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Strategies for Wireless Access Services

Spectrum Access Options

Spectrum Planning Discussion paper SPP 10/06

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1 Introduction

Emerging technologies such as WiMAX and IMT-2000 fourth generation mobile phone standards have the capability to become key economic enablers. To respond to the needs of a competitive and diverse Australian communications industry, there must be enough spectrum released in a timely way so as not to inhibit the rollout of these new technologies.

ACMA understands the nature of the multi-tiered communications industry and acknowledges that some wireless internet service providers (ISPs) are currently being inhibited by a lack of available spectrum capable of supporting wireless access services (WAS). Wireless ISPs play a key role in making broadband available in towns and regional areas, and ACMA recognises that there needs to be spectrum available to support both Australia-wide networks and regional-based networks.

ACMA's strategy for WAS is to ensure that sufficient spectrum is available to meet current and future demand, using technology-flexible arrangements that stimulate competition and recognise the varying needs of operators across Australia. To achieve this, a number of factors need to be considered when identifying spectrum for WAS, including:

- the amount of spectrum that is required to meet both current demand and the estimated future demand;
- where the spectrum is needed and when it should be released (for example, more spectrum will be needed in highly populated areas);
- the most suitable frequency bands, which can be affected by factors such as global harmonisation and economies of scale, standardisation, incumbent services and the potential for sharing or relocation, and whether the spectrum can be made available in a reasonable time frame;
- how to best make the spectrum available—ensuring a technology-flexible framework and determining the most appropriate licensing and allocation mechanism(s); and
- balancing the needs of new and existing users—developing alternative spectrum arrangements for incumbent services if they are required to relocate.

In February 2006, ACMA released the discussion paper *Strategies for Wireless Access Services*[1]. The discussion paper sought stakeholder input on these factors and identified several candidate frequency bands for WAS. The release of the paper was coordinated with

[1] The February 2006 discussion paper can be viewed on ACMA's website at http://www.acma.gov.au/acmainterwr/_assets/main/lib100639/was_discussion.pdf.

ACMA's first spectrum seminar—the topic in this case being spectrum for wireless access. The seminar was well received and ACMA gained valuable input from industry.

Forty-seven submissions[2] were received to the discussion paper which, when studied in the context of ACMA's policy of market-based spectrum liberalisation, helped form the basis for the WAS spectrum strategy.

Purpose

The purpose of this paper is to:

- give an overview of demand for WAS and the estimated future spectrum required to support it;
- provide a brief summary of the responses to the February 2006 WAS discussion paper;
- identify bands that ACMA believes are currently the most suitable candidates for WAS in the short, medium and long term; and
- discuss and seek detailed comments on the identified bands, including some high-level options for band segmentation and licensing.

ACMA will hold a conference in Sydney on 11 and 12 December 2006 that will give stakeholders a further opportunity to discuss issues in this paper. More information about the conference is available on ACMA's website, at www.acma.gov.au.

ACMA expects to announce decisions on bands for WAS following the evaluation of comments received to this discussion paper. Further work may then be required on matters including band segmentation, technical frameworks, arrangements for incumbent services, licensing framework details and allocation procedures.

Submissions

Comments on issues in this paper may be forwarded by close of business on **28 February 2007** to:

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Media enquiries should be directed to Donald Robertson on (02) 9334 7980.

Any other enquiries may be directed to Mr Nevio Marinelli on (02) 6219 5249 or by email to WAS-planning@acma.gov.au.

[2] Submissions can be viewed on ACMA's website at http://www.acma.gov.au/ACMAINTER:STANDARD::pc=PC_100536

Publication of submissions

In general, ACMA publishes all submissions it receives.

ACMA prefers to receive submissions which are not claimed to be confidential. However, ACMA accepts that a submitter may sometimes wish to provide information in confidence. In these circumstances, submitters are asked to identify the material over which confidentiality is claimed and provide a written explanation for confidentiality claims.

ACMA will consider each claim for confidentiality on a case by case basis. If ACMA accepts a confidentiality claim, it will not publish the confidential information unless required by law to do so.

When can ACMA be required by law to release information?

Any submissions provided to ACMA may be released under the *Freedom of Information Act 1982*. ACMA may also be required to release submissions for other reasons including for the purpose of parliamentary processes or where otherwise required by law (for example a court subpoena). While ACMA seeks to consult submitters of confidential information before that information is provided to another body or agency, ACMA cannot guarantee that confidential information will not be released through these or other legal means.

2 Brief overview of WAS demand

High demand for spectrum to support WAS has become evident over the last decade. From small local area networks (LANs) supporting internet access in the industrial, scientific and medical (ISM) bands (2.4 and 5.8 GHz) about six years ago, there is now demand for regional area networks and networks providing Australia-wide coverage. A number of enterprises have already established city-wide networks, and the number of networks in regional towns continues to grow. The continuing increase in the use and capabilities of cellular mobile networks, and the increasing development and demand for converged devices using broadband, is increasing the pressure to provide spectrum to support these services.

The high unmet demand for broadband wireless access (BWA) licences in the 1900-1920 MHz band, released in 2004, indicated the need for a strategy to provide sufficient spectrum to support future WAS development and deployment.

The demand for spectrum to support WAS is being driven by a number of factors:

- increasing demand for broadband;
- increasing use of wireless to provide broadband;
- the requirement for greater bandwidth to cater for new services/applications and an expectation that these services will be available ‘anywhere, anytime’;
- pro-active policies by government providing funding for projects;
- limited access to high rate data services in regional and remote areas; and
- international trends providing an increasing availability of low-cost equipment and other benefits from spectrum harmonisation.

Estimating future spectrum requirements for WAS is a complex task that is dependent on multiple variables including traffic forecasts, subscriber numbers, usage patterns, future deployment scenarios and services to be supported. Submissions to the February paper indicated that there is significant unmet demand, and some respondents provided estimates for additional spectrum which ranged from 30–120 MHz per operator. Internationally, various estimates have been made regarding the amount of spectrum to cater for future WAS requirements. While the actual amount of spectrum is still being debated, organisations such as the International Telecommunication Union (ITU) and Ofcom (the United Kingdom communications regulator) have estimated that significant amounts of spectrum will be required to cater for future growth in WAS.

3 Consultation outcomes

In February 2006, in recognition of national and international wireless communication market trends, ACMA released a public discussion paper to gauge the demand for future WAS and associated spectrum requirements. The discussion paper, entitled *Strategies for Wireless Access Services*, provided information about wireless access demand drivers, international trends and current WAS bands and initiatives. The paper also identified several frequency bands with the potential to support future WAS, discussed regulatory frameworks and provided information on relevant spectrum sharing and incumbent issues.

Forty-seven submissions were received to the discussion paper. Respondents included small and large WAS operators, equipment manufacturers and suppliers, WAS interest groups and forums, and incumbent service operators.

Respondents have been grouped into three main categories: those supporting the allocation of more spectrum for WAS, those opposed to it and those who would be affected if additional WAS spectrum was allocated. The following provides a breakdown of comments received to the issues in the paper.

Spectrum demand

Is more spectrum needed for WAS?

Of the 47 submissions received:

- 23 submissions indicated there is unmet demand for spectrum to support WAS;
- 3 submissions indicated there is already sufficient spectrum available for WAS; and
- 21 submissions did not comment on this matter.

If more WAS spectrum is needed, how much is needed?

Respondents generally answered that enough spectrum is needed to support a business model and plan an efficient network. Factors that respondents suggested ACMA consider when determining how much spectrum to allocate WAS include:

- allowances for improvements in antenna technology and modulation techniques;
- manufacturer recommendations on frequency re-use and coverage for typical equipment;
- allowances for expansion, in-fill, and additional node capacity; and
- requirements for meshing and use of WiMAX for backhaul.

Suggested amounts of spectrum to cater for WAS in the short term ranged from 5 MHz to 120 MHz per operator, with many respondents indicating that 50-60 MHz per operator was preferable. Some respondents suggested 20–30 MHz to deploy services, and 10 MHz to allow for growth. One respondent provided a long-term estimate of 280 MHz per operator, for a competitive market of three operators equating to an additional 840 MHz of spectrum.

When is the additional WAS spectrum needed?

Several respondents requested that more WAS spectrum be made available immediately, particularly in regional and rural areas. Reasons given include:

- to allow small and medium operators to test business models and gain some market share before larger operators dominate the market;
- to satisfy unmet demand for services; and
- the current or impending availability of equipment for particular candidate bands.

How many WAS operators should be permitted in high density areas?

Few respondents commented on this issue. Of those that did, the majority believe that the market should decide the number of operators.

Technology issues

The majority of submissions commented on technology issues:

- respondents strongly favour globally-harmonised spectrum allocations and equipment standardisation;
- respondents strongly favour technology-neutral or technology-flexible regulatory frameworks;
- suggested technologies for consideration in planning purposes include WiMAX, IMT-2000 and IMT-Advanced, CDMA2000, HSUPA, HSDPA, HiperMAN and UMTS; and
- respondents commented that many of these technologies are either available now, or will be available in the next few years.

Candidate bands

The February 2006 discussion paper identified several bands that could potentially be made available for WAS in the short, medium and long term. Respondents identified several preferred bands for WAS; however, as is always the case, the most promising candidate bands are currently used for other radiocommunications services, and any spectrum re-farming will require the development and implementation of relocation options and transitional arrangements for existing users.

SHORT TERM: 1785–1805 MHz

The February discussion paper identified the 1785–1805 MHz band as potentially suitable for WAS in regional areas, with a short implementation time frame (under one year) to meet the immediate need for spectrum in these areas. The band is between the base receive (1710–1785 MHz) and base transmit (1805–1880 MHz) segments of spectrum used primarily for GSM1800 services operating under spectrum licensing. The band 1785–1805 MHz was not

proposed for use in capital city areas due to compatibility issues with the frequency-adjacent GSM1800 services. The discussion paper noted that the band is lightly used with fixed point-to-point links operating in regional and remote areas.

Five respondents commented on this band, including potential service providers and incumbent operators. One submission supported use of this band for WAS, noting its use for WAS in other countries and proposing that the band should also be available in capital cities under spectrum licensing. One submission noted that spectrum licensing compatibility issues meant that viable services would be unlikely in capital city areas. Incumbent operators were concerned about the potential impact that WAS could have on their services and the lack of viable alternatives if required to clear from the band.

ACMA currently believes that the 1785–1805 MHz band is suitable for WAS in regional and remote areas and could be made available in the short term. Further discussion about the suitability of this band is in Chapter 4.

MEDIUM TERM

1725–1785 and 1820–1880 MHz

The February discussion paper identified the bands 1725–1785 MHz and 1820–1880 MHz (two blocks of 60 MHz) as potentially suitable in regional areas for WAS applications using GSM, or other WAS technologies capable of operating in those bands. These bands are some of the bands identified by the ITU as available for countries wishing to implement IMT-2000. In Australia, the bands are used primarily to support GSM1800 services in capital cities. Fixed point-to-point links operate in regional and remote areas.

Nine respondents commented on these bands, including potential service providers, equipment suppliers, industry forums and incumbent operators. Equipment suppliers and industry forums were generally supportive of allocating the bands for WAS. Some submissions commented on the importance of maintaining technological and spectrum harmonisation by supporting IMT-2000 solutions, which would provide for the advantages of economies of scale and roaming. Other submissions noted the suitability of the band for WAS due to existing GSM1800 technology. No existing service provider or potential service provider explicitly indicated support for WAS in this band. Incumbent operators were concerned about the potential impact that WAS could have on their services and the lack of viable alternatives if required to clear from the band.

ACMA currently believes that the bands 1725–1785 MHz and 1820–1880 MHz should not be made available for WAS in regional areas at this stage. Although the bands can be used by GSM technologies, which would provide an established and internationally-harmonised equipment source, submissions to the February paper showed little interest in the bands compared to other candidate bands and this interest was predominantly from equipment suppliers, rather than service providers. Additionally, there is a possible need to support future expansion of existing GSM1800 services in regional areas as well as a need to provide continuing support for fixed point-to-point links in regional areas.

1920–1960 and 2110–2150 MHz

The February discussion paper identified the bands 1920–1960 MHz and 2110–2150 MHz (two blocks of 40 MHz) as potentially suitable in regional areas for WAS applications using IMT-2000, or other WAS technologies capable of operating in those bands. These bands are some of the bands identified by the ITU as available for countries wishing to implement IMT-2000. In Australia, the bands are used primarily to support 3G telecommunications services in capital cities. Space research services operate in the 2110–2120 MHz band and fixed point-to-point links operate in regional and remote areas.

Fourteen respondents commented on these bands, including potential service providers, equipment suppliers, industry forums and incumbent operators. Equipment suppliers and industry forums were generally supportive of allocating the bands for WAS. Some submissions commented on the importance of maintaining technological and spectrum harmonisation by supporting IMT-2000 solutions, which would provide for the advantages of economies of scale and roaming. Other submissions noted the suitability of the band for WAS due to existing 3G technologies. One submission suggested using the 1920–1960 MHz band as an expansion band to address congestion issues in the adjacent 1900–1920 MHz band, which is currently apparatus-licensed for BWA services. The space sciences community expressed concern about the impact on space research services operating in the 2110–2120 MHz band. Incumbent operators were concerned about the potential impact that WAS could have on their services and the lack of viable alternatives if required to clear from the band.

ACMA currently believes that the bands 1920–1960 MHz and 2110–2150 MHz should not be made available for WAS in regional areas at this stage. Although the bands can be used by 3G technologies, which would provide an established and internationally-harmonised equipment source, submissions to the February paper showed little interest in the bands compared to other candidate bands and this interest was predominantly from equipment suppliers, rather than service providers. Additionally, there is a possible need to support future expansion of existing 3G services in regional areas as well as a need to provide continuing support for fixed point-to-point links in regional areas and space research services in the 2110–2120 MHz band.

2025–2110 and 2200–2300 MHz

The February discussion paper identified the bands 2025–2110 MHz and 2200–2300 MHz as potentially suitable for the accommodation of displaced electronic news gathering (ENG) services (should they be required to relocate) and WAS applications in regional areas.

Sixteen submissions commented on these bands. Incumbent space services operators requested protection for their earth stations, and stated that they could not relocate due to the unsuitability of other frequencies and the significant investments they had committed to the current band(s). They also stated that while sharing with ENG services is feasible, they could not share with WAS.

Broadcasters stated that the spectrum is unsuitable for ENG and that they cannot share with space services. Defence opposed use of the 2200–2300 MHz band for both ENG and WAS due to their aeronautical mobile telemetry (AMT) system operating in the band.

Other respondents commented on the suitability of bands around 2 GHz or less as being suitable for WAS due to more economical implementation, or that it would be sensible to harmonise Australian usage of the bands with other countries that use them for ENG.

ACMA currently considers that these bands should not be made available for WAS at this time. These bands have not been identified or targeted internationally for WAS, and there is no indication that these bands are being used by any country for the provision of WAS. As mentioned in the February discussion paper, the deployment of high density mobile services such as WAS is not encouraged in these bands due to the potential affect on the use of the bands by the space operation and research services. Conversely, these bands are being used for ENG in other countries, which shows that sharing with space services is possible; this is also supported by submissions received from incumbent space services operators.

These bands are used extensively by other administrations to support ENG services. ACMA currently believes that these bands may be suitable for accommodating displaced ENG services should they require relocation at some stage.

2500–2690 MHz

The February discussion paper identified the band 2500–2690 MHz as potentially suitable across Australia for WAS applications using new technologies such as WiMAX. Internationally, this band is identified as one of the bands for the implementation of IMT-2000. In Australia, the band is primarily used for ENG applications by free-to-air broadcasters.

Twenty-six submissions commented on this band. Seventeen submissions supported allocating the band for WAS—more than any other candidate band identified in the paper. Both small and large WAS operators, equipment manufacturers and interest groups/forums supported this candidate band. Reasons for support include:

- the global identification of the band for WAS, in particular IMT-2000 and WiMAX;
- the economies of scale and reduced equipment costs that would result from global harmonisation;
- the potential for interoperable equipment and international roaming;
- the potential for the band to accommodate a range of licensing frameworks; and
- the suitability of the band for regional and rural areas due to its propagation characteristics.

Six submissions opposed the reallocation of the band for WAS; four of these respondents were broadcasters. They stated that content gathered using ENG is integral to their programming schedules, and opposed relocating their services to other frequency bands. Reasons for opposition include:

- suitable alternative spectrum for the relocation of ENG has not been identified;
- the costly disruption that relocation would cause to broadcasting services;
- the lack of clear evidence of standardisation for WAS in this band, and no clear public benefit to support an assignment to WAS; and
- the uncertainty as to whether WAS could coexist with satellite services in the band.

Three submissions commented on the band but did not explicitly support or oppose making the band available for WAS. One submission recommended that ACMA delay a final decision on the band until discussion within the ITU Radiocommunications Sector (ITU-R) concludes in 2007.

ACMA currently considers that the 2500–2690 MHz band is a suitable candidate for WAS Australia-wide and could be made available in the medium term. Further discussion about the suitability of this band is in Chapter 4.

3575–3710 MHz

The February discussion paper identified the band 3575–3710 MHz as potentially suitable for WAS. In Australia, the band is mainly used by fixed point-to-point links and the C-band fixed-satellite service (FSS).

Sixteen submissions commented on this band. Eight submissions supported making the band available for WAS. Reasons for support include the identification of the band for the global WiMAX standard and the large-scale consumer benefits this could bring, such as interoperability and reduced customer premises equipment (CPE) costs. The majority of respondents that opposed reallocation of the band were concerned about the potential interference to C-band earth stations. They stated that relocation of earth stations would be too costly or impractical.

Two submissions commented on the effect of making the band available for WAS, but did not explicitly indicate support or opposition.

ACMA currently considers that the 3575–3710 MHz band is a suitable candidate for WAS and all or part of the band could be made available in the medium term. Further discussion about the suitability of this band is in Chapter 4.

4940–4990 MHz

The band 4940–4990 MHz is one of the bands identified by the ITU to achieve regionally-harmonised spectrum for advanced public protection and disaster relief (PPDR) solutions. The February discussion paper stated that the band will not be available for general WAS use as it will be limited to government PPDR agencies, and there will be a requirement to determine sharing arrangements and coordinate with Defence prior to use of the band.

Four submissions commented on this band. Respondents generally supported reservation of the band for PPDR.

As stated in the February discussion paper, this band will not be made available for general WAS.

LONG TERM

520–820 MHz

The 520–820 MHz band is currently used for free-to-air television broadcasting. The February discussion paper stated that there is potential in the long term for the band to become available for WAS due to conversion from analog to digital television.

Of the 16 submissions that commented on this band, seven supported allocating it for WAS. This band was seen as attractive by many organisations promoting WAS because of the long

propagation distances, making it cost-effective to cover large areas that are traditionally difficult to serve due to high infrastructure costs, such as regional and remote Australia.

Some respondents stated that ACMA should continue to monitor international developments for WAS in this band before making a final decision about its use. The broadcasting industry generally opposed making the band available for WAS. They believed that the band should be retained for broadcasting services, and that WAS and broadcasting services could not coexist in the band due to the interference potential.

ACMA currently considers that the 520–820 MHz band is a suitable candidate for WAS and could be made available in the long term. Further discussion about the suitability of this band is in Chapter 4.

820–960 MHz

The February discussion paper identified some limited opportunity for the provision of WAS in the 820–960 MHz band in the future. The band currently supports a wide variety of applications and services, including mobile telephony using GSM900 and CDMA technologies.

Of the nine submissions that commented on this band, the majority did not explicitly support or oppose making the band available for WAS. Most respondents commented on the potential impact on incumbent services in the band.

ACMA currently believes that no further spectrum should be made available in this band for WAS at this time. Although the whole band is identified globally for IMT-2000, only selected portions are currently being used for the provision of WAS in Australia. There is some opportunity for the expansion of services in this band. However, the benefits gained from the allocation of additional spectrum in the band for WAS would need to be compared with the effect on incumbent services. Although this is a possible future action, ACMA does not consider it a priority at this time.

3710–4200 MHz

The February discussion paper identified the 3710–4200 MHz band as a potential future expansion band for WAS if the 3575–3710 MHz band proved to be popular for WAS. The band is currently used for fixed point-to-point services and the FSS in Australia. A number of countries have allocated all or parts of the band for WAS.

Of the nine submissions that commented on this band, seven opposed making it available for WAS. The majority of respondents that objected were incumbent operators, including earth station operators.

ACMA currently believes that this band should not be made available for WAS at this time. It is not considered suitable due to the current lack of global harmonisation, the need to support incumbent services in the short term and the lack of industry support for WAS. In Australia the band is used mainly for fixed point-to-point services (mostly Telstra) and the C-band FSS. The use of the 3.8 GHz band for digital high capacity trunking services has been declining steadily since 1995. However, there are still a significant number of services operating in the band. The FSS currently uses the band for satellite earth station downlink (space to earth) reception and also has a significant number of services in the band.

However, this band is a potential candidate band for future WAS deployments as it is part of the band that the WiMAX Forum has defined as the 3.5 GHz band (3.4–3.8 GHz). It is also

one of the candidate bands under consideration by ITU-R Working Party 8F for the future expansion of next generation mobile phone networks; a decision on this band will be made at the World Radiocommunication Conference (WRC) in 2007. If the band is identified for WAS internationally, then all the benefits associated with global harmonisation and economies of scale will come into play and it may increase pressure to allocate the band for WAS.

Licensing and allocation

Twenty-six submissions commented on WAS licensing issues. There was a varied response to the current licensing regimes.

Some respondents were satisfied with all the current licensing regimes (apparatus, spectrum and class), but the majority preferred one or a combination of two licensing regimes for WAS. Spectrum licensing was generally favoured more for high density areas. Respondents were also supportive of apparatus licensing, but preferred it more in regional and remote areas.

There was a varied response towards class licensing: some respondents believed that it is not suitable for WAS due to the inability to guarantee a quality-of-service (QoS) under it, while others believed that class licensing is suitable for providing services particularly in rural and remote areas.

More general licensing issues that were raised include:

- 'use it or lose it' conditions or rollout obligations, which received broad support from respondents;
- the flexibility of licensing frameworks—respondents stated that they must be flexible enough to encourage innovation and new technologies;
- QoS issues under each of the licensing regimes—respondents thought that the ability to guarantee a QoS under spectrum or apparatus licensing was very attractive, or in some cases vital for commercial viability; and
- the costs to obtain a licence—respondents thought that the low or moderate costs of apparatus licences were attractive, particularly for smaller operators in regional areas.

Six respondents stated that incumbent services must be protected from interference from future WAS deployments, regardless of the licensing regime chosen.

Twenty-one submissions commented on the private park concept. The majority did not explicitly indicate support or opposition for the concept, but instead commented on particular aspects of the concept and how it might work in practice. Issues that were raised include:

- clarifying the rights and responsibilities of licensees;
- processes for managing conflict; and
- ensuring the validity of a self-licensing database.

The concept received support from many ISPs. Three submissions suggested that the concept is more suited to regional and remote areas (rather than city areas).

Five submissions opposed the private park concept. Reasons for opposition include:

- they do not believe that the concept would offer more than is currently available under apparatus, spectrum and/or class licensing;
- potential problems with the framework that may not offer licensees the necessary QoS to deliver a viable commercial service;
- the considerable cost that would be added to equipment from the requirement to use contention-based protocols, which would be passed onto end-users; and
- that the contention-based protocols wouldn't effectively mitigate interference.

Sixteen submissions commented on preferred methods of spectrum allocation for WAS. Several respondents favoured auctions, particularly in city and other high density areas. Other respondents were wary about auctions and stated that they are not suitable for regional and rural areas because:

- they don't stimulate competition; and/or
- they can often result in high bids, which can prevent small and medium operators from competing.

Many respondents commented that regardless of the allocation method, the licence prices must not be a barrier for entry and should be in accordance with federal government policies that support equitable broadband access for all Australians.

Over-the-counter licences and class licences were generally favoured for regional and remote Australia.

4 Suitable spectrum for WAS

Following the consideration of stakeholder comments on candidate WAS bands and other issues relevant to those bands (such as global harmonisation and international trends), ACMA has identified the bands that it believes should be considered further as suitable candidates for WAS in the short, medium and long term.

Short term (within 12 months): 1785–1805 MHz

ACMA considers this band is suitable for WAS in regional and remote areas and will make it available in the short term. The unmet demand in the 1900–1920 MHz band and the continuing demand in the 1.5 GHz band for BWA licences in regional and remote areas indicates that there is an immediate requirement to make more spectrum available in these areas. Although the amount of available bandwidth is relatively small, the spectrum is lightly used and is considered ideal for alleviating short-term demand in regional and remote areas.

As mentioned in the February 2006 discussion paper, ACMA is developing arrangements to support WAS in this band. The technical framework will be designed to minimise the effect on adjacent spectrum-licensed services, and incumbent licensees in the band will not be required to relocate.

ACMA will release a public discussion paper considering technology, technical and licensing issues in the 1785–1805 MHz band in the near future.

Medium term (two to four years): 2500–2690 MHz

This band, which could be made available in the medium term, is considered a suitable candidate for WAS Australia-wide due to the global focus on it by standards organisations, the growing number of countries that have allocated it for WAS, the potential for benefits from economies of scale, and the high level of industry support for it evident in submissions.

Internationally, the 2500–2690 MHz band is identified for IMT-2000 (the global standard for 3G wireless communications) and is also targeted for WAS by other standards organisations and forums (such as the WiMAX Forum). A number of countries (including the USA and Europe as a whole) have already allocated the band for WAS, with an increasing number of other countries foreshadowing similar arrangements in the near future.

In addition, seventeen submissions supported allocating the band for WAS—more than any other candidate band identified in the discussion paper. Both small and large WAS operators, equipment manufacturers, and interest groups/forums supported this candidate band.

Of the spectrum that ACMA has identified for possible future WAS use, ACMA believes the 2500–2690 MHz band could have the greatest impact on Australia's economic development and community benefits through the provision of national wireless communication infrastructure, as:

- the global identification of the band for WAS supports economies of scale and lower equipment costs for operators and consumers; for example, manufacturers such as Intel are targeting chipsets to operate in the 2500–2690 MHz band;
- use of globally-harmonised spectrum allocations facilitates international roaming of devices and meets community expectations of universal connectivity using world market products; and
- the spectrum is particularly suitable for use in regional and remote Australia due to favourable propagation characteristics.

This band is being targeted for the provision of so called 'super 3G' or 4G services capable of supporting not only higher quality voice call services, but also video phone, high-quality live TV or streaming video, high definition video-on-demand, real-time online gaming and music download services that are currently available only via wired networks. These services will also provide improved mobile broadband access to the internet and email services with text-oriented messages transferred as enhanced multimedia messages.

Ubiquitous mobile access to broadband has been identified as a key economic enabler[3]. As this band has been identified globally as a harmonised band for various WAS standards, a timely band transition could provide significant benefits to the Australian communications industry.

Incumbent services

In Australia, the band is currently used for ENG applications by free-to-air television broadcasters. The band is also used by some countries in Asia for national regional satellite

[3] http://www.oecd.org/dataoecd/18/3/16234106.pdf

services. The criteria to enable sharing of satellite services with WAS in this band are currently being studied in the ITU.

ACMA recognises the importance of ENG in providing comprehensive news and media event coverage, and as a result of consultations and other considerations this band may continue to be available for ENG. In the event that this band is made available for WAS, ACMA believes that alternative spectrum arrangements exist that would suitably accommodate ENG requirements.

In addition, should this band be released for WAS, ACMA would continue to engage with the television broadcasting industry with a view to developing arrangements that support ongoing ENG operation. Segmentation options for the band are discussed in Chapter 5.

Chapter 6 discusses licensing options for the band.

SUITABILITY OF 2500–2690 MHz

Considering the importance of the band 2500–2690 MHz for ENG applications in Australia and the suitability of the band for WAS, ACMA seeks additional advice to that provided in response to the February 2006 discussion paper:

1. Should the 2500–2690 MHz band be made available (in whole or part) for WAS applications? If it were, what would the implications (costs) be for ENG applications? (also refer to section 5 'Band Segmentation Options')

2. What are the implications if the band is not made available for WAS?

Medium term (one to three years): 3575–3710 MHz

The 3575–3710 MHz band is considered a suitable candidate for WAS and could be made available in the medium term. The band may provide limited opportunity for the provision of Australia-wide networks due to the presence of incumbent services for which long lead times are required to relocate. It does, however, provide an opportunity for large and small operators wishing to deploy services in a specific area or areas.

Internationally, several countries (including the USA, Canada, Switzerland, France, Japan and Malaysia) have allocated, or are considering allocating, spectrum in or around this band for WAS. This band received support from respondents including Telstra, who is the largest incumbent fixed service licensee in the band. Respondents also indicated that equipment is available for the band. The band is adjacent to the current WiMAX profile band (3.4-3.6 GHz), and is part of the band that the WiMAX Forum has defined as the 3.5 GHz band (3.4–3.8 GHz). The band is also one of the candidate bands under consideration by ITU-R Working Party 8F for the future expansion of next generation mobile phone networks; a decision on this band will be made at the World Radiocommunication Conference in 2007.

ACMA has identified this band as a WAS candidate band for a number of reasons:

- the global identification of the band for WAS, in particular WiMAX and possibly IMT-2000 and next generation systems;
- parts of the band have already been released for WAS in the US and parts of Europe and Asia;
- the potential economies of scale and reduced equipment costs that will result from global harmonisation;
- the potential for interoperable equipment and international roaming; and
- the potential for the band to meet the needs of smaller carriers and ISPs.

Incumbent services

In Australia the band is used mainly for fixed point-to-point services (mostly Telstra) and the C-band FSS. There are also radiolocation services and secondary amateur services in the band 3400–3600 MHz.

The use of the 3.8 GHz band for digital high capacity trunking services has been declining steadily since 1995. This has been mainly due to decreased use by Telstra, but there has been a slight increase in use of the band by other licensees. Given the declining use of the band for fixed services, the availability of other bands for long-haul trunking services, and support by the major incumbent fixed service licensee for WAS in this band, ACMA believes that this spectrum is a suitable candidate for WAS. In the event that this band is made available for WAS, arrangements for dealing with fixed point-to-point services would need to be developed.

The FSS currently uses the band for satellite earth station downlink (space to Earth) reception. There are very few earth stations operating in this band around Australia, which provides scope for use of the band for WAS. In the event that this band is made available for WAS, suitable arrangements for incumbent earth stations would need to be developed.

Chapter 5 discusses options for the 3575–3710 MHz band, and Chapter 6 discusses licensing options.

As mentioned in the February discussion paper, ACMA has identified potential compatibility issues with certain Australian Department of Defence facilities and the deployment of WAS. ACMA is continuing to work with Defence on these issues.

SUITABILITY OF 3575–3710 MHz

Considering the use of the band 3575-3710 MHz for fixed point-to-point links and fixed-satellite services, and the suitability of the band for WAS, ACMA seeks additional advice to that provided in response to the February 2006 discussion paper:

3. Should the 3575–3710 MHz band be made available (in whole or part) for WAS applications? If it were, what would the implications (costs) be for fixed point-to-point links and fixed-satellite services ? (also refer to section 5 'Band Segmentation Options')

4. What are the implications if the band is not made available for WAS?

Longer term (four to ten years): 520–820 MHz

The UHF television bands between 520–820 MHz are considered well-suited for WAS use, and possibly other related wireless applications such as mobile TV. These bands are currently used for transmission of analog and digital free-to-air television broadcasting, but parts of the bands may become available following the switch-off of analog television. This process has been described as the 'digital dividend'. At that point there is an opportunity to use the recovered spectrum to provide new and innovative services. Apart from new or additional digital television services this could include new television applications such as mobile television, BWA services, mobile telecommunications services or public safety communications systems.

In several major economies (US, UK and Japan) decisions have been made to restructure the spectrum that will become available following analog television switch-off. This restructuring could improve the opportunities to introduce some of the new communications technologies mentioned above. ACMA is studying the feasibility of such restructuring as part of its studies of the post analog switch-off situation.

In Media Release 068/06[4] the Minister announced that the date for analog switch-off '... will be reset with a new switchover target to commence in 2010-2012'. However, to achieve this most viewers will need to have converted to receive digital television signals by that time. The process of driving the take-up of digital reception equipment and removing impediments to analog switch-off is known as the Digital Action Plan (DAP), which the government released in late November 2006[5].

ACMA will continue to monitor and review developments in the 520–820 MHz band as they occur.

[4] http://www.minister.dcita.gov.au/media/media_releases/new_media_framework_for_australia
[5] http://www.dcita.gov.au/media_broadcasting/publications_and_reports/recent/digital_action_plan

5 Band segmentation options

2500–2690 MHz

If the 2500–2690 MHz band is not made available for WAS, then the current channelling arrangements could continue to support ENG services. However, if it were to be made available for WAS, the band would need to be restructured. There are a number of possible options for the restructuring of the band that take into account various technical and marketing considerations. The arrangements would need to align with government policy on spectrum allocation, which favours a technology-flexible approach to allow licensees to cater for changing market and consumer needs.

The type of equipment being developed for WAS in this band requires either a paired channelling arrangement or a single channel arrangement. WAS equipment can operate in various channel bandwidths.

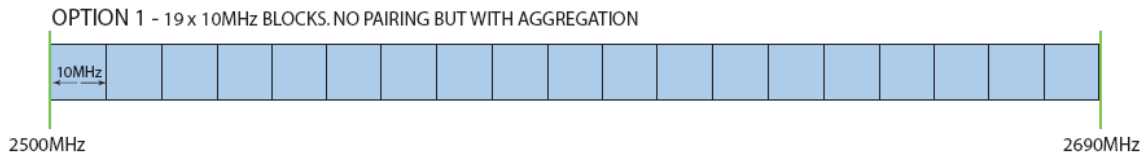
Some segmentation options currently perceived by ACMA as possible for this band are discussed in the following pages. Some of the presented options cater for the ongoing operation of ENG in the band by preserving a block of up to 50 MHz of spectrum for exclusive ENG operation.

The options being considered or implemented in Europe and the USA are provided in Appendix A.

OPTION 1

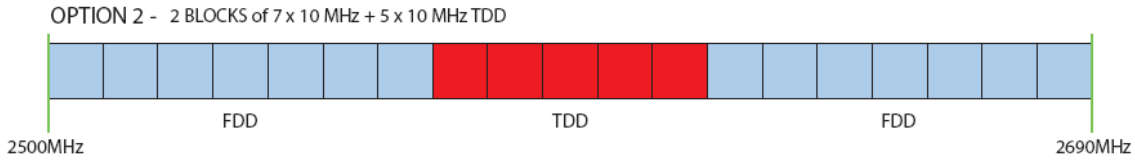
This option provides the simplest arrangement, where the band is segmented into spectrum blocks of equal size.

This suits technologies that require unpaired channels but does not cater well for technologies requiring paired channel arrangements. It also requires clearance of the whole band and does not provide any specific arrangements for incumbent users.



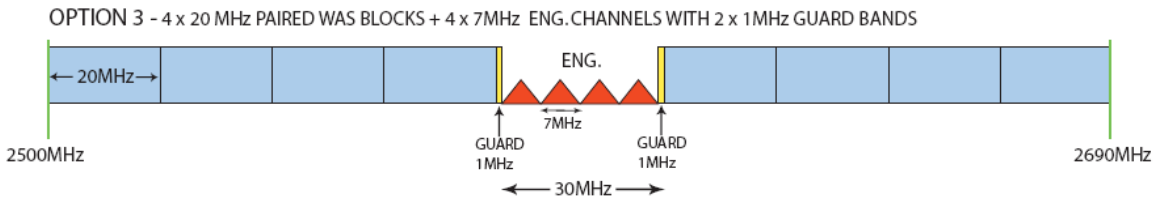
OPTION 2

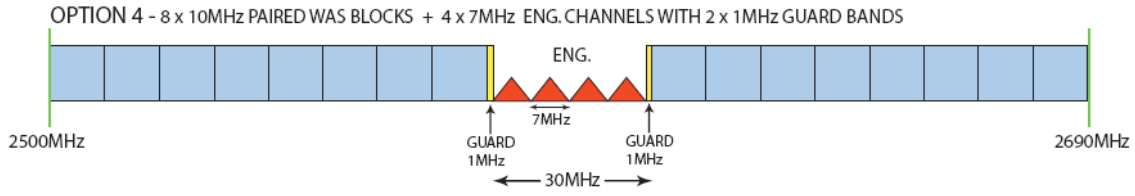
This option provides 2 x 70 MHz blocks for WAS at each end nominally for paired use, and a 50 MHz block for unpaired use. This is one of the current options in Europe, and has similar impacts as option 1—clearance of the whole band is required and there are no provisions for incumbent users. However, the structure potentially leads to a less complicated, less restrictive framework by providing separate blocks for paired and unpaired WAS technologies.



OPTIONS 3 AND 4

These options provide 2 x 80 MHz blocks for WAS at each end of the band and 30 MHz for ENG in the middle. This arrangement has the advantage of providing frequency separation between channel blocks for WAS technologies needing paired channel arrangements. However, the ability to implement systems using single channels is not precluded by this segmentation plan. These options provide 4 x 7 MHz channels for ENG use, which could either be exclusively allocated[6] or used by all broadcasters on a shared basis.



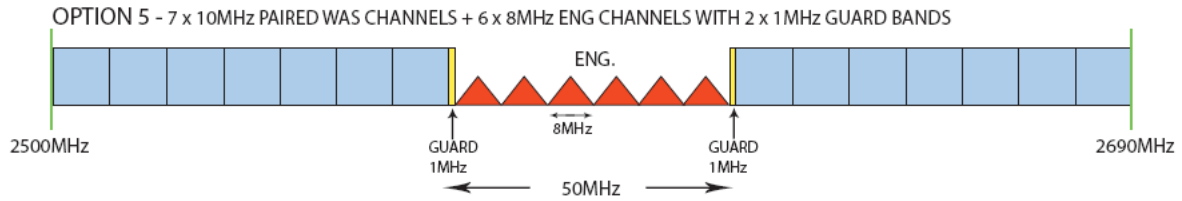


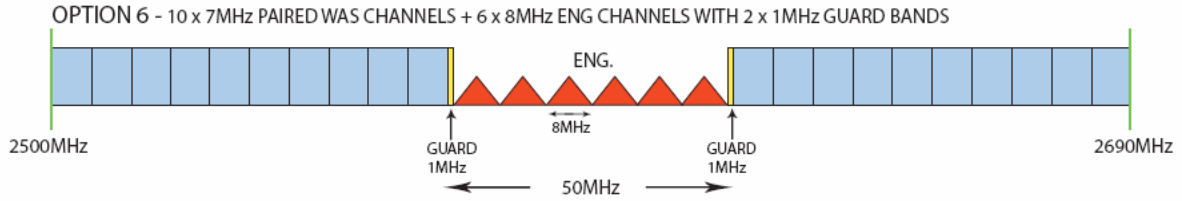
[6] An exclusive channel could be provided for each of the current broadcasters using the band (i.e. 7, 9, 10 and the ABC).

OPTIONS 5 AND 6

These options provide 2 x 70 MHz blocks for WAS at each end of the band and 50 MHz for ENG in the middle. This arrangement also provides opportunities for paired and unpaired WAS technologies, but in this option 6 x 8 MHz channels are available for ENG use.

This could allow for either four channels to be assigned on an exclusive basis with two shared channels, or for all channels to be used by broadcasters on a shared basis subject to industry self-coordination arrangements.





The WAS spectrum blocks in all of these options could be further subdivided. The actual size of the blocks would depend on technical and marketing considerations. For example, current 3G systems (i.e. wideband CDMA) requires 5 MHz channels while plans for future 4G services indicate 20 MHz channels are required as a minimum. Smaller blocks in general provide more flexibility and potentially allow more operators into the band; however, this can also lead to fragmentation of the band where individual operators do not gain access to enough spectrum to operate a viable network. The subdivision of the WAS spectrum blocks will be addressed in subsequent consultations.

2500–2690 MHz

If the 2500–2690 MHz band were made available for WAS:

5. Which segmentation option(s) would you prefer? Why?

Respondents are welcome to suggest alternative segmentation options.

6. What option(s) would you prefer for the management of incumbent services? Why?

3575–3710 MHz

A number of countries have allocated or are intending to allocate spectrum in and around this band for WAS. However, there does not appear to be any clear segmentation options for this band.

The band contains existing FSS earth stations and there is little scope for sharing with WAS in the same geographical area. If the band is to be made available for WAS, one option is to allow existing earth stations to remain in the band while new earth stations or new frequency assignments to existing earth stations would not be permitted (this is known as 'grandfathering'). The existing earth stations would need to be protected for some time into the future. This could be achieved via geographic exclusion zones around the earth stations. Another option is to clear the existing earth stations; however, satellite operators have indicated that it would be costly to move these facilities and that there is no suitable alternative spectrum available.

Similar options are available for fixed point-to-point links in the band. For example:

- all point-to-point links in the band could be cleared to allow for the deployment of WAS; however, if WAS is not deployed then fixed services have been cleared for no reason;
- point-to-point links could be cleared in certain geographic areas only;
- point-to-point links could remain a primary service and new WAS could be required to coordinate with them; or
- point-to-point links could remain a primary service, then become secondary after a predetermined time or immediately after the allocation to WAS is made.

3575–3710 MHz

If the 3575–3710 MHz band were made available for WAS:

7. How much spectrum in the band should be made available? Why?

8. What option(s) would you prefer for the management of incumbent FSS earth stations? Why? In particular, should FSS earth stations be 'grandfathered'? If so, for how long? In general, what arrangements should be considered for the protection of earth stations?

9. What option(s) would you prefer for the management of incumbent fixed point-to-point services? Why?

6 Licensing options

ACMA currently uses three distinct regulatory frameworks for the management of WAS:

Class licensing—'spectrum commons'

Users can operate devices in designated segments of spectrum on an uncoordinated and shared basis. Devices must be operated in accordance with specified parameters typically including frequency bands, radiated power limits, and out-of-band emission levels. Users do not have to apply to ACMA to operate in class-licensed spectrum and no fees are payable. However, devices do not receive interference protection and are not coordinated in terms of location and numbers of devices in operation. This means that it can be difficult for providers of commercial services to guarantee a QoS.

Apparatus licensing—'command and control'

This approach involves coordinating a particular radiocommunications device with existing licensed services. If coordination is successful, an apparatus licence is issued to authorise operation of that device at a specified site or within a specified area[7]. The licence specifies technical conditions for the operation of the device such as frequency, transmit power and emission type. The licence may be issued for up to five years[8] and may be renewed by the licensee upon expiry. Licensees are required to pay an annual tax.

Spectrum licensing—'private spectrum'

This approach provides exclusive spectrum access to a potentially large geographic area (Australia-wide, state or regional area). Licensees are responsible for network deployment and QoS management within the bounds of a generic technical framework. The technical framework manages interference at the frequency and geographic boundaries and provides for a degree of technology flexibility, but is biased to support an assumed service model. Spectrum licences can be issued for up to 15 years, and are usually issued via an auction.

ACMA prefers technology-flexible licensing arrangements that give the government a return for use of a community resource, especially in highly populated areas, but do not delay

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7 The described approach relates to the issue of an assigned apparatus licence; that is, where a licensee requires an individual frequency to be assigned. Non-assigned apparatus licences, while not currently used for WAS, are issued for services that do not require individual frequency assignment, or when a frequency can be selected from a predetermined suite.

8 The maximum apparatus licence duration currently allowed under the *Radiocommunications Act 1992*.

deployment of WAS in regional and remote Australia. Traditionally, interference is managed under apparatus or spectrum licensing by allowing each user an exclusive frequency band at a site or over an area. There are inefficiencies built into this arrangement as users may not use their exclusive spectrum space to its maximum extent all the time, and the leeway built into the geographic and frequency separations represent spectrum that may be unused.

The challenges of licensing WAS are:

- getting the right pricing and delivery mechanisms across the country;
- making spectrum as widely available as possible while avoiding the 'tragedy of the commons' or unfettered use that can occur under class licensing, which can make the band less than ideal for some services;
- ensuring opportunities for smaller carriers to compete with established telecommunications carriers, particularly in regional areas; and
- reducing or removing 'dead zones', or areas of limited service, that can occur at the boundaries of spectrum licences.

These challenges may be addressed by a potential new concept for managing WAS that was outlined in the February 2006 discussion paper—the 'private park'. The private park combines elements of apparatus, spectrum and class licensing. ACMA seeks comments from industry on this concept and its application to WAS licensing.

PRIVATE PARK

Conceptually, private park spectrum would be similar to the class-licensed bands around 2.4 and 5 GHz. Each licensee could use the entire spectrum band and interference would be controlled by specifying conditions of use[9]. Limits would be needed to prevent overpowering and to ensure efficient reuse of the spectrum. These limits could be regionally specific; that is, different for each designated density area so as to recognise the need for more power in areas of dispersed population.

The difference between class licensing and a private park is in authorised users. In class-licensed bands, anyone may operate within the bounds of the licence. In a private park, entry would subject to those holding a licence. The availability of these licences could be controlled.

The February 2006 discussion paper described three private park licensing options: 'business class' (covering an entire state or territory), 'economy class' (covering low and remote spectrum demand areas in a state/territory) and 'discount economy class' (covering remote density areas only). However, four tiers of licensing options may better recognise the differing needs of operators in different regions of Australia. The following scenario (illustrated in Figure 1) is an example of how the private park could be structured:

1. The first tier of licensing would give access to an entire state or territory, including the capital city. ACMA suggests that two operators be provided for in each state/territory (while providing competition in the market, restricting the number of

[9] It is predicted that in the future, devices will have the capability to avoid interference automatically through techniques such as dynamic frequency selection and contention-based protocols. A private park would lend itself to the operation of these types of devices.

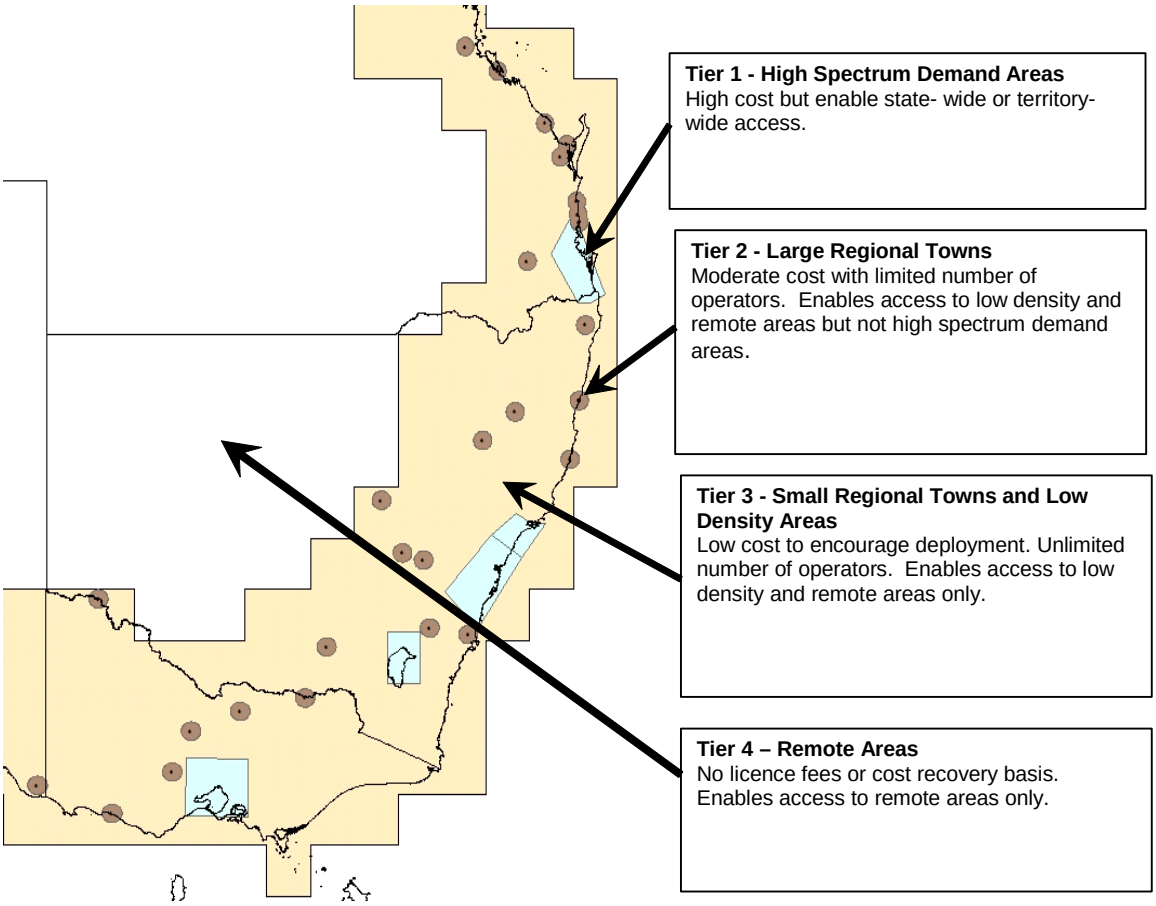
operators gives some level of confidence that QoS can be maintained). Options for the allocation of first tier licences include:

a. two licences in each state/territory;
b. one licence in each state/territory and one licence Australia-wide; or
c. two licences Australia-wide.

Recognising their value and the limited number that would be made available, these licences would be sold at auction.

2. The second tier of licensing would give access to a large regional town and the remainder of the state/territory, but would exclude the capital city and other large regional towns. Access to multiple regional towns would be allowed but a separate licence would need to be applied for in each town. ACMA would need to determine which regional towns would fall into this option, possibly based on population. As access to large regional towns is likely to be sought after, the number of second tier licences available in each town could be limited to three. Limiting the number of licences in popular areas would provide some level of confidence that QoS can be maintained. A price-based allocation process could be used where demand exceeded supply, otherwise licences could be issued for a predetermined set price. To prevent hoarding and anti-competitive behaviour, first tier licensees would be ineligible to apply for a second tier licence in their state/territory as they would already have access under their first tier licence.
3. The third tier of licensing would give access to a state/territory, including all small regional towns, but would exclude the capital city and all large regional towns. An unlimited number of apparatus licences could be issued over-the-counter for this option. Limiting the number of licences in these areas is not seen as necessary as it is anticipated that the number of operators would be naturally limited.
4. The fourth tier of licensing would give access to remote density areas only, and access rights could be provided under a class licence.

Figure 1: Conceptual private park licence areas showing a four-tier structure



The February 2006 paper discussed the possible requirement for registration of devices to assist licensees in coordination and interference evaluation. ACMA seeks feedback as to whether device registration would be necessary. If device registration is supported, ACMA believes that it should not allow 'spectrum reservation' i.e. the registration of a device does not set a date prescient for operation.

Coordination over licence boundaries and between licensees jointly operating in the spectrum would be the responsibility of the licensees. Private park licensees would have to coordinate with non-WAS licensees in adjacent bands in the normal manner, taking into account any prescribed protection requirements. ACMA would not anticipate being involved in coordination or entering into negotiations over coordination disputes.

ACMA suggests that transmitters already in operation be given priority in interference coordination; that is, a licensee would have to coordinate the deployment of their transmitters with other transmitters already in operation. ACMA would expect that licensees would negotiate amongst themselves to develop equitable band access arrangements in a timely manner. ACMA also suggests that the coordination priority be lost if the transmitter ceases operation for any reason other than breakdown or maintenance, and that the downtime be limited to five working days.

ACMA suggests that licensees be permitted to install equipment, including base stations, anywhere within the boundary of their licence. This could minimise or eliminate 'dead zone'

areas that can occur under spectrum or apparatus licensing, which results when licensees are required to locate their transmitter(s) a minimum distance from the licence boundary to avoid causing interference into adjacent areas.

Further information about these frameworks can be found in the February 2006 WAS discussion paper (available on ACMA's website at http://www.acma.gov.au/ACMAINTER.:STANDARD::pc=PC_100424).

AGGREGATION

ACMA is considering the use of aggregation to help minimise fragmentation of bands and anti-competitive behaviour while increasing the utility of bands. Aggregation allows operators who gain access to blocks of spectrum through an auction (or other allocation) process to amalgamate their separate blocks into a contiguous block, nominally providing for better spectrum efficiency and less onerous coordination requirements. ACMA suggests that operators be required to aggregate to either end of a band to minimise anti-competitive behaviour. In the case where a band is segmented such that there are upper and lower segments, as in options 3-6 discussed in Chapter 5, and where operators gain access to spectrum in both segments, they would be required to aggregate either low in both segments or high in both so as to preserve options for operators requiring access to paired spectrum.

2500–2690 MHz

10. Which licensing option(s) would you prefer for WAS in the 2500–2690 MHz band? Why?

11. What areas should the licences cover? (e.g. Australia-wide, capital cities, regional areas, state-wide)

12. If the 2500–2690 MHz band was allocated for WAS, and a block of spectrum in the band was preserved for ENG operation, how should the ENG spectrum be licensed? Why?

3575–3710 MHz

13. Which licensing option(s) would you prefer for WAS in the 3575–3710 MHz band? Why?

14. What areas should the licences cover? (e.g. Australia-wide, capital cities, regional areas, state-wide)

GENERAL LICENSING ISSUES

15. If WAS were authorised under a class licence or a private park (in either of these bands), what should the maximum equivalent isotropically radiated power (EIRP) be? Why?

16. Is device registration necessary under a private park? If not, what other arrangements could be used to allow coordination?

17. Should aggregation of spectrum lots be allowed? If so, how should lots be aggregated (low, high or other)?

OTHER ISSUES

18. What other issues should ACMA consider?

7 Summary of issues for comment

ACMA seeks comments on the following issues by close of business **28 February 2007**:

Suitability of candidate bands

Recognising the suitability of the identified bands for WAS, and their importance for incumbent services:

1. Should the 2500–2690 MHz band be made available (in whole or part) for WAS applications? If it were, what would the implications (costs) be for ENG applications? (also refer to section 5 'Band Segmentation Options')
2. What are the implications if the 2500–2690 MHz band is not made available for WAS?
3. Should the 3575–3710 MHz band be made available (in whole or part) for WAS applications? If it were, what would the implications (costs) be for fixed point-to-point links and fixed-satellite services ? (also refer to section 5 'Band Segmentation Options')
4. What are the implications if the 3575–3710 MHz band is not made available for WAS?

If the 2500–2690 MHz band were made available for WAS:

5. Which segmentation option would you prefer? Why? Respondents are welcome to suggest alternative segmentation options.
6. What option(s) would you prefer for the management of incumbent services? Why?

If the 3575–3710 MHz band were made available for WAS:

7. How much spectrum in the band should be made available? Why?
8. What option(s) would you prefer for the management of incumbent FSS earth stations? Why? In particular, should FSS earth stations be 'grandfathered'? If so, for how long? In general, what arrangements should be considered for the protection of earth stations?
9. What option(s) would you prefer for the management of incumbent fixed point-to-point services? Why?

Licensing options

10. Which licensing option(s) would you prefer for WAS in the 2500–2690 MHz band? Why?

11. What areas should the licences cover? (e.g. Australia-wide, capital cities, regional areas, state-wide)
12. If the 2500–2690 MHz band was allocated for WAS, and a block of spectrum in the band was preserved for ENG operation, how should the ENG spectrum be licensed? Why?
13. Which licensing option(s) would you prefer for WAS in the 3575–3710 MHz band? Why?
14. What areas should the licences cover? (e.g. Australia-wide, capital cities, regional areas, state-wide)

General licensing issues

15. If WAS were authorised under a class licence or a private park (in either of these bands), what should the maximum equivalent isotropically radiated power (EIRP) be? Why?
16. Is device registration necessary under a private park? If not, what other arrangements could be used to allow coordination?
17. Should aggregation of spectrum lots be allowed? If so, how should lots be aggregated (low, high or other)?

Other issues

18. What other issues should ACMA consider?

Appendix A: 2500–2690 MHz band segmentation arrangements in other countries

Europe

In Europe the band 2500–2690 MHz band is designated for use by administrations wishing to implement IMT-2000. However, this decision is currently under review as it has been argued that the band is also suitable for many other fixed and mobile uses such as WiMAX (IEEE 802.16) and mobile broadband (IEEE 802.20).

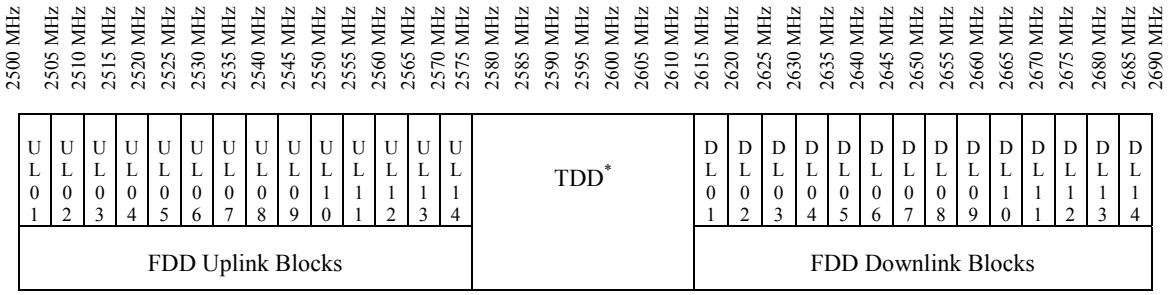
The current European arrangements for the band are shown in Figure A1.

Although it has been mandated that the band should be made available for IMT-2000 by the end of 2008, some flexibility is afforded to administrations to determine, at a national level, the availability of the 2500–2690 MHz band for IMT-2000/UMTS in order to meet their specific deployment of existing systems (e.g. fixed service, multichannel multipoint distribution service (MMDS), ENG-OB) based on market demand and other national considerations.

Many countries have put arrangements in place to meet the 2008 deadline. In many cases this requires clearance of the band. For example, in the UK the band is currently used for broadcasting video links (ENG). In 2003 Ofcom (the communications regulator) gave notice to these users to vacate the band by 31 December 2006; in March 2006 Ofcom announced that existing licensees would be subject to a rolling three-month notice period from 1 January 2007.

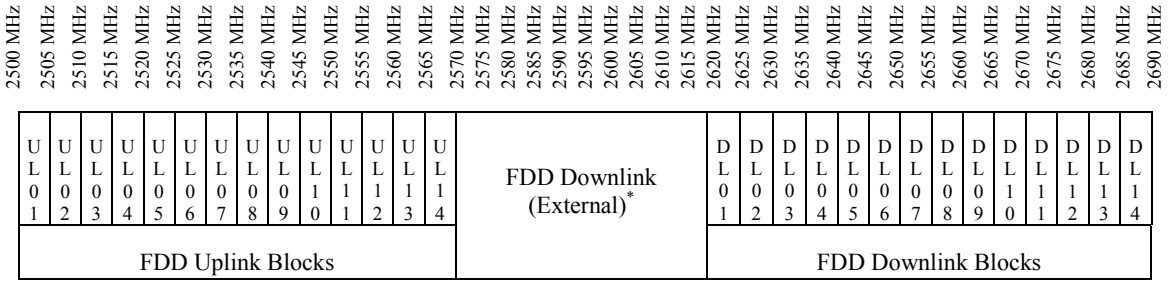
Figure A1: 2500-2690 MHz band segmentation arrangements in Europe[10]

ALTERNATIVE 1: IMT-2000/UMTS CHANNELLING ARRANGEMENTS BLOCKS IN THE BAND 2500 – 2690 MHz



*Any guard bands required to ensure adjacent band compatibility at 2570 MHz and 2620 MHz boundaries will be decided on a national basis and taken within the band 2570 – 2620 MHz.

ALTERNATIVE 2: IMT-2000/UMTS CHANNELLING ARRANGEMENTS BLOCKS IN THE BAND 2500 – 2690 MHz



*Any guard bands required to ensure adjacent band compatibility at 2570 MHz and 2620 MHz boundaries will be decided on a national basis and taken within the band 2570 – 2620 MHz.

USA

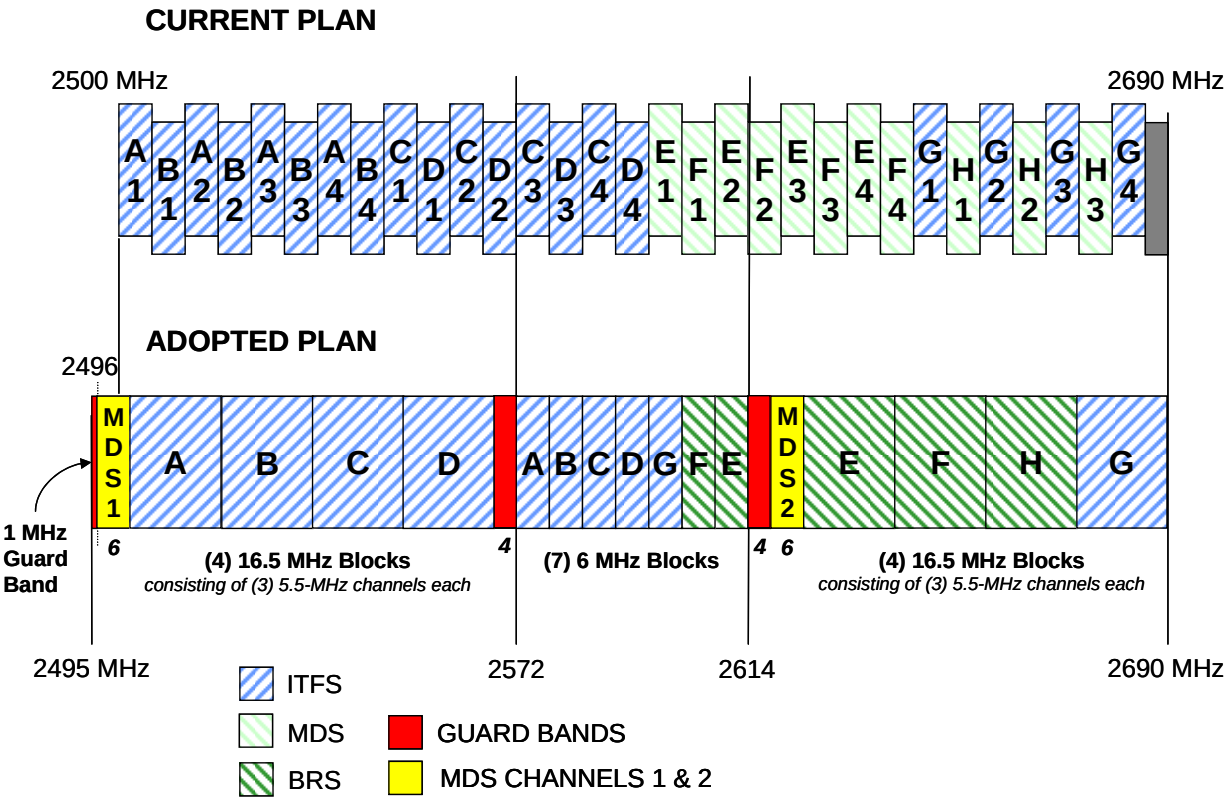
In the USA the band has been used for multipoint distribution service (MDS)[11] and instructional television fixed service (ITFS), a mixture of high and low-powered broadcasting services. As a result of a consultation process that began in early 2003, the band has been restructured to 'facilitate more efficient use of the spectrum'. The new band plan, as shown in Figure A2, eliminates the use of interleaved channels by MDS and ITFS licensees and creates distinct band segments for high power operations, such as one-way video transmission, and low power operations, such as two-way fixed and mobile broadband applications. By grouping high and low power users into separate portions of the band, the

[10] Source: ECC/DEC/(05)05 - Electronic Communications Committee (ECC) decision of 18 March 2005 on harmonised utilisation of spectrum for IMT-2000/UMTS systems operating within the band 2500-2690 MHz. Available at http://www.ero.dk/documentation/docs/doc98/official/Word/ECCDEC0505.DOC.

[11] 'MDS' refers to both multipoint distribution service (MDS) and multichannel multipoint distribution service (MMDS) licences.

new band plan reduces the likelihood of interference caused by incompatible uses and creates incentives for the development of low-power, cellularised broadband operations, which were inhibited by the prior band plan. In order to reflect these new opportunities for providing broadband service, the FCC renamed the MDS service the broadband radio service (BRS), while maintaining the ITFS label for ITFS licences and operations.

Figure A2: 2500-2690 MHz band segmentation arrangements in the USA[12]



[12] Source: Federal Communications Commission (FCC) Wireless Telecommunications Bureau news release 10 June 2004: *FCC Promotes the Deployment of Wireless Broadband Services by Creating New Rules for the 2495-2690 MHz Band while Protecting Educational Services*. Available at http://wireless.fcc.gov/cgi-bin/wtb-document-index.pl?t=0&y=4&m=6.