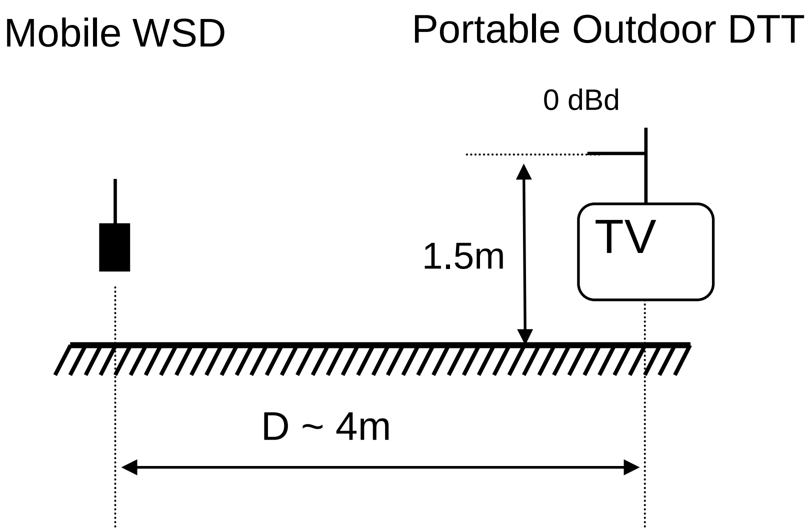

Figure 8. A possible reference geometry for portable outdoor reception

The coupling loss G between the WSD and the victim portable receiver at short range can be modelled as free space loss. Typical values are tabulated below, with the corresponding restriction on WSD EIRP.

Parameter	Symbol	Value	Units	Notes
Separation from WSD to DTT receiver	D	4	m	
Frequency	F	650	MHz	
Free space loss	FSL	40.8	dB	
Antenna Gain	G_{ant}	2.15	dBi	Includes 3dB feeder loss
Wall loss	BPL	8	dB	
Wall variance	S_{BPL}	5.5	dB	
% of worst case walls to consider		50.00%	%	
Number of walls to consider		0		
Worst case wall loss		0.00	dB	
Polarisation discrimination		3.00	dB	WSD antenna is misaligned with DTT antenna
Coupling between WSD and DTT	G	41.6	dB	
Link BW	B	7.6	MHz	DVB-T, 8MHz channels
Receiver Noise Figure	NF	7	dB	Assumed tuner performance, with preamp
Receiver Noise Floor	N	-98.2	dBm	kT, 290K
I/N	ι	0	dB	
Receiver protection ratio	R	-40	dB	Assumption for 2nd adjacent channel
Co-channel protection ratio	R	20	dB	Assumed performance
Maximum WSD EIRP	P_{WSD}	3.5	dBm	

Table 5. Link budget for protection of portable outdoor reception using I/N method

The restrictions on WSD EIRP are quite severe, but clutter between the WSD and DTT antenna and body loss terms, given that this mode of reception tends not to be used for primary sets, may allow the restrictions to be reduced.

2.2.2 Reference Geometry for Indoor Portable Protection

The ECC 159 geometry for protection of portable is shown below and is applicable for reception either at 1.5m or 4m height.

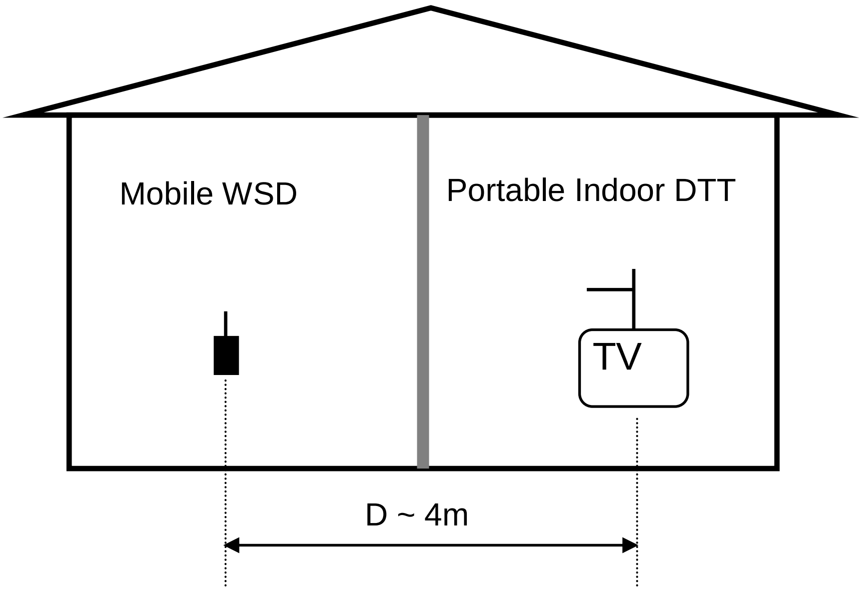

Figure 9. A possible reference geometry for portable indoor reception

The coupling loss G between the WSD and the victim portable receiver at short range can be modelled as free space loss. Typical values are tabulated below, with the corresponding restriction on WSD EIRP.

Parameter	Symbol	Value	Units	Notes
Separation from WSD to DTT receiver	D	4	m	
Frequency	F	650	MHz	
Free space loss	FSL	40.8	dB	
Antenna Gain	G_{ant}	2.15	dBi	Includes 3dB feeder loss
Wall loss	BPL	8	dB	
Wall variance	s_{BPL}	5.5	dB	
% of worst case walls to consider		50.00%	%	
Number of walls to consider		1		
Worst case wall loss		8.00	dB	
Polarisation discrimination		3.00	dB	WSD antenna is misaligned with DTT antenna
Coupling between WSD and DTT	G	49.6	dB	
Link BW	B	7.6	MHz	DVB-T, 8MHz channels
Receiver Noise Figure	NF	7	dB	Assumed tuner performance, with preamp
Receiver Noise Floor	N	-98.2	dBm	kT, 290K
I/N	ι	0	dB	
Receiver protection ratio	R	-40	dB	Assumption for 2nd adjacent channel
Co-channel protection ratio	R	20	dB	Assumed performance
Maximum WSD EIRP	P_{WSD}	11.5	dBm	

Table 6. Link budget for protection of portable indoor reception using I/N method

The precise restrictions depend on the chosen distance and the I/N value. Assuming 1 wall and a physical separation of 4m, the WSD will need to be restricted to a power of around +11.5dBm as shown in Table 6 . This is based on an I/N limit of 0dB and assumes 3dB polarization discrimination and no antenna pattern discrimination between the WSD and the portable antenna. In practice, some additional discrimination may be offered by the antenna pattern, allowing the restriction to be relaxed slightly.

These limits potentially restrict some WSD applications, but it should be remembered that the geolocation database allows a flexible approach to be taken whereby only populated areas will require this level of protection and the implied restriction on the WSD EIRP.

3 Conclusions

It has been shown that a typical broadcast cell supports reception using a variety of devices and antennas, including fixed outdoor, portable outdoor and portable indoor. As signal strength increases towards the centre of the cell, reception on lower performance installations becomes possible and experience shows that such devices are widely used by consumers when reception conditions allow it.

ECC 159 showed that the protection of portable devices places significant restrictions on WSD EIRP, which might prevent some applications. As a consequence, some regulators are considering protecting only fixed DTT reception. Any additional coverage margin provided by the broadcast network, which could support portable reception, is then made available to the white space device as an interference budget. This approach makes the assumption that the optimised 10m receive installations typically deployed at the edge of the broadcast cell will be installed throughout the cell and carries a significant risk that sub-optimum installations close to the centre of the cell may be significantly degraded by WSD deployment. This is considered a significant issue in the UK where it is estimated that up to 25% of DTT reception makes use of indoor antennas, including set top antennas.

This document proposes an alternative approach where the protection geometry is varied within a coverage area to protect the expected modes of reception. The thresholds for different reception modes have been derived using link budgets. Illustrative WSD EIRP limits have been developed to show how the WSD EIRP might be constrained as a function of DTT field strength.

It is suggested that the portable modes, which require the greatest restriction on the WSD are applied only to areas where the signal strengths are sufficient to support them. Where mobile or nomadic portable reception can be sacrificed, the restrictions can be removed taking into account population data. Areas with no known population need not be restricted by the portable reference geometry, thus enabling higher power access points or base stations on the edges of populated areas.

4 References

1. GE06 : Final Acts of the Regional Radiocommunication Conference for planning of the digital terrestrial broadcasting service in parts of Regions 1 and 3, in the frequency bands 174-230 MHz and 470-862 MHz (RRC-06)
2. Implementing Geolocation, Ofcom Consultation Document published 9th November 2010, http://stakeholders.ofcom.org.uk/binaries/consultations/geolocation/summary/geolocation.pdf