Ofcom Local TV

Transmission mode testing

Date of Issue: 23rd February 2012

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Appendix A – Detailed test results (13 pages)

Version History

Version number	Date	Comments	Author
v1.0	23/02/12	Initial report	IS

1. Indemnity

DTG Testing Ltd. has used its best endeavours to ensure the quality and accuracy of its work. However, it accepts no liability for any losses resulting from the use of the information provided in this document.

2. Approval

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Report approved for release by: Richard Carlton (Director, DTG Testing)

Date: 23rd February 2012

3. Executive Summary

To enable the launch of local TV services in 2013, Ofcom commissioned DTG Testing to carry out testing on its receiver collection, and examine the compatibility with existing receivers of certain DVB-T transmission modes which are currently unused in the UK.

The testing was split into two parts. The first part of the testing involved combining three locally generated test multiplexes with the national broadcast multiplexes which were received live off-air. These signals, were fed into the DTG Testing receiver collection and the behaviour of each receiver was noted. The main focus of the test was to ensure that reception of the national multiplexes was not disrupted, and that the audio/video content on the three test multiplexes was also presented correctly by receivers. To this end, DTG Testing developed test streams using the three specified modes (two QPSK, and one 16-QAM) and mixed them with the live signal, as received from Crystal Palace to simulate the effects of such transmissions in a controlled environment. On the whole, the receiver collection behaved as desired and functioned correctly with both the broadcast and test multiplexes. Only three receivers presented issues (two of those suffer from the well known 'split-NIT' issue). Refer to Sec 10 for more details.

The second part of the testing involved picking three of the top selling receivers in the UK (sales data derived from GfK), and running detailed RF sensitivity tests across the frequency spectrum, using custom Rohde& Schwarz measuring equipment. This exercise presented no issues at all, and all the receivers behaved in line with expectations.

4. Overview

Ofcom is expecting to license a number of local television services from mid-2012, with the launch of the first services expected from the second half of 2013. The anticipated model is for a single multiplex operator (MuxCo) to be licensed to provide an additional multiplex at a number of established transmitter locations around the UK. The multiplex would need to use a robust transmission mode to achieve reasonable coverage and would therefore be able to accommodate a small number of programme services.

There is an expectation that the additional multiplex should be able to accommodate three programme services. One would be the local service and two of these could be quasi-'national' services.

To this end, Ofcom has proposed a number of tests that are intended to inform the decision on which transmission mode should be adopted by the new local multiplexes, by examining the compatibility of several currently unused DVB-T modulation modes against a fully representative selection of DTT receivers.

5. Digital TV Group and DTG Testing

DTG Testing is the UK Digital TV industry's interoperability test house and a wholly owned subsidiary of the Digital TV Group, the not-for-profit industry association for digital television in the UK. Our mission for both is to enable the development of fully reliable and compliant digital TV and media products and services, primarily for the horizontal market, through world-class specification development, conformance testing and consensus building.

Within DTG Testing's laboratory we host the de facto collection of DTT and D-Sat Receivers for the UK Market. This receiver collection is used to simulate switchover events and other network changes such as LTE impact. Our lab is the only UKAS ISO/IEC 17025:2005 accredited laboratory for terrestrial television receiver testing in Europe.

Work at DTG Testing spans across industry and Government, with conformance testing of manufacturers devices for the UK's Digital Switchover Certification Mark (the 'digital tick') Freeview, Freeview HD, Freesat, Freeview Australia, Freeview New Zealand and Hong Kong MHEG trademark licences. In addition to this compliance work, we also undertake testing for the Department of Business Innovation and Skills (BIS). This testing ensures that production models comply with the relevant requirements for the digital

tick. As a result of these works and our excellence in understanding and developing broadcast technology, we have developed the World's only industry-accredited MHEG test suite and extensions have been developed for New Zealand, Australia and Hong Kong. We continue to work with other countries to provide support services to their DSO activities.

In addition to conformance work, DTG Testing manages the Engineering Channel, which is used in the UK for over-air upgrades to receiver software and interactive application testing for the Freeview, Freeview HD and Freesat services. Over-air downloads enable manufactures update software in deployed receivers to correct potential issues caused by digital switchover (DSO) events, in and other network changes such as LTE in legacy receivers.

DTG Testing has over 10 years experience of bringing together broadcasters, service providers, manufacturers and other key stakeholders to define detailed broadcast and receiver specifications and to provide regimes to measure conformance against brand requirements.

6. Test Setup

The testing was split into two sections.

- Section A – generation of three test multiplexes, mixing with the off-air signal and feed into receiver collection held at the DTG Testing site.

- Section B – perform detailed RF sensitivity checks for each of the three modes, for the three top selling receivers available in the DTG Testing collection (based on data available from GfK, Dec 2011).

7. Section A testing

Three test multiplexes operating at the following parameters were generated by DTG Testing in the lab, as detailed below.

si01_21c_2k_qpsk_cr23_gi32_v1.0.0.ts	
Bit Rate	8,042,781bps
Duration	300 seconds
Frequency	21C (474Mhz)
Bandwidth	8MHz
Transmission Mode	8K
Code Rate	2/3
Guard Interval	1/32
Hierarchy	Non-hierarchical
Constellation	QPSK

si01_45c_2k_qpsk_cr34_gi32_v1.0.0.ts	
Bit Rate	9,048,128bps
Duration	300 seconds
Frequency	45C (666Mhz)
Bandwidth	8MHz
Transmission Mode	8K
Code Rate	3/4
Guard Interval	1/32
Hierarchy	Non-hierarchical
Constellation	QPSK

si01_68c_2k_16qam_cr12_gi32_v1.0.0.ts	
Bit Rate	12,064,171bps
Duration	300 seconds
Frequency	68C (850Mhz)
Bandwidth	8MHz
Transmission Mode	8K
Code Rate	1/2
Guard Interval	1/32
Hierarchy	Non-hierarchical
Constellation	16-QAM

Each transport stream consisted of two services, labelled SIT 1 and SIT 2. SIT 1 contained HD MPEG4 video encoded at 1280x720i. SIT 2 contained SD MPEG2 video encoded at 720x576. The three transport streams were played out simultaneously using PCI based DekTec modulator cards, aligned and mixed with the off-air signal from Crystal Palace, giving a total of nine multiplexes.

A receiver that supports QPSK and 16-QAM signaling should have assigned the correct logical channel number to the services and when selected, each service should have presented video, audio, subtitle and data components.

8. Section A stream details

Service	Description
SIT1 QPSK 2/3 (0x100)	Digital Television Service – Logical channel 601
	Signalled in NIT, SDT, and PAT. EITpf.
	PMT 0x101 PCR 0x102 ES 0x120 Video - AVC H264 1280x720i ES 0x130 Audio MPEG1-Layer 2 ES 0x140 Subtitle ES 0x108 MHEG data component
SIT2 QPSK 2/3 (0x200)	Digital Television Service – Logical channel 602
	Signalled in NIT, SDT, and PAT. EITpf.
	PMT 0x201 PCR 0x202 ES 0x220 Video - SD 720x576 ES 0x230 Audio – MPEG1-Layer 2 ES 0x240 Subtitle ES 0x208 MHEG data component
SIT1 QPSK 3/4 (0xB00)	Digital Television Service – Logical channel 611
	Signalled in NIT, SDT, and PAT. EITpf.
	PMT 0xB01 PCR 0xB02 ES 0xB20 Video - AVC H264 1280x720i ES 0xB30 Audio MPEG1-Layer 2 ES 0xB40 Subtitle ES 0xB08 MHEG data component
SIT2 QPSK 3/4 (0xC00)	Digital Television Service – Logical channel 612
	Signalled in NIT, SDT, and PAT. EITpf.
	PMT 0xC01 PCR 0xC02 ES 0xC20 Video - SD 720x576 ES 0xC30 Audio – MPEG1-Layer 2 ES 0xC40 Subtitle ES 0xC08 MHEG data component
SIT1 16QAM 1/2 (0x1500)	Digital Television Service – Logical channel 621
	Signalled in NIT, SDT, and PAT. EITpf.
	PMT 0x1501 PCR 0x1502 ES 0x1520 Video - AVC H264 1280x720i ES 0x1530 Audio MPEG1-Layer 2 ES 0x1540 Subtitle ES 0x1508 MHEG data component
SIT2 QPSK 1/2 (0x1600)	Digital Television Service – Logical channel 622
	Signalled in NIT, SDT, and PAT. EITpf.
	PMT 0x1601 PCR 0x1602 ES 0x1620 Video - SD 720x576 ES 0x1630 Audio – MPEG1-Layer 2 ES 0x1640 Subtitle ES 0x1608 MHEG data component

9. Section A test plan and expected results

Each DTT receiver was subjected to the combined signal (nine multiplexes), and the behaviour of each receiver checked to ensure two things – continued reception of the national multiplexes and whether it could decode each of the locally generated multiplexes as well.

A factory reset was performed prior to the test and an auto scan done to ensure that the receiver picked up the bouquet of nine multiplexes.

The following tests were carried out:

- Audio/Video/Data/Subtitles were checked on each of the national multiplexes for normal operation.
- Ensure that the channel numbering/placement remained unaffected by the presence of the test multiplexes and an EPG was successfully presented.
- Check Audio/Video/Data/Subtitles on each of the locally generated multiplexes.

As each of the multiplexes had both an SD and HD service, the DVB-T receivers were not expected to decode and present the HD service, or pick up the broadcast HD multiplex PSB3.

10. Overview of test results for Section A testing

An overwhelming majority of the receivers (iDTVs, STBs, DTRs) under test behaved as expected, and continued to present the existing national multiplexes unaffected. In addition, most receivers also decoded the three test multiplexes, generated locally and mixed with the off-signal from Crystal Palace.

However, some receivers exhibited abnormal behaviour and these are highlighted below.

Manufacturer	Model	Type of receiver	Sales figures *	Issue observed
A	X	SD (DVB-T) Recorder	~ 167,000	LCNs (channel numbers) for national multiplexes were incorrectly mapped on the EPG, one national multiplex was not picked up.
A	Y	SD (DVB-T) Set top box	~ 19,000	LCNs for national multiplexes were incorrectly mapped, one national mux was not picked up.
B	Z	SD (DVB-T) Interactive Digital Television	Not available	Receiver picked up only one of the test multiplexes (QPSK 2/3), and the remaining two could not be detected.

The detailed results follow in Appendix A, where these receivers are highlighted in yellow.

NOTE: The X & Y models from manufacturer A are known to suffer from the 'split NIT' problem[1], and are frequently found to present issues such as incorrect channel placement when tested with an off-air signal.

[1] The NIT is the Network Information Table, a set of data used by receivers that is transmitted alongside the programme content within a multiplex. The size of the NIT has increased in recent years as more services have launched on the Freeview platform and a small number of receivers has been found to behave abnormally when the NIT exceeds a certain size and splits into multiple sections.

With regards to the receiver from manufacturer B, it continued to pick up the national multiplexes and was able to receive one of the QPSK modes (2/3 CR) successfully, though could not present the other two test modes (no services installed/presented). Manufacturer B has been informed about this situation, and is investigating the issue.

* The national sales figures are representative by chassis and accurate up to December 2011. Provided by GfK, and rounded up.

11. Section B testing

Detailed RF sensitivity checks were run, across the frequency band used for terrestrial transmissions in the UK and the three top selling receivers that were available in the DTG Testing receiver collection were chosen (represented by chassis[2], rather than individual receiver sales). These were:

Manufacturer	Model	Type of device	Sales figures *
Philips	DTR220	SD (DVB-T) Set top box	~ 1 million
Humax	9300T	SD (DVB-T) Recorder	~ 480,000
Goodmans	GDB7	SD (DVB-T) Set top box	~ 365,000

* The national sales figures are representative by chassis and accurate up to December 2011. Provided by GfK, and rounded up.

The tests were run on the following frequencies:

- Channel 21 – 474.000 MHz with positive and negative offsets
- Channel 45 – 666.000 MHz with positive and negative offsets
- Channel 68 – 850.000 MHz with positive and negative offsets

[2] The chassis is the core hardware and software within a receiver. Different receivers sometimes contain the same chassis and would therefore exhibit similar performance.

12. Section B test setup

The devices were setup for automated testing, using a custom Rohde & Schwarz TS4510 RF test system, available within the DTG Test Lab. The system was calibrated up to ISO 17025 standards, and forms part of the UKAS accredited test facilities at DTG Testing.

Each device was tested according to instructions provided in the current D-Book, up to the point of failure (where the picture would present macroblocking).

13. Section B test results

PHILIPS DTR 220[3]

	QPSK 2/3 (dbm)	QPSK 3/4 (dbm)	16QAM 1/2 (dbm)
CH 21 negative offset (473.833 MHz)	-93.80	-92.70	-90.00
centre frequency (474.000 MHz)	-93.90	-92.70	-90.00
positive offset (474.167 MHz)	-93.70	-92.70	-90.00
CH 45 negative offset (665.833 MHz)	-93.10	-92.10	-89.70
centre frequency (666.000 MHz)	-93.20	-91.90	-89.80
positive offset (666.167 MHz)	-92.90	-92.00	-89.30
CH 68 negative offset (849.833 MHz)	-91.30	-90.30	-87.70
centre frequency (850.000 MHz)	-91.40	-90.50	-87.80
positive offset (850.167 MHz)	-91.30	-90.30	-87.60

[3] There are no performance figures available for the specified modes in the D-Book.

HUMAX PVR-9300T

	QPSK 2/3 (dbm)	QPSK 3/4 (dbm)	16QAM 1/2 (dbm)
CH 21 negative offset (473.833 MHz)	-94.00	-92.60	-90.10
centre frequency (474.000 MHz)	-94.00	-92.80	-90.10
positive offset (474.167 MHz)	-94.00	-92.60	-90.00
CH 45 negative offset (665.833 MHz)	-93.30	-92.50	-89.90
centre frequency (666.000 MHz)	-93.30	-92.40	-89.80
positive offset (666.167 MHz)	-93.20	-92.30	-89.90
CH 68 negative offset (849.833 MHz)	-90.60	-89.50	-86.90
centre frequency (850.000 MHz)	-90.70	-89.50	-86.90
positive offset (850.167 MHz)	-90.70	-89.60	-87.00

Goodmans GDB7

	QPSK 2/3 (dbm)	QPSK 3/4 (dbm)	16QAM 1/2 (dbm)
CH 21 negative offset (473.833 MHz)	-93.70	-92.80	-90.20
centre frequency (474.000 MHz)	-93.80	-92.80	-90.20
positive offset (474.167 MHz)	-93.70	-92.90	-90.20
CH 45 negative offset (665.833 MHz)	-92.10	-91.30	-88.40
centre frequency (666.000 MHz)	-92.20	-91.30	-88.40
positive offset (666.167 MHz)	-92.10	-91.30	-88.50
CH 68 negative offset (849.833 MHz)	-89.20	-88.30	-85.40
centre frequency (850.000 MHz)	-89.10	-88.30	-85.50
positive offset (850.167 MHz)	-89.10	-88.40	-85.50

14. Overview of test results for Section B testing

There were no surprises to be found generally when the RF sensitivity tests were performed, and all devices presented results which were broadly consistent, and in line with expectations.