Australian
Broadcasting
Authority

DISCUSSION PAPER

DRAFT
TERRESTRIAL TELEVISION
DIGITAL CHANNEL PLAN

Tasmania

Part 1: Hobart

APRIL 1999

SUBMISSIONS TO THE ABA

Submissions on the matters raised in this discussion paper and draft DCP (DCP) may be made to the ABA as follows:

by email: digital@aba.gov.au

by mail: Draft DCP for Hobart
Australian Broadcasting Authority
PO Box 34
BELCONNEN ACT 2616

by fax: (02) 6253 3277

Please quote file reference 1999/5152 in your reply.

The ABA would prefer submissions to be sent by email or on an IBM compatible or Mac 3.5 inch floppy disk wherever possible.

Any enquiries concerning technical matters raised in this document should be directed to Mr Luke Blackman on (02) 6256 2860. Other enquiries should be directed to Mr Michael Barry on (02) 6256 2884.

The closing date for submissions is 5.00 pm, Monday 31 May 1999.

All submissions received will be made available for public inspection[1].

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[1] If you do not wish your submission to be made public please ensure that it is clearly marked "Confidential - Not for the Public File" on the top of the first page of the document.

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1 EXECUTIVE SUMMARY

1.1 BACKGROUND

The *Television Broadcasting Services (Digital Conversion) Act* 1998 commenced operation in July 1998 (the Digital Conversion Act). The effect of the Digital Conversion Act was to introduce a new schedule (Schedule 4) to the *Broadcasting Services Act* 1992 (the Act), which provides for the conversion of transmission of broadcasting services from analog mode to digital mode.

The Act requires the Australian Broadcasting Authority (ABA) to formulate legislative schemes for the conversion of commercial and national television broadcasting services from analog to digital mode. The Commercial Television Conversion Scheme (CTC) was determined by the ABA on 22 March 1999. The National Television Conversion Scheme is expected to be finalised shortly. As part of the implementation of these schemes, the ABA is preparing digital channel plans (DCPs) identifying spectrum options that can be used for conversion of analog to digital television (or other purposes), in all television markets. The ABA is planning to maximise the number of channels available for digital television throughout Australia, with the same bandwidth of 7 MHz as is available for analog channels.

The Minister has stated that the existing community television sector will be guaranteed free access to the spectrum needed to broadcast one standard definition digital channel[2]. The 1 January 2000 Review terms envisage that this will be provided free of charge by the provider of a datacasting service.

All technical and general assumptions considered by the ABA in preparing DCPs are set out in the *Draft DTTB Planning Handbook – April 1999*.

In accordance with clause 6(3)(g) of Schedule 4 of the Act, all channels proposed for transmitters for digital services are planned on the basis of co-location with existing analog transmitters. Similarly, where consequential analog channel changes are required in order to implement the DCP, the new analog channels have been planned on the basis that the same site will continue to be used as much as practicable.

The address for submissions on the matters discussed in this paper and the draft DCP is indicated on the inside front cover of this document.

[2] Media Release – *Digital – A New Era in Television Broadcasting* – Senator the Hon Richard Alston, 24 March 1998.

1.2 PRELIMINARY VIEWS

Hobart Digital Channels

Preliminary View 1 VHF channels are proposed to be used for digital television services in Hobart.

Preliminary View 2 Six channels (VHF - 7, 8, 9A, 10, 11 and 12) are proposed to be allotted for digital television services in Hobart.

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Bicheno Analog Channels Change

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Preliminary View 6 Analog channel 51 is proposed to be assigned to the TVT channel 8 service, and analog channel 54 to ABT channel 10 for use by local area transmitters where required.

Launceston Analog Channels Change

Preliminary View 7 UHF channel 59 is proposed to be allotted to the Launceston region and assigned to the TNT channel 11 analog television service for use by local area transmitters in order to overcome any unacceptable interference from the co-channel Hobart digital service.

Taroona Analog Channels Change

Preliminary View 8 UHF channel 40 is proposed to be allotted to the Taroona region and assigned to the TVT channel 8 analog television service for use by local area transmitters in order to overcome any unacceptable interference from the co-channel Hobart digital service.

1.3 AREA OF DCP

This discussion paper and accompanying draft DCP relates to the Hobart and south east Tasmania region of the licence area covered by the Tasmania commercial television services – TVT and TNT. Commercial and national television services in this area will be commencing digital transmissions on 1 January 2001.

Television broadcasters serving the remaining areas of the Tasmania commercial television licence area - are not required to commence digital transmissions on 1 January 2001, but on a date to be determined between 1 January 2001 and 1 January 2004. Accordingly, digital planning options for the remaining areas of Tasmanian will be dealt with separately in later parts to this DCP.

2 INTRODUCTION

2.1 LEGISLATIVE FRAMEWORK

The CTC Scheme determined by the ABA on 22 March 1999 provides:

9 Preparing draft digital channel plan

(1) If the ABA wishes to make a digital channel plan, it must prepare a draft version of the plan, having regard to the matters in this section.

(2) The ABA must have regard to whether the parts of the broadcasting services bands that are to be allocated for use for broadcasting services or other uses (including datacasting) are efficiently structured.

(3) The ABA must have regard to the policy objectives of this scheme mentioned in subclause 6(3) of Schedule 4 to the Act.

(4) The ABA may also have regard to the cost, to holders, tower owners, tower operators and site operators, of:

(a) allotting particular channels; and

(b) digital transmission using the channels.

(5) The ABA may also have regard to the likely cost, and disruption, to consumers caused by having to receive commercial television broadcasting services in digital mode using allotted channels.

(6) The ABA may also have regard to any interference that digital transmission using a particular channel is likely to cause to analog transmission.

(7) If a regional equalisation plan is in force for a particular area, the ABA may also have regard to the plan.

(8) The ABA may also have regard to other matters it considers relevant.

The policy objectives mentioned in clause 6(3) to Schedule 4 to the Act are as follows:

(a) the objective that each holder of a commercial television broadcasting licence for a metropolitan licence area is required to commence transmitting the commercial television broadcasting service concerned in digital mode in that area on 1 January 2001;

(b) the objective that each holder of a commercial television broadcasting licence for a regional licence area is required to commence transmitting the commercial television broadcasting service concerned in digital mode in that area by such date during the period:

(i) beginning on 1 January 2001; and

(ii) ending immediately before 1 January 2004;

as the ABA determines under the scheme;

(c) the objective that there should be a transitional period for a licence area, that is:

(i) to be known as the ***simulcast period***; and

(ii) to run for 8 years or for such longer period as is prescribed in relation to that area; and

(iii) in the case of a metropolitan licence area—to begin on 1 January 2001; and

(iv) in the case of a regional licence area—to begin on the date determined in relation to that area in accordance with paragraph (b);

throughout which the holder of a commercial television broadcasting licence for that area is required to transmit simultaneously the commercial television broadcasting service concerned in both analog mode and digital mode in that area;

(d) the objective that, throughout the simulcast period for a licence area, the holder of a commercial television broadcasting licence for that area should be authorised, under one or more transmitter licences, to use one or more additional channels to transmit the commercial television broadcasting service concerned in digital mode in that area;

(e) the objective that the additional channels should occupy the same amount of bandwidth as the channels used by the holder of the commercial television broadcasting licence to transmit the commercial television broadcasting service concerned in analog mode in that area;

(f) the objective that, as soon as is practicable after the start of the simulcast period for a licence area, and throughout the remainder of that period, the transmission of a commercial television broadcasting service in digital mode in that area should achieve the same level of coverage and potential reception quality as is achieved by the transmission of that service in analog mode in that area;

(g) the objective that, during the simulcast period for a licence area, there should, as far as is practicable, be co-location of:

(i) transmitters used by the holder of a commercial television broadcasting licence for that area to transmit the commercial television broadcasting service concerned in digital mode in that area; and

(ii) transmitters used by the holder to transmit that service in analog mode in that area;

(h) the objective that, at the end of the simulcast period for a licence area, all transmissions of commercial television broadcasting services in analog mode in that area are to cease and that each holder of a commercial television broadcasting licence for that area is to either:

(i) continue to transmit the commercial television broadcasting service concerned in digital mode in that area using the additional channels that were used for digital transmission during the simulcast period and

surrender any transmitter licence that authorised analog transmission of that service in that area during the simulcast period; or

(ii) transmit the commercial television broadcasting service concerned in digital mode in that area using the channels that were used during the simulcast period to transmit that service in analog mode and surrender any transmitter licence that authorised digital transmission of that service on the additional channels in that area during the simulcast period;

(j) the objective that, after the end of the simulcast period for a licence area, the transmission of a commercial television broadcasting service in digital mode in that area should achieve the same level of coverage and potential reception quality as was achieved by the transmission of that service in analog mode in that area immediately before the end of that period;

(k) the objective that holders of commercial television broadcasting licences be permitted to use any spare transmission capacity that is available on the digital transmission channels for the purpose of the transmission of datacasting services;

(l) the objective that the ABA is to consult holders of commercial television broadcasting licences about the implementation of the scheme;

(m) the objective that, if the implementation of the scheme affects particular broadcasting transmission towers, the ABA is to consult the owners and operators of those towers.

2.2 EVALUATION CRITERIA

This draft DCP has been prepared having regard to the matters mentioned in clause 9 of the CTC Scheme, including the policy objectives set out in subclause 6(3) of Schedule 4 to the Act. The ABA has also had regard to the technical assumptions set out in the *Draft DTTB Planning Handbook - 1999*.

The ABA has also developed some general principles to which it will have regard in preparing a DCP. These are referred to under other matters the ABA considers relevant at the end of this section.

The relevant matters in clause 9 are discussed below:

- *The ABA must have regard to whether the parts of the broadcasting services bands that are to be allocated for use for broadcasting services or other uses (including datacasting) are efficiently structured*.

This includes such matters as:

- the use of previously 'taboo' channels (eg adjacent channels to existing analog channels);

- the use of single frequency networks (SFNs) where appropriate, given current technical knowledge;

- the non-use of VHF Band I for digital transmissions due to susceptibility to electrical noise;

- the non-use of VHF Band II, and channel 5A, to comply with international radiofrequency allocations;

- the non use of channel 9A in some areas because of non-standard alignment of channel 10. This means channel 9A is available in these areas as a 6 MHz channel only.

- the use of digital channels in the same grouping as existing analog channels in an area, as far as possible.

Efficient structuring of the broadcasting services bands is also related to the concept of maximising radiofrequency spectrum productivity. In the early stages of the DCP development, the ABA's engineers articulated a goal of finding capacity for eight 7 MHz services in each market. This goal was aimed at ensuring the DCPs were efficiently structured, in the sense of maximising spectrum productivity. In reality, however, different numbers of additional services, or no additional services at all, may be possible in particular areas. The objective in clause 9(2) suggests that the ABA should seek to maximise the number of channels available across all markets, though this objective obviously needs to be weighed against the other objectives in each case.

The internationally recognised UHF broadcasting spectrum for the Asia-Pacific region spans 392 MHz (ranging from 470-862 MHz) allowing the use of 49 UHF Band IV and V channels with a television channel bandwidth of 8 MHz. However, in Australia the spectrum allocated for television broadcasting in the UHF Band is limited to 300 MHz (520-820 MHz). In order to partly compensate for the limited UHF television spectrum made available for broadcasting in Australia, 7 MHz bandwidth channels are used, thereby permitting the use of forty-two 7 MHz channels.

The parts of the broadcasting service bands suitable for digital use are Bands III, IV and V, which comprise VHF channels 5A to 12 and UHF channels 28 to 69.

Channels in Band I (VHF channels 0, 1 and 2) are not suitable for digital transmissions, as they are susceptible to interference from electrical noise. Channels in Band II (VHF channels 3, 4 and 5) are within the spectrum used for FM radio in Australia and, therefore, are not considered for digital television services. Channel 5A in Band III is suitable for digital transmissions, although no new television services will be planned using channel 5A as it has been internationally assigned to services provided by low earth orbiting satellites. In areas where channel 10 is used, channel 9A is a 6 MHz channel (202 to 208 MHz) due to the non-standard alignment of channel 10 (208 to 215 MHz), therefore, not suitable for transmitting commercial and national digital television services.

Channel 12 has only recently become available for transmitting television services. No analog services are currently transmitted on channel 12. It is a clear channel which can, and should, be used for digital services wherever possible in order to maximise the efficient use of the spectrum.

The UHF analog television allotment plan is based on the use of Band IV channels for wide coverage services and Band V channels for translators and gap-fillers to complement the wide coverage VHF/UHF services. The same premise is generally being used in the planning of digital television services.

There is imperfect knowledge about digital signal propagation at this stage. Neither VHF or UHF is inherently preferable - both have different characteristics which may result in greater spectrum efficiency depending on various conditions:

VHF Characteristics	UHF Characteristics
• Different propagation characteristics may provide better signal coverage in rough terrain, vegetated areas and built-up areas.	• Not as susceptible to man-made noise. • Line of sight propagation
• Larger coverage can result in spectrum efficiency, through use of fewer transmitters.	• Spectrum efficiency is improved as reuse distance is lowers
• VHF outdoor antennas are physically large; • In high signal level areas an outdoor receive antenna may not be needed due to lower signal losses in penetrating buildings.	• UHF antennas have advantages over VHF antennas as they: - are less expensive; - are smaller (having less impact visually); - have higher gain and better directivity to reject unwanted signals; and - present a lower wind profile in cyclonic areas.
• Possibility of second harmonic interference from FM radio.	• Second harmonic interference from FM radio is not present

- *The ABA must have regard to the policy objectives of the Commercial Television Conversion Scheme mentioned in subclause 6(3) of Schedule 4 to the Broadcasting Services Act 1992.*

The policy objectives in subclause 6(3)(a) to (m) relevant to preparation of a draft DCP are summarised below, followed by the ABA's comments on the extent to which each objective has been achieved.

Subclause 6(3)(a), (b) and (c): These policy objectives state that:

- digital transmissions must start on 1 January 2001 in metropolitan areas, and on a date to be determined by the ABA between 1 January 2001 and 1 January 2004 in regional areas; and

- there is to be a simulcast period of 8 years or longer in each area.

At a very early stage in the conversion process, consultations with broadcasters revealed that they would require certainty about channel allotments at least 18 months before digital transmissions are scheduled to commence. In practical terms, this requires the ABA to finalise all relevant parts of the DCP by mid 1999 to ensure that broadcasters have sufficient time to procure equipment, establish transmission facilities and carry out testing. The ABA expects to meet this deadline.

Subclause 6(d): Broadcasters should be authorised to use one or more additional channels to transmit their services in digital mode in an area.

The draft DCP meets this policy objective.

Subclause 6(e): The additional channels should occupy the same amount of bandwidth as the channels currently used by broadcasters to transmit in analog mode in an area.

All additional channels allotted to broadcasters in the draft DCP occupy 7 MHz, the same bandwidth as channels used for analog transmissions.

Subclause 6(f) and (j): Transmissions in digital mode should achieve the same level of coverage and potential reception quality as transmissions in analog mode as soon as is practicable.

In consultation with existing and potential broadcasters and relevant Government agencies, the ABA has prepared a document entitled *Draft DTTB Planning Handbook – April 1999*. The first draft of this document was released for comment on 12 November 1998, and a second draft was released in April 1999.

The Handbook provides broadcasters and planners with:

- the general and technical assumptions necessary to meet legislative requirements outlined in the commercial and national conversion schemes; and

- an explanation of the technical planning processes involved in the planning of new digital television services as well as the conversion of existing analog television services;

for the introduction of digital terrestrial television in Australia.

Subclause 6(g): During the simulcast period there should, as far as is practicable, be co-location of transmitters used for analog and digital transmissions.

The draft DCP has been developed on the assumption that existing sites used for analog transmissions will be used for digital transmissions as much as practicable. As noted above, the DTCPCG, in drawing up channel-planning options for the ABA to consider, assumed that digital services would be transmitted from the same main transmission sites as used for analog.

Subclause 6(l): The ABA is to consult broadcasters about the implementation of the scheme.

A group known as the FACTS Specialist Group, Spectrum Planning Committee, was convened by existing broadcasters with the aim of developing a DCP. The Group did not include representatives from the subscription television industry, potential new broadcasters, narrowcasters or the Australian Communications Authority (ACA).

At the Committee's meeting of 28 August 1998, the ABA proposed the Committee change its name, be expanded to contain wider industry representation and become an advisory group reporting to the ABA, which has ultimate responsibility for making the DCP. The Group's new name is the Digital Television Channel Planning Consultative Group (DTCPCG).

The DTCPCG is developing options for the DCP (for consideration and final determination by the ABA). The Channel Planning Group consists of representatives from the ABA, metropolitan and regional commercial broadcasters, the National Transmission Agency (NTA), the ACA, the Department of Communication, Information Technology and the Arts (DCITA) Laboratory, Pay TV operators, potential datacasters and the Federation of Australian Commercial Television Stations (FACTS).

- *The ABA may have regard to the cost to holders, tower owners, tower operators and site operators, of*:

    (a) allotting particular channels; and

    (b) digital transmission using the channels.

Channels have been allotted, to the maximum extent possible, in such a way as to minimise costs to the broadcasting industry and related parties.

Broadcasters have been assigned channels in the draft DCP that maximise their capacity to use existing infrastructure, such as transmitting antennas, sites and towers. Generally, this means that, wherever possible, broadcasters that currently transmit an analog service on VHF have been allotted VHF channels for their digital service and, similarly, broadcasters that currently transmit an analog service on UHF have been allotted UHF channels for their digital service. In this way, some broadcasters may be able to use standby transmitters to transmit a digital service, while others may be able to use existing antennas to transmit services in both analog and digital mode.

The draft DCP has been developed on the assumption that digital coverage from existing sites will ultimately match analog coverage from those sites, thereby minimising the need to establish permanent additional sites for transmission of digital services.

During the simulcast period, it will be necessary in some instances to operate digital services at lower power to reduce the potential to interfere with existing analog services. In such cases, it may be necessary to establish temporary transmission facilities to meet the policy requirement to achieve equivalent digital coverage as soon as is practicable after the start of the simulcast period and throughout the remainder of that period.

In the draft DCP, channel assignments to broadcasters are proposed in accordance with the following ABA endorsed channel assignment guidelines.

CHANNEL ASSIGNMENT GUIDELINES

These guidelines are intended as a starting point and may be varied depending on particular circumstances.

The guidelines will be applied in the order given below:

- If the lower adjacent channel to an analog service is available for digital use, then that channel is to be assigned to the broadcaster operating the analog service. If this channel is not available, then:

- If the upper adjacent channel to an analog service is available for digital use, then that channel is to be assigned to the broadcaster operating the analog service. If neither the lower nor the upper adjacent channels are available, then:

- Remaining channels are then assigned by assigning the lowest available digital channel to the broadcaster operating the analog service with the lowest channel and each channel is then assigned in turn by increasing channel number, although where sufficient channels are available, a broadcaster's digital channel should be in the same band as their analog service (VHF Bands I and II excepted).

In the special case of a SFN, the ABA will give consideration to a range of factors in assigning digital channels, applying the above steps where appropriate.

The ABA's adoption of the above guidelines does not preclude the ABA from, at any time, deciding on different assignments in any given market on a case by case basis.

The reasoning underpinning these guidelines is set out in the document - *Channel Assignment Guidelines Explanatory Paper (see Appendix 1).*

- *The ABA may have regard to the likely cost, and disruption, to consumers caused by having to receive commercial broadcasting services in digital mode using allotted channels.*

Channels have been allotted, to the maximum extent possible, in such a way as to minimise costs to consumers.

Analog television services are transmitted on VHF (channels 0-12) and UHF (channels 28-69). In some markets, all television services are only on VHF or only on UHF; in other markets, both VHF and UHF are used.

Channels are grouped into three bands within VHF and two bands within UHF:

VHF Band I: channels 0-2
VHF Band II: channels 3-5
VHF Band III: channels 5A-12

UHF Band IV: channels 28-35
UHF Band V: channels 36-69

In order to receive the best possible television reception, consumers need to purchase an antenna or antennas that correspond to the channel band or bands being used in their market. For example, if television services are being transmitted on channels 2, 7, 9, 10 and 28 in a particular market then, ideally, consumers need to purchase three antennas – a VHF Band I antenna, a VHF Band III antenna and a UHF Band IV antenna. In reality, however, consumers find that an adequate picture can be obtained in this instance using only two antennas, or one combined Band III/IV antenna.

Another consideration is polarity of transmissions. In a particular market, all services might be transmitted in horizontal polarity only, or vertical polarity only; in other markets, some services might be transmitted in horizontal polarity and other services in vertical polarity.

The polarity of transmissions in a market can affect the cost of receive antennas. For example, in the Canberra market, analog services in Band III are transmitted vertically and analog services in Band IV are transmitted horizontally. This means that consumers need to purchase a special receive antenna with both horizontal and vertical crosspieces.

The directional alignment of receive antennas is also an important consideration. Co-location of transmitters used to provide analog and digital services in an area will eliminate the need for consumers to purchase and point an additional receive antenna or antennas towards different transmit sites for analog and digital reception.

In any particular market, antennas capable of receiving analog transmissions will also be capable of receiving digital transmissions, provided that channels allotted for digital transmissions are in the same or nearby Band, are transmitted in the same polarity as analog transmissions and provided also that analog and digital transmitters are co-located.

When allotting channels for a market, particular attention was given to ensuring that, as far as possible, consumers would not be required to purchase an additional receive antenna. As noted above, the DTCPCG's planning parameters and assumptions included statements that DTV channel allocations should aim for services being either adjacent or in the same band as the related analog television service, and that analog and digital transmitters are co-located. See also the Channel Assignment Guidelines mentioned above.

- *The ABA may have regard to any interference that digital transmission using a particular channel is likely to cause to analog transmission.*

The potential for interference to existing analog services was a very important consideration in preparing the draft DCP.

An important objective of both the DTCPCG and the ABA in developing the DCP was to avoid as far as possible the potential for interference between digital and analog transmissions.

Interference criteria are set out in drafts of the *DTTB Planning Handbook* released for comment in November 1998 and April 1999.

It is important to note that there is imperfect knowledge about the characteristics of digital propagation and, consequently, about the potential for interference between digital and analog services. As more digital tests are carried out, a better understanding will be achieved.

In the ABA's judgement, in view of the tight timetable for implementing digital conversion, digital channel planning should proceed on the basis of current knowledge about digital propagation, but at the same time, recognising that revisions to the DCP may be required at a later stage as the results of digital tests become available.

- *The ABA may have regard to any regional equalisation plan in force for a particular area.*

No regional equalisation plan exists yet for the area covered by this DCP.

- *The ABA may have regard to other matters it considers relevant.*

The ABA wrote to regional broadcasters requesting details of channels assigned to them as part of the analog regional equalisation plan relating to commercial services, but that remain unused. If any of these unused channels are subsequently found to be needed for digital coverage, and if the broadcaster has not used those channels, the ABA may request the broadcaster to surrender the transmitter licences authorising analog transmissions on those channels.

In a few instances, it may be necessary to vary the characteristics, including technical specifications, of a regional broadcasting service, in order to implement the DCP. Section 14 of the CTC Scheme sets out the procedures the ABA must follow.

The ABA has also developed some general principles to which it will have regard in preparing a DCP (not in any particular order). Some of these are contained within the matters to which the ABA must have regard under clause 9 of the Scheme. Others are policy objectives specifically identified by the ABA and should be considered as other matters that the ABA considers relevant in accordance with sub-clause 9 (8) of the Scheme. The weight to be given to each of these matters will vary from case to case.

The ABA considers the following policy objectives relevant:

1. To ensure efficient use of the spectrum

2. To maximise the efficiency and competitiveness of the broadcasting industry

3. To minimise interference to analog channels

4. To ensure that the service in digital mode in an area achieves the same level of coverage and potential reception quality as is achieved by transmission of the service in analog mode.

5. To minimise the likely cost and disruption to consumers

6. To minimise the likely cost to the broadcasting industry and the operators and owners of transmission towers.

7. Analog TV channels are only to be moved on the condition that there is no direct cost to the viewers concerned and only after full consultation with those viewers and other appropriate bodies and persons eg the relevant members of Parliament.

8. No person's viewing of (or method of access to) a commercial or national television broadcasting service should be removed or otherwise significantly degraded within any licence area.

9. Existing VHF broadcasters should, as far as possible, be treated equally in each market.

10. Subject to identifying adequate spectrum for conversion of existing analog services, spectrum should be planned on the basis of maximising the number of 7 MHz channels in any market.

The evaluation criteria discussed in this section are further explored in the discussion of the draft DCP at Section 5.

SECTION B: DIGITAL PLANNING FOR PART 1, TASMANIA

3 BACKGROUND

3.1 EXISTING ANALOG SERVICES

Existing analog channels used by television services in Hobart and neighbouring/affected areas:

Area Served	Site	VHF ERP (W)	UHF ERP (W)	Polarisation	Pattern	Analog
Hobart	Mt Wellington	200,000	1,300,000	H	VHF OD UHF DA	2, 6, 28, 31, 34*, 40*
Taroona	White Point Rock	380	2,000	V	DA	8, 11*, 40*, 43, 46, 49
Acton Road	Single Hill		20	H	DA	52, 55, 58, 61, 64*, 67*
NE Suburbs (Hobart)	Government Hill		6,400	H	DA	54, 57, 60, 63, 66*, 69*
New Norfolk	Sheppards Hill		320	H	DA	53, 56, 59, 62, 65*, 68*
Maydena	Abbotsford Lookout	6	100	H	DA	8, 46, 49, 52*, 55*, 58
Strathgordon				H	DA	8, 43, 46, 49, 52*, 55*
North East Tasmania	Mt Barrow	300,000	2,000,000	H	DA	3, 9, 29, 32, 35, 41*, 44*
Bicheno	NTA Site	1,000	600	H	DA	8, 10, 36*, 39*, 42*, 48
Launceston	Juliana Street	50	2,000	H	DA	11, 53*, 56, 59, 62, 65, 68*

* Channels allotted in the analog Frequency Allotment Plan (FAP) that are not currently in use.

3.2 CONSULTATION

The DTCPCG is contributing to the preparation of channel-planning options for the ABA's consideration. The role of the DTCPCG is as follows:

> *to advise and make recommendations to the ABA on the development of the Digital Channel Plan. The Group will also advise the ABA on some of the general technical assumptions which it may take into account in developing the Digital Channel Plan.*

The Group adopted the following broad planning parameters and assumptions:

1. The DTV Channel Plan is to be developed on the basis of matching PAL coverage for a minimum of six DTV services, plus any additional requirements identified by the ABA for datacasting;

2. The DTV Channel Plan is to be developed on the basis of power levels required after the end of transition (ie after analog is turned off);

3. The DTV Channel Plan is to be completed in a time-frame which permits digital broadcasting to commence by the dates specified in the 24 March 1998 statement by the Minister for Communications, the Information Economy and the Arts.

4. The DTV Channel Plan is to be based on capacity required to provide HDTV to the edge of the licence area (assumed approx 19.3 Mbit/s capacity) and overspill at the boundary addressed;

5. National services should initially assume licence area boundaries matching those for commercials;

6. Modulation mode used for planning should be that used for test transmissions for the field tests in Sydney although 8k COFDM modulation system may need to be employed for some SFN if required;

7. The DTV Channel Plan should generally be based on UHF in regional areas; however, it should indicate if there is a Band III digital option available where there are existing VHF analog stations;

8. Planning should initially assume use of the same main transmission sites as used for analog;

9. DTV channel allocations should aim for services being either adjacent or in the same band as the related analog television service; and

10. The DTV Channel Plan is to be developed on the basis of allotting Band III channels to existing metropolitan broadcasters in the five mainland State capital cities to the extent possible.

The DTCPCG created sub-groups to consider digital channel planning options for each area. The Hobart Digital Channel Planning Sub-group comprises representatives from the following organisations:

Government:

ABA; Australian Broadcasting Corporation (ABC); National Transmission Agency (NTA); and Special Broadcasting Service (SBS).

Industry:

WIN Television Tasmania (TVT) and Southern Cross Television (TNT).

The group held a meeting on 16 March 1999 in Hobart.

3.3 OVERVIEW

As digital channels planned in one region directly affect channel availability in neighbouring markets, planning for digital television services in the Hobart region has been undertaken with consideration for digital channel requirements for remaining areas of Tasmania.

The Digital Conversion Act requires licensees to commence digital transmissions in:

- metropolitan licence areas on 1 January 2001, and
- regional licence areas, on a date to be determined between 1 January 2001 and 1 January 2004.

The ABA's first objective is to prepare DCPs for metropolitan licence areas and those regional licence areas where broadcasters have indicated to the ABA that they wish to start on 1 January 2001. As licensees do not propose to commence digital transmissions in other parts of Tasmania on 1 January 2001, the draft DCP for those regions is not being circulated for comment at this time. This will allow flexibility in planning digital channels in those areas.

The ABA intends to complete plans for the remainder of Tasmania by July 2000.

A DCP option for Hobart was presented to the ABA for consideration after deliberations by the Digital Television Channel Planning Consultative Group:

use of VHF channels.

(put forward by ABA Engineering)

This proposal is discussed in Sections 4 and 5.

4 HOBART DIGITAL CHANNELS

Alternatives for overcoming interference from Hobart VHF digital services to existing co-channel analog services in Bicheno, Launceston and Taroona which result from this plan are discussed in Preliminary Views 5, 6 (Bicheno), 7 (Launceston) and 8 (Taroona).

4.1 DRAFT DIGITAL CHANNEL PLAN

4.1.1 Band proposed to be used for Hobart digital television services

Preliminary View 1

VHF channels are proposed to be used for main station digital television services in Hobart.

Reason:

In the current Tasmanian analog broadcasting environment, two main wide coverage sites provide coverage for the majority of the state: Mt Wellington, serving Hobart and the south-east of Tasmania, and Mt Barrow, serving the north-east of the state. At both sites, a combination of VHF and UHF analog services currently operate. Due to Tasmania's rugged terrain, a large number of low- and medium-powered translators provide infill and coverage extension for these main services. These translators operate on VHF Band III, UHF Band IV and UHF Band V channels.

These two sites will comprise the primary digital television infrastructure for Tasmania, at least in the initial stages of the simulcast period. Therefore, these two sites have been allotted the highest priority for digital channel capacity in Tasmania.

Melbourne and North East Tasmania (Mt Barrow) analog services operate with co-channel assignments. This co-channelling causes substantial intermittent interference to both services, due to ducting across the Bass Strait. Given the 'cliff–edge' fall off of digital signals, such interference may at times completely prevent reception of digital signals. It is therefore vital to avoid co-channelling NE Tasmania with Victorian digital services if at all practical.

Due to the proposed allotment of high power VHF Digital Television channels in Melbourne and the use of VHF channels for analog in Melbourne and Regional Victoria, no VHF channels will be available to serve North East Tasmania as wide coverage digital services. Similarly, high-power UHF channels for Digital Television in Melbourne and regional Victorian markets will greatly constrain availability of wide coverage UHF channels in North East Tasmania.

Distance and terrain allow assignments for wide coverage Hobart digital television channels to be made independently of similar assignments for Melbourne and Victoria, free of co-channel interference. However, wide coverage digital services for Hobart and North East

Tasmania are unable to operate co-channelled. Therefore, any assignment of UHF channels for Hobart ahead of the completion of digital television planning for the rest of Tasmania will reduce the likelihood of finding sufficient channel capacity to meet the needs of North East Tasmania (Mt Barrow).

In order to meet the required timetable for the implementation of digital television in Hobart before planning for the rest of Tasmania, the most practical solution is to allot VHF channels. This allotment in Hobart will have no affect on UHF channel availability for North East Tasmania, and hence will allow a Digital Channel Plan to be determined for Hobart, independent of the rest of Tasmania.

At its meeting on 16 March 1999, the Hobart DCP sub-group endorsed a primarily VHF solution for digital television services in Hobart. At the DTCPCG meeting on 23 March 1999, there was general support for the primarily VHF proposal. It was noted that additional UHF capacity may be found for Hobart after completion of planning for the remainder of Tasmania.

Use of VHF Band III in Hobart, will allow broadcasters to use the existing VHF transmission infrastructure for digital conversion. In addition, a VHF Band III analog television service (TNT 6) has been operating in Hobart for decades, eliminating the need for viewers to change their existing antennas. It is possible however, that these Band III receive antennas may not be suitable for reception of channel 12.

Evidence:

At the DCP Sub-group meeting in Hobart various accounts were given of intermittent interference between northern Tasmania and Victoria analog services. Such as intermittent co-channel interference from a high powered Ballarat service (ABRV11) causes total picture failure in the medium-powered analog translator service in Launceston (TNT11) for approximately 5 days a year.

Detailed engineering assessment of television broadcasting spectrum potentially suitable for use in Hobart indicates that there is capacity for six VHF digital channels (see Proposed Hobart digital channel allotments, below), provided a number of analog translators are re-assigned to alternative channels.

Preliminary engineering assessment of channel capacity for North Tasmania (Mt Barrow) shows the constraints in channel allocation.

4.1.2 Proposed Hobart digital channel allotments

Preliminary View 2

Six channels are proposed to be allotted for digital television services in Hobart. These channels are:

VHF Band III channels 7, 8, 9A, 10, 11 and 12

and all will operate with a maximum ERP of 50 kilowatts

Reason:

Suitable VHF transmitting and receiving antennas are presently in place for the two existing analog VHF services operating from Mt Wellington.

Six VHF Band III channels can be readily identified that will have minimal impact on capacity in the surrounding areas.

Note: Allotment of channels 10 and 11 will be such that channel 9A will be available as a full 7 MHz channel. The channels will be 9A (202 - 209 MHz), 10 (209 – 216 MHz) and 11 (216 – 223 MHz).

Evidence:

The ABA's digital channel study indicates that allotment of channels 7 and 8 will cause interference to two TVT 8 analog commercial services, Taroona and Maydena. Allotment of channel 8 as a Hobart digital service may also cause co-channel interference to Strathgordon analog commercial TVT 8 service. Channels 7 and 8 therefore will be available for digital services in Hobart if the analog commercial service for Taroona moves to an alternative UHF channel. Analog services operating in Strathgordon and Maydena are low-powered and depending on the severity of the interference, it may be resolved by an increase in power. However, if interference is sufficiently severe then it may be necessary to move these services to UHF channels. Alternative channels for these two services, if required, will be identified during planning for the remainder of Tasmania.

The ABA's calculations indicate that operation of digital channels 8, 9A and 10 in Hobart will cause interference to Bicheno analog commercial TVT 8 service and analog national service ABT 10. Therefore, these channels can only be used for digital services in Hobart if these Bicheno analog services move to UHF channels.

A Hobart channel 11 digital service may interfere with a South Launceston commercial analog translator, TNT 11. Therefore, channel 11 can only be used for digital services in Hobart if the South Launceston TNT 11 service moves to a UHF channel. Launceston viewers already have UHF reception antennas, since all other Launceston services are on UHF channels; the broadcaster may also be able to share existing UHF facilities. Moving TNT 11 to UHF in South Launceston may require TNT to install an additional UHF analog transmitter to provide comparable reception to its current VHF service.

It should be noted that the possible effects of local oscillator interference or image interference have not been fully assessed, as insufficient information on receiver performance is not currently available. Furthermore, it is the responsibility of the broadcaster to check for and resolve any electro-magnetic compatibility problems with radio-communications services operating in the area.

4.1.3 Proposed Hobart digital channel assignment

Preliminary View 3

The assignment of digital channels for use in Hobart is proposed to be as per the table below:

Area Served	**Analog /Digital**	**Analog channel assignments/ Proposed digital channel assignments**					
Hobart	Analog	TVT 6	ABD 2	SBS 28	TNT 31	Not assigned	
	Digital	7	8	9A	10	11	12

Reason:

Channel assignments are in accordance with the ABA's Channel Assignment Guidelines, the reasoning behind these guidelines is set out in the explanatory paper (Appendix 1).

This preliminary view is subject to public interest considerations and a satisfactory resolution between broadcasters regarding required consequential analog changes.

4.1.4 Digital channels not allotted for existing translators

Preliminary View 4

The allotment of digital channels for existing commercial and national television translators in the Hobart region at Taroona, Acton Road, NE Suburbs, Rokeby and New Norfolk is not proposed at this time.

The DCP will be varied and additional digital channels allotted if it is established that they are needed to satisfy the objective of achieving the same level of coverage and potential reception quality of the digital television services as is achieved by the same service in analog mode.

Reason:

There is insufficient empirical knowledge of digital coverage at this stage. As more knowledge becomes available through the use of test transmissions and further studies, the need for local area transmitters will be reviewed on a case by case basis. This approach is aimed at achieving maximum spectrum productivity.

4.2 CONSEQUENTIAL ANALOG CHANGES

In preparing the draft digital channel plan the ABA has at all times given the interests of viewers a high priority. Although the changes to analog services in regional areas described below may have a significant impact on viewers, the ABA believes that these changes will impact on fewer viewers than the alternative digital channel plan discussed under section 5.

In considering the draft DCP the ABA has noted that broadcasters being allocated particular digital channels have been negotiating with the affected analog broadcasters over ways of resolving potential interference problems, including the provision of local area transmitters or changes to the frequencies and/or power levels of regional transmitters. These proposed changes to regional analog services are described in the following sections.

The use of some channels shown in the draft digital channel plan may depend on the assignee taking responsibility for public interest considerations caused by changes to existing analog transmissions. Use of the digital channel may depend on these analog transmission and reception issues being adequately addressed by a licensee. This may involve bearing some or all of the cost of installing new analog transmission facilities and any necessary resultant re-tuning of domestic TV receivers or changes to domestic receive antennas. This would be necessary to overcome interference caused by the new digital service and to ensure continued analog reception during the simulcast period.

The ABA has power to impose conditions on a broadcaster's television broadcasting licence and/or its transmitter licence (s) so as to require a licensee to discharge their responsibilities in this regard. In considering whether to impose any such conditions, the ABA would have regard to any agreements reached between broadcasters about such matters and any undertakings made to the ABA.

The ABA invites submissions addressing potential analog channel changes as a consequence of the draft DCP.

4.2.1 Bicheno alternative analog channels - Allotment

Preliminary View 5

If required, two channels are proposed to be allotted for analog use to the existing Bicheno TVT channel 8 and ABT channel 10 television services in order to overcome any unacceptable interference from the digital television services emanating from Hobart on channels 8, 9A and 10. These channels are:

UHF Band V	***51, 54***

Reason:

Detailed engineering assessment indicates that digital channels operating on channels 8, 9A and 10 in Hobart will cause severe interference to co-channelled VHF analog services TVT8 and ABT10 in Bicheno. To allow continued operation, both these Bicheno services should be moved to UHF.

Channels 51 and 54 have been identified as suitable. These channels are close in frequency to the other UHF analog service in Bicheno (on channel 48); and viewers can use their existing Band V VHF antennas to receive these proposed channels.

Evidence:

ABA Engineering's UHF channel study indicates that channels 51 and 54 are available for Bicheno.

4.2.2 Bicheno alternative analog channels - Assignment

Preliminary View 6

The assignment of the analog channels for the TVT commercial television service and the ABT national television service in Bicheno is proposed to be:

Area Served	Existing analog channel assignments/ Proposed analog channel assignments	
Bicheno	TVT 8	ABT 10
Bicheno	51	54

Reason:

Maintains the order of existing analog channel assignments

4.2.3 Launceston alternative analog channel

Preliminary View 7

One channel is proposed to be assigned for analog use to the existing TNT channel 11 commercial television service in Launceston. This channel is:

UHF Band IV 59

Reason:

Engineering studies indicate that the allotment of channel 11 to a Hobart digital service will cause severe interference to the existing Launceston analog commercial television translator TNT 11. Therefore, in order for channel 11 to be used for a digital service in Hobart, the TNT 11 service must change channel.

Channel 59 has been identified as a suitable alternative analog channel for TNT 11 as it is well within the band of the other existing UHF Band V analog television services for

Launceston (on channels 56, 62 and 65). Viewers can use their existing UHF receive antennas to receive channel 59, and it is likely that TNT will be able to share the existing UHF transmit antenna facilities to transmit its analog service on channel 59.

Evidence:

Detailed engineering assessment into television broadcasting spectrum for an analog channel in Launceston indicates that channel 59 is available.

4.2.4 Taroona alternative analog channel

Preliminary View 8

One channel is proposed for the existing TVT channel 8 analog commercial television service in Taroona. This channel is:

UHF Band IV	***40***

Reason:

Engineering studies indicate that the allotment of channels 7 and 8 to a Hobart digital service will cause severe interference to the existing TVT channel 8 analog commercial television service. Therefore, in order for channels 7 and 8 to be used for a digital service in Hobart, the TVT 8 service will need to change channel.

Channel 40 has been identified as a suitable alternative analog channel for the TVT 8 translator, as it is well within the band of the other existing UHF Band V analog television services on channels 43, 46 and 49 for Taroona. Viewers can therefore use their existing UHF receive antennas to receive channel 40, and it is likely that TVT may be able to share the existing UHF transmit antenna facilities to transmit its analog service on channel 40.

Evidence:

Detailed engineering assessment into television broadcasting spectrum for an analog channel in Launceston indicates that channel 59 is available.

5 DRAFT DIGITAL CHANNEL PLAN - EVALUATION

In this section the option for digital channel planning in Hobart is assessed. The assessment is based on the evaluation criteria set out in Section 2.2. Where the criteria have been fully addressed in that section, no further comment is made in this section.

The relevant criteria in clause 9 of the CTC Scheme (which include the ABA's policy principles) requiring further discussed are set out below:

- *Efficient use of the parts of the broadcasting services bands allocated for digital use*

In the ABA's preliminary view, the draft DCP makes most efficient use of the spectrum available for digital services for Tasmania for the following reasons:

  - it avoids allotment of UHF channels that could be required in areas where allotment of digital services would be more constrained by neighbouring allotments, such as the NE Tasmania services from Mt Barrow.

  - it allots VHF channels that are unavailable for use by digital services in the most spectrally constrained areas of Tasmania, thereby providing channels for digital services in Hobart without significantly affecting digital channel capacity in neighbouring ares

- *Same level of coverage and potential reception quality in digital mode as in analog*

The draft DCP requires no restriction on digital transmission for any channel in Hobart during the simulcast period. However a number of existing analog services may be required to be re-assigned alternative UHF channels; where this is required, suitable UHF spectrum has been identified.

- *Consultation with existing broadcasters*

The preferred option has been fully considered by the DTCPCG and its Hobart sub-group. Both groups accepted the option proposed by the ABA for Hobart. It was noted that additional UHF capacity may be found for Hobart when planning is undertaken for the remainder of Tasmania.

- *Costs to broadcasters, tower owners, tower operators and site operators*

The draft DCP could allow network operators to use the existing two Mt Wellington VHF analog transmission facilities for digital services for Hobart. Hence new tower facilities on Mt Wellington for new digital services are not likely to be needed. Therefore, to provide digital services, broadcasters may only require new transmitters rather than comprehensive new transmission facilities.

The draft DCP also involves additional expenditure relating to the need for up to six existing analog translator services to change their operating specifications. Four of these affected translators will be required to be re-assigned to UHF channels due to possible interference from high powered digital services from Hobart.

- *Cost and disruption to consumers in receiving digital services*

Channels have been allotted, to the maximum extent possible, in such a way as to minimise costs to consumers.

The draft DCP imposes minimum costs on many Hobart viewers as VHF services are already well established. However those existing VHF antennas may not be suitable for receiving channel 12.

VHF is better for indoor antenna reception as it has a better height loss factor than UHF (a significant population in Hobart is using indoor antennas for television reception).

- *Interference to existing analog services from new digital services*

The draft DCP requires up to six existing VHF Band III analog translator services to either be re-assigned alternative UHF channels or increase transmission power. Where required this DCP identifies alternative channels for these affected services.

Given the large number of analog translator in Tasmania, it is highly unlikely that alternative wide coverage channel for Hobart could be found without comparable interference to existing analog services.

- *Maximise the efficiency and competitiveness of the broadcasting industry*

At the DTCPCG meeting of 23 March 1999, existing commercial broadcasters in Tasmania and the ABC indicated their support for the preferred option.

The DCPs have been drafted with efficient use of spectrum and existing infrastructure in mind. In general, proposed channel assignments capitalise on the resource of existing transmit and receive antennas. The selection, where possible, of frequencies likely to be amenable to reception on existing receive antennas, minimises the potential inconvenience and cost to audiences. It also promotes the early reception of, and therefore the competition between, digital services. In many instances, channel assignments result in the most likely interference between digital and analog signals being between the signals of different broadcasters, promoting the likelihood of early attention to interference problems, and the transaction costs involved in resolving cases of interference.

In addition, the channel assignments selected are in general those that maximise spectrum productivity and density of use. The ABA has decided to proceed in an incremental manner, initially identifying frequencies for main channels and deferring the detailed consideration of the need for translators. This approach provides the certainty required by broadcasters for the

timely acquisition of equipment, while allowing for fuller empirical testing, evaluation of requirements, and assessment of alternative proposals for translators.

- *Cost and disruption to consumers in receiving analog services and level of consultation with affected viewers*

The draft DCP imposes cost and disruption to some consumers receiving the Bicheno, Launceston Taroona, Maydena and Strathgordon VHF analog translator services. In these locations comparable UHF service already operate and hence UHF antennas will, to a large degree, already be in place, this results in minimising cost to consumers.

- *No loss or degradation of reception of existing analog services*

Only those translators identified in the draft DCP will be affected and where required alternative channels have be allotted which will achieve comparable coverage to existing services in those areas.

- *Equal treatment of existing VHF broadcasters within the same market*

In the draft DCP all broadcasters are assigned VHF channels with identical digital transmission specifications.

- *Maximise the number of 7 MHz channels available for digital services in any market, subject to there being adequate spectrum for conversion of existing services.*

The draft DCP results in six Band III 7 MHz channels being made available. Four of these channels will be used for digital conversion of the existing analog broadcasters, leaving two channels available for other uses.

Use of VHF spectrum initially in Hobart ensures that sufficient spectrum can be identified for Hobart ahead of digital channel planning for the remainder of the State. Additional channel capacity for Hobart could be identified when planning is undertaken for the remainder of Tasmania.

6 APPENDICIES

APPENDIX 1: *Channel Assignment Guidelines Explanatory Paper*

APPENDIX 2: Digital Channel Summary

APPENDIX 3: Channel Interference Assessment for Hobart

APPENDIX 4: Channel Interference Assessment for North East Tasmania

APPENDIX 5: Draft Digital Channel Plan:

APPENDIX 1

Australian
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CHANNEL ASSIGNMENT GUIDELINES EXPLANATORY PAPER

Purpose

The purpose of this paper is to outline the benefits of having channel assignment guidelines and to set out the strengths of the guidelines used for the development of the draft DCPs over other options which could have been used.

Introduction

The *Television Broadcasting Services (Digital Conversion) Act 1998* commenced operation in July 1998. The effect of the legislation was to introduce a new schedule ('Schedule 4') to the *Broadcasting Services Act 1992* (the Act), which provides for the conversion of transmission of broadcasting services from analog mode to digital mode.

Schedule 4 requires the ABA to develop legislative schemes for the conversion of commercial and national television broadcasting services from analog to digital mode over a period of time. The ABA is empowered under the conversion schemes to develop a digital channel plan (DCP) and the technical assumptions to which the ABA will have regard when making a DCP.

The DCP and the technical assumptions will determine:

- the channels to be allotted in each area;
- the technical specifications of those channels; and
- the channels to be assigned to broadcasters.

This information is required by the broadcasters to enable them to commence planning the implementation of their digital services and to procure transmitters and related transmission infrastructure.

Existing Analog Channel Assignments (Metro Markets)

In all metropolitan markets (Adelaide, Brisbane, Melbourne, Perth and Sydney) the main television services transmit on identical channels.

Metropolitan Television Service	Channel	Frequency Medium	Television Band
Australian Broadcasting Corporation (ABC)	2	VHF[3]	I
Seven Network	7	VHF	III
Nine Network	9	VHF	III
Ten Network	10	VHF	III
Special Broadcasting Service (SBS)	28	UHF[4]	IV
Community Television (CTV)	31	UHF	IV

In regional areas channel assignments are less consistent due to technical restraints imposed by neighbouring metropolitan markets, and the legacy of past analog assignments.

Why Have Digital Channel Assignment Guidelines?

In determining appropriate channel assignments it is preferable for the ABA to adopt a consistent and well reasoned approach across Australia. Whilst each area is decided separately the guidelines provide a framework within which individual assignments may be determined.

Digital Channel Assignment Guidelines Used for the Development of the Draft DCPs

The Guidelines used for the development of draft DCPS may be called the adjacent channel method.

The adjacent channel assignment guidelines involve applying the following in the order listed:

- If the lower adjacent channel to an analog service is available for digital use then that channel is to be assigned to the broadcaster operating the analog service. If this channel is not available, then:
- If the upper adjacent channel to an analog service is available for digital use then that channel is to be assigned to the broadcaster operating the analog service. If neither the lower nor the higher adjacent channel are available, then:
- Remaining channels are then assigned by assigning the lowest available digital channel to the broadcaster operating the analog service with the lowest channel and each channel is then assigned in turn by increasing channel number, although where sufficient channels are available a broadcaster's digital channel should be in the same band as their analog service (VHF Bands I and II excepted).

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[3] Very High Frequency (VHF)

[4] Ultra High Frequency (UHF)

For the main transmitters in metropolitan markets the assignments that would result from this policy are illustrated in the following table:

Area Served	**Analog /Digital**	**Analog channel assignments/ Proposed digital channel assignments**				
Metro	Analog	ABN 2	ATN 7	TCN 9	TEN 10	SBS 28
	Digital	12	6	8	11	29

Advantages

- Most existing broadcasters are well placed to use their own existing infrastructure (eg feed cable, tower and broadcasting antenna). Under other options (discussed below) the broadcasters would be required to incur considerable additional expenditure in the order of millions of dollars. (See information under 'Transmission Antenna' in Attachment A).
- The introduction of digital television on VHF Band III is less likely to cause disruption to existing domestic receiver installations (See 'Receiving Antenna' in Attachment A). Although the number of homes in Sydney without a UHF antenna is not known, if conservatively 100 thousand homes needed to purchase a UHF television to receive the new digital broadcasters at approximately $100 per antenna, then the cost for these Sydney homes would be $10 million in total.
- Under the adjacent channel method, the analog broadcaster has control of the digital signal that may interfere with their adjacent analog services and hence can adjust digital power levels to achieve the desired service quality.
- This option results in the analog channels 7, 9 and 10 being assigned digital channels 6, 8 and 11 respectively, in metropolitan markets. Although channels 6 and 8 in general are the most power-limited channels due to interference to analog services in adjacent areas, they are in fact network 7 and 9's preferred digital channels in all metropolitan areas. As a result, any technical problems associated with their assignment are much more likely to be successfully resolved. In the case of channel 6, short term test transmissions by ATN 7 have already taken place in Melbourne. Likewise NWS 9 in Adelaide have been issued a short-term test licence for channel 8. Network 10 have also indicated their preference for digital channel 11.
- The ABC has indicated that they would be happy with the assignment of digital channel 12. Because this channel is largely unencumbered it will minimise implementation costs for the national broadcaster.

Disadvantages

- This option, similar to options 3, 4 and 5 below does not resolve the competition issue of the possibility of new services using 7MHz channels (such as datacasters or a 4th commercial network in the event one is planned after 2006), being isolated on UHF. Nor does it achieve the outcome of equalising the desirability of VHF and UHF.

Use of Adjacent Channels – Advantages and Disadvantages

As well as the above advantages and disadvantages to the Guidelines used to prepare the draft DCPs the use of adjacent channels, whether lower or upper, have certain advantages and disadvantages worth noting.

Advantages

- The close spacing of the frequencies will tend to result in less variation in signal levels at a viewer's receiver than if there is greater frequency separation. This is because radiowave propagation phenomena such as reflection and diffraction tend to affect different frequencies differently. Use of adjacent channels by the same broadcaster should therefore mean a better match in the coverage for that station's digital and analog services.
- The analog broadcaster also has control of the digital signal that may interfere with their analog services and hence can adjust digital power levels to achieve the desired service quality for the analog service. The digital signal is also more likely to be transmitted from the same site as the analog service. This is important as it helps to maintain the required signal differences that are needed to avoid interference.

Disadvantages

- The higher cost of combining equipment used to combine the analog and digital signals into the one transmission antenna (~$100,000 or so). The higher cost is a result of more stringent filtering requirements for adjacent channels. However, if separate antennas are being used for the digital and analog services this may not be a significant issue.
- The preference by broadcasters to use the existing broadcasting antenna imposes a restriction on the digital channel that is adjacent to the analog channel, due to the interference that may be generated within the combiner[5]. If a separate antenna system is used then this combiner restriction is not required. The operation of the analog channel 7 restricts the digital channels 6 and 8 if a common broadcasting antenna is used. Therefore the analog channels 7, 9, 10 and 28 may restrict channels 6, 8, 9A, 11 and 29 if a common antenna system is used. However, this is not considered a problem because the ERP required for same coverage is below the combiner restraints. Additionally, to avoid interference to neighbouring analog television services during the simulcast period, the ERP for digital services must in some cases be limited even further than the limitation imposed by a common antenna system. The combiner constraints are therefore not a prime concern.

Other Options for Digital Channel Assignment

There are various other options for the assignment of digital services which the ABA could have used in developing its Channel Assignment Guidelines. Depending on the availability of digital television channels in the VHF and UHF bands within each market, the following options may be available.

Option 1. A composite VHF/UHF solution, ie two out of the five existing broadcasters could be assigned digital VHF channels, the remaining three would be

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[5] Combiner – a device used to mix radiowaves so that a common feeder cable and antenna system can be used.

assigned digital UHF channels. Alternatively a 3 VHF/ 2 UHF split could be adopted.

Option 2. A total UHF solution, ie all the existing broadcasters to be assigned a digital channel in the UHF band.

Option 3. Digital channels to be assigned in existing ascending analog order, eg 2 analog / 6 digital; 7 analog / 8 digital; 9 analog / 11 digital; 10 analog / 12 digital; 28 analog / 29 digital.

Option 4. Digital channels to be assigned in opposite order to their analog counterparts but still within the current VHF/UHF analog assignment, eg 2 analog / 12 digital; 7 analog / 11 digital; 9 analog / 8 digital; 10 analog / 6 digital; 28 analog / 29 digital.

Option 5. Digital channels to be assigned in opposite order to their analog counterparts regardless of their analog VHF/UHF assignment, eg 2 analog / 29 digital; 7 analog / 12 digital; 9 analog / 11 digital; 10 analog / 8 digital; 28 analog / 6 digital.

Options 1 and 2 – Advantages and Disadvantages

These two options provide a greater balance between UHF and VHF or a preference for a complete UHF channel assignment. The advantages and disadvantages of these options are as follows.

Advantages

- Neither SBS nor any new broadcaster would be isolated on UHF. Under Option 1 and 2, more digital channels are being introduced on UHF, whether it be existing broadcasters or datacasters. This would be an advantage in terms of not leaving any new services using 7MHz channels (such as datacasters or a 4th commercial network in the event one is planned after 2006), at a competitive disadvantage in being the only services on UHF. However, it may be noted that there are other possible strategies for dealing with this such as moving channel 10 to make VHF channel 9A into a full 7MHz channel. It may also be argued that any new services, whether datacasters or commercial network, on UHF would create their own demand for UHF services and that the differences between VHF and UHF are likely to diminish over time as technical developments take place.

Disadvantages

- More disruption to existing domestic receiver installations because of greater use of UHF. (See information under ‘Receiving Antenna’ in Attachment A).
- Broadcasters would be required to incur considerable additional expenditure. (See information under ‘Transmission Antenna’ in Attachment A). However, it may be noted that conversely, the provision of existing analog VHF broadcasters with a digital UHF channel would allow new providers to implement services on the spare VHF channels which might reduce their establishment costs because they would be able to share the existing analog infrastructure.
- There would be the need to develop criteria for deciding which of the VHF broadcasters migrates to UHF. In consideration of the above points this would not be an easy task.

Options 3, 4 and 5 - Advantages and Disadvantages

These options maximise the use of VHF Band III channel assignments.

Advantages

- The close spacing of the frequencies will tend to result in less variation in signal levels at a viewer's receiver than if there is greater frequency separation. This is because radiowave propagation phenomena such as reflection and diffraction tend to affect different frequencies differently. The requirement of 'same level of coverage and potential reception quality' is more likely to be met with a VHF solution. (See under 'Propagation' in Attachment A).
- Grouping digital television services in the same band as existing analog television services should maximise the ability of viewers to receive the digital signal without changing their current receiving antenna installation.
- The broadcasters' preference would be for a digital channel that is within the performance envelope of the existing receiving and transmission antenna which minimises implementation costs and impact to the viewer.

Disadvantages

- The higher cost of combining equipment used to combine the analog and digital signals into the one transmission antenna (~$100,000 or so). The higher cost is a result of more stringent filtering requirements for adjacent channels. However, if separate antennas are being used for the digital and analog services this may not be a significant issue.
- The preference by broadcasters to use the existing broadcasting antenna imposes a restriction on the digital channel that is adjacent to the analog channel, due to the interference that may be generated within the combiner[6]. If a separate antenna system is used then this combiner restriction is not required. The operation of the analog channel 7 restricts the digital channels 6 and 8 if a common broadcasting antenna is used. Therefore the analog channels 7, 9, 10 and 28 may restrict channels 6, 8, 9A, 11 and 29 if a common antenna system is used. However, this is not considered a problem because the ERP required for same coverage is below the combiner restraints. Additionally, to avoid interference to neighbouring analog television services during the simulcast period, the ERP for digital services must in some cases be limited even further than the limitation imposed by a common antenna system. The combiner constraints are therefore not a prime concern.
- This option does not resolve the competition issue of the possibility of new services using 7MHz channels (such as datacasters or a 4th commercial network in the event one is planned after 2006), because they do not avoid the possibility of isolation of a 4th commercial network on UHF. Nor does it achieve the outcome of equalising the desirability of VHF and UHF.

Conclusion

The channel assignment option used to prepare the draft DCPs is the best approach because it:

- involves the least disruption to most viewers (including least cost);
- involves the least cost to broadcasters (can utilise existing infrastructure);

Combiner – a device used to mix radiowaves so that a common feeder cable and antenna system can be used.

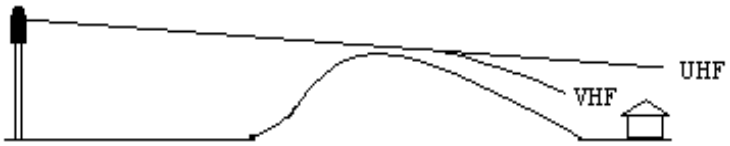
- is the best option in terms of meeting the existing legislative timeframe (1/1/2001);
- is the best option in terms of replicating existing analog coverage from existing sites;
- involves the best utilisation of interference limited channels (channels 6 and 8);
- gives the channel with the least interference problems to the ABC (channel 12).

Adopting these Guidelines does not preclude the ABA from, at any time, deciding on different assignments in any given market on a case by case basis.

ATTACHMENT A – FURTHER INFORMATION ON TECHNICAL ISSUES

Propagation

The VHF band compared to the UHF band has a greater reception distance (coverage) for the same transmission power. The lower VHF frequencies propagate further and also have a greater ability to diffract (curve) around and over object like hills and buildings. Whereas UHF frequencies are essentially line of sight reception.



Multipath Interference

Due to the greater diffraction ability of VHF and the fact that band III receiving antenna have generally a broader beam width, VHF television services are prone to multipath interference (ghosting) where multiple signals are received as the result of reflections from objects (trees, building hills and airplanes).

Many of the translators established in Metropolitan markets are not in areas of deficient reception but are used to solve the multipath problems. The COFDM modulation technique employed by digital television services have the ability to mask multipath problems, thus this may remove the need for many translator services.

(Removing the need for translators, although spectrum efficient and less costly for broadcasters will mean that the television viewers in translator areas will need to purchase another antenna directed towards the main digital transmissions.)

Transmission Antenna

The existing transmission antennas have particular characteristics. Depending on those characteristics, some channels would be preferred over others.

The transmission antenna is constructed to provide optimal performance (antenna gain) at a particular channel or over a range of channels. The greater the range, the greater the cost, and more likely a reduction in performance compared to a single channel antenna.

Consider Sydney which has three transmission towers: the first tower with Channel 2 (ABC) and Channel 28 (SBS); the second tower with Channel 7 and Channel 10; and the third tower with Channel 9.

- It can be assumed that the antenna performance of the second transmission covers a range extending from at least channel 7 to channel 10 (ie VHF channels 7, 8, 9, 9A, and 10). It is not clear however how the antenna performance will be at VHF channels 6, 11 and 12. A broadcaster's preference would be for a digital channel that is within the performance envelope of the existing transmission antenna characteristics in order to minimise establishment costs.
- Channel 12 was not part of the television band until recent years, and therefore the existing Band III transmission antennas may not perform sufficiently for transmission of this channel. So either a separate antenna is installed or a new transmission antenna covering VHF channels 6 to 12 could be installed to allow sharing between broadcasters.

- Digital television services are not going to be on Band I, therefore the ABC could not use its existing antenna or feeder cable for digital transmissions regardless of whether it is assigned VHF Band III or a UHF channel.
- Similarly, assigning a UHF channel to either the Seven, Nine or Ten Networks would prevent them from using their existing antenna and feeder cables for digital transmissions. It would require them to install a UHF antenna or share the SBS infrastructure.

In addition to existing analog antenna characteristics, it is not clear whether the ABC/SBS transmission tower could support a Band III antenna, nor whether the Channel 7/Channel 10 or Channel 9 transmission towers could support a UHF antenna. There may be considerable expense required to upgrade the structural capabilities of the existing analog transmission towers for the introduction of digital television.

Receiving Antenna

Grouping digital television services in the same band, as existing analog television services should maximise the ability of a viewer to receive the digital signal without changing their current receiving antenna installation.

Area Served	**Analog channel assignments**				
Metro	ABN 2	ATN 7	TCN 9	TEN 10	SBS 28
Antenna	Band I	Band III	Band III	Band III	Band IV
Area Served	**Proposed digital channel assignments**				
Metro	12 #	6	8	11	29
Antenna	Band III	Band III	Band III	Band III	Band IV

The performance of many existing antennas may be deficient in respect to reception of certain channels, particularly channel 12 which was not part of the television band until recent years. Therefore, existing antennas may not perform adequately and could require replacement. It is estimated that the cost of a new combined Band III and Band IV receiving antenna would cost approximately $150.

Arguably, the most popular viewing formats would be the commercial stations followed by the ABC, SBS and then Community TV. Based on this assumption, metropolitan residents are more likely to have a Band III VHF antenna to receive the three commercial stations than a Band IV UHF antenna to receive SBS or Community TV. (It would be difficult, if not impossible, to determine the number of residents with UHF antennas.)

The introduction of digital television on VHF Band III is less likely to cause disruption to existing domestic receiver installations, and therefore more preferred by broadcasters.

Channel 9A

Until recently channel 9A and channel 12 were not part of the broadcasting services bands. These channels are now available for digital channel planning.

Channel 9A has only 6 MHz bandwidth unless channel 10 is moved up in frequency by 1 MHz. Some channel 11 television services may also need to be moved by 1 MHz given the move by channel 10 on the lower adjacent channel.

The Ten Network would require its transmitter to be retuned. The television translator services receive its programming feed from the channel 10 service, and then rebroadcast on a different channel. The translator receivers would also be required to be retuned. It would also require some sort of announcement by channel 10 to the viewers to co-ordinate the change.

The viewers that receive the channel 10 service directly (not from a translator) would be required to retune their television and videocassette recorders (VCR's). Although some televisions/VCRs have automatic retuning ability. It would be anticipated that the average viewer would have difficulty retuning their television receivers.

Technical Restraints

The Act requires the existing broadcasters to provide a digital television service with comparable coverage to that of its analog service. Technical restraints imposed on a particular channel, to prevent interference to existing analog television services, may prevent a comparable coverage during the simulcast.

The proposed television channel assignment strategy in the metropolitan areas results in the analog commercial VHF channels 7, 9 and 10 being assigned digital VHF channels 6, 8 and 11 respectively. Although VHF channels 6 and 8 in general are the most power-limited channels due to interference to analog services in adjacent areas, they are in fact Network 7 and 9's preferred digital channels in all metropolitan areas. As a result, any technical problems associated with their assignment are much more likely to be successfully resolved. Similarly network 10 have indicated their preference for digital channel 11.

The assignment of digital channel 12 (largely unencumbered) to the ABC will minimise implementation costs for the national broadcaster.

DIGITAL CHANNEL SUMMARY

The following table shows the proposed digital channels for main stations identified for Hobart:

Area Served	No. of Digital Channels	Digital Channel
Hobart (main)	**6**	**7, 8, 9A, 10, 11, 12**

CHANNEL INTERFERENCE ASSESSMENT FOR HOBART

Channel	**Maximum* interim ERP (kW)**	**Final Maximum ERP (kW)**	**Comment**
6	NA	NA	UNAVAILABLE (in use as TNT6 Hobart)
7	50	50	Clear for use (if translator TVT8 Taroona and TVT8 Maydena shifts to UHF)
8	50	50	Clear for use (if translator TVT8 Taroona, TVT8 Bicheno, TVT8 Strathgordon and TVT8 Maydena shifts to UHF)
9	NA	NA	UNAVAILABLE (in use as TVT9 NE Tas)
9A	50	50	Clear for use (if translator ABC10 Bicheno shifts to UHF)
10	50	50	Clear for use (if translator ABC10 Bicheno shifts to UHF)
11	50	50	Clear for use (if translator TNT11 Launceston shifts to UHF)
12	50	50	Clear for use

No further assessments of higher channels (Band IV and Band V) were undertaken, as sufficient capacity has been identified above.

CHANNEL INTERFERENCE ASSESSMENT FOR NORTH EAST TASMANIA

Channel	Comment
6	UNAVAILABLE (in use as TNT6 Hobart and as digital channel for HSV7 Melbourne)
7	UNAVAILABLE (in use as HSV7 Melbourne)
8	UNAVAILABLE (in use as digital channel for GTV9 Melbourne)
9	UNAVAILABLE (in use as TVT9 NE Tas and as GTV9 Melbourne)
9A	UNCERTAIN
10	UNAVAILABLE (in use as ATV10 Melbourne)
11	UNAVAILABLE (in use as digital channel for ATV10 Melbourne)
12	UNAVAILABLE (in use as digital channel for ABV2 Melbourne)
27	UNAVAILABLE (6 MHz only)
28	UNAVAILABLE (in use as SBS28 Melbourne)
29	UNAVAILABLE (in use as digital channel for SBS28 Melbourne)
30	UNAVAILABLE (in use as unassigned digital channel Latrobe Valley)
31	UNAVAILABLE (in use as CTV31 Melbourne)
32	UNAVAILABLE (in use as unassigned digital channel Melbourne)
33	UNAVAILABLE (in use as unassigned digital channel Latrobe Valley)
34	UNAVAILABLE (in use as unassigned digital channel Ballarat)
35	UNAVAILABLE (in use as unassigned digital channel Melbourne)
36	UNAVAILABLE (in use as unassigned digital channel Latrobe Valley)
37	UNAVAILABLE (in use as unassigned digital channel Ballarat)
38	**Potentially Available**
39	UNAVAILABLE (in use as unassigned digital channel Latrobe Valley)
40	UNAVAILABLE (in use as unassigned digital channel Ballarat)
41	**Potentially Available**
42	UNAVAILABLE (in use as unassigned digital channel Latrobe Valley)
43	UNAVAILABLE (in use as unassigned digital channel Ballarat)

Channel	Comment
44	**Potentially Available**
45	UNAVAILABLE (in use as unassigned digital channel Latrobe Valley)
46	UNAVAILABLE (in use as unassigned digital channel Ballarat)
47	**Potentially Available**
48	UNAVAILABLE (in use as unassigned digital channel Latrobe Valley)
49	UNAVAILABLE (in use as unassigned digital channel Ballarat)
50	**Potentially Available**
51	UNAVAILABLE (in use as unassigned digital channel Latrobe Valley)
52	**Potentially Available**
53	**Potentially Available**

APPENDIX 5

Australian
Broadcasting
Authority

DRAFT
DIGITAL CHANNEL PLAN

Tasmania

Hobart

APRIL 1999

Digital Channel Plan - Hobart Digital Television TV - Draft

Service Category	Proposed Assignment	Cha	Service Licence No	Technical Specification No	Attach No	Area Served
Commercial – Digital TV	TVT 6	7	SL132	TS10009361	1.1	Hobart
National – Digital TV	ABC 2	8	N/A	TS10009364	1.2	Hobart
National –Digital TV	SBS 28	9A	N/A	TS10009365	1.3	Hobart
Commercial – Digital TV	TNT 31	10	SL133	TS10009371	1.4	Hobart
Unassigned	Available	11	N/A	TS10009377	1.5	Hobart
Unassigned	Available	12	N/A	TS10009378	1.6	Hobart

Use of some of these channels may depend on the assignee taking responsibility for public interest considerations caused by changes to existing analog transmissions. Use of the digital channel may depend on these analog transmission and reception issues being adequately addressed by a licensee. This may involve bearing some or all of the cost of installing new analog translator and any necessary resultant re-tuning of domestic TV receivers or changes to domestic receive antennas. This would be necessary to overcome interference caused by the new digital service and to ensure continued analog reception during the simulcast period.

The ABA has power to impose conditions on a broadcaster's television broadcasting licence and/or its transmitter licence(s) so as to require a licensee to discharge their responsibilities in this regard. In considering whether to impose any such conditions, the ABA would have regard to any agreements reached between broadcasters about such matters and any undertakings made to the ABA.

Attachment 1.1

DIGITAL CHANNEL PLAN : Hobart Digital Television - Draft

Category :	Commercial - Digital TV
General Area Served :	Hobart (TAS)
Proposed Assignment:	TVT 6

TECHNICAL SPECIFICATION - Digital Television

Specification Number :	TS10009361

Transmitter Site :-

Nominal location :	WIN Television Tower MT WELLINGTON		
Australian Map Grid :	Zone	Easting	Northing
Reference	55	519174	5250651
Site Tolerance :	Refer to Technical Planning Guidelines		

Emission :-

Frequency Band & Mode	VHF Band III - TV
Centre Frequency :	184.5 MHz (Ch.7)
Polarisation	Horizontal
Maximum antenna height	58 m

Output Radiation Pattern :-

Bearing or Sector (Clockwise direction)	Maximum ERP
At all angles of azimuth	50 kW

Attachment 1.2

DIGITAL CHANNEL PLAN : Hobart Digital Television - Draft

Category :	National - Digital TV
General Area Served :	Hobart (TAS)
Proposed Assignment:	ABT 2

TECHNICAL SPECIFICATION - Digital Television

Specification Number :	TS10009364

Transmitter Site :-

Nominal location :	NTA Tower MT WELLINGTON		
Australian Map Grid : Reference	Zone 55	Easting 519185	Northing 5250351
Site Tolerance :	Refer to Technical Planning Guidelines		

Emission :-

Frequency Band & Mode	VHF Band III - TV
Centre Frequency :	191.5 MHz (Ch.8)
Polarisation	Horizontal
Maximum antenna height	84 m

Output Radiation Pattern :-

Bearing or Sector (Clockwise direction)	Maximum ERP
At all angles of azimuth	50 kW

Attachment 1.3

DIGITAL CHANNEL PLAN : Hobart Digital Television - Draft

Category :	National - Digital TV
General Area Served :	Hobart (TAS)
Proposed Assignment:	SBS 28

TECHNICAL SPECIFICATION - Digital Television

Specification Number :	TS10009365

Transmitter Site :-

Nominal location :	NTA Tower MT WELLINGTON

Australian Map Grid :	Zone	Easting	Northing
Reference	55	519185	5250351

Site Tolerance :	Refer to Technical Planning Guidelines

Emission :-

Frequency Band & Mode	VHF Band III - TV
Centre Frequency :	205.5 MHz (Ch.9A)
Polarisation	Horizontal
Maximum antenna height	84 m

Output Radiation Pattern :-

Bearing or Sector (Clockwise direction)	Maximum ERP
At all angles of azimuth	50 kW

Attachment 1.4

DIGITAL CHANNEL PLAN : Hobart Digital Television - Draft

Category :	Commercial - Digital TV
General Area Served :	Hobart (TAS)
Proposed Assignment:	TNT 31

TECHNICAL SPECIFICATION - Digital Television

Specification Number :	TS10009371

Transmitter Site :-

Nominal location :	NTA Tower MT WELLINGTON		
Australian Map Grid :	Zone	Easting	Northing
Reference	55	519185	5250351
Site Tolerance :	Refer to Technical Planning Guidelines		

Emission :-

Frequency Band & Mode	VHF Band III - TV
Centre Frequency :	212.5 MHz (Ch.10)
Polarisation	Horizontal
Maximum antenna height	84 m

Output Radiation Pattern :-

Bearing or Sector (Clockwise direction)	Maximum ERP
At all angles of azimuth	50 kW

Attachment 1.5

DIGITAL CHANNEL PLAN : Hobart Digital Television - Draft

Category :	Unassigned
General Area Served :	Hobart (TAS)
Proposed Assignment:	Unassigned

TECHNICAL SPECIFICATION - Digital Television

Specification Number :	TS10009377

Transmitter Site :-

Nominal location :	NTA Tower MT WELLINGTON		
Australian Map Grid : Reference	Zone 55	Easting 519185	Northing 5250351
Site Tolerance :	Refer to Technical Planning Guidelines		

Emission :-

Frequency Band & Mode	VHF Band III - TV
Centre Frequency :	219.5 MHz (Ch.11)
Polarisation	Horizontal
Maximum antenna height	84 m

Output Radiation Pattern :-

Bearing or Sector (Clockwise direction)	Maximum ERP
At all angles of azimuth	50 kW

Attachment 1.6

DIGITAL CHANNEL PLAN : Hobart Digital Television - Draft

Category :	Unassigned
General Area Served :	Hobart (TAS)
Proposed Assignment:	Unassigned

TECHNICAL SPECIFICATION - Digital Television

Specification Number :	TS10009378

Transmitter Site :-

Nominal location :	NTA Tower MT WELLINGTON		
Australian Map Grid :	Zone	Easting	Northing
Reference	55	519185	5250351
Site Tolerance :	Refer to Technical Planning Guidelines		

Emission :-

Frequency Band & Mode	VHF Band III - TV
Centre Frequency :	226.5 MHz (Ch.12)
Polarisation	Horizontal
Maximum antenna height	84 m

Output Radiation Pattern :-

Bearing or Sector (Clockwise direction)	Maximum ERP
At all angles of azimuth	50 kW