Australian Government

Digital Dividend Green Paper

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Minister's foreword

Free-to-air television broadcasting services currently use radiofrequency spectrum in what is known as the Very High Frequency (VHF) and Ultra High Frequency (UHF) bands. From its beginnings in Sydney in 1956, free-to-air broadcast television has rapidly grown to become a major media distribution in Australia, providing information and entertainment in almost every Australian household.

Some 50 years later both the communications and entertainment landscapes have been transformed. As part of this, we—the users of technology—have made an array of fixed and wireless communication devices an intrinsic part of everyday personal and work life. These devices provide access to a variety of services which entertain, inform and educate us, improve the productivity of our work and business activities and connect us with one another.

We are now on the cusp of converting our free-to-air television services from analog to digital. This process begins this year and will be completed by the end of 2013. It will release a large amount of spectrum—a digital dividend—which will provide us with a once-in-a-generation opportunity to encourage the introduction of new digital services and to improve existing services.

Analog television spectrum in the UHF bands is 'waterfront property' because of its ability to carry signals over long distances, penetrate buildings and carry large amounts of data. This spectrum is valuable to potential purchasers, but of far greater benefit are the opportunities it can offer to all Australians by providing new services for individuals and businesses.

Internationally, analog television transmission is being phased out and countries are realising their digital dividends as part of this process. The trend overseas has been to more efficiently use that part of the spectrum designated for broadcasting services by reorganising, or 'restacking', these services in order to create a contiguous block of cleared spectrum. This action has expanded the number of potential uses of the cleared spectrum.

The Australian Government has decided that it too will seek to restack spectrum to maximise the digital dividend in line with major developed economies, and has agreed on a set of principles and a target digital dividend of 126 MHz.

The digital dividend can potentially be used to provide a range of new communications services including super-fast mobile broadband. The ability to have high capacity internet access in a range of locations is already proving valuable to users of 3G networks both in Australia and overseas, and this demand will only grow.

However, there is no 'either/or' approach in terms of free-to-air digital television and the digital dividend. The Government is committed to ensuring that the high quality free-to-air digital services that Australians enjoy will continue to be provided.

The purpose of this paper is to seek comments on a range of issues that will assist the Government in making a final decision on the size and location of the digital dividend. The Government has already commenced a productive dialogue with stakeholders on these issues, and I encourage all parties with a view to make a submission to this process.

Senator the Hon Stephen Conroy

Minister for Broadband, Communications and the Digital Economy

Contents

Purpose of this paper

The Australian Government's primary policy objective in relation to the digital dividend is to maximise the benefit that use of the spectrum will bring to the Australian community and economy over time. The Australian Government considers that this would best occur through maximising the digital dividend.

The focus of this paper is the radiofrequency spectrum in the UHF bands that could potentially be freed up by the cessation of analog television transmissions. A primary objective of spectrum management is to maximise the efficient allocation of spectrum.

It is the Government's intention to maximise the value of the freed up spectrum to the Australian community and economy by reorganising or 'restacking'[1] broadcasting services to clear a large contiguous block of spectrum at the upper end of the broadcasting services band portion of UHF Band V. Studies both commissioned and undertaken by the Government have identified that at least 126 MHz of this spectrum could be freed up by digital television switchover. This is therefore the Government's target for the digital dividend.

However, before making a final decision on the digital dividend, the Government is consulting the Australian community.

This paper seeks comments on the potential uses of this digital dividend spectrum, the potential benefits of these uses to the Australian community and economy, and the costs involved in releasing a contiguous block of spectrum by restacking broadcasting services.

Responses will assist in informing Government decisions on the final size and location of Australia's digital dividend. Following final decisions, the Government will consider the options for allocation of the digital dividend.

Making a submission

Stakeholders are encouraged to participate in this consultation process and may provide written comments on any aspect of the issues canvassed. In particular, views are sought on the questions asked in the comments boxes throughout the paper.

Unless the author of a submission clearly marks it 'confidential', the Department of Broadband, Communications and the Digital Economy (the Department) will treat the submission as public, and the Department may publish that submission on its website or provide it to third parties. Please note that where the submission is marked 'confidential', the Department may disclose the submission to the responsible Minister, in response to a request by a House or a Committee of the Parliament of the Commonwealth of Australia, or where authorised or required by law.

The Department will not publish submissions if to do so would breach applicable laws or promote a product or a service, or the submission contains offensive language or expresses sentiments that are liable to offend or vilify sections of the community.

Please note that the Department reserves the right not to publish submissions it deems inappropriate for reasons other than those outlined above.

Submissions are due by 5:00 pm, 26 February 2010 (Australian Eastern Daylight Saving Time).

[1] Restacking will involve some television services moving to new channels for transmission purposes.

Submissions can be made in one of the following ways:

1. by post to the following address:

   The Manager
   Digital Dividend Section
   Department of Broadband, Communications and the Digital Economy
   GPO Box 2154
   Canberra ACT 2601

or

2. by email attachment to digitaldividend@dbcde.gov.au

All submissions must have a coversheet attached. Coversheets are available at *www.dbcde.gov.au/digitaldividend* or can be requested from the Department on 02 6271 1645.

Chapter one: What is the digital dividend?

The digital dividend is the term used to describe the spectrum freed up as a result of the switchover from analog to digital television transmission. The Government has announced that analog television transmission will be progressively turned off from 2010 with a complete switchover to digital television transmission by December 2013.

In Australia, parts of the radiofrequency spectrum have been designated as the broadcasting services bands which are primarily for the use of existing and future radio, television and datacasting services.

Five of the designated broadcasting services bands are currently used to provide analog television services as follows:

- Very High Frequency (VHF) television Band I: 45-52 MHz (channel 0) and 56–70 MHz (channels 1 and 2)
- VHF television Band II: 85–108 MHz (channels 3, 4 and 5)
- VHF television Band III: 137–144 MHz (channel 5A) and 174–230 MHz (channels 6, 7, 8, 9, 9A, 10, 11 and 12)
- Ultra High Frequency (UHF) television Band IV: 526–582 MHz (channels 28 to 35)
- UHF television Band V: 582–820 MHz (channels 36 to 69).

A total of 57 channels (15 VHF and 42 UHF) are used to provide analog television services across Australia. This means that analog television broadcasting currently makes use of 399 MHz of spectrum.

A total of 50 channels (8 VHF Band III and 42 UHF) may be used to provide digital television services. This means that 350 MHz of spectrum is available for the provision of digital television services. However, the size of the digital dividend can be more than the simple difference between the amount of analog broadcasting spectrum and the amount of digital broadcasting spectrum, as explained below.

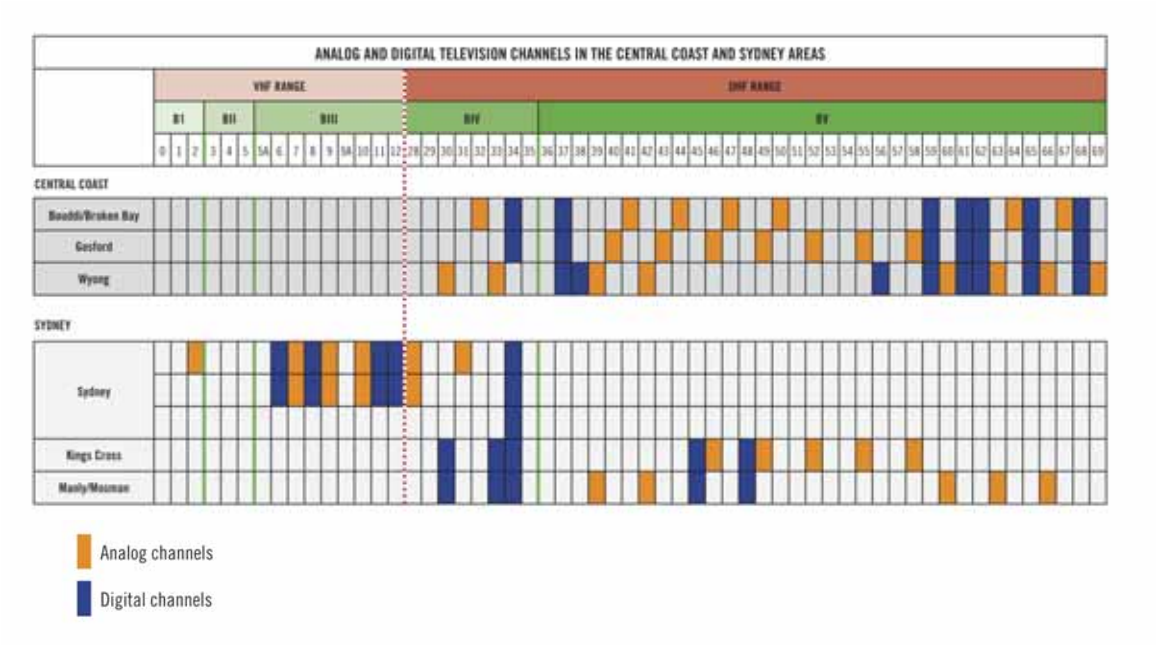
When digital television was introduced into Australia, its frequency allocations were fitted in around the existing analog television allocations. The Australian Government allocated broadcasters additional spectrum to simulcast in digital on the condition that the analog channels are returned to the Government at analog switch-off.

Analog television is currently broadcast in all five bands while digital television uses only Bands III (VHF), IV (UHF) and V (UHF). The switchover to digital television and the vacating of spectrum by analog services will potentially yield a digital dividend in both the VHF and UHF bands.

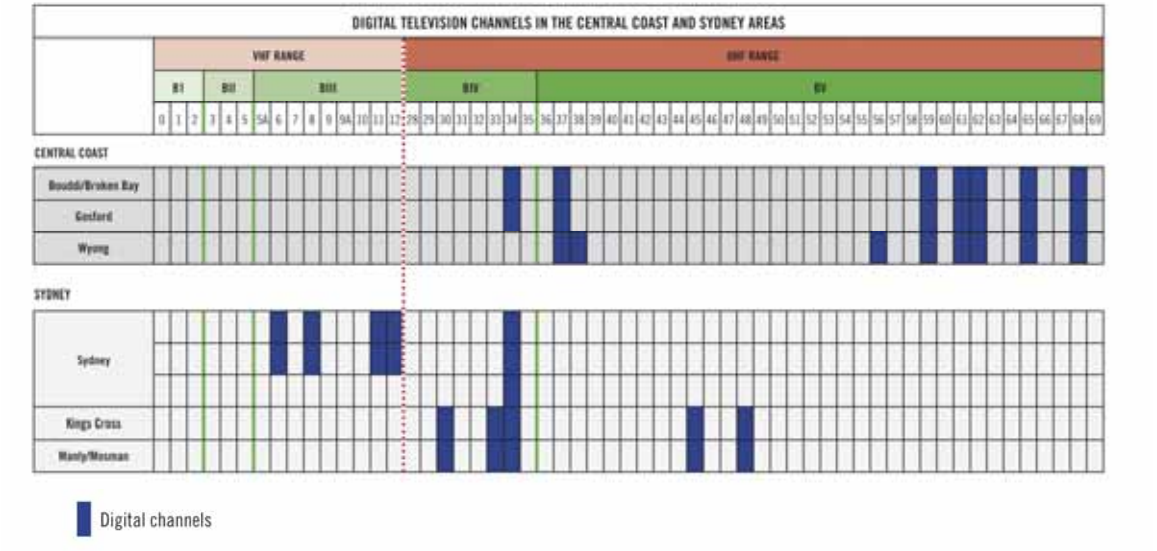
To illustrate how the potential UHF digital dividend can be realised, the diagram on page 8 shows the channels utilised by current broadcasting services in the Central Coast (New South Wales) and Sydney areas[2]. The vertical axis specifies the areas served within the greater geographic areas of the Central Coast and Sydney, while the horizontal axis depicts each channel and its allocation. The blue squares represent digital services, while the orange squares represent analog services. Similar patterns

[2] Channel allocation shown is in accordance with the Australian Communications and Media Authority's (ACMA's) *Radio and Television Broadcasting Stations Handbook*, January 2009.

are repeated across the country. The grey squares are channels that are not currently used for analog or digital television broadcasting in the represented areas.



Without restacking, after analog television switch-off is completed, digital television services would be scattered throughout the bands. However, the 7 MHz channels that are currently used to provide analog television services, as represented by the orange squares in the diagram above, will no longer be required to transmit analog television. This will leave a patchwork of vacated spectrum blocks interleaved throughout the band (see diagram below).



Contiguous blocks of spectrum are more valuable to many potential users of digital dividend spectrum than interleaved 7 MHz blocks of spectrum that are scattered amongst the digital broadcasting services. A contiguous block of spectrum can potentially be used to provide a range of communications services including mobile voice services and both fixed and mobile wireless broadband services.

It is desirable to clear contiguous digital dividend spectrum at the higher frequency end of the UHF bands to maximise its value to users. In order to do so, the digital television services remaining after switchover can be organised much more efficiently. This is known as 'restacking' and involves moving television services to different transmission channels.

While use of the broadcasting services bands is regulated by the *Broadcasting Services Act 1992*, the Minister for Broadband, Communications and the Digital Economy has authority under the *Radiocommunications Act 1992* to change the designation of spectrum that makes up the broadcasting services bands. If spectrum is removed from the broadcasting services bands, the Australian Communications and Media Authority (ACMA) is able to replan and reallocate the spectrum for other uses.

International context

Television broadcasters around the world are moving to digital-only platforms. The United States completed its transition to digital-only terrestrial broadcasting on 12 June 2009. The United Kingdom commenced its region by region switchover to digital-only terrestrial broadcasting in November 2007 and is scheduled to complete the transition to digital by the end of 2012.

As a result of this technological transition, a significant number of governments of developed economies are now planning for and, in some cases, allocating their digital dividends.

The international regulatory framework for UHF spectrum is an important consideration in determining the digital dividend.

The International Telecommunication Union (ITU), a specialised agency of the United Nations, is responsible amongst other things for the global coordination of radiofrequency spectrum. World Radiocommunication Conferences are held periodically by the ITU for member states to agree to revisions to the Radio Regulations, the international treaty governing the use of radiofrequency spectrum.

The primary objective of this aspect of the work of the ITU is to ensure interference-free operations of radiocommunication systems through implementation of the Radio Regulations and Regional Agreements, and the efficient and timely update of these instruments through the processes of the World and Regional Radiocommunication Conferences.

International coordination to minimise interference in spectrum use is of less relevance to Australia in determining the digital dividend due to our relative geographic isolation. However, aligning dividend spectrum with other countries is an important consideration in enhancing the potential for communications and equipment manufacturers to realise economies of scale and set lower prices for network and handset equipment, and to facilitate global roaming through the use of harmonised frequencies for delivering communications services.

UHF spectrum allocations arising out of WRC-07

At the most recent World Radiocommunication Conference held in 2007, referred to as WRC-07, revisions were made to spectrum allocations in UHF spectrum where potential digital dividend spectrum is located. The range 790–960 MHz in global region one (comprising Europe, the Middle East, Africa and Russia) and region three (comprising Asia and Australasia) was identified for use by administrations wishing

to implement international mobile telecommunications (IMT). In region two (the Americas), the spectrum range 698–960 MHz was identified for the implementation of IMT.

In addition to the allocation of 790–960 MHz in region three, a number of countries (Bangladesh, China, Korea, India, Japan, New Zealand, Papua New Guinea, Philippines and Singapore) specifically identified the band or portions of the band 698–790 MHz for the implementation of IMT.

The allocations made at WRC-07 recognise that parts of the band 806–960 MHz are already extensively used in the three regions for mobile telecommunications systems, and that the switch-off of analog broadcasting transmissions in many countries will make spectrum in the band 698–862 MHz available for mobile applications.

The allocations do not restrict individual countries in allocating digital dividend spectrum how they see fit after taking national requirements into consideration.

Digital dividend developments by region

In region one, consistent with WRC-07 allocations, the European Union (EU) is working towards harmonising the 790–862 MHz band for mobile telecommunications use. While individual member states can proceed with digital dividend allocations as they choose, the European Commission is working towards a method for harmonising use of UHF spectrum across the EU.

A number of EU member states including Finland, France, Germany, Spain and Sweden have allocated or are planning to allocate 72 MHz comprising the band 790–862 MHz for mobile telecommunications use. The United Kingdom has also announced that it will make changes to its previously announced digital dividend bands to harmonise the 790–862 MHz band for mobile telecommunications with other European countries. The United Kingdom will reallocate 128 MHz of UHF spectrum in two bands as its digital dividend.

The harmonisation of the use of UHF spectrum is of particular importance in Europe to prevent harmful interference between countries that are in close geographic proximity.

In region two, the United States allocated 108 MHz of dividend spectrum as its digital dividend in the ranges 698–746 MHz and 746–806 MHz. The licences were primarily purchased for mobile and wireless communications use. Canada has also identified its digital dividend to be located in the 698–806 MHz block.

In region three, in which Australia is located, Japan is planning to allocate 60 MHz of UHF spectrum above 710 MHz for purposes other than television broadcasting. New Zealand has announced plans to make 112 MHz of UHF spectrum in the range 694-806 MHz available for mobile telecommunications.

International alignment

Harmonising Australia’s potential digital dividend with other economies expands the potential for Australia to realise economic benefits associated with harmonised frequency use.

At WRC-07, a number of administrations in ITU region three identified the range 698–806 MHz for implementing mobile communications.

Economies in ITU region three often make use of technologies from the United States and Europe and consequently often use the same spectrum arrangements. Australia's UHF broadcasting arrangements do not fully align with those of other economies including those in Asia. In particular, the upper end of Australia's broadcasting band is 820 MHz which does not align with Europe's 862 MHz. This makes harmonising the digital dividend with that of Europe's impractical. It is far more practical to align the Australian digital dividend with that of the Americas and similarly aligned Asian economies where the upper end of the UHF broadcasting band is 806 MHz.

The digital television switchover and digital dividend planning process is not as advanced in region three as it is in the United States and Europe. It is therefore possible for region three economies to work together to develop digital dividend spectrum arrangements that maximise the ability to utilise customer and network equipment developed overseas and to facilitate global roaming should dividend spectrum be used to provide such services.

Chapter two: Determining the digital dividend

Spectrum required to deliver existing broadcasting services in digital

The first step the Australian Government has taken in order to realise a digital dividend is to identify the amount and location of spectrum that can potentially be released as a result of the cessation of analog television broadcasting.

An independent engineering consultancy firm, Kordia Pty Ltd, was commissioned by the Department of Broadband, Communications and the Digital Economy to identify issues and options for releasing spectrum after analog television is switched off in Australia.

Kordia found that it is possible for 126 MHz of UHF spectrum to be released as a digital dividend, assuming the provision of up to six in-home digital television channels nationwide (each 7 MHz channel can support a number of digital television services). Restacking of digital broadcast services would need to occur in order to release this spectrum as a contiguous block.

The ACMA has also undertaken detailed technical case studies in order to determine the amount of spectrum that could feasibly be made available as a digital dividend following the switch-off of analog television services.

The ACMA concludes that, given the assumptions of the case studies, it would be technically feasible to provide the five existing digital television channels and one additional in-home channel using spectrum in the channels below channel 52 in the current broadcasting services bands. The ACMA work demonstrates that restacking of broadcasting services into these channels could enable the freeing up of a contiguous block of 126 MHz of spectrum in the upper UHF band (694–820 MHz or UHF channels 52 to 69).

The Government's digital dividend target

Following these technical studies, the Government agreed on the broad principles that it intends to use in consideration of the digital dividend. These are that:

- future uses of spectrum cannot be accurately predicted, but allowing the market to determine an outcome after the Government has taken into account issues relating to the public interest is likely to result in spectrum being made available for optimal use
- larger contiguous blocks of spectrum are more economically optimal than smaller or interleaved blocks
- as a technology taker, Australia needs to align spectrum allocations with major developed countries or risks not being able to utilise the latest communications equipment produced for these countries
- the digital dividend should be thought of as an economic gain, and
- the approach to realising the dividend should be determined, recognising that there may be some trade-offs between efficiency on the one hand, and the level of disruption to current spectrum users on the other (including inconvenience and costs for television viewers and broadcasters).

Consistent with these principles, the Government has decided that:

- realisation of the dividend will be based on an approach that involves the restack of some digital television broadcasting services in order to maximise efficiency, and
- Australia should seek to free an amount of radiofrequency spectrum of a similar size to the digital dividend achieved in the United States (108 MHz) and United Kingdom (128 MHz).

Given these technical and economic considerations the Government's target digital dividend is 126 MHz of contiguous UHF spectrum.

However, the Government's primary policy objective in relation to the digital dividend is to maximise the dividend in order to increase the benefit that use of the spectrum will bring to the Australian community and economy over time. The Government is committed to doing this while maintaining Australians' existing access to free-to-air digital television services.

As recognised by the guiding principles, this will involve some trade-offs between efficiency and the disruption to spectrum users. The most significant trade-offs in terms of the digital dividend are assessing the benefits of clearing a large, contiguous block of digital dividend spectrum against the costs of clearing the spectrum by restacking broadcasting services and the impact a reduction in the size of the broadcasting services bands would have for the future delivery of broadcasting services.

These are discussed in the following chapters of this paper. When commenting, respondents are asked to ensure that as much as possible benefits and costs are quantified. In particular, the Government is seeking comments on economic and productivity benefits that could arise from a restacked digital dividend and the financial, economic and consumer impact costs of restacking broadcasting services.

Chapter three: Potential benefits of the digital dividend

UHF spectrum in the broadcasting services bands is highly valued due to its desirable characteristics for delivering communications services. It is able to carry signals over long distances, penetrate buildings and carry large amounts of data.

Future developments in broadcasting and communications technologies and consumer demand for services will affect the purposes for which the dividend will ultimately be used.

In addition, the structure of the spectrum available will dictate the purposes for which it can be used. While small blocks of spectrum interleaved between existing broadcasting services are valuable for additional broadcasting services, they have far less technical and commercial value for a range of other uses. Such small blocks of spectrum have corresponding low maximum data carrying capacity, meaning that a significant number of potential uses identified below are not feasible. The requirement for guard bands to prevent interference with broadcasting services would also significantly impair the use of interleaved spectrum.

If the vacated spectrum is reorganised or restacked into larger contiguous blocks, it is anticipated that it will be suitable for a larger number of potential spectrum uses.

The following sections outline a number of potential uses of digital dividend spectrum. Those seeking to make a case for a particular use of digital dividend spectrum are expected to do so based on the value of the proposed use to the Australian community and economy.

Mobile telecommunications and broadband

Developments in technology and demand for new services have increased demand for spectrum. This demand is greatest in bands between 400 MHz and 3.5 GHz.

Mobile telecommunications provide a wide range of services using mobile handsets and other devices including voice, messaging services and broadband access.

Internationally, the take up of mobile telecommunications services is increasing at a significant rate. The majority of spectrum licences from the most recent auction of 700 MHz digital dividend spectrum in the United States were acquired by telecommunications providers.

The market for mobile phones in Australia is mature but growth in usage, and in particular broadband applications, is expected to continue in the future. This suggests that spectrum demand for delivery of these services is likely to increase in the future.

In Australia, three carriers offer mobile telecommunications services on a national basis over both second-generation, or 2G, cellular networks and third-generation, or 3G, cellular networks. 2G networks use Global System for Mobiles (GSM) network technology. GSM is a Time Division Multiple Access-based technology that supports voice, data and text messaging and allows roaming between different networks. The General Packet Radio Service (GPRS) and Enhanced Data rate for GSM Evolution (EDGE) data standards have also been incorporated into existing GSM networks and offer enhanced data services.

3G networks have been offered by providers in Australia since 2003. 3G networks provide enhanced services to mobile handsets including music and video downloads,

and mobile broadband. Carriers have also recently enabled, or are in the process of enabling, their 3G networks with the High Speed Download Packet Access (HSDPA) standard to enhance speeds.

Mobile telecommunications services require either paired or non-paired blocks of spectrum. For paired blocks, two non-adjacent blocks of spectrum are required to avoid interference between the 'transmitting' and 'receiving' parts of the system. This technique is called Frequency Division Duplexing (FDD). For unpaired blocks, transmitting and receiving is managed using the same block of spectrum with different time slots used to avoid interference. This technique is called Time Division Duplexing (TDD). The required block size depends on several factors, although the transmission bandwidth of the telecommunications system is a key factor. Some telecommunications systems offer either FDD or TDD while future systems may support both duplexing techniques.

Spectrum in which the digital dividend would be located has been identified for the provision of mobile telecommunications services by the ITU[3]. In 2006, the ACMA released a discussion paper on strategies for wireless access services, including mobile telecommunications services. Submissions received to that paper indicate that the broadcasting services band in the 520–820 MHz range is attractive spectrum for the provision of these services[4].

The ability of UHF spectrum to carry signals over long distances makes it well suited for delivering cost-effective mobile telecommunications services to those geographic locations in regional and remote Australia which have been traditionally difficult to serve due to high infrastructure costs.

Significant growth in mobile telecommunications services is expected in the future with an increased uptake of 3G services as demand grows for the sharing of digital multimedia, mobile internet access and video streaming, as well as a range of other services.

Technologies that could be used for fourth generation (4G) networks include long term evolution (LTE) and mobile WiMAX. These technologies will theoretically provide peak data speeds of 100 Megabits per second and higher (using 2 x 20 MHz channels). Real world speeds will be lower and depend on a number of factors including the number of people sharing the available bandwidth, the distance of the user from the base station, the frequency of the spectrum used (lower frequencies are able to go further and have better in-building penetration, but higher frequencies have more available bandwidth) and the amount of backhaul. Next generation technologies aim for more spectrally efficient standards, although the technologies tend to also occupy larger bandwidths. A successful demonstration of LTE technology has already been conducted in Australia.

Developments in network technologies will impact significantly on future spectrum requirements for mobile telecommunications services, specifically in relation to the future developments in fourth generation network technologies.

[3] UHF spectrum was identified by administrations wishing to implement international mobile telecommunications (IMT) at the ITU WRC-07.
[4] *www.acma.gov.au/WEB/STANDARD/pc=PC_100424*

Questions

3.1 Should digital dividend spectrum be used to provide mobile telephony and broadband services?

3.2 How much spectrum would be required to provide these services?

3.3 When would this spectrum be required?

3.4 What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

Fixed wireless broadband

There has been a rapid increase in the number of wireless broadband users in recent years. Continual improvement in technology suggests strong growth in the future.

The growth of wireless broadband services will be influenced by the Government's announcement on 7 April 2009 that it will establish a company to roll out and operate a National Broadband Network (NBN). The Government expects it will take eight years to roll out the network.

The Government's objective is to achieve 90 per cent coverage of the fibre-to-the-premises (FTTP) network and the remaining coverage to be delivered through next generation wireless and satellite technologies, within the $43 billion funding envelope.

The timetable and sequencing of the roll-out will be considered by an implementation study and by NBN Co Limited.

The Government has also announced that it will require the use of FTTP technology in greenfield developments that receive planning approval from 1 July 2010.

Extensive roll-out of FTTP providing very high speed broadband services may reduce the market for fixed wireless broadband connections, particularly where these have been used to service locations in metropolitan areas that have been broadband blackspots. At the same time, the NBN will be a fixed network and, as indicated above, the evidence available indicates a growing interest in users being able to access fast broadband when they are away from their premises and on the move—a need that only mobile broadband can meet.

Questions

3.5 How might the roll-out of the NBN impact on the provision of fixed wireless broadband services?

3.6 How much spectrum would be required to provide these services?

3.7 How many networks will need to be accommodated to provide a competitive communications industry?

3.8 When would this spectrum be required?

3.9 What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

National Broadband Network spectrum implications

The discussion paper *National Broadband Network: Regulatory Reform for 21st Century Broadband* notes the importance of spectrum to deliver superfast broadband services using wireless technologies in areas that will not be covered by fibre optic cable.

The Government views fixed-line and mobile broadband access as complementary. This view is supported by the telecommunications industry, including the Australian Mobile Telecommunications Association[5].

Moreover, the expansion of the fixed line capacity through the NBN may assist development of wireless services, particularly mobile wireless, through the provision of additional competitively priced backhaul. In this way wireless and fixed line services have the potential to complement each other, enhancing access to the internet and driving growth in the communications market.

Questions

3.10 What are the spectrum implications associated with the NBN?

3.11 What other implications might the NBN have for the allocation of digital dividend spectrum?

3.12 What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

Mobile television and multimedia

Mobile television refers to the transmission of television programming to mobile handsets. The three main delivery options for mobile television are unicasting to a particular user over a mobile telecommunications network, multicasting (whereby data is transmitted to a controlled set of users in a network), and broadcasting

[5] Australian Mobile Telecommunications Association, Submission to *National Broadband Network: Regulatory Reform for 21st Century Broadband* discussion paper, June 2009, p. 3.

(one-way transmission from one or more points to a potentially unlimited number of receivers).

Service providers already provide mobile television services using the unicasting model over 3G networks in Australia. Unicasting has the advantage of using established networks and existing spectrum allocations however there is insufficient capacity to serve a large audience. More recently, some 3G networks in Australia have deployed multicasting technologies that offer significant capacity improvements over the unicasting approach.

A broadcast network for mobile television using broadcasting services bands spectrum would allow a very large audience to be served. A mobile television broadcast network however would likely need a dense network of transmitters to achieve high levels of coverage/availability. Such networks are expected to be more akin to mobile communications network design than current broadcasting network design. This would likely incur large establishment costs due to the need to install extra equipment at existing mobile network sites or construct new transmitter sites and would require use of handsets designed to receive mobile television signals in those bands (in addition to 3G bands).

Mobile television broadcast trials have been conducted in metropolitan areas in Australia using different standards. There are a number of competing technical standards that could be used to deliver mobile television over a broadcast platform including Digital Video Broadcasting-Handheld (DVB-H), Digital Multimedia Broadcast (DMB) and MediaFLO.

It is likely that spectrum demand for delivering mobile television services will increase in the future, however this will depend on technological developments. Future developments in next generation network technology, such as LTE, could allow mobile television to be provided using the unicast or multicasting methods with fewer capacity limitations associated with delivering broadcast mobile television than currently exist.

Questions

3.13 Should digital dividend spectrum be used to provide mobile television services?

3.14 How much spectrum would be required to provide these services? Please provide estimates for each delivery model (i.e. unicasting, multicasting and broadcasting).

3.15 When would this spectrum be required?

3.16 What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

Potential broadcasting uses

The transmission of analog and digital television services is the primary current use of broadcasting services bands spectrum. Analog and digital free-to-air television

services are transmitted on VHF and UHF broadcasting spectrum bands using 7 MHz channels. Some VHF spectrum is also used to deliver analog FM and digital radio services.

To facilitate the introduction of digital television when many households had not yet purchased digital television receiving equipment, legislation provided for a period of dual or 'simulcast' transmission in both analog and digital mode. Free-to-air commercial and national broadcasters have been allocated sufficient digital spectrum to enable their digital television services to broadly match the coverage of their analog television services. There is a requirement that spectrum used for analog services be returned by these broadcasters at the end of the simulcast period and this forms the basis of the digital dividend.

There are a number of potential broadcasting uses and hence pressures to gain access to some of this spectrum.

Improving the quality and scope of existing broadcasting services

Standard definition and high definition are picture quality standards that are available through digital television programming. Standard definition television (SDTV) can provide wide-screen pictures using a picture quality standard which broadly matches or slightly exceeds very good quality analog television. High definition television, or HDTV, is a higher quality picture and sound standard which provides the viewer with increased picture resolution. HDTV provides significantly higher picture resolution compared with SDTV, resulting in potentially sharper, more lifelike pictures and a better audiovisual experience when watched on television sets designed to display HDTV.

The national broadcasters, metropolitan commercial and the majority of regional commercial broadcasters must provide a service that comprises the core channel (simulcast in analog and SD) and an HD multi-channel until switchover. These broadcasters are also permitted to provide an additional SD multi-channel. After switchover, it will be a commercial decision for each broadcaster as to the combination of SD and HD services they provide.

The data requirements of HDTV are higher than for SDTV. At present, broadcasters must fit both standard and high definition content within one 7 MHz channel. Significant expansion of HDTV, or provision of substantial additional numbers of SDTV services, would require access to additional 7 MHz channels.

HDTV is now an established feature of the television system in Australia being provided by both free-to-air and subscription broadcasters, and there is also a rapidly growing DVD market in high definition products. Most television sets now sold in the Australian market are capable of displaying HDTV, which could lead to higher expectations about the availability of this programming format. Consumers are also likely to continue to demand more television content, with new channels provided by commercial and national broadcasters growing in popularity.

Other potential sources of demand for broadcasting services bands spectrum include:

- extending the terrestrial coverage of existing digital television services, and
- converting local government or community run analog television self-help retransmission facilities to digital.

While the great majority of Australians have access to broadcaster-provided terrestrial free-to-air television, changing demographics and the propagation characteristics of digital television mean that some potential viewers may not have access to a terrestrial digital signal.

The Government is working with free to air broadcasters to address digital signal deficiencies, including through the availability of a new satellite service to provide services to those with poor or no terrestrial coverage.

Questions

3.17 Should digital dividend spectrum be used to allow expansion or enhancement of existing broadcasting services? What would it deliver?

3.18 How much spectrum would be required to provide these services?

3.19 When would this spectrum be required?

3.20 What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

Migration to next generation broadcasting technologies—DVB-T2 and MPEG-4

Future developments in broadcast technology standards have the potential to provide even more spectrally efficient delivery of digital terrestrial television services. The next generation of broadcast technology standards include DVB-T2 and MPEG-4, both of which could allow more services to fit into the current spectrum channels. No doubt there will be further development of standards in the future.

DVB-T2 is a next generation development of the DVB-T technical standard currently used as the basis for free-to-air television broadcasting. It brings an increase of between 30 to 50 per cent in the program-carrying capacity of each channel in comparison to DVB-T2.

MPEG-4 is a new audio-visual coding standard and provides the capacity to potentially double the program-carrying capacity of each channel.

The current generation of digital television and network equipment, and of digital television sets and set top boxes, operates using the original technical standards adopted for digital television (DVB-T and MPEG-2). Although inclusion of MPEG-4 electronics in sets is now occurring, most people cannot receive signals using either DVB-T2 modulation or MPEG-4 audio-visual coding. The Government does not propose to move to a new standard in the foreseeable future, at least prior to switchover being completed. However, looking to the long term, if free-to-air television broadcasting is to take advantage of these new standards in the future, there would need to be a conversion path for both broadcasting transmission equipment and receivers.

Freeview[6], in its specifications for receivers that bear its label, has additional requirements relating to MPEG-4 in order to 'future-proof' the receiver for possible changes in technology in the longer term.

One of the options that might be considered to make this transition without disruption to viewers is a simulcast, where broadcasting services are transmitted using both standards until such time as all customers and broadcasters have migrated their equipment to the new standards.

A full simulcast of all available services on distinct channels would require a large amount of spectrum and is probably not technically feasible within the current spectrum available to broadcasters. However, it may be possible to use spectrum to migrate aspects of broadcasters' services (for example, their HDTV service) or to run trials of new services (for example, new 'teaser' MPEG-4 channels sitting alongside existing MPEG-2 channels) to encourage viewers to purchase receivers compatible for both standards. In much the same way, unique HD digital television content such as that offered by ONE HD is already prompting viewers to purchase HD compatible receivers.

Reserving spectrum for this potential future transition would not maximise the digital dividend. However, the option remains for some broadcasters to obtain the spectrum for a simulcast if the digital dividend were offered for sale in a service neutral and technically flexible open auction process.

Questions

3.21 Should digital dividend spectrum be used to implement DVB-T/MPEG-2 to DVB-T2/MPEG4 or DVB-T/MPEG-4 conversion strategies? If so, which strategies?

3.22 Would additional spectrum be required? If so, how much?

3.23 When would this spectrum be required?

3.24 What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

Retention of broadcasting spectrum for new broadcasting or similar services

At transmitter sites around the country, two channels have been reserved for new digital television services. The reserved channels are known as Channel A and Channel B, and were originally reserved for a limited range of in-home broadcasting services (known as 'datacasting' or 'narrowcasting') and for mobile television services. Although trials of datacasting and mobile television services have been conducted on this spectrum, it has never been allocated for the purposes for which it was originally reserved.

[6] Freeview is owned by the ABC, SBS, Seven, Nine, Ten, Southern Cross, Prime and WIN.

Some, or all, of this spectrum could be provided for new broadcasting or similar services (such as mobile television) or it could be included in the dividend. Achievement of a dividend of 126 MHz is expected to require one of Channels A or B to be rolled into the dividend. Even if this spectrum was rolled into a contiguous dividend, it would still be open for the Government to decide that a portion of the dividend be made available for new broadcasting services.

Community television stations currently operate analog transmissions in the metropolitan areas of Sydney, Melbourne, and Brisbane on UHF channel 31. Trial community television services have also been licensed in Adelaide and Perth using UHF channel 31, and in Lismore using UHF channel 68.

On 4 November 2009 the Minister for Broadband, Communications and the Digital Economy announced that the Government will temporarily allocate one of the two vacant channels to the community broadcasting sector in capital cities, allowing Community TV stations C31 in Melbourne, TVS in Sydney, QCTV in Brisbane and Channel 31 Adelaide to simulcast their services until the switch to digital-only television in capital cities in 2013. The community licensee in Perth will commence digital-only broadcasts in early 2010. Under this arrangement the allocated spectrum is still potentially available for inclusion in the digital dividend after 2013. However, the Government has indicated it will consider longer term arrangements for Community TV prior to the completion of digital switchover in 2013.

Under the *Broadcasting Services Act 1992*, the Minister has a limited power to enable the provision of new commercial television broadcasting. Therefore, there is the potential for new commercial television broadcasting licences to be allocated in the future to provide additional in-home television services.

A statutory review of whether one or more commercial television broadcasting licences should be allocated to use broadcasting services bands spectrum is scheduled to be conducted before 1 January 2012.

This paper is not intended to review whether or not particular types of services should or should not be allowed or supported. For example, it is not intended to consider whether or not a fourth terrestrial commercial licence should be allocated.

A further potential use of broadcasting spectrum is to expand digital radio services to regional Australia. Digital radio has commenced using VHF spectrum in capital cities, but decisions have yet to be made regarding its roll out in regional Australia. While the digital dividend relates to UHF spectrum, ways in which VHF spectrum are used potentially impact on the re-stacking of existing UHF channels, particularly if less VHF spectrum is available to television services than is currently the case.

Questions

3.25 Should spectrum from the digital dividend remain designated as broadcasting services bands spectrum to provide capacity for additional broadcasting services?

3.26 How much spectrum would be required for this purpose?

3.27 When would this spectrum be required?

3.28 What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

Other uses

Government uses

The objectives of legislation governing spectrum allocation provide that adequate provision of spectrum be made for use by agencies involved in defence or the national security of Australia, law enforcement or the provision of emergency services, and for public or community services[7].

Spectrum is essential for conducting many Government functions including defence services, national security, law enforcement, emergency services, public and community services and meteorological functions.

Defence, including the Australian Defence Force, the Department of Defence and organisations undertaking authorised activities for the general purpose of defence, is currently the largest spectrum user in Australia among both the public and private sectors. Current defence spectrum allocations account for approximately 25 per cent of spectrum in the most congested and high demand bands below 5 GHz.

Demand for spectrum for Government uses is expected to remain steady if not increase in the future. Government spectrum allocation includes arrangements where government use is given unique status in Australian spectrum management arrangements, and where government access to the spectrum is on the same basis as for all other users.

Questions

3.29 Is access to digital dividend spectrum required for government purposes? If so, for what purposes?

3.30 How much spectrum would be required for these purposes?

3.31 When would this spectrum be required?

3.32 What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

Class-licensed uses

Wireless audio devices (including radio microphones, guitar and keyboard transmitters), biomedical telemetry transmitters and transmitters used for underground communications are categorized as low-interference potential devices for radiocommunications licensing purposes.

The devices operate in broadcasting services bands spectrum under a class licence using the ‘white space’ between television broadcasts[8]. Under the licence, all class licensed users operate in the spectrum on a shared basis with other class licensed users and are subject to the conditions of the class licence.

[7] Section 3 of the *Radiocommunications Act 1992*.

[8] Some transmitters used for underground communications may also operate in other spectrum bands in the VHF range.

It is a condition of the operation of a device under the class licence that the device does not cause interference to other radiocommunications devices. A device will not be afforded protection from interference caused by other radiocommunications services[9].

Transmissions from wireless audio devices must not originate in the coverage area of a broadcasting station or datacasting service station operating in the same channel.

Most wireless audio devices operate in the UHF bands and currently use analog technology. Demand for spectrum for use of these devices in the future is difficult to forecast however is expected to rise. The adoption of multichannel audio to accompany high definition broadcasts has the potential to increase the future demand for spectrum for these devices.

Questions

3.33 How much spectrum are these devices likely to require in the future?

3.34 Will there be room in the broadcasting services bands, after digital switchover and restacking, to meet their future spectrum requirements?

3.35 Should separate UHF spectrum be reserved Australia-wide for use by these devices from the digital dividend spectrum? If so, how much?

3.36 When would this spectrum be required?

3.37 What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

[9] Radiocommunications (Low Interference Potential Devices) Class Licence 2000.

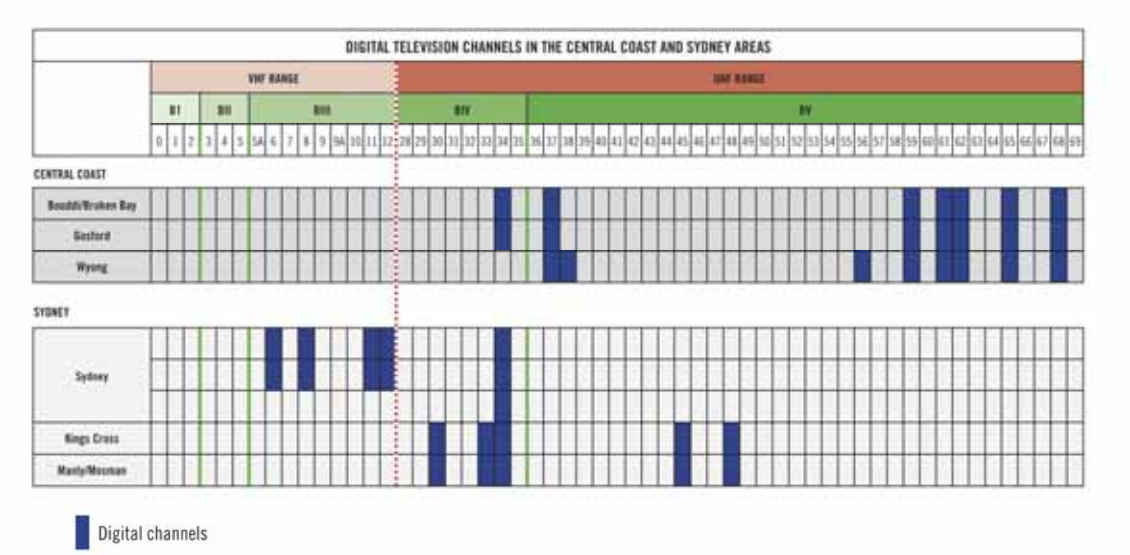
Chapter four: Costs of maximising the digital dividend

Restacking UHF spectrum

In UHF Bands IV and V, the channels used to provide analog television are located in between spectrum allocated for digital television broadcasting. As noted earlier, when analog television is switched off it will leave many small vacant blocks of spectrum scattered or interleaved throughout these bands.

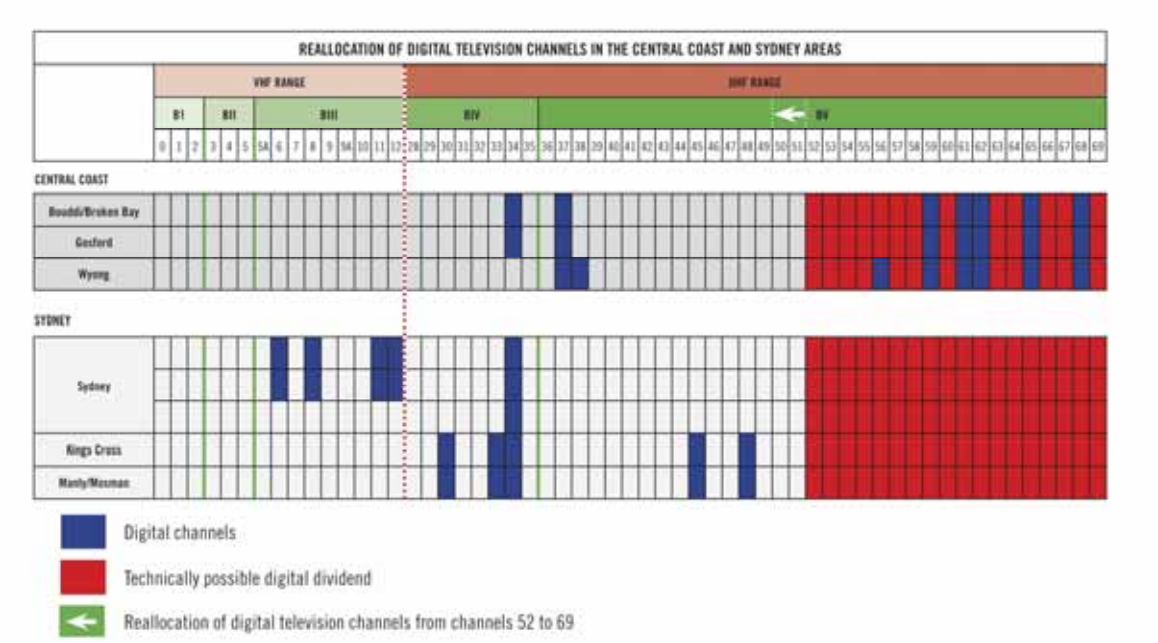
Restacking the remaining digital broadcasting services to new frequencies will allow the creation of a large, contiguous block of free spectrum at the top end of the broadcasting services bands. This will allow for a more efficient use of spectrum.

The diagram below provides an example for illustration purposes only. The diagram shows digital television channels scattered throughout the bands that will be present after the completion of digital television switchover. The vertical axis specifies the areas served within the geographic areas of the Central Coast (New South Wales) and Sydney. The horizontal axis shows each digital channel and its allocation. Note that this is the same diagram as that shown second on page 8.



In order to clear 126 MHz of spectrum, or 18 channels, at the top of the UHF Band V, the digital television services above channel 51 would be reallocated to channels in UHF Band IV and the remainder of UHF Band V[10]. This is shown in the diagram on page 26. The two examples of the Central Coast and Sydney as provided in the diagram indicate that restacking could potentially impact the Central Coast to a much greater extent because digital television channels are located in channels 52 to 69 in this area.

[10] The diagram indicates the general process of reallocating digital television services above channel 51 into VHF Band III, UHF Band IV and the portion of UHF Band V below channel 52. The actual channels that services would be reallocated to would be finalised in accordance with the final decision on the size and location of the digital dividend.



Impact of restacking

In Australia, spectrum in the 520–820 MHz portion of the UHF bands is primarily used by broadcasters to transmit their television services and for these services to be retransmitted in analog mode by third parties. Many of those retransmission services are operated by local councils or progress associations. Some were self-funded while others were established with assistance from the SBS Self-help Retransmission Subsidy Scheme or the previous Government's Television Black Spots Program.

The spectrum is also used by a group of other users (known as 'class-licensed low-interference potential devices') and by some apparatus-licensed devices via 'drop through' arrangements, in which the ACMA authorises non-broadcasting uses in 'spare' broadcasting services band spectrum[11].

The following section discusses the impact of restacking on viewers, broadcasters and other users of the broadcasting services bands. These issues are by no means unique to Australia. Other countries making the transition to digital television are already facing the same types of issues in advance of Australia, and they are an unavoidable part of restacking.

Impact of restacking on viewers

Equipment reconfiguration and replacement

When viewers first install digital television reception equipment they need to undertake an initial scan of channels as part of their television or set top box set-up process.

If any of the digital channels received by a viewer has its channel changed the viewer may need to conduct a television receiver or set-top box channel rescan in order to continue receiving that service.

[11] Section 34 of the *Broadcasting Services Act 1995* provides for the 'drop through' arrangements that allow the broadcasting services bands spectrum to be put to alternative uses.

Depending upon the approach adopted for the restack, this may need to occur more than once in the lead up to switchover. For most viewers, this will be a relatively simple process, and may also need to be done when new digital channels are introduced by a broadcaster. Some receivers may rescan automatically. The number of service changes needed by broadcasters, and therefore the number of potentially affected viewers, increases with the size of the digital dividend. This is because more digital television services need to be shifted or restacked in order to achieve a larger dividend.

In a relatively small number of cases, domestic antenna arrangements may be affected by some of the channel changes to digital television services that will be necessary to realise the digital dividend. This is because not all UHF antennas are capable of receiving the full range of UHF Band IV and V channels from channel 28 to 69. However, if services previously transmitted on channels above UHF channel 51 are relocated to other Band V channels (i.e. channels in the range from channel 36 to 51), then it is expected that viewers will not need to modify or replace their existing UHF antennas. In any restacking the Government would work to minimise any changes that would require viewers to replace their existing UHF antennas.

Questions

4.1 What issues will arise through viewers being required to rescan? Can receivers be developed that are able to automatically rescan?

4.2 In the small number of cases potentially affected, what is the likely cost for viewers associated with replacing their existing UHF antennas? It would be helpful if the cost per antenna and the likely total cost for all affected viewers could be identified.

Impact of restacking on broadcasters

Transmission facilities

A restack of the UHF spectrum would require broadcasters to move a number of digital television services to different frequencies and this exercise may necessitate purchasing new transmission equipment and/or retuning existing equipment.

Questions

4.4 What is required in the restacking process for broadcasters? Are there potential spectrum use implications? How much time is required for broadcasters to plan and implement transmissions at new frequencies?

4.5 How much is it likely to cost broadcasters to move digital television services to alternative frequencies, both in terms of the purchasing of new transmission equipment or the retuning of existing equipment? It would be helpful if best and worst case scenarios could be presented.

Impact of restacking on other users

Users of low interference potential devices

As noted above, low interference potential devices operate under a class licence and include wireless audio devices, transmitters used for underground communications and biomedical telemetry transmitters.

These devices operate in the white space between broadcasting services in the UHF spectrum and users have already invested in equipment that is tuned to work at these frequencies. However, new services that use the digital dividend spectrum may not leave as much white space in which these devices can operate. A restack of digital broadcasting services within the broadcasting services bands may also cause previously utilised frequencies to be no longer accessible to users of these devices.

Operators of these devices may therefore need to move frequencies. There are costs associated with any move, in terms of retuning or development and purchasing new equipment compatible with new frequencies. There is also a risk of disruption to users of these devices.

Questions

4.6 How would low-interference potential devices be best accommodated in the UHF bands in light of the proposed digital dividend and the restacking of digital broadcasting services?

4.7 Do these devices use specific frequencies within the UHF bands? Which frequencies do they use?

4.8 What costs would be involves for users to move frequencies?

4.9 Should one or more discrete frequency bands be set aside within the UHF bands for use by low-interference potential devices?

Acronyms and Abbreviations

2G	Second-generation mobile telephone services
3G	Third-generation mobile telephone services
4G	Fourth-generation mobile telephone services
ABC	Australian Broadcasting Corporation
ACMA	Australian Communications and Media Authority
AM	Amplitude modulation
AMTA	Australian Mobile Telecommunications Association
BSA	*Broadcasting Services Act 1992*
BSB	Broadcasting services band
DAB	Digital audio broadcasting
DMB	Digital Multimedia Broadcast
DRM	Digital radio mondiale
DTT	Digital terrestrial television
DVB-H	Digital video broadcasting-handheld
DVB-T	Digital video broadcasting-terrestrial
DVB-T2	Digital video broadcasting-terrestrial: second-generation
EDGE	Enhanced data rate for GSM Evolution
FM	Frequency modulation
FTA	Free-to-air
FTTP	Fibre-to-the-premises
GHz	Gigahertz
GPRS	General Packet Radio Service
GSM	Global System for Mobiles
HDTV	High-definition television

HSDPA	High Speed Downlink Packet Access
LIPD	Low interference potential device
LTE	Long Term Evolution
MBMS	Multimedia Broadcast Multicast Service
MediaFLO	Media Forward Link Only
MFN	Multi-frequency network
MHz	Megahertz
MPEG-2	Moving Picture Experts Group-second generation
MPEG-4	Moving Picture Experts Group-fourth generation
NBN	National Broadband Network
SBS	Special Broadcasting Service
SDTV	Standard-definition television
SFN	Single frequency network
T-DAB	Terrestrial digital audio broadcasting
TDMA	Time Division Multiple Access
UHF	Ultra high frequency
VHF	Very high frequency
WCDMA	Wideband code division multiple access
WiMAX	Worldwide Interoperability for Microwave Access