GTech Surveys Limited

Television and Radio Signal Baseline Survey & Reception Impact Assessment

Smithfield Phase 6, Manchester

CHANGE HISTORY

Issue	Date	Details of Changes	
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GTech Surveys Ltd.

GTech Surveys is a Midlands based broadcast and telecommunications consultancy conducting projects throughout the entire UK.

We undertake television and radio reception surveys (signal surveys), conduct broadcast interference and reception investigations, and support telecommunications planning work for wind farm developers, construction companies, architects, broadcasters and Local Planning Authorities.

In addition to these broadcast services, we review and prepare ES & EIA Telecommunications Chapters and documents, liaising with telecommunication providers and advising developers with respect to associated Section 75 and 106 Agreements and planning conditions. Additionally, we verify television transmitter coverage and performance and are actively involved with the UK's Digital Television Switchover project, working for Digital UK, Ofcom and Arqiva.

Only professional broadcast engineers undertake our fully insured products and services.

GTech Surveys is a Consultant Member of the Confederation of Aerial Industries. More information about the Confederation of Aerial Industries and CAI consultants can be found on their website - www.cai.org.uk

We also conduct technical research. During 2009, we undertook nationwide television reception survey work for the BIS – The UK Department for Business, Innovation and Skills. We conducted nationwide house visits to assess antenna system performance to aid the government understand the UK's readiness for the Digital Television Switchover.

Executive Summary

Broadcast reception impact assessments and a television and radio signal baseline survey have been undertaken to determine the potential impacts on the reception of television and radio broadcast services from the proposed Smithfield Phase 6 development. The effects on the reception of VHF (FM) radio, analogue terrestrial television, digital terrestrial television and digital satellite television service reception have all been assessed.

From the findings of the fieldwork and from impact modelling, no adverse impacts have been identified for the reception of any television or radio broadcast network. No interference is expected for any television or radio service and subsequently, no pre or post-construction mitigation measures are required. Overall, the proposed development would have a neutral effect on the reception of television and radio broadcast services for local residents.

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This report follows the following structure:

Chapter 1 provides an introduction to the work

Chapter 2 discusses the different forms of interference and how these can impact different television and radio broadcast platforms

Chapter 3 provides a description of available television and radio services in the study area

Chapter 4 provides a description of the pre-construction television and radio reception conditions around the proposed development

Chapter 5 describes the predicted impacts of the proposed development upon television and radio broadcast reception before any mitigation measures are applied

Chapter 6 identifies any suitable mitigation circumstances and measures for any affected broadcast user

Chapter 7 contains an evaluation of the residual effects following mitigation

Chapter 8 describes a methodology to determine the causes of interference

Chapter 9 is the conclusion

This study was undertaken in April 2012, to investigate areas where the proposed development could cause interference to television and radio broadcast service reception. The report also details the baseline reception conditions for future reference.

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1 - Introduction

This report outlines the findings of a comprehensive field survey undertaken to determine the viewing preference of residents located around the proposed Smithfield Phase 6 development, Manchester, and identifies the effects the proposed development may have on the reception of television and radio broadcast services.

A desktop study was first undertaken, based on broadcast transmission information, plans of the proposed development and maps of the area. A site visit was then subsequently conducted to establish the baseline and radio television reception conditions. Modelling techniques and field assessment of viewers' choice of transmitter have then been used to predict the potential effects upon broadcast reception in the area. The impacts of the proposed development are consequently analysed, and together with various mitigation options, conclusions are drawn on the overall effects of the proposed development on television and radio broadcast services for local residents. The effects on VHF (FM) radio, analogue terrestrial television, digital terrestrial television and digital satellite television service reception are discussed.

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2 - The Mechanisms of Interference to Television Broadcast Services

Analogue Television Interference

This is not applicable for this study, as analogue television services in the Granada TV region were switched during 2010. For more information regarding the switch to digital only television services, please refer to Digital UK's website –

http://www.digitaluk.co.uk/when_do_i_switch/granada

Interference Mechanisms

Any structure will produce two zones of potential disruption to television reception. One zone is where the development creates a 'shadow' (affects all television broadcast platforms) and the other where it gives rise to a 'reflection' (usually affects terrestrial analogue television only). At the frequencies used for broadcasting, the processes of creating a 'shadow' or a 'reflection' are somewhat more complicated than with visible light, but thinking of the problem in these terms is still a helpful way of approaching the matter.

'Shadowing' Effects

In the area behind the structure, the television transmitter is effectively screened from the viewer and the strength of the signal is reduced - Figures 1 and 2.

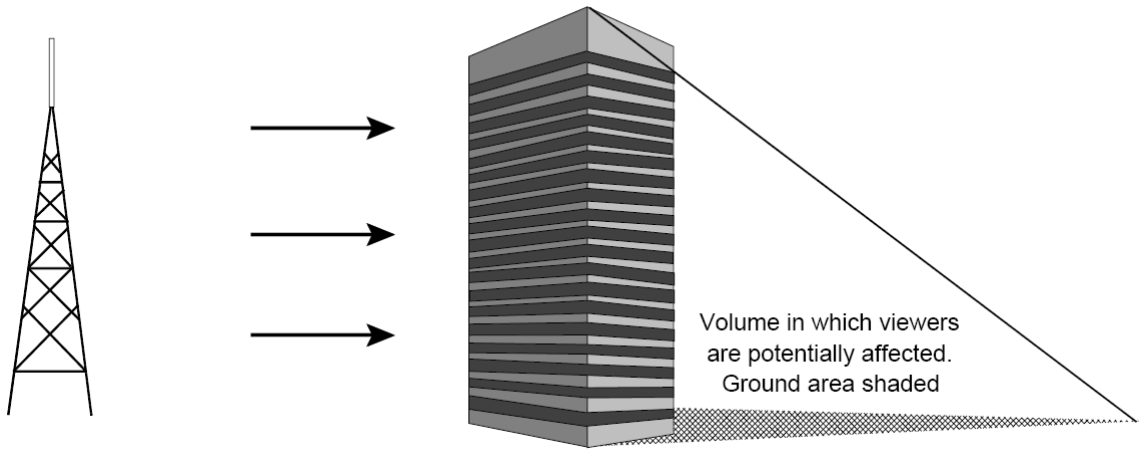

Figure 1 - Affected area in the 'shadow' zone behind the structure

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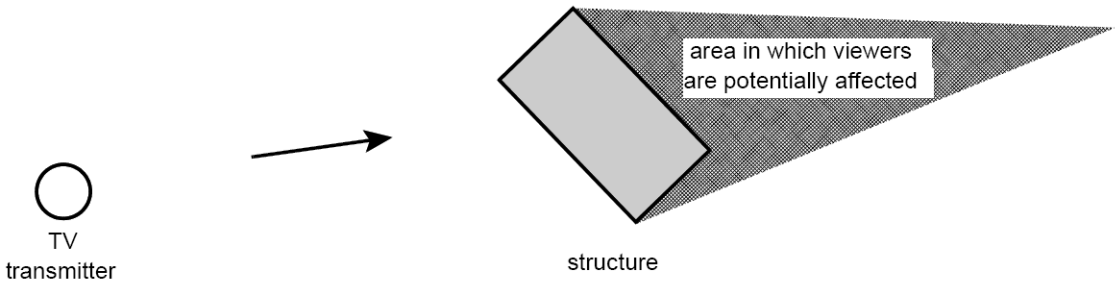

Figure 2 - Plan view of the ‘shadow’ zone

Television signals do not create such a ‘hard’ shadow as visible light, and for the purposes of explanation, a ‘shadow’ zone must be considered which is divided into three sub-zones.

i. Within a few tens of metres from a solid structure, over the region where optical view of the transmitter is lost, the reduction in signal strength is critically dependent on the specific design and composition of the structure. For most brick and concrete buildings the reduction is severe and in some cases almost total.

ii. Further away from the structure (e.g. beyond 250 metres, but this varies depending on its size) the limit of the ‘shadow’ zone and signal reduction are determined by diffraction at the edges of the structure and reflection off surrounding structures. The simple condition of whether or not a location has an optical view of the transmitter is not enough to classify the potential interference zone adequately. In general, the effect is that the signal appears to bend around the sides of the structure; the shadow zone reduces in size and the signal strength is reduced by much less than simple ray optics would suggest.

iii. Even further away from the structure (e.g. 5 km) complex multiple reflections and diffraction, caused by structures in the locality, may result in the ‘shadow’ zone becoming almost non-existent, against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal as presented to the television receiver. This is shown in Figure 3.

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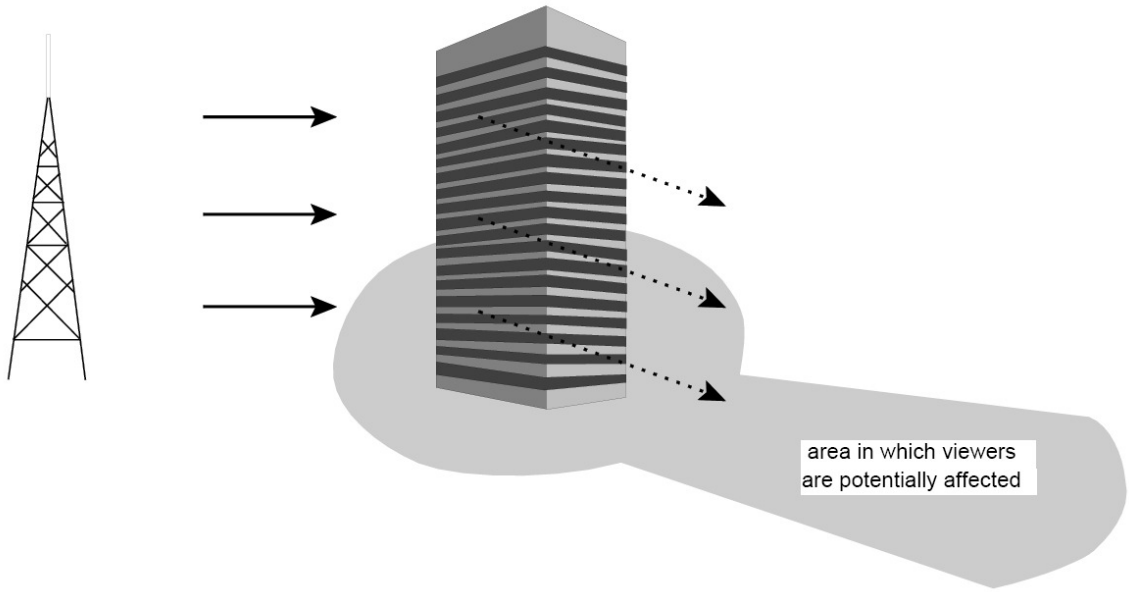

Figure 3 - Affected areas in the ‘reflected’ zone of the structure

‘Reflection’ Effects

The second zone of potential interference is produced by ‘reflection’ or ‘scattering’ of the incident signal, see Figure 3. Analogue reception is more likely to be affected than digital terrestrial reception, which is more robust due to the technical makeup of the digital signal.

Consider Figure 4, the direct signal travels a distance P1 to the viewer, whilst the signal reflected from the structure travels slightly further, distance (P2 + P3). Although travelling at the speed of light, the different path lengths can mean that one signal arrives with a significant delay relative to the other. This results in a second image appearing on the viewer’s screen, displaced from the first. This type of interference is known as ‘ghosting’. If the reflecting signal is complex, several ‘ghost’ images can result.

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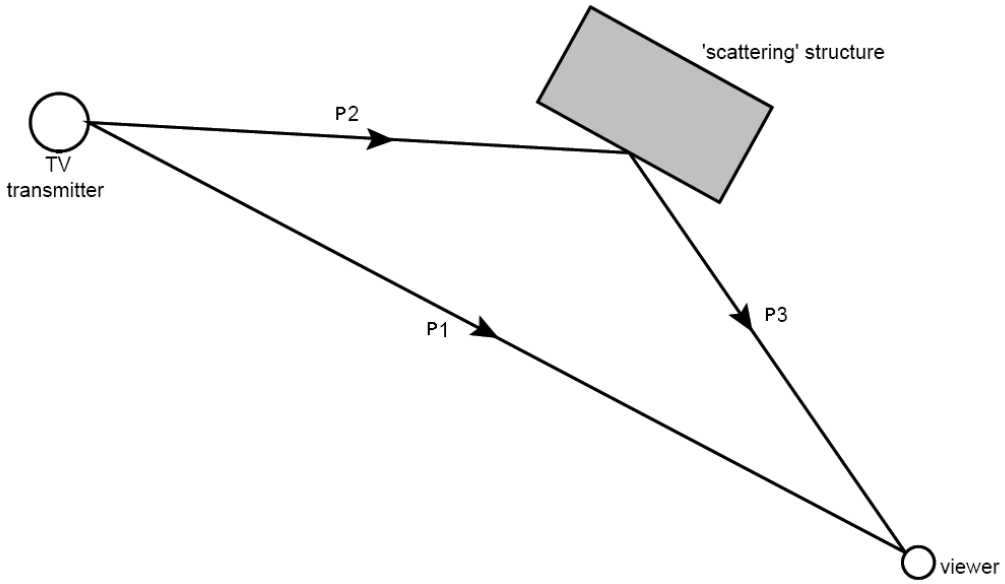

Figure 4 - Direct and Indirect Signal Paths

To avoid interference it is necessary to ensure that the ratio of wanted signal along the direct path (P1) to the unwanted signal along indirect paths (P2+P3) is sufficiently high. Domestic TV receiving antennas generally have a significant directional response to incoming signals, which means that the antenna may discriminate against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal, as presented to the television receiver. This is shown in Figure 5.

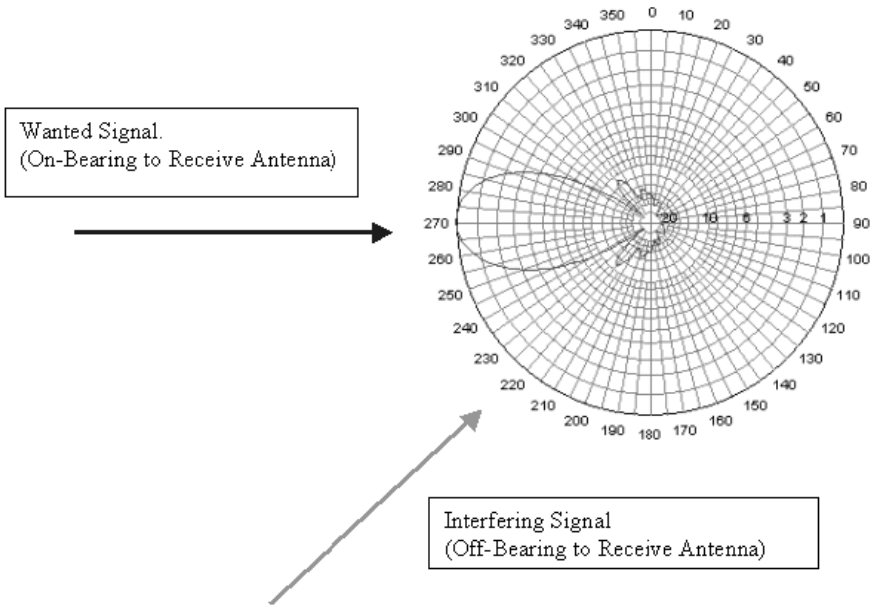

Figure 5 - Typical Domestic Television Receive Antenna Response

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Digital Terrestrial Television (DTT) - Freeview

Analogue television is susceptible to many forms of interference. One of the disadvantages analogue systems have is that once the signal has been corrupted, the information contained within the signal is also disrupted. Consequently, this is then evident upon viewer's screens in the form of interference.

The digital television broadcast platform offers many advantages over older analogue broadcast technologies. Due to the way picture signals are encoded and broadcast, digital television offers a much more resilient platform against the types of interference encountered by analogue television broadcast networks. The construction of digital signals ensures that they are much more impervious to the effects of interference from indirect secondary reflections, which consequently ensures good quality and coherent data stream integrity at the receiver, resulting in an interference free picture.

It is widely accepted that DTT is much more resilient to the effects of building generated television interference. It is also understood that building generated interference can reduce the reliability of DTT services if signal levels are low and bit error rates (BERs) are high. However, due to the structure of the digital signal (specifically relating to the 'guard interval'), interference to DTT signals is almost practically impossible. Technical information regarding the Freeview signal can be found in the Appendix.

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Non Terrestrial Television Services

Digital Satellite Television Services – Freesat & Sky

Digital satellite television services are provided by geo-stationary earth orbiting satellites positioned above the equator. To ensure good reception of digital satellite television services, satellite receive antennas (satellite dishes) are normally positioned away from trees and other clutter and are orientated to face the southern (south southeast) skies.

Disruption to digital satellite television services is normally caused by an obstruction on the line of sight from the satellite to the receive antenna e.g. a tall building or tall trees. Adverse weather can also influence reception. This is further detailed in the Appendix.

In the United Kingdom, Freesat and Sky services come from the 28.2 degrees east ASTRA satellite cluster. The transmission footprints of the satellites can be found in the Appendix.

Figure 6 below shows typical clearance distances and obstruction heights for interference free satellite television reception.

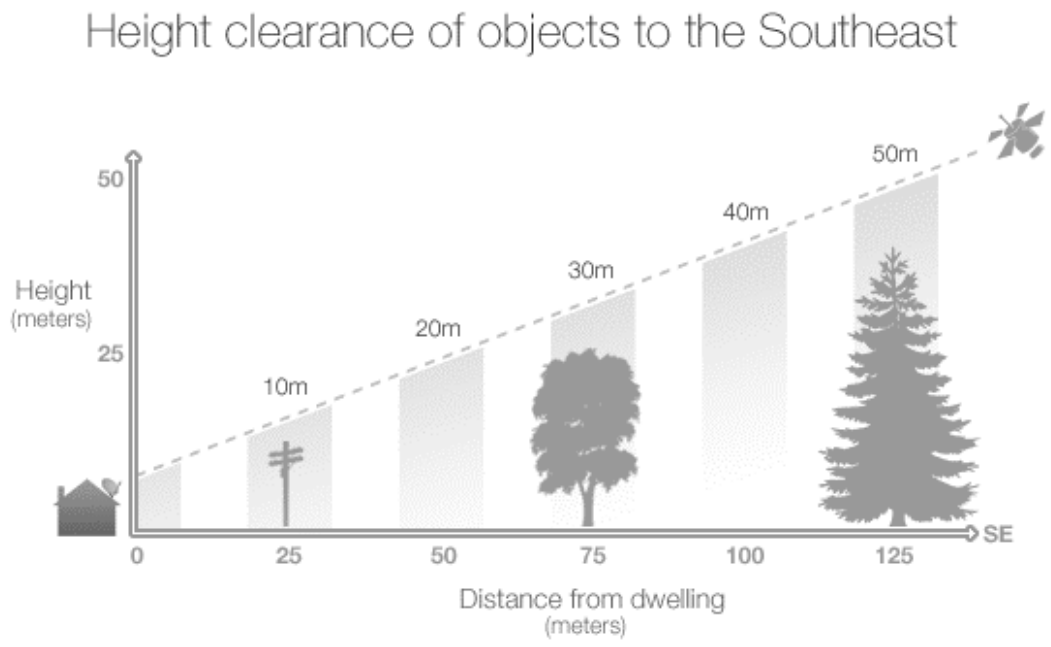

Figure 6 - Typical Clearance Distances and Obstruction Heights for Interference Free Satellite Television Reception

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VHF (FM) Radio Interference & BBC National and Local Radio Services

VHF (FM) radio services are broadcast from similar structures as terrestrial television services. Many things can cause radio interference, however simple remedies exist that can quickly reduce the effects. Most reception problems on FM radio are caused either by a weak signal or by some kind of interference.

Radio transmission signals will reflect into 'shadow' areas and also reflect from structures to cause 'multi-path' effects. The effect of multiple signals is to create zones of signal cancellation and signal enhancement. This is often demonstrated by the need to carefully position portable radio receivers for good reception or the fluctuation in signal quality whilst listening VHF (FM) broadcasts in a vehicle. Due to the wavelength of the VHF (FM) signal (at 100 MHz, the wavelength is 3 metres) zones of interference can quickly and easily physically move around as the interference is generated from the sum interaction of all incoming signals. Consequently, prediction of VHF (FM) interference is not practically possible due to the complex interaction of reflected signals with wanted signals, the design of radio receivers and radio signal propagation characteristics.

The remedies listed in the Appendix are normally sufficient to resolve all interference issues. Buildings rarely cause radio interference but there is little that can be done during the design stage to reduce any adverse effects. Due to the lower frequencies in use for radio transmission and the methods by which the signals are encoded, it is very unlikely that a building will disrupt radio services.

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3 - Available Television Broadcast Services

Analogue Terrestrial Television

The areas around the proposed development are no longer served by analogue television transmissions due to the recently completed Digital Television Switchover.

Digital Terrestrial Television (DTT) - Freeview

The area is served by DTT services from the Winter Hill transmitter (NGR SD 660144), 24.5 kms to the northwest of the proposed development.

Technical transmission information for each service at the aforementioned transmitter site is detailed in Table A, found in the Appendix.

Digital Television Switchover

During early 2010, Digital Television Switchover was completed at the Winter Hill transmitter. For more information regarding the UK's Digital Television Switchover, please refer to the Digital UK website * –

www.digitaluk.co.uk

Up to date technical information regarding the Granada TV region and Winter Hill transmitter group switchover, can be found on the Digital UK website * –

www.digitaluk.co.uk/when_do_i_switch/granada

* - Websites & links verified April 2012

Digital Satellite Television – Freesat & Sky

Digital satellite television services are provided by geo-stationary earth orbiting satellites positioned above the equator. For the reception of the 28.2 degrees east ASTRA satellite cluster, dish elevations of 22.9 degrees are required at this latitude. Optimal receive dish azimuths are 143.8 degrees with respect to true north.

VHF (FM) Radio

The areas around the proposed development are served by FM radio services of

- BBC Radio1, 2, 3, and 4 from Winter Hill

Technical transmission information for each radio service at the aforementioned transmitter site is detailed in Table B, found in the Appendix.

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The Winter Hill transmitter is shown with respect to the proposed development in Figure 7.



Figure 7 – The Location of the Winter Hill transmitter and the direction of the outgoing DTT signals

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4 - Description of Pre-construction (Baseline) Television and Radio Reception Conditions

Survey Method

Due to the complex nature of television and radio interference, field investigations must be undertaken in the general area around a development site to fully evaluate any potential effects.

Additionally, investigations are carried out in all areas where predicted (modelled) interference may occur. In this study, field measurements were undertaken up to 2 kilometres away from the development site. These are identified in Figure 7, and the measurements are detailed in Tables C and D, found in the Appendix.

The following data was recorded:

- When available, field strengths, MER (modulation error ratios) and CSI (channel status information) of DTT transmissions from the Winter Hill transmitter

- Viewing preference (choice of television transmitter) of residents in all areas visited

- Field strengths of VHF (FM) radio transmissions from the Winter Hill transmitter

All television measurements were carried out using a log-periodic receive antenna, mounted on GTech Surveys's broadcast survey vehicle, at a receive height of 10m AGL (industry standard height for such work - used to mimic standard aerial installation height on domestic properties).

Radio measurements were taken with a half wavelength folded dipole antenna at 2m AGL, industry standard height for such work.

During the survey, no assessment was made of reception conditions within viewers' homes. Survey procedures, signal measurements and the survey equipment used are detailed in the Appendix.

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Survey Results and Observations

The taller buildings to the immediate northwest of site dominate the reception conditions. Building use within the study is mainly commercial and any receive antenna systems are mounted on the rooftops of these buildings ensuring optimal reception conditions.

Analogue Terrestrial Television

- Due to the completed Digital Television Switchover, analogue signals are no longer available in the study area.

Digital Terrestrial Television - Freeview

- DTT services were available at all surveyed locations from the Winter Hill transmitter. At all locations, received signal levels were well in excess of recommended minimum amounts and the technical quality of received signals was found to be excellent[1]. DTT services currently provide good coverage and service throughout the study area.

Digital Satellite Television – Freesat & Sky

- During the survey, it was noted that approximately 20% of households in the survey area had satellite-receiving equipment in place.

VHF (FM) Radio

- VHF (FM) radio reception conditions were deemed to be excellent throughout the study area. In-car reception was deemed to be excellent at all locations. This is due to the proximity of the Winter Hill transmitter.

[1] – Signal levels as specified by The Digital TV Group - UK Digital TV Receiver Recommendations, Version 1.4, dated 18 June 2008 and The Digital TV Group - Digital TV Group R Book 5, 2005 Edition

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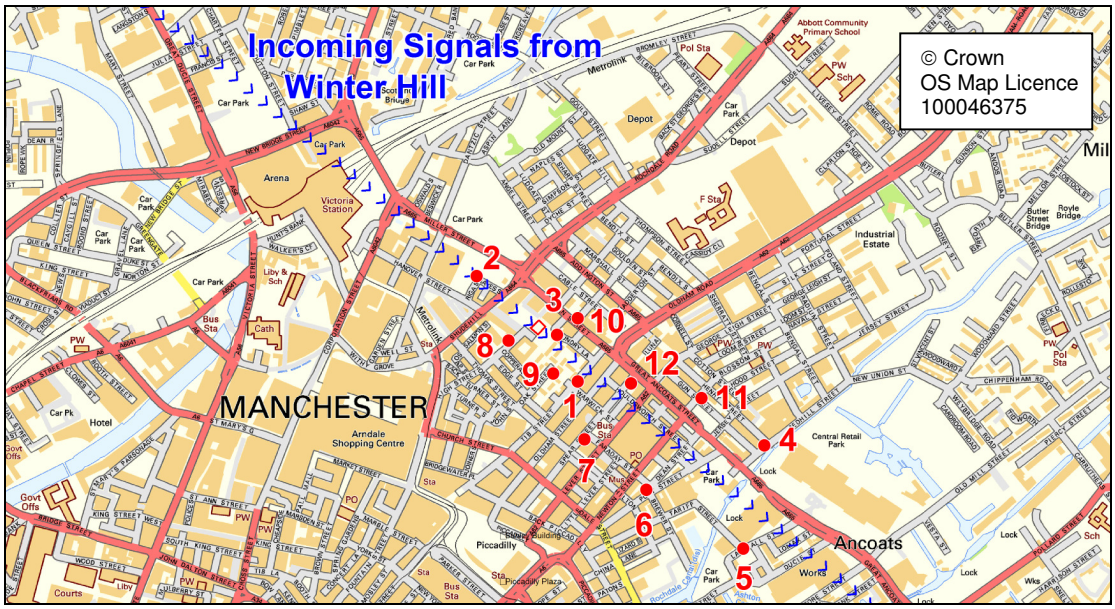

Figure 8 - Surveyed Locations, the location of the Proposed Development and direction of signals from the Winter Hill transmitter

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5 - Predicted Impacts and Effects

Methodology

To assess the effects of the proposed development upon broadcast service reception, the development was considered to create interference to services in the immediate areas around the site, in signal reflection areas and in the shadow zones. These methods, used in conjunction with broadcast transmission information, plans and maps of the study area and modelling techniques (further described in the Appendix), contribute towards predicting the potential effects upon broadcast service reception in the study area.

The field survey then investigated the areas identified as being at risk of interference and assessed all available services and the viewing preferences of residents in order to determine if the computed risk is practically valid.

The collected data is finally used to determine what actual risks exist and what viable solutions are available to minimise any risk effects.

Predicted Effects from Modelling

Analogue Terrestrial Television

- Due to the completed Digital Television Switchover, analogue signals are no longer available in the area. Consequently, interference would not be possible.

Digital Terrestrial Television - Freeview

- Digital services are much less affected by signal reflections. Modelling has indicated that DTT services are not at risk from signal interference generated from the proposed development. This is due to the proposed development's location with respect to the high signal levels received and the favourable proximity of residents with respect to the proposed development. All terrestrial receiving antennas in proximity of the development site are mounted on top of existing tall buildings, ensuring optimal reception.

- Due to their form and mass, the existing taller buildings in the study area already have a more dominating and significant influence on reception conditions in the locality. When taking into account the proposed development, any reception changes in the area from the proposed development can be classed as insignificant.

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Digital Satellite Television – Freesat and Sky

- Buildings can disrupt digital satellite television reception by causing obstructions on the line of sight to the receive dish from the serving satellite. However, as there are no digital satellite television users located to the immediate northwest of the site, no interference is possible.

VHF (FM) Radio

- Due to the current excellent VHF (FM) radio coverage within the study area and the broadcast nature and encoding / decoding methods used for VHF (FM) radio broadcast services, it is very unlikely that the proposed development will impact the reception of radio transmissions in the study area.

Predicted Effects Taking Into Account Survey Findings

The predicted effects are discussed below and summarised in Table 1.

Analogue Terrestrial Television

- Now that Digital Television Switchover has occurred, analogue signals are no longer available in the area. Consequently, interference is not possible.

Digital Terrestrial Television - Freeview

- The proposed development will not impact DTT services.

Digital Satellite Television - Freesat & Sky

- The proposed development will not impact digital satellite television reception.

VHF (FM) Radio

- The proposed development will not impact the reception of VHF (FM) radio broadcasts.

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Broadcast platform	Area(s) of predicted interference	Risk of interference	Antenna protection (Chapter 2)	Alternative good digital reception
Analogue TV	None	No	N/A	N/A
DTT - Freeview	None	No	N/A	N/A
Digital Satellite TV – Freesat & Sky	None	No	N/A	N/A
VHF (FM) Radio	None	No	N/A	N/A

Table 1 - Summary of Predicted Interference

Predicted Effects - Conclusions

- Interference to analogue television services would not be possible.
- Interference to DTT services is not expected.
- Interference to digital satellite television reception is not possible.
- Interference to VHF (FM) radio services is not expected

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6 – Mitigation Circumstances & Measures

Mitigating Circumstances

None applicable.

Mitigation Measures

None required.

As no impacts have been predicted, no mitigation measures are required. However, if procedures for investigating any causes of interference are required, the methodology outlined in Chapter 8 should be followed.

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7 - Evaluation of Residual Effects

Effect / Impact	Type of Effect / Impact	Probability of Effect Occurring	Policy Importance or Sensitivity	Magnitude of Effect	Significance	
					Level	Rationale
Interference to television & radio broadcast services	Negative / Adverse	Unlikely	Local	Neutral	Not significant	Interference to analogue television services is no longer possible due to the recent switch to digital only television services. The study area is very well served by DTT transmissions from the Winter Hill transmitter and modelling has indicated that the proposed development would not impact these services. This is due to the favourable locations of residents with respect to the scheme and the current good coverage provided by Winter Hill DTT services. Due to the location of the proposed development with respect to the locations of satellite receive dishes, interference to digital satellite reception will not be possible. Due to the current good coverage of VHF (FM) radio services and the nature of VHF (FM) interference, the proposed development is unlikely to cause radio interference. When all considered, the proposed development will have a neutral effect upon television and radio reception for local residents.

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8 - Investigating The Causes of Interference

If reports of television or radio interference are received, a procedure is required to enable the developer to determine the validity of a claim. It is recommended that the following procedure is applied for any reports of interference. If clusters or patterns of interference form, such data would quickly enable an investigation to take place and will greatly decrease the time taken to resolve the matter.

Based on information received from the developer, an initial investigation would be carried out to validate the claim. In order for an expert to undertake this, the developer is required to log any complaints.

The log should contain the following as a minimum –

- full contact details of the complainant (name, address, contact number etc)
- a physical description of the interference, identifying which TV sets are affected
- whether FM radio has been affected
- whether satellite TV has been affected
- dates and the times of day when interference is noticed
- the channels it affects
- when the interference was first noticed

This information would be then be assessed through the findings of this report to validate any claim or claims. Previous experience has shown that the majority of reports of interference have been down to either; user error with equipment; damaged or incorrectly set up receiving equipment or confusion regarding domestic technical appliances. Most reception problems can be resolved with simple technical advice. However, if a pattern of interference emerges that corresponds with any theoretical or predicted impacts, or if clusters of interference have formed within the study area, further investigations are required.

House Visits and Interference Investigation Field Work

By taking identical signal measurements inside the residential property where interference has been reported, and also outside using a broadcast signal survey vehicle, a comparison can be made against the unknown antenna system (the residential property's antenna) and the calibrated antenna systems of the survey vehicle. The overall quality of the residential antenna system is then determined and any faults present are then identified from analysis of the technical measurements. All signal measurements will be taken with the same equipment. Inside the property, the measurements will be undertaken at the TV socket (wall plate). Externally, the survey vehicle's mast will be raised to the same height as that of the property's receiving antenna

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and as close to the property as possible, to replicate the reception environment.

From the findings of the analysis of these measurements, visual inspections of the resident's receiving systems and from the desktop-based analysis, the interference source will be identified and solutions will be found to restore the reception of broadcast services for the affected resident.

The technical measurement procedure is detailed in the Appendix.

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9 – Conclusions

A desktop study and field survey have been performed to assess the possible effects and impacts on the reception of television broadcast services from the proposed Smithfield Phase 6 development, Manchester. The study has focused on the three television broadcast platforms that could possibly be impacted by the proposed development – analogue terrestrial television, digital terrestrial television and digital satellite television services; and VHF (FM) radio services.

Analogue Terrestrial Television

Due to the recently completed Digital Television Switchover, it is now not possible for the proposed development to impact analogue terrestrial television reception, as analogue transmissions have been switched off in the study area.

Digital Terrestrial Television (DTT)

From modelling (no viewers are located in any areas where interference could occur) and analysis of current local reception conditions, the proposed development is not expected to have any effect upon the reception of DTT services. DTT is more commonly known as 'Freeview'. The existing taller buildings located around the proposed development have a far more significant impact upon DTT reception and signal conditions.

Digital Satellite Television

Due to the location, mass and form of the proposed development, the angle of the incoming satellite signals and the locations of local satellite television viewers, the proposed development cannot impact the reception of digital satellite signals. No interference is expected.

VHF (FM) Radio

Due to the existing good radio coverage in the study area and the methods used for the encoding and reception of VHF (FM) radio services, no building generated interference is expected.

Overall, due to these factors, it is expected that the proposed development will have a neutral effect upon the reception of television and radio broadcast services for local residents. No pre or post-construction mitigation measures are required and no interference is expected for any broadcast platform.

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APPENDIX

Television and Radio Transmission Frequencies

Survey Measurements

An Overview of, BER, CBER, CNR and MER Measurements and Definitions

The Freeview (DVB T2) Signal

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Investigating the Causes of Interference

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Digital Terrestrial Television (DTT) Services

Digital TV Multiplex	Multiplex Operator	UHF Channel Number *	Channel Frequency Fc (MHz) **	Transmitter Power (kW)
BBC A	BBC	62 -	801.833	100
D3&4	Digital 3 & 4	59	778.000	100
BBC B	BBC	54-	737.833	100
SDN	SDN	58	770.000	100
Arqiva A	Arqiva	61 -	793.833	100
Arqiva B	Arqiva	55	746.000	100

Table A – Winter Hill Digital Television Services ***

VHF (FM) Radio Services

Analogue FM Service	Frequency (MHz)
BBC Radio 1	98.10
BBC Radio 2	88.50
BBC Radio 3	90.70
BBC Radio 4	92.90

Table B – Winter Hill VHF (FM) Radio Services ***

Key -

Public Service Broadcaster (PSB) Digital Multiplexes
Commercial (COM) Digital Multiplexes

* - Digital multiplexes with a “+” or “-“ sign operate with a frequency offset making the centre frequency + or - 167 kHz.

** - The nominal centre frequency, Fc (in Megahertz) of the multiplex can be calculated using Fc=8n+306, where ‘n’ is the UHF channel number.

*** - Information correct at time of writing. Information provided by DigitalUK and Arqiva

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Measurement Point Number	Channel	54	55	58	59	61	62
	Frequency	738.00	746.00	770.00	778.00	793.83	801.83
	Service	BBC HD	Arqiva B	SDN	D 3 & 4	Arqiva A	BBC A
1	FS	83.5	76.2	70.7	77.0	73.6	71.7
	CSI	-	27	24	22	26	27
	MER	-	28.8	26.1	27.8	31.1	30.9
2	FS	72.4	75.9	68.2	67.5	63.6	66.7
	CSI	-	22	21	26	28	27
	MER	-	28.9	30.0	31.2	28.9	29.3
3	FS	96.3	93.0	91.0	90.0	93.7	95.2
	CSI	-	31	27	27	30	33
	MER	-	21.5	22.1	26.1	22.1	17.4
4	FS	82.2	77.5	72.6	74.6	75.0	76.2
	CSI	-	29	25	26	23	23
	MER	-	29.4	28.0	32.2	30.2	29.8
5	FS	86.6	79.9	77.8	79.2	77.6	83.0
	CSI	-	26	27	22	22	21
	MER	-	30.8	26.0	28.9	30.0	29.8
6	FS	84.2	76.0	79.0	75.9	74.8	72.4
	CSI	-	28	25	23	19	21
	MER	-	28.9	27.6	31.2	28.9	29.3
7	FS	80.8	82.1	76.5	71.2	63.0	67.3
	CSI	-	31	29	22	24	27
	MER	-	29.1	26.8	28.3	27.7	24.0
8	FS	81.5	76.7	74.5	73.9	76.0	73.7
	CSI	-	35.6	32.5	29.5	30.1	29.2
	MER	-	22.6	29.6	23.5	24.9	27.3
9	FS	94.0	79.3	76.2	72.4	79.0	74.6
	CSI	-	34	33	24	37	32
	MER	-	22.8	24.9	26.6	27.7	24.1
10	FS	82.0	78.6	74.6	75.7	75.0	76.1
	CSI	-	28	31	29	34	24
	MER	-	29.8	24.8	26.6	23.6	24.2
11	FS	87.8	73.8	78.4	74.0	73.8	75.1
	CSI	-	35.8	35.5	28.3	31.3	25.8
	MER	-	23.2	27.1	26.1	25.4	27.1
12	FS	76.7	77.9	76.8	76.5	72.2	72.2
	CSI	-	37	32	25	34	33
	MER	-	19.8	21.1	26.9	30.3	25.5

Table B - Field Strength & Technical Measurements of Winter Hill Digital Television Services

Field strength values are indicated in dBµV/m
Frequencies listed are in MHz
MER values are in dB
CSI values are in %

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Location	Frequency	98.2	88.6	90.8	93
	Service	Radio 1	Radio 2	Radio 3	Radio 4
1		70.8	69.1	69.0	77.5
2		79.4	76.0	84.2	83.6
3		59.4	64.2	70.4	69.1
4		78.2	78.9	76.9	70.7
5		78.5	79.3	79.3	75.4
6		69.5	75.5	74.6	73.2
7		71.8	76.9	66.8	66.1
8		74.2	74.7	82.7	77.4
9		67.9	71.2	67.4	70.4
10		75.8	73.4	65.3	65.5
11		77.3	65.2	65.1	72.0
12		79.5	69.4	64.1	73.6

Table D – Field Strength Measurements of Winter Hill VHF (FM) Radio Services

Key -

Field strength (FS) values are indicated in dBµV/m
Frequencies listed are in MHz

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Survey Measurements

Signal Level [1]

The first and easiest parameter to check is signal level (also referred to as amplitude or signal strength). In many cases this gives a good indication of the available decoding margin, or the extent of any shortfall.

The level of a DTT signal is measured in the usual units of dBµV, but the values that will be encountered are much lower than for analogue signals (see Table 1, recommended signal levels) and the relative levels will vary from one transmitter to another. It is helpful to understand that the level of a DTT signal represents the total power of all the carriers in the Coded Orthogonal Frequency Division Multiplexing (COFDM) signal and not the level of each individual COFDM carrier.

	Max Signal Level	Min Signal Level
Analogue TV	80 dBµV	60 dBµV
DTT	70 dBµV	45 dBµV (see notes)

Table 1 – Recommended Signal Levels

(1) The 45 dBµV figure applies where the set top box (STB) or integrated digital TV (idTV) is the first item in the radio frequency (RF) distribution chain. (This is the normal arrangement and is strongly recommended) A 5dB higher level is necessary to take into account the typical low gains and high noise figures for any satellite receiver or video cassette recorder (VCR), either operating or in standby mode, used ahead of the STB or idTV.

(2) The recommended signal levels in Table 1 are measured at the outlet plate except where a satellite receiver or VCR is used ahead of the STB or idTV, in which case they are measured at the input to the STB or idTV. They assume a minimum C/N (carrier-to-noise ratio) requirement, including a satisfactory margin, of 26dB for 64-QAM rate 2/3 and 22dB for 16-QAM rate 3/4.

(3) These levels are recommendations and should be used only as a guide. Individual installations may need more or less signal level in order to achieve an acceptable decoding margin, depending on the particular system configuration.

For satisfactory reception of digital signals, it is important that ALL of the signals applied to the receiver, both analogue and digital, are within the ranges shown in Table 1. Digital signals are generally in the region of 17dB lower in power than analogue, and in some cases significantly lower still. Particular care is needed when ensuring adequate levels of digital signal, that the analogue signals are not too great, causing overload in the receiver. (Although the distortion on the analogue signals may not be very noticeable, the DTT signals could suffer from such high levels of intermodulation products that they can no longer be decoded.)

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Similarly, in existing installations where the analogue signals are delivered at around 60 dBµV, digital signals may only be in the region of 40 to 45 dBµV and therefore give unreliable service.

These maximum and minimum levels define a so-called window of operation for the receiver. Note that as the difference in power level between the weakest digital signal and the strongest analogue signal increases, the size of the window decreases.

[1] – Source information – "The Digital TV Group - Digital TV Group R Book 2", 2002 Edition

An Overview of, BER, CBER, CNR and MER measurements and definitions in Layman's Terms

Common practice dictates that in order to measure the quality of a received DTT signal we have to look at one or more of the following parameters: Bit-Error Rate (BER), Channel BER (CBER), Carrier-to-Noise Ratio (CNR) and Modulation Error Ratio (MER). The Channel State Information (CSI) feature available in DTT measurement equipment is a very valuable tool providing additional insight into the quality of reception in a typical domestic or professional DTT installation.

Using the BER alone is an ill-advised "hit-or-miss" strategy because of the 'cliff-edge effect' characteristic of any digital TV system. A BER reading below the reference quasi error free (QEF) value of 2×10-4 might wrongly lead us to conclude that the receiving conditions are satisfactory.

However, the BER provides a very narrow signal measurement range. Even for vanishingly small BER readings, a small drop in the level of received DTT signal can push the DTT receiver over the digital cliff edge beyond the point of system failure. The CBER is closely related to the BER providing a wider signal measurement range. Depending on the type(s) of unknown disturbance(s) affecting our DTT installation (noise, co-channel or adjacent PAL, co-channel DTT, etc.), the CBER corresponding to the reference QEF BER of 2×10-4 varies between 4 and 7 in 100 [1]. Unfortunately, the CBER is not a reliable indicator of how far the digital cliff edge is.

DTT engineers need a tool with a wide measurement range that solves the shortcomings of the BER and CBER. This measurement tool should provide some estimate of the noise margin of the DTT installation. That is, how far are the current reception conditions from those yielding the received signal unusable? A first candidate comes to mind: CNR or, alternatively, its sibling the MER.

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The CNR is defined as the ratio of the average RF power of the DTT signal to the power of the noise present in the UHF channel. Similarly, the MER is defined as the ratio of the average power of the DTT signal to the average power of the constellation errors. It can therefore be used to give a more direct indication of decoding margin when, as is often the case, there is co-channel interference as well as noise in the channel. The higher the MER value, the **better** the reception conditions. Our measurement equipment provides a maximum MER measurement value of 32 to 33 dB.

In situations where there is no multipath propagation so that the channel frequency response remains reasonably flat, CNR and MER are in principle the same thing. In practice, the accuracy of the measured CNR is limited by the noise floor of the measurement equipment and by the presence of other disturbances on adjacent UHF channels. Likewise, both the receiver's noise floor and other issues resulting from its practical implementation degrade the MER estimate.

Channel State Information (CSI)

Some flavour of CSI is used internally by all commercial DTT receivers to achieve the recommended target system performance. The CSI counts the effect of both the noise present in the channel and the shape of the transmission channel itself. In other words, the CSI gives a measure of the reliability of the received DTT signal. We measure the average of the CSI across the UHF channel occupied by the DTT signal. The higher the percentage value of CSI, the **less** reliable DTT reception is.

As explained in [2], the CSI can be used as a means to measure the noise margin in a DTT installation. Let us call CSI_{QEF} the percentage CSI measured at the point where the measurement equipment displays the reference QEF BER. The noise margin in dB is then approximately given by –

$$NM\ (dB) = \frac{CSI_{QEF} - CSI}{2.6}$$

This empirical approximation represents a good estimate for NM below 8dB. The CSI alone, on the other hand, has a wider measurement range, providing meaningful results for NM of up to 15dB.

[2] – Source information – J. Lago-Fernández, "Using Channel State Information (CSI) to Characterize DVB-T Reception", IBC, Amsterdam, 12-17 September 2002

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The Post DSO Freeview Signal



2nd Generation Terrestrial - The World's Most Advanced Digital Terrestrial TV System

What is DVB-T2?

DVB-T2 is the world's most advanced digital terrestrial transmission (DTT) system, offering more robustness, flexibility and at least 50% more efficiency than any other DTT system. It supports SD, HD, mobile TV, or any combination thereof.

Background

DVB-T is the most widely adopted and deployed DTT standard. Since its publication in 1997, over 70 countries have deployed DVB-T services and 45 more have adopted DVB-T. This well-established standard benefits from massive economies of scale and very low receiver prices.

Due to the European analogue switch-off and increasing scarcity of spectrum, DVB drew up Commercial Requirements for a more spectrum-efficient and updated standard. DVB-T2 easily fulfils these requirements, including increased capacity, robustness and the ability to reuse existing reception antennas. The first version was published in 2009 (EN 302 755) and the latest update in 2011 included the T2-Lite subset for mobile and portable reception (BlueBook A122).

How does it work?

Like its predecessor, DVB-T2 uses OFDM (orthogonal frequency division multiplex) modulation with a large number of sub-carriers delivering a robust signal, and offers a range of different modes, making it a very flexible standard. DVB-T2 uses the same error correction coding as used in DVB-S2 and DVB-C2: LDPC (Low Density Parity Check) coding combined with BCH (Bose-Chaudhuri-Hocquengham) coding, offering a very robust signal. The number of carriers, guard interval sizes and pilot signals can be adjusted, so that the overheads can be optimised for any target transmission channel.

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The key new technologies in DVB-T2 are:

- Multiple Physical Layer Pipes allow separate adjustment of the robustness of each delivered service within a channel to meet the required reception conditions (for example in-door or roof-top antenna). It also allows receivers to save power by decoding only a single service rather than the whole multiplex of services.
- Alamouti coding is a transmitter diversity method that improves coverage in small-scale single-frequency networks.
- Constellation Rotation provides additional robustness for low order constellations.
- Extended interleaving, including bit, cell, time and frequency interleaving.
- Future Extension Frames (FEF) allow the standard to be compatibly enhanced in the future.

As a result, DVB-T2 can offer a much higher data rate than DVB-T OR a much more robust signal. For comparison, the two bottom rows show the maximum data rate at a fixed C/N ratio and the required C/N ratio at a fixed (useful) data rate.

	DVB-T	**DVB-T2** (new / improved options in red)
FEC	Convolutional Coding+Reed Solomon 1/2, 2/3, 3/4, 5/6, 7/8	LDPC + BCH 1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Modes	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM, 256QAM
Guard Interval	1/4, 1/8, 1/16, 1/32	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
FFT Size	2k, 8k	1k, 2k, 4k, 8k, 16k, 32k
Scattered Pilots	8% of total	1%, 2%, 4%, 8% of total
Continual Pilots	2.6% of total	0.35% of total
Bandwidth	6, 7, 8 MHz	1.7, 5, 6, 7, 8, 10 MHz
Typical data rate (UK)	24 Mbit/s	40 Mbit/s
Max. data rate (@20 dB C/N)	29 Mbit/s	47.8 Mbit/s
Required C/N ratio (@22 Mbit/s)	16.7 dB	8.9 dB

Sourced from * -

http://www.dvb.org/technology/fact_sheets/DVB-T2_Factsheet.pdf

** - Websites & links accessed and verified March 2012*

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VHF (FM) Radio Interference

Hissing or fading

Hissing or fading means the signal reaching the radio receiver is not strong enough. If this is affecting a portable radio with a telescopic aerial, ensure it is fully extended, tilting and swiveling the aerial until the best signal is received. Moving the radio to another position, such as near a window, higher up or in another room may improve reception conditions. If the FM tuner is part of a hi-fi system, make sure the wire or ribbon cable aerial supplied is connected.

Stereophonic reception requires a stronger signal than monophonic. If hissing is heard when listening to stereophonic, switch to monophonic mode.

If there is still no improvement, a separate aerial (as long as the radio has an aerial socket) may be required. An aerial installed on the roof or the outside of the house is optimal.

Distorted S and Z sounds (sibilance)

This is caused by what is known as multipath distortion. It happens because signals from the transmitter travel by more than one path to the radio: one signal is reflected off tall buildings or hills and arrives a moment later than the direct signal, causing interference. Remedies:

- For a portable radio, move it around the room.
- Tune to another frequency for the same station.
- Use a directional rooftop aerial that picks up only the direct signal from the transmitter.

Twittering and whistling

These annoying sounds (sometimes called 'birdies') are usually caused by another station transmitting on a frequency very close to the wanted station's frequency. A separate aerial, preferably a directional rooftop aerial, may reduce the interference.

Twittering noises can also be caused by high air pressure, which brings fine weather and also allows FM signals to travel further than normal. Interference from strong foreign stations may be heard. There is nothing that can be done to reduce these effects - reception will only improve when the weather changes.

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Buzzing, crackling and clicks

Bursts of buzzing or regular clicks are often caused by interference from something powered by electricity, such as a domestic appliance or a faulty fridge or central heating thermostat. Try switching off or disconnecting appliances one at a time to see if there is an improvement. Also check the radio in case it has a loose aerial connection or mains lead.

Rain Fade

Rain fade refers primarily to the absorption of a microwave Radio Frequency (RF) signal by atmospheric rain, snow or ice, and losses are especially prevalent at frequencies above 11 GHz. It also refers to the degradation of a signal caused by the electromagnetic interference of the leading edge of a storm front. Rain fade can be caused by precipitation at the uplink or downlink location. However, it does not need to be raining at a location for it to be affected by rain fade, as the signal may pass through precipitation many miles away, especially if the satellite dish has a low look angle. From 5 to 20 percent of rain fade or satellite signal attenuation may also be caused by rain, snow or ice on the uplink or downlink antenna reflector, radome or feed horn.

Rain fade causes data stream break up on digital services and increased noise on received analogue pictures. During times of very heavy rain, users may receive no signal at all, as set top boxes may not be able to lock onto the data transport streams and decode the information.

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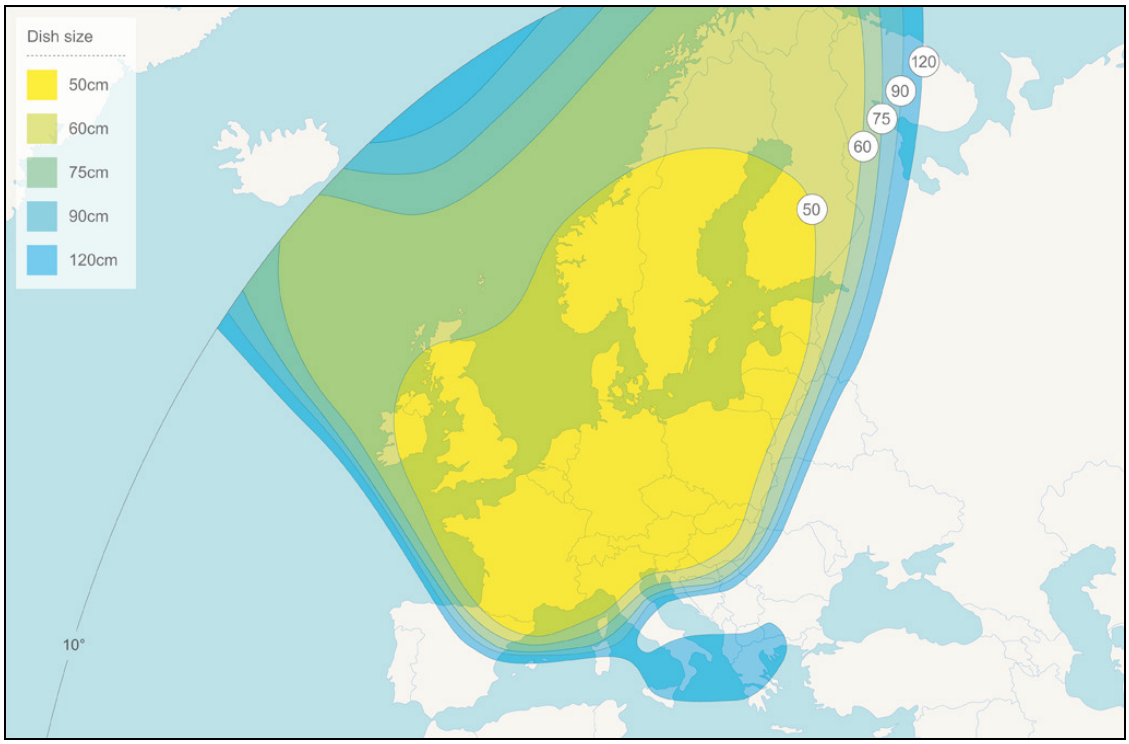
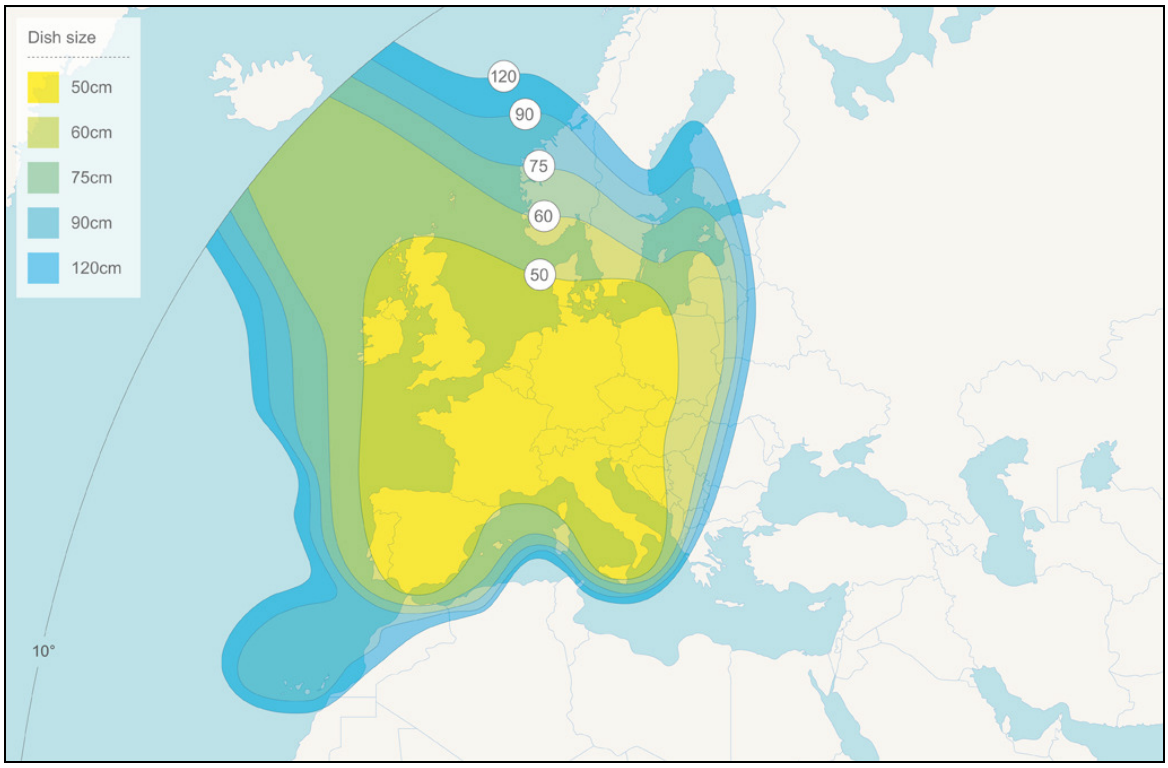
ASTRA 2A, ASTRA 2B and ASTRA 2D satellite Transmission Footprints



ASTRA 2A and ASTRA 2B Footprint Image - North Beam



ASTRA 2A and ASTRA 2B Footprint Image South Beam

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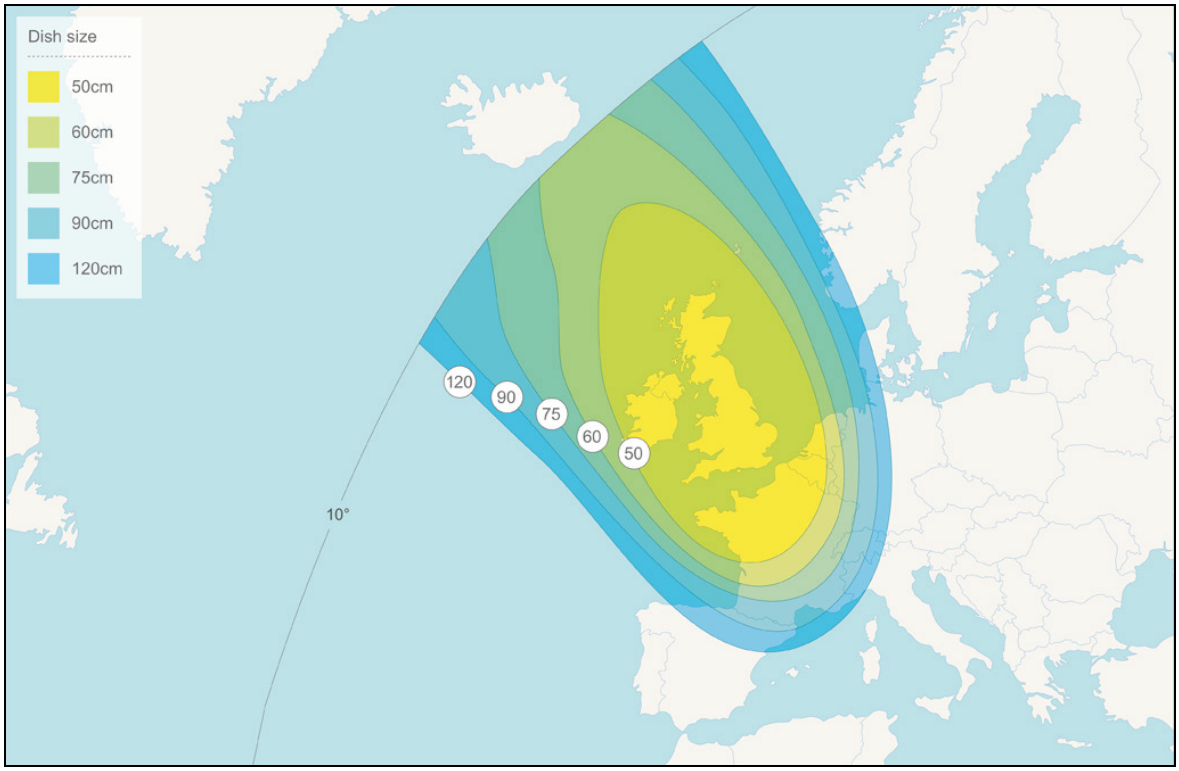

ASTRA 2D Footprint Image

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Survey Procedures

Park survey vehicle in a safe place in a chosen area

Ensure hazard and sidelights are switched on

Check for overhead power and telephone cables, trees and other hazards

Wear correct PPE

TV Signal Measurements

Raise the mast up to the correct height (10m AGL) and rotate the antenna to the orientation of the incoming transmissions

Peak up the level of the incoming signals by rotating the mast so the receive antenna is optimally aligned to the transmission source

Lock the mast off so it cannot free rotate

Record the values of the received field strengths, MER and CSI for all available DTT multiplexes

Repeat all measurements for all other available television transmissions sources

Once all measurements have been undertaken, lower the mast and return it to its forward facing position

Note the percentage of properties with satellite receive dishes

Note the viewing preference of all residents

Drive away to the next location only when it is safe to do so and the mast is fully retracted

NB - Whilst a measurement is being undertaken the vehicle should not be left unattended at any time.

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Survey Equipment

Survey Vehicle

Survey Vehicle 1 aka 'Mozart' – Ford Tourneo, Moondust Silver

Field Strength Measurements for Digital and Analogue Television Broadcasts

1 x Promax Prolink 4C Premium – Serial Number PK4COPAB11B / 060419030005 Running firmware version 2.47

1 x Sony Wide screen CRT Reference Receiver KV–16TIU – Serial Number 4014480

1 x Professional Broadcast Wideband Log Periodic 8 element antenna – CSA Radiation Systems International

All RF cables, interconnects and systems of professional quality and calibrated to determine feeder losses and antenna gains. These are factored into the results, providing accurate descriptions of actual field strength values at 10m AGL for each surveyed location.

References

The building information found in Chapter 2 was sourced from the following Ofcom document * –

http://licensing.ofcom.org.uk/binaries/spectrum/fixed-terrestrial-links/wind-farms/tall_structures.pdf

** - Websites & links accessed and verified April 2012*

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National Legislation and Planning Polices

National Planning Policy Framework
March 2012, Department for Communities and Local Government

NB - This framework replaced Planning Policy Guidance 8: Telecommunications (23 August 2001).

With regards to telecommunications, the National Planning Policy Framework states as an objective in section 5 that,

5. Supporting high quality communications infrastructure

42. *Advanced, high quality communications infrastructure is essential for sustainable economic growth. The development of highspeed broadband technology and other communications networks also plays a vital role in enhancing the provision of local community facilities and services.*

43. *In preparing Local Plans, local planning authorities should support the expansion of electronic communications networks, including telecommunications and high speed broadband. They should aim to keep the numbers of radio and telecommunications masts and the sites for such installations to a minimum consistent with the efficient operation of the network. Existing masts, buildings and other structures should be used, unless the need for a new site has been justified. Where new sites are required, equipment should be sympathetically designed and camouflaged where appropriate.*

44. *Local planning authorities should not impose a ban on new telecommunications development in certain areas, impose blanket Article 4 directions over a wide area or a wide range of telecommunications development or insist on minimum distances between new telecommunications development and existing development. They should ensure that:*

they have evidence to demonstrate that telecommunications infrastructure will not cause significant and irremediable interference with other electrical equipment, air traffic services or instrumentation operated in the national interest; and

they have considered the possibility of the construction of new buildings or other structures interfering with broadcast and telecommunications services.

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Investigating The Causes of Interference

The detailed indoor measurement procedure is described as follows:

- Locate wall plate or coaxial fly lead feeding the main TV set.
- Ensure that any masthead amplifier power supply units are left in circuit.
- Connect correct F-Type adapter (typically a Belling-Lee socket and plug) and connect to the calibrated CT100 F-Type to F-Type lead.
- Set the signal meter to the digital setting and ensure that the channel bandwidth for these measurements has changed to 8 MHz (default).
- Record the carrier levels for all available DTT services.
- Record the CSI (channel status information) and MER (modulation error ratio) values for all available DTT services.
- Reconnect aerial to television or set-top-box and ensure television set is working correctly.
- Note the aerial system setup e.g. use of splitters, masthead amplifiers, use of benchmarked aerials, cable lengths, age of system, type of aerial etc.
- Undertake the same measurements at other signal outlets in the property, if permitted by the owner.

The detailed outdoor measurement procedure is as follows:

- Ensure the survey vehicle is located in close proximity to the property.
- Raise the mast up to a nominal height of 10m AGL with the antenna orientated towards the incoming transmissions and with the correct polarisation. If the domestic aerial height is less than 10m, lower the vehicle aerial to a matching height and repeat measurements.
- Repeat the measurements taken during the indoor measurement procedure, as detailed above.

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