



Australian Government
**Australian Communications
and Media Authority**

Australia's regulator for broadcasting, the internet, radiocommunications and telecommunications

www.acma.gov.au

Strategies for Wireless Access Services

Spectrum Planning Discussion Paper SPP 1/06

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1 Summary

Purpose

The purpose of this paper is to stimulate discussion and solicit information from stakeholders that will allow the Australian Communications and Media Authority (ACMA) to gauge the demand for future wireless access services (WAS) and associated spectrum support requirements. Stakeholder views will be used by ACMA to guide the development of short, medium and long-term spectrum strategies to support the development and deployment of WAS, including in regional and remote Australia.

This paper represents the initial step in the process to develop spectrum strategies to support WAS. Subject to the feedback ACMA receives, any subsequent detailed spectrum planning action will undergo further consultation with stakeholders and potentially affected incumbent licensees.

Scope

This paper examines:

- the scope of WAS and gives examples of WAS technologies (section 2);
- demand drivers for WAS and spectrum to support them, such as government funding programs, the need for broadband services in regional and remote Australia, spectrum harmonisation and the resulting benefits, and the need for more bandwidth to support new and evolving applications (section 3);
- the benefits of standardisation and non-proprietary technology platforms with international market trends (section 4);
- the convergence of fixed and mobile services and related bandwidth and mobility implications (section 5);
- the bands currently allocated for WAS in Australia (section 6) and potential future WAS bands (section 7). Several of the potential future WAS bands discussed in this paper were foreshadowed in *From DC to Daylight—Accounting for Use of the Spectrum in Australia*, the spectrum management strategy released by the Australian Communications Authority (ACA) in June 2004; and
- current regulatory frameworks and the challenges faced in accommodating new technologies, the desired features of a framework to manage WAS. A ‘private park’ concept is explored as one example of an alternative framework to manage WAS technologies (section 8).

This paper does not discuss market allocation mechanisms for spectrum in detail - if support is demonstrated for the allocation of additional WAS spectrum, the consideration of allocation mechanisms will be the subject of future consultation. The allocation and regulatory implications of emerging technologies such as ultra wideband (UWB), software-defined radio and cognitive radio will also be the subject of future consultation papers.

Background

The development of strategies to support future WAS spectrum requirements are necessary for a number of reasons:

Broadband communications is becoming increasingly important

It is widely recognised that access to broadband ‘can deliver substantial social and economic benefits’.¹ WAS may play an increasingly significant role in providing broadband communications as the proportion of broadband services provided by wireless in Australia is currently low. The continuing development of wireless broadband technologies and the inherent advantages over wireline and cable such as mobility, lower costs and ease of deployment, may also stimulate greater WAS demand.

Need to cater for different markets

These factors make WAS attractive to large operators, who typically provide a wide range of services on a national or wide-area basis, while giving opportunities for small operators to compete in localised markets providing niche services. There are also an increasing number of vendors and manufacturers becoming involved in the debate over spectrum allocation issues. Overall, the market is becoming increasingly complex and the needs of all segments need to be catered for when planning for future spectrum requirements.

Range of available and developing WAS technologies and demand for spectrum

Access to radiofrequency spectrum is central to addressing emerging expectations for ubiquitous fixed, mobile and nomadic connectivity provide by WAS. A wide range of WAS technologies currently exists, and ACMA has made a number of frequency bands available to support them.

However, ACMA is already unable to satisfy all requirements for assignments in certain bands. Answering the questions of how much spectrum is required and over what timeframe are essential to effectively plan for the future spectrum requirements of WAS.

There is also an increasingly rapid development of new WAS technologies requiring greater bandwidth and access to greater amounts of spectrum. The development of these technologies is challenging the current regulatory frameworks and may require ACMA to re-assess the way spectrum is managed to ensure that we can best respond in an ever-changing technical environment.

¹ DCITA report: *Australia's Broadband Connectivity*, January 2003.
http://www.dcita.gov.au/data/assets/pdf_file/21288/BAG_report.pdf.

Understanding the new technologies, how they operate, which will dominate, when they will become available and their spectrum needs, is central to ACMA's understanding of what should be done to accommodate future WAS requirements from a technical and regulatory perspective.

Issues for comment

This paper seeks comments, including justification for any claims made, on the following key issues:

Spectrum demand

- 1) Noting the increasing bandwidth demands of consumers, convergence and other issues discussed in this paper (sections 3 and 4), are the existing Australian WAS spectrum allocations (section 6 and Appendix C) sufficient to accommodate:
 - (i) the growth of WAS applications in both city and regional areas?
 - (ii) diversity in the provision of wireless services?

- 2) Whilst noting the government's preference for technology neutrality in spectrum allocation, ACMA seeks comment on:
 - (i) current technology issues, including the role of 'open' wireless systems relevant to WAS spectrum allocation (section 4);
 - (ii) relevant international standardisation and allocation issues (section 4 and Appendix B);
 - (iii) the technologies that should be taken into consideration for planning purposes; and
 - (iv) the practical timeframes for the availability of these technologies.

- 3) If the existing WAS allocations are not considered adequate (and noting question 2), how much additional spectrum is expected to be needed in:
 - (i) city areas; and
 - (ii) regional and remote areasto support a viable and competitive Australian WAS deployment into the future?

- 4) Noting question 3, when is the additional WAS spectrum needed?

- 5) How many WAS operators should be provided for in high density areas?

Candidate bands

- 6) Assuming that additional spectrum is needed for WAS:
 - (i) which candidate bands (section 7) are most likely to provide large-scale consumer benefits if WAS were introduced? Why?
 - (ii) are there any additional bands that should be considered?

Licensing and allocation approach

7) Noting the current regulatory frameworks (section 8), their relative advantages and disadvantages, and the spectrum needs of city, regional and remote areas, ACMA seeks comments on:

- (i) the preferred regulatory framework(s) for WAS (please list any specific bands you think these frameworks would be suitable for);
- (ii) the desired characteristics of an alternative framework for managing WAS; and
- (iii) the 'private park' concept as an example of an alternative framework for managing WAS (subsection 8.3 and Appendix D).

8) How should licences be allocated in city, regional and remote areas? Examples of allocation methods include auction, 'over-the-counter', and class licensing.

Incumbent users

9) Assuming that additional spectrum needs to be made available for WAS and noting that the needs of incumbent users must be considered:

- (i) what are the economic, social and technical impacts on incumbent spectrum users?
- (ii) what options exist for the relocation of incumbent users?
- (iii) how much time is needed to implement such relocation?

Other matters

10) Are there any other relevant matters that ACMA should consider?

Comments may be forwarded by close of business **Monday 3 April 2006** to:

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Status of responses to this discussion paper

This discussion paper provides information to assist people in making comments to ACMA. Nothing in this paper should be taken as binding ACMA to any particular course of action in later processes.

Respondents to this discussion paper should note that:

- unless confidentiality is expressly requested, responses will be made public on the ACMA website (www.acma.gov.au), together with the name of the author(s). Respondents are requested to indicate clearly if they wish to keep some or all of their response confidential;
- unconditional permission to publish responses will be assumed unless the author expressly states otherwise; and
- even if a submission is not intended for public release, ACMA may be required to release it in accordance with statutory requirements such as requests made under the *Freedom of Information Act 1982*.

2 Wireless Access Services (WAS): What are they?

2.1 Overview of Wireless Access Services

The term 'wireless access services' (WAS) encompasses the variety of ways that telecommunications carriers, internet service providers (ISPs) or other service providers deliver a radio connection from an end-user to a core network, usually a public network, such as a public switched telephone network, the internet, or a local/wide area network. WAS covers a range of other terms such as fixed wireless access (FWA), broadband wireless access (BWA), wireless local loop (WLL), multipoint distribution system (MDS) and radio local area network (RLAN).

WAS are being deployed as a supplement and an alternative to fixed and mobile telecommunications networks, digital subscriber line (DSL) technologies, cable and satellite². WAS technologies are particularly attractive to service providers who do not have the capacity to build extensive fixed wireline infrastructure.

Where wireless technology is used to provide the 'last mile connection'³ it avoids the high capital costs associated with the installation of fixed wireline and cable. The relatively lower infrastructure costs and potentially faster deployment have increased the viability of service provision in the less commercially attractive areas such as regional and remote Australia. Depending on the frequency band chosen, either bandwidth or distance can be optimised, and sometimes both.

Figure 1 (see next page) illustrates the trade-off between speed and distance.⁴ Personal area networks are usually low-powered, high bandwidth applications operating under class licences. Local area networks (LANs) and metropolitan area networks are higher-powered systems operating under either class licences or apparatus licences.

² Although satellite communications are also wireless, this paper focuses on the requirements for WAS using terrestrial networks.

³ The term 'last mile' can be misleading. In some cases wireless access can be provided at up to 50 km from the base station. 'Last mile' is essentially the final connection to the user terminal from the local telephone company switching facility.

⁴ Source: US Federal Communications Commission (FCC) publication *Connected and On The Go*. The FCC is the US communications regulator.

When operating within the radiated power constraints of class licences, bandwidth (in this case in terms of megabits per second or Mbps) must be traded for distance (in technical terms the trade is bandwidth for system margin). An important feature of WAS is the ability to deliver services on the move. If they are in range, commuters can access internet connections and may access their work LANs almost anywhere they go. In the right frequency band, wireless access also has the ability to connect residences which are spread out geographically (i.e. in areas with a so-called low tele-density).⁵

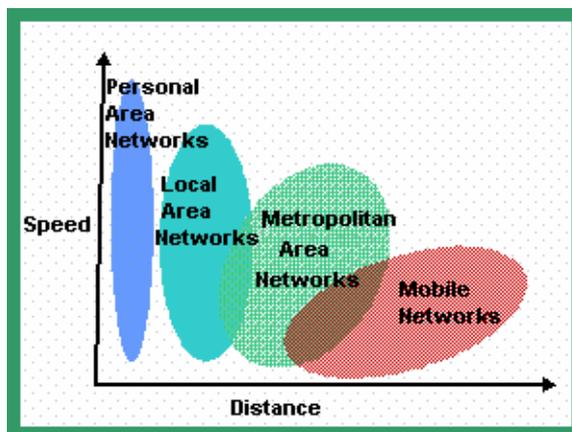


Figure 1: WAS Technologies

2.2 WAS Technologies

Examples of WAS technologies include IEEE⁶ 802.11 (also known as Wi-Fi, short for ‘wireless fidelity’), IEEE 802.16 and ETSI⁷ HiperMAN (commonly known as WiMAX⁸). In addition, Adaptix, iBURST and Navini are examples of proprietary systems deployed in Australia that are providing WAS. Data rates provided by these technologies vary greatly depending on the application, but as mentioned previously, it usually comes down to a trade-off between speed and distance. In general, these WAS technologies attempt to provide data rates that are equivalent to wireline and cable technologies. Technologies used for WAS over short to medium distances of around 100 metres (typical of RLANs) can provide user data rates of 10–54 Mbps. Technologies used to provide WAS over longer distances for metropolitan area networks may provide average user data rates between 200 kilobits per second (kbps) and 1 Mbps.

Second generation (2G) mobile phone systems such as GSM and CDMA can also be considered as WAS. Initially they only provided voice and low-speed internet access. There have been a number of enhancements made, such as GPRS and EDGE for GSM and 1xRTT for CDMA, to increase the data capabilities of these technologies which have resulted in average data rates of 80–120 kbps. The IMT-2000 family of standards (commonly known as third generation or 3G, which includes CDMA2000 and WCDMA) are also continuing to evolve. One of these enhancements, known as HSDPA, is expected to provide average data rates of 400–700 kbps.⁹

⁵ A term commonly used to describe the number of telephone lines per some unit of the population (often per 100 people); the density of telephone lines in a community (cyber.law.harvard.edu/readinessguide/glossary.htm).

⁶ Institute of Electrical and Electronics Engineers

⁷ European Telecommunications Standards Institute

⁸ WiMAX stands for worldwide interoperability for microwave access.

⁹ Please refer to the glossary for the definition of acronyms used in this paragraph.

Although these enhancements continue, the International Telecommunication Union (ITU) recognises that eventually there may be limitations to using IMT-2000 to cater for future requirements of WAS. It states:

The services that users will want, and the rising number of users, will place increasing demands on access networks. These demands may eventually not be met by the enhancement of IMT-2000 radio access systems (in terms of peak bit rate to a user, aggregate throughput, and greater flexibility to support many different types of service simultaneously). It is therefore anticipated that there will be a requirement for a new radio access technology or technologies at some point in the future to satisfy the anticipated demands for higher bandwidth services.¹⁰

¹⁰ Recommendation ITU-R M.1645: *Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000*, page 11.

3 Wireless Access Demand Drivers

Demand for broadband services in Australia, as in other parts of the world, continues to increase dramatically. The latest report¹¹ from the Australian Competition and Consumer Commission (ACCC) on broadband deployment shows that, as at 30 September 2005, the take-up of broadband services (defined as any high speed connection greater than 200 kbps) had increased by 98% from September 2004. BWA figures were included in this report, but as not all wireless ISPs provided data the take-up figures are incomplete. It is estimated that the overall percentage of BWA is small and that the BWA market has significant potential for growth. This potential can be seen in the growing number of people who use wireless devices, such as mobile phones or laptops with Wi-Fi capabilities, to access the internet.

The potential is also evident in the business plans of new carriers. Of the 40 carrier licences ACMA granted in 2004–05, 26 of these carriers stated their intention to deploy wireless broadband networks.¹²

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

Pro-active policies by government which provide funding for pilot projects

The Australian Government has established several programs with significant funding to encourage and develop the growth of telecommunications and broadband services across Australia (for more detail see Appendix A). As an example, the latest program announced¹³ by the Australian Government, *Connect Australia*, provides \$1.1 billion for the development of regional telecommunications. One of the objectives of these programs is to facilitate delivery of broadband through the most appropriate, cost-effective and sustainable technologies. In many cases WAS provide an appropriate means of meeting this objective, considering the high capital costs of providing cable or DSL services in regional and some city areas.

¹¹ <http://www.accc.gov.au/content/index.phtml/itemId/693170>

¹² ACMA report: *Telecommunications Services Availability in Australia 2004-05*, November 2005. http://www.acma.gov.au/ACMAINTER.131456:STANDARD:224205112:pc=PC_100215.

¹³ DCITA media release 126/05 (7 November 2005): 'Government broadband support is good for the regions' http://www.minister.dcita.gov.au/media/media_releases/government_broadband_support_is_good_for_the_regions.

Limited access to high data rate services in regional and remote areas

There is concern regarding parity of services between metropolitan and regional areas. In regional and remote areas, where costs of providing service can be high and potential returns on investment low, there is a perceived reluctance by some larger operators to provide adequate services. However, as identified in the ACMA report *Telecommunications Services Availability in Australia 2004-05*¹⁴, wireless access accounts for the majority of regional broadband network operators. Smaller wireless ISPs are calling for additional spectrum to be made available in these areas to facilitate the deployment of WAS to cater for the demand and provide competition to incumbent operators.

Spectrum harmonisation and the increasing availability of low-cost standardised equipment

Spectrum increases in value and utility if the same spectrum is allocated for similar use across many countries. Internationally, the processes of spectrum harmonisation for particular services through organisations like the ITU, and development of global standards through organisations such as IEEE and ETSI, are recognised as delivering economies of scale and lower equipment costs for operators and wireless ISPs. Other benefits of spectrum harmonisation include:

- increased potential for interoperability;
- improved spectrum management and planning; and
- facilitation of international roaming and circulation of equipment.

In particular, end-users and consumers stand to benefit from global standardisation and resulting economies of scale.

New applications requiring greater bandwidth

Devices capable of accessing the internet with enhanced features, such as improved cameras, colour screens, battery life and storage capabilities, are becoming increasingly available. Coupled with anticipated applications like multiplayer online gaming, the capture and transmission of video and high-resolution photos, video telephony, real-time video streaming, music downloading, mapping and transaction services, this will potentially drive the need for more bandwidth to support WAS.

Typically, any new advanced functionality initially fulfils the demands of a premium niche market. However experience shows that, in time, with increased market penetration, competition and volume production, costs fall and more users come to take advantage of such functionality moving from a niche to a mass market deployment further increasing demand for bandwidth.

¹⁴ http://www.acma.gov.au/ACMA/INTER.262626:STANDARD:559018727:pc=PC_100215

4 International Trends

Users and consumers in every corner of the world, including developing countries, make use of an ever-expanding range of wireless personal communication devices. With the proliferation of consumer demand for a wide range of plug-and-play wireless products, standardisation and spectrum harmonisation are increasingly essential.

Generally speaking, it is the frequency bands between about 450 MHz and 6 GHz that are most in demand for wireless applications due to their optimum characteristics for radio-based local access applications (see section 5). Appendix B (*International allocations and developments for WAS*) outlines recent allocation activities in North America, Europe and the Asia-Pacific. Whilst demonstrating regional differences and the accommodation of some proprietary technologies, the common threads include standardisation of technologies and frequency bands.

WAS standardisation

True economies of scale and potentially seamless global interoperability are realisable through standardised air interface protocols and harmonised WAS (fixed and mobile) spectrum allocations. The *Australian Radiofrequency Spectrum Plan* (Spectrum Plan)¹⁵ allocations are broadly aligned to international allocations (ITU Region 3) but regional differences and historic trade-related standardisation issues, especially between European and North American interests, remain a challenge. In a global context, Australia is a small market for wireless products and services and, in common with most other countries, Australia follows European and North American WAS standardisation and market trends. For example, despite some variation in the actual frequency ranges used, products using air interfaces such as Wi-Fi (IEEE 802.11), IMT-2000 and Bluetooth are in practice supported on a global basis. Economies of scale have a direct bearing on the cost of infrastructure for service providers and consumer equipment.

Furthermore, international travel is commonplace for business and pleasure, with the expectation from travellers that wireless devices will continue to operate beyond the national border and provide connectivity wherever they may be in the world.

Accordingly, there are significant social and economic benefits to be gained from the deployment of standardised non-proprietary technology platforms operating in internationally harmonised frequency bands. Australia supports the role of international standardisation and appreciates the role of the ITU and recognised standards organisations in facilitating the cost-effective delivery of services and products. The Australian

¹⁵ http://www.acma.gov.au/ACMAINTER.4849984:STANDARD:2105187424:pc=PC_2713

Government's policy of technology neutrality in spectrum allocation is intended, *inter alia*, to facilitate innovation and the development of open, non-proprietary communication platforms.

5 Bandwidth, Mobility and Convergence

The bands between about 450 MHz and 6 GHz are in high demand for fixed and mobile local access applications. The higher microwave frequencies offer the advantage of more bandwidth for high speed communication applications, but communication distances are limited by propagation constraints. The dynamic nature of the mobile radio environment is also dependent on frequency; lower frequencies are preferred, especially where cost considerations and low tele-density warrant the installation of fewer base stations¹⁶. On the other hand, the bands below about 500 MHz are inherently limited by bandwidth and congested with narrowband services (for example, land mobile).

WAS applications range in bandwidth from voice applications, using transmission bandwidths in the order of several kHz, through to high-speed internet and video, with bandwidths in the order of several MHz. Many technology advances, particularly in coding and compression, have increased the spectrum efficiency of wireless devices, but the evolutionary development trend for new functionality and user expectations continue to push the boundary of local loop bandwidth. Whilst bandwidth requirements for wireline are also increasing, the wireless situation is greatly complicated by interference and competition for limited spectrum bandwidth.

Despite these spectrum resource limitations, wireless has the trump advantage of mobility and potentially ubiquitous fixed, mobile, and nomadic access. In practice, many 2G mobile phone networks already accommodate both fixed and mobile users. This trend is expected to continue for 3G and advanced 3G wireless services; IMT-2000 systems will continue to evolve from their mobile voice and data origins towards capabilities for local residential telephony access and broadband services. On the other hand, many point-to-multipoint WAS provide area-based telephony and broadband services in residential and commercial markets to both fixed and nomadic customer terminal equipment (for example, BWA and LAN (IEEE 802.11) systems). It is also anticipated that standardisation developments will lead to area-based fixed systems to accommodate mobile and nomadic users (for example, WiMAX wide area network systems based on IEEE 802.16e). In other words, there is a worldwide trend of convergence between fixed and mobile WAS standards and technologies.

As a result, the regulatory distinctions between fixed and mobile access systems are also becoming increasingly blurred. The existing regulatory distinctions between applications may appear arbitrary as new applications are developed.

¹⁶ Resolution 224 (WRC-2000) and Article 5.317 of the ITU Radio Regulations.

The radiocommunications sector of the ITU (known as the ITU-R) recognises that the service-based definitions in the ITU *Radio Regulations* are out-of-date and is studying the issues under Resolution **951 (WRC-03)** '*Options to improve the international regulatory framework*'. Similarly, ACMA recognises that there may be a need to review the Australian *Radiocommunications Regulations 1993* to ensure that any artificial and unnecessary roadblocks to converged services are avoided.

However, provided both fixed and mobile allocations are available in bands of interest, there is little regulatory impediment to convergence, at least at the level of the Spectrum Plan.

6 Current Bands and Initiatives

Table 1 summarises the bands currently allocated for WAS in Australia. With convergence of fixed and mobile services, bands supporting mobile telecommunications systems are included as well. More detailed information on each of these bands is contained in Appendix C.

Table 1: Current Allocations for WAS in Australia

Band	Licensing Regime	Current Usage
501–520 MHz	Apparatus	Regional and rural areas only—point-to-multipoint for voice telephony (not allowed within 200 km of capital cities and not within areas designated for spectrum licensing in the 500 MHz band). This band is extensively used with little scope for growth.
825–845 MHz paired with 870–890 MHz	Spectrum	Mobile telephony (CDMA) ¹⁷
890–915 MHz paired with 935–960 MHz	Apparatus	Mobile telephony (GSM900)
915–928 MHz	Class	RLAN/BWA, other low-powered devices
1427–1535 MHz	Apparatus	Digital radio concentrator systems (DRCS) and BWA in regional and remote areas (DRCS is not allowed within 200 km of capital city GPOs and other specified locations). Point-to-point links This band is extensively used with little scope for growth.

¹⁷ Telstra recently announced an intention to re-farm this spectrum to provide 3G (universal mobile telecommunications system or UMTS) services that might include HSDPA.

Band	Licensing Regime	Current Usage
1710–1785 MHz paired with 1805–1880 MHz	Spectrum Apparatus	Australia-wide (restricted to the lower 15 MHz in regional areas)—mobile telephony (GSM1800). Point-to-point links in remote areas.
1900–1920 MHz	Spectrum Apparatus	Capital cities only—3G services. Regional and remote areas only—BWA. A large number of licences have been issued, limiting availability in some regional areas. Secondary status point-to-point links in regional and remote areas.
1920–1980 MHz paired with 2110–2170 MHz	Spectrum Apparatus	Capital cities and regional areas (restricted to the upper 20 MHz)—3G mobile telephony and broadband. Point-to-point links in remote areas.
2010–2025 MHz	Spectrum Apparatus	Capital cities and regional areas only—BWA; licences to be auctioned in 2006. Remote areas only—BWA. Point-to-point links.
2302–2400 MHz	Spectrum	Originally used for point-to-multipoint systems supporting pay TV and other applications. Major licensees have announced transition to WAS using WiMAX technologies.
2400–2483.5 MHz	Class	RLAN/BWA, other low-powered devices.
3425–3442.5 MHz paired with 3475–3492.5 MHz	Spectrum Apparatus	Capital cities and major regional centres only—FWA/BWA. Regional and remote areas only—BWA. Limited availability, licences issued in most populated centres.
3442.5–3475 MHz paired with 3542.5–3575 MHz	Spectrum	Capital cities and regional areas only—FWA/BWA.
5725–5850 MHz	Class Apparatus	RLAN/BWA, other low-powered devices. Regional and remote areas only—point-to-point links for BWA.
26.85–28.35 GHz, 31–31.3 GHz	Spectrum	Local multipoint distribution systems (LMDS).

7 Potential Future WAS Bands

Internationally the WAS industry is focusing its attention on frequency bands under 6 GHz, particularly bands in the 1–3 GHz range, due to the benefits for WAS applications in terms of coverage (due to favourable propagation characteristics) and equipment costs. This is particularly beneficial for mobile and nomadic applications. In Australia, as elsewhere in the world, there are a large number of existing services in bands targeted for WAS applications. These existing services will need to be taken into consideration when determining possible future arrangements for WAS.

The bands discussed below could potentially support WAS applications in the future. At this stage not all the identified bands will be required to support WAS applications, particularly in regional areas. It is prudent to focus planning activity on those bands that will provide economies of scale benefits for consumers; that is, a solution that has a high degree of international commonality and not a unique Australian solution.

Bands have been categorised as short, medium or long term by the amount of planning required if WAS were to be introduced.

7.1 Short Term

Candidate bands rated as short term are those where supporting arrangements can be in place within one year. Typically these bands have few incumbent users or the existing frameworks can support WAS applications with minor, if any, modifications.

Currently, only one band has been identified as a short-term option.

7.1.1 1785–1805 MHz in Regional Areas

The Spectrum Plan allocates the band 1785-1805 MHz to the fixed and mobile services on a primary basis. Under Spectrum Plan footnote 384A, this band is identified as part of the bands available for countries wishing to implement IMT-2000 in accordance with ITU Resolution **223 (WRC-2000)**.

This band is between the base transmit (1710–1785 MHz) and base receive (1805–1880 MHz) segments of spectrum used primarily for GSM1800 services operating under spectrum licensing. The spectrum is lightly used with 80 point-to-point fixed links Australia-wide, mainly in remote areas (see Appendix E for more details). Compatibility issues with frequency-adjacent GSM1800 services make operation unviable in the major capital cities (Adelaide, Brisbane, Melbourne, Perth and Sydney). However, outside those areas WAS operation is considered feasible in the band 1785–1800 MHz (15 MHz), with a 5 MHz guard band at 1800–1805 MHz.

Only WAS applications operating in single-frequency mode using time division duplex (TDD) can be supported.

While use of the band 1785–1805 MHz may introduce compatibility issues if two-frequency WAS applications were supported in the bands 1725–1785 MHz and 1820–1880 MHz (see 7.2.1), ACMA’s provisional view is that the need for immediate options for regional WAS applications outweighs that concern. Compatibility issues mean that operation would need to be on a site-based coordination basis.

ACMA will release a discussion paper seeking comment on proposed technical requirements for WAS operating in this band in the near future.

7.2 Medium Term

Candidate bands rated as medium term are those where supporting arrangements can be in place within one to five years. Typically these bands have already been subject to replanning and only a moderate number of incumbents remain, or WAS applications can be supported on a transitional basis (for example, sharing at the same status as incumbent users before the introduction of final arrangements).

7.2.1 1725–1785 MHz & 1820–1880 MHz in Regional Areas

The Spectrum Plan allocates these bands to the fixed and mobile services on a primary basis. Under Spectrum Plan footnotes 384A and 388, these bands are identified as some of those available for countries wishing to implement IMT-2000 in accordance with ITU Resolutions **212 (Rev.WRC-97)** and **223 (WRC-2000)**. Radio astronomy facilities conduct passive observations in part of these bands (refer to Spectrum Plan footnote AUS87).

In Australia the bands 1710–1785 MHz and 1805–1880 MHz are used primarily to support GSM1800 services in capital city and regional areas. However, in regional areas GSM1800 use is restricted to 1710–1725 MHz and 1805–1820 MHz, while 1,547 fixed point-to-point links operate in the remainder of the bands in regional and remote areas (see Appendix E).

The bands 1725–1785 MHz and 1820–1880 MHz (two blocks of 60 MHz) could be suitable in regional areas for WAS applications using GSM, or other WAS technologies capable of operating in those bands.

7.2.2 1920–1960 MHz & 2110–2150 MHz in Regional Areas

The Spectrum Plan allocates these bands to the fixed and mobile services on a primary basis, with an additional primary allocation to the space research service in the band 2110-2120 MHz. Under Spectrum Plan footnote 388, these bands are identified as some of those available for countries wishing to implement IMT-2000 in accordance with ITU Resolution **212 (Rev.WRC-97)**.

In Australia, the bands 1920–1980 MHz and 2110–2170 MHz have been allocated via spectrum licensing and are being used primarily to provide 3G services using frequency division duplex (FDD) technologies such as WCDMA. However, in regional areas spectrum licences were only allocated in the bands 1960–1980 MHz and 2150–2170 MHz.

The bands 1920–1960 MHz and 2110–2150 MHz are mainly used for fixed point-to-point links; 280 links currently operate in regional and remote areas. In addition, in the band 2110–2120 MHz space research services (Earth-to-space, deep space) operate at various locations, particularly at New Norcia (WA) and Tidbinbilla (ACT). In the adjacent band 2025–2110 MHz, space operation (Earth-to-space) and space research (Earth-to-space) services again operate at various locations but mainly at Gngangara (WA), New Norcia (WA) and Tidbinbilla (ACT). Appendix E provides further information on the incumbent services.

The bands 1920–1960 MHz and 2110–2150 MHz (two blocks of 40 MHz) may be suitable in regional areas for WAS applications using 3G technologies, or other WAS technologies capable of operating in those bands.

7.2.3 2025–2110 MHz & 2200–2300 MHz

The Spectrum Plan allocates these bands to the space operation service, space research service, Earth exploration-satellite service, fixed service and mobile service on a primary basis. Radio astronomy facilities conduct passive observations in part of these bands (refer to Spectrum Plan footnote AUS87).

In Australia these bands are mainly used for fixed services, with 284 point-to-point links Australia-wide; the majority of links are located in remote or regional areas. The space operation and space research services operate in these bands primarily at Tidbinbilla (ACT), Gngangara (WA) and New Norcia (WA). Appendix E provides further information on the incumbent services.

To support possible use for electronic news gathering (also known as ENG, which currently operates in the 2500–2690 MHz band—see 7.3.3), and in anticipation of WAS applications using proprietary radio technologies, a spectrum embargo¹⁸ was placed on the bands 2025–2110 MHz and 2200–2300 MHz in August 2005. Due to the importance of the bands in serving communities in remote areas, exceptions for fixed point-to-point links may be allowed in these areas.

The mobile service is restricted by footnote 391 in the Spectrum Plan, which prohibits the introduction of high-density mobile systems such as IMT-2000 because of the risk of unacceptable interference to the space services. Studies¹⁹ have shown that sharing with low-density mobile systems such as ENG is feasible and has been done successfully in other countries (examples include USA, UK and Hong Kong). In light of those studies, sharing with ENG is considered to be a viable option, subject to the establishment of appropriate coordination arrangements with the space services stations. Space services sharing with WAS applications would require more restrictive conditions on WAS operation (such as a large geographic separation). Considering the use of these bands for ENG by other countries, ITU-R Recommendation **723 (WRC-03)** may also be of relevance.

ACMA believes these bands are worthy of consideration for ENG and/or WAS in regional areas. Accommodating ENG may require some fixed link clearances in urban areas. Clearance in remote and regional areas is unlikely where spectrum sharing may be feasible.

¹⁸ Spectrum embargo 23: http://www.acma.gov.au/acmainterwr/radcomm/frequency_planning/spectrum_embargoes/emb23.pdf

¹⁹ See Recommendation ITU-R SA.1154.

7.2.4 2500–2690 MHz

Planning for the introduction of WAS in this band should be considered in conjunction with the bands 2025–2110 MHz and 2200–2300 MHz.

The Spectrum Plan allocates the 2500–2690 MHz band to various fixed, mobile and satellite services on a primary basis; there are also some secondary allocations. Radio astronomy facilities conduct passive observations in part of this band (refer to Spectrum Plan footnote AUS87). Internationally, consistent with footnote **5.384A** and ITU Resolution **223 (WRC-2000)**, this band is identified as one of the bands for the implementation of IMT-2000²⁰. The band is also subject to current studies under World Radiocommunication Conference 2007 (WRC-07) Agenda Item 1.9 (sharing between space and terrestrial services); ITU-R Recommendation **723 (WRC-03)** also has relevance to ENG applications. In addition to IMT-2000, the band is also under consideration by other standardisation interests (the WiMAX Forum²¹) for BWA fixed and mobile applications using IEEE 802.16 and ETSI HiperMAN standards. As indicated in Appendix B, a number of other countries have already allocated this band for use by WAS (such as the USA and Europe as a whole).

At the World Radiocommunication Conference 2003 (WRC-03), Australia supported the designation of the band for IMT-2000. Nationally, the potential need for re-allocation of the band was foreshadowed in *From DC to Daylight—Accounting for Use of the Spectrum in Australia*²², the spectrum management strategy released by the ACA in June 2004. In consideration of national communication infrastructure demands and international market, standardisation and technology trends, ACMA saw the need to facilitate a detailed planning process in the 2500–2690 MHz band. To preserve spectrum options and limit speculative spectrum hoarding, in June 2005 ACMA placed Embargo 43 on the band to prevent the assignment of frequencies to any new service proposals, but existing services such as ENG could continue to operate. A complementary spectrum embargo was placed on the 2025–2110 MHz and 2200–2300 MHz bands (see 7.2.3 above), as these bands could provide additional or complementary planning options.

The current Australian usage of the 2500–2690 MHz band is detailed in Appendix E. The band is used principally for ENG applications by the free-to-air television broadcasters. ENG is a type of nomadic (television outside broadcast) communication link used to transfer video and sound footage from news event locations to the studio. Operations are typically concentrated in the metropolitan areas, but include special events at regional locations such as the Bathurst race tracks, and it is understood that such regional ENG use is increasing. Australian broadcasters indicate that continued operation and access to spectrum for ENG is paramount to the successful coverage of news in Australia. ACMA is aware that ENG operators have made recent investments in the band in the form of deployments of digital ENG technology and acknowledges that sharing between WAS and ENG is not generally considered feasible, at least in the high-density city areas. Accordingly, any definitive WAS allocation in the 2500–2690 MHz band will also need to take account of the current and future needs of ENG stakeholders.

²⁰ Resolution **223 (WRC-2000)** (*resolves 1*) states 'to invite administrations implementing IMT-2000 or planning to implement IMT-2000 or planning to make available, based on market demand and other national considerations, additional bands or portions of the bands above 1 GHz identified in No **5.384A** for the terrestrial component of IMT-2000; due consideration should be given to the benefits of harmonised utilisation of the spectrum for the terrestrial component of IMT-2000, taking into account the use and planned use of these bands by all services to which these bands are allocated.'

²¹ <http://www.wimaxforum.org/home>

²² http://www.acma.gov.au/ACMAINTER.131456:STANDARD:879364072:pc=PC_1650

The band 2500–2960 MHz provides potentially 190 MHz in capital city and regional areas of Australia for WAS using new technologies such as WiMAX.

7.2.5 3575–3710 MHz

The Spectrum Plan allocates the 3575–3710 MHz band to various fixed, mobile and satellite services. Spectrum embargo 42²³ preserves spectrum options in this band, pending ACMA planning and the consideration of WAS use of the band.

Incumbent users in the band 3575–3710 MHz include 192 fixed point-to-point links operating in the 3.8 GHz band (3580–4200 MHz)²⁴, principally made up of Telstra's long-haul trunk microwave systems and the C-band (3700–4200 MHz) fixed-satellite service (FSS) (Appendix E provides further details).

On 3 June 2005 the ACA issued a media release announcing the embargo and planning process in the 3575–3710 MHz band in support of BWA systems²⁵. Strong interest was evident from media enquiries and requests for further information from large and small ISPs and equipment vendors. Enquiries from incumbent users were limited, but it is clear that they also have an interest in BWA. In practice, satellite operator use of this part of the 'extended C-band' (3400–3700 MHz)²⁶ by licensed stations is relatively light, with only eight licensed stations in Australia. There are an unknown number of stations that rely on fortuitous reception which are not licensed and are not provided with interference protection.

Earth station issues

The band 3575–3600 MHz is allocated to the FSS (space-to-Earth) on a secondary basis. The band 3600–3710 MHz is allocated to the FSS (space-to-Earth) on a co-primary basis with the fixed and mobile services.

The majority of this band (3575–3710 MHz) is part of the extended C-band. Records indicate that the extended C-band is not used as intensively in Australia as compared to the standard C-band (seven extended C-band records versus 124 standard C-band records). In general, the C-band has never been used as extensively in Australia as in some other countries. This is due to the fact that in Australia the 3.8 GHz band (3580–4200 MHz)²⁷ has been designated to support fixed point-to-point services with Earth stations permitted provided they could coordinate with fixed links.

As this band is used by the FSS for Earth receive stations, there is no interference potential from Earth stations into WAS. However, if Earth station receivers are afforded protection from WAS, it would compromise the deployment of WAS.

²³ Issued on 26 May 2005:

http://www.acma.gov.au/acmainterwr/radcomm/frequency_planning/spectrum_embargoes/emb42.pdf

²⁴ http://www.acma.gov.au/acmainterwr/radcomm/frequency_planning/frequency_assignment/docs/fx3/3-8g.pdf

²⁵ http://www.acma.gov.au/ACMAINTER.2490560:STANDARD:1314648567:pc=PC_9212

²⁶ The 'extended C-band' is an extension of the standard C-band (3700–4200 MHz).

²⁷ http://www.acma.gov.au/acmainterwr/radcomm/frequency_planning/frequency_assignment/docs/fx3/3-8g.pdf

ACMA has also identified potential difficulties in achieving compatibility between certain established Australian Department of Defence (Defence) facilities and the possible deployment of WAS systems in this band. ACMA is working with Defence on this issue.

7.2.6 4940–4990 MHz

The band 4940–4990 MHz is one of the bands identified by the ITU at WRC-03 under Resolution **646 (WRC-03)** to achieve regionally-harmonised spectrum for advanced public protection and disaster relief (PPDR) solutions.

At present, PPDR applications are mostly narrowband and support voice and low data-rate applications, typically in channel bandwidths of 25 kHz or less. It is anticipated that many future applications will be wideband-based (with data rates in the range of 384–1000 kbps) and/or broadband-based (with data rates in the range of 1–100 Mbps).

This band will not be available for general use by WAS 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.

ACMA will monitor and review the band as developments occur. No other action is planned at this stage.

7.3 Long Term

Candidate bands rated as long term are those bands where supporting arrangements will take five to ten years or longer to implement. Typically these bands have complex incumbency issues and the need to continue to support existing services means consideration of a number of bands, not a single band in isolation. Industry consultation is lengthy, detailed and complex.

7.3.1 520–820 MHz

This band is currently used for free-to-air television broadcasting. There is a potential in the long term that spectrum may become available in the band due to the conversion from analog to digital television. In a recent speech the Minister for Communications foreshadowed the development of a ‘Digital Action Plan’ to achieve analog switch-off, with the aim of making more spectrum available for new, innovative services for television, radio and potentially other platforms.

This process is underway in other countries, particularly in the USA where parts of this spectrum have already been recovered and made available for other uses. The United Kingdom has also recently announced a ‘Digital Dividend Review’, where the completion of the switch to digital will be completed by 2012. It also states: ‘*This cleared spectrum—the Digital Dividend—offers real opportunities for wireless innovation.*’²⁸—these innovations include mobile and wireless broadband services.

Planning for the introduction of WAS in this band is rated as very long term. ACMA will monitor and review the band as developments occur. No other action is planned at this stage.

²⁸ http://www.ofcom.org.uk/media/news/2005/11/nr_20051117

7.3.2 820–960 MHz

This band, known as the 900 MHz band, currently supports a wide variety of applications and services. One of the major applications is mobile telephony using GSM900 and CDMA technologies (see section 6). Other applications include low-capacity point-to-point links and cordless telephone services. Considering that some segments of this band are lightly used, there may be some limited opportunity for the provision of WAS in the future.

7.3.3 3710–4200 MHz

This band is currently used for fixed point-to-point services in Australia (see Appendix E). A number of countries have allocated this band for WAS. France, for example, has allowed a number of trials in the 3400–3800 MHz band for the provision of WLL using WiMAX technologies. Germany has indicated that the band 3600–3800 MHz will be allocated for WLL providing high-speed internet access to alleviate the shortage of spectrum in the 3400–3600 MHz band. Japan plans to allocate the entire 3400–4200 MHz band to WAS by 2012.

If the band 3575–3710 MHz (considered a medium-term option above) proves to be popular for WAS, the band 3710–4200 MHz could potentially be used as a future expansion band.

8 Designing a Framework for the Future

Industry advice suggests that the continued and future operation of WAS would be better supported by improved regulatory arrangements. This section discusses current arrangements and possible deficiencies, developments affecting future requirements and possible alternatives to current arrangements.

8.1 Overview of Current Regulatory Frameworks

The ability of a WAS provider to manage and guarantee a quality-of-service (QoS) is governed by the supporting regulatory framework. This is an important consideration for WAS providers, particularly where there is a requirement to satisfy carrier service obligations under the *Telecommunications Act 1997* or broadband infrastructure funding schemes.

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

- ‘public park’—spectrum commons;
- site-based—command and control; and
- area-based—private spectrum.

Discussion on each of the regulatory frameworks is given below.

‘8.1.1 Public Park’—Spectrum Commons

The ‘public park’ approach allows users to operate devices in designated segments of spectrum on an uncoordinated and shared basis. Users must operate devices in accordance with specified parameters typically including frequency bands, radiated power limits, and out-of-band emission levels. Technical and operational conditions may also be specified. Public park spectrum is administered using class licences²⁹ in Australia, though it has some similarities to unlicensed or licence-exempt spectrum concepts in other countries.

Users do not have to apply to ACMA to operate in public park 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. Anyone can operate any number of devices, anywhere, as long as they abide by the conditions of the class licence. This results in greater flexibility for industry, but no protection or surety on the spectrum

²⁹ http://www.acma.gov.au/ACMAINTER.4784448:STANDARD:687539825:pc=PC_1612

integrity of the systems. The interference management relies largely on the ‘level playing field’ approach where all users are subject to the same limitations on radiated power and frequency range.

Some niche operators deploy services in public park spectrum, but it is not favoured by comprehensive service carriers and larger-scale ISPs, particularly those with government infrastructure funding. This is because they cannot guarantee and manage QoS due to the risk of interference, especially in high spectrum use areas. Another major problem with public park spectrum is ‘the tragedy of the commons’³⁰ whereby too much unfettered use can make the band less than ideal for some services.

RLANs and Wi-Fi hotspots operate in public park bands.

8.1.2 Site-based—‘Command and Control’

The site-based approach, also known as ‘command and control’, involves coordinating a particular radiocommunications device with previously-licensed services. If coordination is successful, a site-specific licence (an apparatus licence) is issued to authorise operation of that device. The licence specifies technical conditions for the operation of the device such as frequency, transmit power and emission type. The scope to change any of these parameters after the service is licensed depends primarily on whether it can be re-coordinated with other services in the band.

The licence may be issued for up to five years³¹ and may be renewed by the licensee upon expiry. Licensees are required to pay an annual fee.

Devices are fully coordinated by either ACMA or accredited persons³². Detailed information about the service is recorded and maintained by ACMA in its Register of Radiocommunications Licences to facilitate coordination. The coordination provides an assured level of QoS with closely-managed interference levels. However, this is administratively cumbersome for large numbers of stations and is time-consuming and inflexible for operators who wish to deploy services quickly. It can also be resource-intensive for ACMA as it involves individual licensing and detailed frequency coordination.

The site-based approach has seen a significant number of licences for WAS assigned in regional areas. The lower cost of acquisition (compared to the cost of acquiring ‘spectrum space’ under the area-based framework) enables smaller companies to service smaller communities.

8.1.3 Area-based—‘Private Spectrum’

The area-based approach provides exclusive spectrum access to a potentially large 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 neutrality, but is biased to support an assumed service

³⁰ The over-use of a natural resource as a result of unclear property rights. If ownership of a resource is not established, everyone has an incentive to take as much of it as possible, quickly depleting the resource (highered.mcgraw-hill.com/sites/0072487488/student_view0/glossary.html).

³¹ The maximum apparatus licence duration currently allowed under the *Radiocommunications Act 1992*.

³² A person may apply to ACMA for accreditation under Part 5.4 of the *Radiocommunications Act 1992*. An accredited person may issue frequency assignment certificates and interference impact certificates. For more information please refer to http://www.acma.gov.au/ACMAINTER.131684.STANDARD.336563830:pc=PC_500.

model. Boundary issues increase and flexibilities decrease with decreasing ‘spectrum space’ (the frequency and area of the licence). Licensees can resolve boundary issues through negotiations with adjacent (band or area) licensees; however, they are not obliged to do so. ‘Dead zones’, or areas of limited services, may result in such cases. While boundaries are designed to be in low population areas to minimise such events, it is not always possible to achieve that objective.

Larger operators generally favour the private spectrum approach as it facilitates the deployment of large-scale networks over large geographic areas. However, where operators focus deployment in and around major cities, rollout to regional areas may be delayed for a number of years. This practice (colloquially referred to as ‘cherry-picking’), combined with the perceived reluctance of some operators to trade or sell their unused spectrum to others, is a source of frustration to both alternative service providers and consumers.

Spectrum space can be expensive to acquire and may be beyond the means of most medium and all smaller ISPs and carriers. Spectrum space is usually auctioned and can be administered via either spectrum licensing or apparatus licensing. The choice depends on the specific details of the band in question.

Spectrum licensing is generally seen as more attractive by large operators as it provides for 15-year licence periods, compared with a maximum of five years under apparatus licensing (after which an apparatus licence may be renewed).

8.2 Considerations for Future Management of WAS

The following issues, which concern accommodation of WAS technologies, challenge some traditional regulatory arrangements.

Network interconnection and private carriage of public and carrier traffic

Wi-Fi, WiMAX and related technologies are expected to evolve into open communications networks that support dynamic establishment of inter-network communications paths (these are commonly known as ‘mesh networks’). This will involve the dynamic establishment of linkages and passage of data between disparate stations, and will involve both base stations and user terminals. This means that traditional concepts of limiting communications to stations within the network of a single licensee break down. Radiocommunications licences will need to permit such dynamic communications between all stations and all licensees using the band.

There may also be associated issues with public telecommunications through privately-owned stations, including the possible impact on QoS obligations.

Sustainability of site-based approach

Ubiquitous deployment of stations using WAS technologies raises questions about the viability of coordinating stations for licensing purposes.

Increasingly, software-configurable equipment is being developed that is capable of performing a spectrum availability assessment before transmission (i.e. collision detection and avoidance or contention resolution protocols) potentially making some traditional spectrum coordination requirements obsolete.

8.3 Frameworks for the Future

Desired Framework Characteristics and Flexibilities

ACMA prefers flexible and technology-neutral licensing arrangements that give the government a return for use of a community resource, especially in highly populated areas, but does not delay deployment of WAS in regional and remote areas of Australia. Single-owner, wide-area licences that occur under spectrum licensing have in some cases failed to achieve this.

The challenges 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 in public park spectrum;
- ensuring opportunities for smaller carriers to compete with established telecommunications carriers, particularly in regional areas;
- reducing or removing ‘dead zone’ spectrum coverage inefficiencies; and
- ensuring that radio bandwidth capacity meets public internet protocol bandwidth demand.

Existing apparatus licence types are effective in accommodating traditional types of radiocommunications but there is a limit to the extent that they can be used to accommodate these new technologies.

The creation of a new licence framework and associated subordinate legislation may provide the necessary flexibilities. ACMA believes that the characteristics of a new licence framework should include the following:

- authorise the operation of any number of base stations within the licence area;
- be non-specific as to the type of station authorised to communicate with base stations i.e. authorise both fixed and mobile stations;
- permit intercommunication between stations of networks of different licensees; and
- reliance on licensees to undertake the necessary frequency coordination and device registration.

Notwithstanding the arrangement outlined above, there may still be a requirement for dispute resolution. The cooperation of industry peak bodies to assist ACMA to establish device registration mechanisms may be necessary.

In effect the characteristics outlined above have features of class, apparatus and spectrum licensing frameworks. A ‘private park’ licensing approach is one example of an alternative framework that incorporates the above characteristics that could be used to manage future WAS.

Discussing the ‘Private Park’ Framework—combining elements of class, apparatus and spectrum licensing

A multi-tiered fee-based licensing approach that relies on device registration and frequency coordination by licensees is one example of a feasible alternative to existing arrangements. ACMA has been considering such a framework which has similar

characteristics to the non-exclusive licensing provisions outlined in *FCC Report and Order 05-56*³³. A summary of a possible framework is discussed below (see Appendix D for further details). If shown support from stakeholders, the work necessary to develop and implement the private park concept means that it is a medium to long-term option.

The private park is a frequency band where identical shared-use licences are offered to more than one licensee. Each licensee could use the entire spectrum band and interference is controlled by specifying conditions of use. Devices would typically avoid interference automatically through techniques such as dynamic frequency selection and contention-based protocols. Licensees would be required to self-coordinate and register devices in an online ACMA database. To avoid licensees denying spectrum access to others by using false bulk registrations, the licences would not give precedence to devices based on time of registration.

As with class licensing arrangements, ACMA would not be responsible for the coordination of devices to avoid interference. Entry to the private park would be controlled by issuing a limited number of licences in high spectrum demand areas to avoid the QoS issues that can arise with class licensing.

ACMA believes that there should be no ‘hard boundaries’ between licence areas to minimise or eliminate the ‘dead zone’ problem that can occur under the area-based framework. The only requirement would be for the base station transmitter to be geographically located within the licensed area.

The licensing framework would offer three options, each authorising access to different coverage areas. ‘Prime’ licences would provide access to all areas within a state or territory (including the capital city). To ensure licensees gain access to sufficient spectrum to manage QoS, these licences would be limited in number to between two and five, depending on available spectrum. The price of these licences would reflect their high market value and limited availability, and would be issued by auction.

The second option would provide access to low density and remote density areas in a state or territory, but would not authorise access within high spectrum demand areas such as capital cities. In order to promote competition and service rollout, the number of licences made available may not be limited. In practice, it may be unnecessary to restrict entry as competition in the market may limit the number of providers. These licences would be sold over-the-counter at a moderate fixed price.

The third option, with no restriction on the number of licences, would provide access to remote density areas only. Access rights would either be sold over-the-counter at a token cost recovery fee or be class-licensed.

³³ http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-56A1.pdf

8.4 Comparison of WAS Licensing Options

Table 2: Advantages and Disadvantages of Licensing Options for WAS

Licensing Option	Advantages	Disadvantages
Class	<ul style="list-style-type: none"> • Users do not have to apply for or pay for a licence • High level of flexibility for device deployment • Systems can be shared between different licensees • Allows for rapid deployment of services 	<ul style="list-style-type: none"> • Devices are not coordinated and do not receive interference protection • Difficult for operators to guarantee a QoS
Apparatus	<ul style="list-style-type: none"> • Devices are fully coordinated and receive interference protection • Provides an assured QoS level • Licences can be transferred to other users 	<ul style="list-style-type: none"> • Can be administratively cumbersome for large numbers of stations and may not facilitate rapid deployment of services • Potentially limited scope to change system parameters once service is licensed • Licence fees are payable • Maximum licence period is five years (though licence may be renewed)
Spectrum	<ul style="list-style-type: none"> • Offers exclusive access to a spectrum space, which provides an assured QoS level • Provides technology neutrality and a high level of flexibility • Licence periods of up to 15 years • Licences can be traded, and can be subdivided or combined in the frequency or geographic domain • Licensees manage own network deployment and coordination 	<ul style="list-style-type: none"> • Can be expensive to acquire and beyond the means of medium and small ISPs • 'Dead zones' may occur • Rollout of services to regional and remote areas can be significantly delayed if licensees focus only on 'cherry picking' the high-density areas • 'Winner takes all'
'Private Park'	<ul style="list-style-type: none"> • High level of flexibility for device deployment • Access to regional and remote areas could be inexpensive • Facilitates multiple operators and competition • Deployment of services in regional and remote areas would not be subject to delays due to rollout in capital cities • No 'hard boundaries' so 'dead zones' should not occur • No precedence given to devices based on time of registration to avoid 'capture' of band by false, bulk registrations 	<ul style="list-style-type: none"> • May be unsuitable in capital cities where licensees may prefer certainty of spectrum access to manage QoS levels • Depends on cooperation between licensees in and outside the park • Licence fees could be payable

9 Issues for Comment

WAS technologies are developing rapidly and demand for their use in Australia is growing, particularly for broadband internet. The high demand cannot be satisfied by current spectrum arrangements. ACMA intends to respond to community expectations for WAS, as reflected in government policy, by making additional spectrum available for WAS, particularly in regional and remote areas of Australia. ACMA also wishes to promote diversity and competition in the provision of such services.

A number of frequency bands already support fixed and mobile WAS under different licensing arrangements. It would be prudent to focus planning activity on those bands that will provide economies of scale benefits for consumers and can deliver Australia-wide solutions. A number of additional frequency bands are identified as having potential for allocation to WAS, including bands identified under international standardisation efforts. However, re-farming and allocation of any of the identified bands presents its own unique challenges.

This paper has examined:

- the scope of WAS and gives examples of WAS technologies (section 2);
- demand drivers for WAS and spectrum to support them, such as government funding programs, the need for broadband services in regional and remote Australia, spectrum harmonisation and the resulting benefits, and the need for more bandwidth to support new applications (section 3);
- the benefits of standardising non-proprietary technology platforms with international market trends (section 4);
- the convergence of fixed and mobile services and the impact it has on bandwidth requirements and mobility (section 5);
- the bands currently allocated for WAS in Australia (section 6) and potential future WAS bands (section 7); and
- current regulatory frameworks and the challenges faced in accommodating new technologies, the desired features of a framework to manage WAS, and a ‘private park’ concept as one example of an alternative framework to manage WAS technologies (section 8).

Before considering the allocation of further spectrum and ahead of any formal decision(s), ACMA seeks the views of stakeholders on a number of threshold issues (please include justification for any claims made):

Spectrum demand

- 1) Noting the increasing bandwidth demands of consumers, convergence and other issues discussed in this paper (sections 3 and 4), are the existing Australian WAS spectrum allocations (section 6 and Appendix C) sufficient to accommodate:
 - (i) the growth of WAS applications in both city and regional areas?
 - (ii) diversity in the provision of wireless services?

- 2) Whilst noting the government's preference for technology neutrality in spectrum allocation, ACMA seeks comment on:
 - (i) current technology issues, including the role of 'open' wireless systems relevant to WAS spectrum allocation (section 4);
 - (ii) relevant international standardisation and allocation issues (section 4 and Appendix B);
 - (iii) the technologies that should be taken into consideration for planning purposes; and
 - (iv) the practical timeframes for the availability of these technologies.

- 3) If the existing WAS allocations are not considered adequate (and noting question 2), how much additional spectrum is expected to be needed in:
 - (i) city areas; and
 - (ii) regional and remote areasto support a viable and competitive Australian WAS deployment into the future?

- 4) Noting question 3, when is the additional WAS spectrum needed?

- 5) How many WAS operators should be provided for in high density areas?

Candidate bands

- 6) Assuming that additional spectrum is needed for WAS:
 - (i) which candidate bands (section 7) are most likely to provide large-scale consumer benefits if WAS were introduced? Why?
 - (ii) are there any additional bands that should be considered?

Licensing and allocation approach

7) Noting the current regulatory frameworks (section 8), their relative advantages and disadvantages, and the spectrum needs of city, regional and remote areas, ACMA seeks comments on:

- (i) the preferred regulatory framework(s) for WAS (please list any specific bands you think these frameworks would be suitable for);
- (ii) the desired characteristics of an alternative framework for managing WAS; and
- (iii) the ‘private park’ concept as an example of an alternative framework for managing WAS (subsection 8.3 and Appendix D).

8) How should licences be allocated in city, regional and remote areas? Examples of allocation methods include auction, ‘over-the-counter’, and class licensing.

Incumbent users

9) Assuming that additional spectrum needs to be made available for WAS and noting that the needs of incumbent users must be considered:

- (i) what are the economic, social and technical impacts on incumbent spectrum users?
- (ii) what options exist for the relocation of incumbent users?
- (iii) how much time is needed to implement such relocation?

Other matters

10) Are there any other relevant matters that ACMA should consider?

Appendix A: Federal Government Broadband Funding Programs

The Federal Government has established several programs with significant funding to encourage and develop telecommunications and broadband services across Australia.

National Broadband Strategy

In March 2004 the Department of Communications, Information Technology and the Arts (DCITA) launched the *National Broadband Strategy*. The strategy was developed in response to recommendations of the 2002 Regional Telecommunications Inquiry.

The strategy has funding of \$242 million over four years. The key elements of the strategy are outlined briefly below.

Higher Bandwidth Incentive Scheme (HiBIS)

The purpose of HiBIS was to improve equitable access to affordable broadband services in rural and remote areas. The scheme provided a financial incentive to service providers to offer broadband services at prices reasonably comparable with those available in urban areas. HiBIS was allocated funding of \$157.8 million.

HiBIS ceased at the end of 2005; it has been replaced by the *Broadband Connect* program from 2006 (see below).

Demand Aggregation Strategies

The Government has contributed \$8.4 million towards the funding of a network of Demand Aggregation Brokers. The purpose of the program is to coordinate demand at a regional level so there is a viable business case for rolling out infrastructure to areas that would not otherwise receive broadband services.

Coordinated Communications Infrastructure Fund (CCIF)

The focus of the CCIF is to improve the delivery of health, education and government services in rural, regional and remote Australia by supporting infrastructure projects that maximise opportunities for improved broadband access and services. CCIF was allocated \$23.7 million in funding; applications for CCIF funding ceased in April 2005.

Metropolitan Broadband Connect (MBC)

MBC has been allocated \$50 million over three years to improve access to broadband services in metropolitan Australia. The program targets people unable to access broadband services at prices similar to those available to the majority of metropolitan

customers. In November 2005 DCITA released draft program guidelines for MBC for public comment; the program commenced on 1 January 2006.

Connect Australia

On 17 August 2005, the Government announced the biggest regional telecommunications assistance package in Australian history—a \$1.1 billion communications package called *Connect Australia*. The package aims to:

- improve the rollout of affordable broadband connections to people living in regional, rural and remote areas;
- extend mobile phone coverage;
- build new regional communications networks; and
- set up telecommunications services for remote indigenous communities.

The four elements of the *Connect Australia* package are outlined below.

Broadband Connect

This is an \$878 million program that will build on HiBIS to support the rollout of new wireless, satellite, fibre and high-speed copper broadband infrastructure. *Broadband Connect* commenced on 1 January 2006 and will end on 30 June 2009.

Clever Networks

This program has received \$113 million to be invested in new broadband infrastructure that will be supplemented by at least matching funding from other governments or private industry. These networks will be built to improve the delivery of services such as health and education in regional, rural and remote areas. *Clever Networks* will end on 30 June 2010.

Mobile Connect

This program aims to extend terrestrial mobile coverage and continue satellite handset subsidies. *Mobile Connect* has received \$29.5 million until 30 June 2009.

Backing Indigenous Ability

This is a \$90 million program that will deliver community phones, internet access and videoconferencing in remote indigenous communities. Funding will end on 30 June 2010.

In addition, the Government has established a \$2 billion *Communications Fund* in capital, which will be invested to deliver an income stream to fund new communications services for rural Australia.

Appendix B: International Allocations and Developments for WAS

This appendix briefly outlines the regulatory developments of other administrations in relation to WAS.

USA—Federal Communications Commission (FCC)

In September 2001 the FCC announced it had added a mobile allocation to the band 2500–2690 MHz, making this spectrum available for advanced mobile and fixed terrestrial wireless services, including 3G services. The FCC chose not to relocate existing instructional television fixed service and multichannel multipoint distribution services (MMDS) licensees, or otherwise modify their licences, due to their extensive use of the band. By September 2005, licensees had commenced deployment of broadband wireless technologies in this band.

In 2002 the FCC reallocated the band 698–746 MHz, which had previously been used for television broadcasting. The recovery of this band was possible due to the conversion from analog to digital transmission, which is spectrally more efficient. Licensees in this band can provide fixed, mobile and broadcast services. The FCC has suggested that possible uses of this spectrum include digital mobile operations, fixed and mobile wireless commercial services (such as TDD-based and FDD-based services), and fixed and mobile wireless uses for private and internal radio needs.

In November 2003 the FCC allocated 90 MHz of spectrum at 1710–1755 MHz and 2110–2155 MHz for ‘advanced wireless services’ (AWS), which includes 3G mobile broadband services. The FCC plans to auction this spectrum from June 2006.

In May 2004 the FCC established the Wireless Broadband Access Taskforce to identify and recommend possible changes to FCC policies that would facilitate rapid deployment of wireless broadband services in the USA. The Taskforce published its findings in a report in February 2005 entitled *Connected & On The Go*³⁴. The report made several recommendations to facilitate the deployment of wireless broadband, including:

³⁴ http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-257247A1.pdf

- promoting voluntary frequency coordination amongst private industry in ‘unlicensed spectrum’ to mitigate potential interference among users;
- improving access to licensed spectrum by streamlining FCC spectrum allocation and assignment procedures, expediting the transition of the digital television spectrum to advanced wireless services, and considering new configurations that may be particularly conducive to wireless broadband applications when adopting spectrum band plans; and
- increasing the technical and regulatory flexibility of FCC rules applicable to the use of licensed spectrum, such as facilitating secondary market arrangements and enhancing opportunities for more efficient and dynamic sharing of spectrum among different users.

In September 2004 the FCC allocated an addition 20 MHz of spectrum for AWS and 3G services in the band 1915–1920 MHz paired with 1995–2000 MHz, and 2020–2025 MHz paired with 2175–2180 MHz.

On 10 March 2005 the FCC allocated the band 3650–3700 MHz to support BWA operation. An unlimited number of national, non-exclusive licences will be offered. All terrestrial operations in the band are required to use technology that includes a contention-based protocol. The arrangements also provide for the grandfathering of existing incumbent services, including terrestrial fixed and fixed-satellite services. The FCC approach implements extensive exclusion areas around the grandfathered services.

In October 2005 the FCC announced it had allocated the band 2155–2175 MHz for AWS, including 3G mobile broadband services.

UK—Ofcom

In April 2000 Ofcom’s predecessor, the Radiocommunications Agency (RA), auctioned five 3G licences in the bands 1900–1980 MHz and 2110–2170 MHz. The licences expire at the end of 2021.

In June 2003 the RA awarded 15 licences in the 3.4 GHz band for FWA services. Ofcom is considering making additional spectrum available in the 3.6–4.2 GHz band.

In February 2005 Ofcom published a consultation document about 12 bands that it expects to be available for allocation by the end of 2008. The document stated that the bands 1790–1798, 2010–2025 and 2500–2690 MHz could be used for next generation mobile applications or wireless broadband applications. It also stated that the band 1781.7–1785 MHz paired with the band 1876.7–1880 MHz could be used for low-power GSM applications.

In November 2005 Ofcom published an information memorandum and associated draft regulations for the auction of several licences in the band 1781.7–1785 MHz paired with 1876.7–1880 MHz.

In November 2005 Ofcom also announced the launch of the ‘Digital Dividend Review’, which will investigate options to maximise use of recovered spectrum from the television switch-over from analog to digital systems. Ofcom estimates that the switch-over will release up to 112 MHz of spectrum in the UHF band (470–854 MHz). This spectrum could be used to provide a wide range of services, including BWA and new mobile

services. The Review is expected to be completed by the third quarter of 2006, and the conversion to digital television by 2012.

In December 2005 Ofcom, together with ComReg (the Commission for Communication Regulation in the Republic of Ireland), announced proposals to allocate licences in the band 1785–1805 MHz. Ofcom said the licences could be used to provide, among other things, BWA and mobile technologies. The licences are expected to be auctioned in 2006 and will be issued for a minimum of 15 years.

Ofcom is planning to extend spectrum trading to the 2G and 3G bands in 2007.

Canada—Industry Canada

In November 2001 Industry Canada announced it would introduce a mobile primary allocation to the band 2500–2690 MHz, which would be in addition to the pre-existing fixed primary allocation. This makes the band potentially available for 3G mobile phones services. In following with the FCC, Industry Canada also stated that incumbent licensees would not be required to relocate.

In February 2004, August 2004 and January 2005, 842 licences to provide WAS were auctioned in the 2.3 GHz (2305–2320 MHz and 2345–2360 MHz) and 3.5 GHz (3475–3650 MHz) bands. The purpose of the licensing process was to facilitate the growth of wireless communications services in the 2.3 GHz band and FWA systems in the 3.5 GHz band in both urban and rural areas. The auctions raised over CAD\$68 million.

In June 2005 Industry Canada released a paper for public consultation that proposed to make the band 4940–4990 MHz available for broadband public safety services. This spectrum was previously used for long-haul microwave facilities but is no longer needed as it has been superseded by fibre optic transmission systems.

Industry Canada is also currently considering proposals to allocate the following bands for AWS:

- 1710–1755 MHz paired with 2110–2155 MHz;
- 1910–1920 MHz paired with 1990–2000 MHz; and
- 2020–2025 MHz paired with 2155–2180 MHz.

In Canada the band 953–960 MHz is shared by fixed studio-to-transmitter links and FWA systems on a geographical basis. FWA systems also operate in the 1427–1525 MHz bands in many rural areas of Canada to provide access to voice and data services.

New Zealand—Ministry of Economic Development (MED)

In 2002 the MED auctioned management rights³⁵ in the band 890-899.8 MHz suitable for cellular services, and the band 3410–3587 MHz suitable for WLL and LMDS. The auction raised over NZD\$9 million. Management rights in the band 1785–1805 MHz were also offered but failed to sell; the rights sold via closed tender in January 2003.

³⁵ A management right (MR) is technology-neutral and gives the purchaser (or band manager) the ability to use and manage the spectrum under the scope of the MR as they see fit (within the bounds of regulation). The band manager may sub-divide or aggregate adjoining rights, and/or create spectrum licences and dispose of them to themselves or another party.

The MED has made spectrum available for FWA services in the 3.5 GHz band (3413.5–3513.5 MHz and 3420.5–3520.5 MHz) under both private management rights and spectrum licences. Successful applicants for spectrum licences were announced in December 2005.

The MED has issued administrative licences for fixed services in the band 1429.5–1461.5 MHz paired with 1490–1492 MHz; the licences are currently being used to provide FWA services.

There are also several bands which have been made available for private management rights that MED suggests would be suitable for WAS:

- 1710–1880 MHz for 2G and 3G technologies (and fixed services);
- 1920–1980 MHz for 2G and 3G technologies (and fixed services);
- 2010–2025 MHz for TDD, 3G technologies (and fixed services);
- 2025–2110 MHz paired with 2200–2300 MHz for FWA (and fixed services). FWA services have already been deployed in this band;
- 2110–2170 MHz for 2G and 3G technologies; and
- 2300–2396 MHz for MMDS, FWA or fixed services.

The band 2500–2690 MHz is currently used for itinerant fixed linking for television outside broadcast operations, but has been identified for possible expansion of 3G services³⁶.

European Conference of Postal and Telecommunications Administrations (CEPT)

CEPT is the European regional organisation dealing with postal and telecommunications issues and currently has 45 member countries.

The European Radiocommunications Committee (ERC) of CEPT made a decision³⁷ on 29 November 1999 that CEPT Member Administrations should make provisions to allow the harmonised utilisation of spectrum in the bands 1900–1980 MHz, 2010–2025 MHz and 2110–2170 MHz for terrestrial universal mobile telecommunications systems (UMTS). The decision also stated that the frequency bands shall be designated by administrations, subject to market demand, for the provision of public UMTS services. The decision came into force on 31 January 2000.

CEPT Recommendation 13-04³⁸ recommends that the band 3400–3600 MHz be identified as a preferred band for FWA applications within CEPT.

On 18 March 2005 CEPT announced a decision³⁹ to designate the 2500–2690 MHz band for terrestrial IMT-2000 systems. However, after pressure from several EU Member States (including the UK and Norway), the European Commission (EC) is reviewing that decision in respect of whether to mandate IMT-2000 over other wireless standardisation

³⁶ *Table of Radio Spectrum Usage in New Zealand* (<http://www.rsm.govt.nz/planning/pib21/pib21-08.html>).

³⁷ For more information refer to ERC/DEC/(99)25 at <http://www.ero.dk/documentation/docs/doc98/official/pdf/DEC9925E.PDF>.

³⁸ <http://www.ero.dk/documentation/docs/doc98/official/pdf/REC1304E.PDF>

³⁹ *ECC Decision of 18 March 2005 on harmonised utilisation of spectrum for IMT-2000/UMTS systems operating within the band 2500–2690 MHz*: <http://www.ero.dk/documentation/docs/docfiles.asp?docid=2056&wd=N>

efforts (for example, WiMAX). The UK and EC support a technology-neutral approach, against France and Finland, which are pushing to mandate IMT-2000. If agreement cannot be reached in the EC Radio Spectrum Committee, the issue will move to the European Parliament.

Switzerland—Federal Communications Commission (ComCom)

In 2000 ComCom auctioned licences in the bands 3410–3494 MHz and 3510–3594 MHz for WLL services. The licences are technology-neutral and were issued for 10 years.

ComCom auctioned four 15-year UMTS licences in December 2000. The licence conditions require that by the end of 2004, operators had to cover at least 50% of the Swiss population with UMTS services. The bands 1900–1980 MHz, 2010–2025 MHz and 2110–2170 MHz were made available for UMTS from 2002.

In November 2005 ComCom announced that three licences would be auctioned in the second quarter of 2006 for BWA, which would make the deployment of WiMAX possible in Switzerland. The licences are in the 3.41–3.6 GHz frequency range; two licences will each have a bandwidth of 2 x 21 MHz and the third licence will have 2 x 17.5 MHz. The licences will expire at the end of 2016.

ComCom intends to designate the band 2500–2690 MHz for UMTS/IMT-2000 systems by 1 January 2008.

ComCom also plans to allocate the band 3600–3800 MHz for FWA systems, which will have co-primary use of the band with the FSS (sufficient geographical separation between fixed links and FSS stations will be required).

France— Autorité de Régulation des Communications Électroniques et des Postes (ARCEP)

In May 2001 ARCEP's predecessor, ART (Autorité de Régulation des Télécommunications), issued two licences for 3G services in the bands 1940–1980 MHz and 2130–2170 MHz. In January 2004 the frequency bands were extended to 1900–1980 MHz and 2110–2170 MHz.

In July 2004 ARCEP granted 20 authorisations in the 3.4–3.8 GHz band to allow the testing of new WLL equipment using WiMAX technology. The testing was authorised until 31 January 2006.

In July 2005 ARCEP announced that it had proposed to the Minister of Industry procedures for the delivery of WLL authorisations in the 3.4–3.6 GHz band. These authorisations could enable the development of networks based on WiMAX technology. ARCEP also announced that frequencies would be made available in the 3.6–3.8 GHz band for WLL authorisations.

In January 2006 ARCEP announced it had received applications from 45 companies and consortia for licences in the band 3.4–3.6 GHz.

Japan—Ministry of Internal Affairs and Communications (MIC)

In June 2000 the bands 1920–1980 MHz and 2110–2170 MHz were allocated to three operators for 3G services.

In its 2005 publication *Information and Communications in Japan*, the MIC foreshadowed its plans to examine reallocation to secure 330–340 MHz of spectrum in the 1.7 GHz and 2.5 GHz bands for mobile communications systems in the next five years.

On 9 November 2005 MIC announced that from 1 December 2005, IMT-2000 would be introduced into the 1.7 GHz and 2 GHz bands.

Japan has also made the band 4.9–5 GHz available for WAS. Incumbent fixed licensees will be permitted to stay in the band until the next re-licensing period in 2007.

Japan is also considering allocating the following bands from 2012:

- 3400–3600 MHz and 3625–4200 MHz to cellular services; and
- 4400–4900 MHz to both cellular and nomadic wireless access (NWA) services.

Republic of Korea—Ministry of Information and Communication

In December 2000 the MIC issued two 3G licences in the 1940–1980 MHz band for WCDMA. In August 2001 the MIC issued a third 3G licence in the 1920–1940 MHz band for CDMA2000. The licence was issued for 15 years.

In November 2004 the MIC announced it had allocated spectrum in the 2.3 GHz band for WiBro (wireless broadband). In early 2005 licences were issued to three operators to deploy WiBro services (one operator has since cancelled its plans to launch a WiBro service, citing market saturation). Commercial WiBro services became available in November 2005.

Singapore—Infocomm Development Authority (IDA)

In 2001 the IDA issued three 3G licences in the bands 1900–1920 MHz, 1920–1980 MHz and 2110–2170 MHz. The licences were issued for 20 years; licensees were required to deploy a nation-wide network by 2004.

In February 2004 the IDA announced its intention to allocate the bands 2300–2350 MHz and 2500–2690 MHz for BWA services. Following this announcement, in May 2005 the IDA conducted an auction for 25 spectrum lots of 5 MHz and 6 MHz in these bands to support BWA services.

In February 2005 the IDA announced that it would study the possibility of co-existence of BWA and fixed satellite services in the 3.5 GHz band to support the possible deployment of WiMAX.

Hong Kong—Office of the Telecommunications Authority (OFTA)

In October 2001 OFTA auctioned four 3G licences in the bands 1900–1980 MHz, 2020–2025 MHz and 2110–2170 MHz. The licences were issued for 15 years.

In March 2004, following public consultation, OFTA released a paper announcing preliminary decisions about a number of bands that could be deployed for mobile services in future:

- unallocated 3G spectrum in the bands 1900–1904.9 MHz and 2010–2019.7 MHz should not be allocated at present, as the application for TDD spectrum was still evolving and the relevant technical standards were not yet mature;
- additional ITU allocations for 3G services in the band 1980–2010 MHz paired with 2170–2200 MHz, and the band 2500–2690 MHz, were not ready for assignment and that they should be kept in reserve; and
- unallocated personal communications service (PCS) spectrum in the bands 1780.1–1785 MHz and 1875.1–1880 MHz should be reserved for the future expansion and frequency rationalisation of incumbent GSM and PCS licensees.

In November 2004 OFTA released a statement that said it would grant the ‘right of first refusal’ to incumbent GSM and PCS licensees for existing 2G spectrum in the bands 890–915 MHz, 935–960 MHz, 1710.5–1780.1 MHz and 1805.5–1875.1 MHz. 2G licences expire from July 2005 to September 2006; new technology-neutral licences in these bands would be valid for 15 years. OFTA also stated that due to the inefficient use of assigned spectrum by CDMA and time division multiple access (TDMA) networks, it would not offer the ‘right of first refusal’ to existing CDMA and TDMA licensees. Licensees would be given a three-year period to migrate their existing customers to other mobile networks, and would ultimately receive one-third of their original assigned spectrum (2.5 MHz of paired spectrum). The vacated spectrum would be re-farmed or reserved for future use pending the outcome of a spectrum policy review.

In August 2005 OFTA announced it would offer 180 MHz of spectrum for BWA services in the 3.5 GHz band (3410–3500 MHz and 3510–3600 MHz). The spectrum will be divided into six frequency block-pairs and licences will be allocated for 15 years. Licensees will be required to start offering services within two years after being awarded the spectrum. The FSS can operate in this band on a secondary basis.

Malaysia—Malaysian Communications and Multimedia Commission (MCMC)

In April 2003 the MCMC assigned the following bands for IMT-2000 to two operators:

- 1950–1965 MHz, 2020–2025 MHz and 2140–2155 MHz; and
- 1935–1950 MHz, 2015–2020 MHz and 2125–2140 MHz.

The spectrum was assigned for 15 years. The operators commenced commercial 3G operations in 2005.

In July 2005 the MCMC announced its intention to conduct a second round of tender for additional spectrum to roll out 3G services in the following bands:

- 1920–1935 MHz paired with 2110–2125 MHz, and 1915–1920 MHz; and
- 1965–1980 MHz paired with 2155–2170 MHz, and 2010–2015 MHz.

At the close of tender in November 2005 the MCMC had received three tender bids; the MCMC expected to complete the evaluation of bids by the end of February 2006.

The MCMC has allocated the band 2504–2688 MHz for MMDS and the band 3.4–3.7 GHz for FWA.

Appendix C: Current Bands and Recent Initiatives in Australia

A number of bands are currently available for WAS in Australia and several others are under development. The currently-released bands are summarised below. With convergence of fixed and mobile services, bands supporting mobile telecommunications systems are also included.

501–520 MHz (apparatus and spectrum-licensed)

This band is used in regional and rural areas to provide point-to-multipoint services. The band is predominantly used by Telstra to deliver voice telephony services in regional and remote areas. With a large usage by existing services there is little scope to support growth by new operators. A technology upgrade may support WAS applications.

The band is shared with narrowband (12.5/25 kHz) land mobile, point-to-point and point-to-multipoint services which operate predominantly in capital city areas under apparatus and spectrum licences.

825–845 MHz and 870–890 MHz (spectrum-licensed)

These bands were sold as paired spectrum in the 1998 and 1999 auctions for PCS. The predominant use of these bands is for the provision of mobile telephony using CDMA technology. Telstra has the largest network, which covers 98% of the population; Hutchinson and AAPT have registered networks in various capital cities and regional areas. Telstra has upgraded most of its network to the 1xRTT standard, which enables it to offer mobile data services at a maximum data rate of 144 kbps (70 kbps average). It has also upgraded part of the network to the EV-DO technology, which provides maximum data rates to 2 Mbps (300 to 500 kbps average).

In November 2005 Telstra announced that it would use these bands to deploy a new network using 3G (or '3GSM')/HSDPA technology. It is reported that this will allow it to offer mobile broadband at download speeds of 2-3 Mbps (peak).

890–915 MHz & 935–960 MHz (apparatus-licensed)

These bands were assigned to three major telecommunication operators in 1992. All three operators have rolled out extensive mobile telephone networks using GSM technology. While initially providing only voice and low-rate data, upgrades via the GPRS and EDGE platforms have enabled average mobile data capabilities of 100 kbps.

915–928 MHz (class-licensed)

This band contains WAS authorised by the LIPD Class Licence⁴⁰. They operate in a radio-noisy environment and share the band with other radiocommunications services and industrial, scientific and medical (ISM) equipment. The latter can be particularly serious sources of noise whose locations are not recorded. There are also severe constraints to avoid interference to adjacent GSM services.

1427–1535 MHz (apparatus-licensed)

This band has traditionally been used for fixed point-to-point links and Telstra's point-to-multipoint DRCS network. The band 1452–1492 MHz is currently subject to replanning for digital audio broadcasting (DAB). The paired spectrum bands 1432.5–1450.5 MHz and 1493–1511 MHz (DRCS duplex channels 2–10) were recently released for more general use by point-to-multipoint systems, including BWA, where they can be coordinated and outside areas where DAB is expected to be deployed.

There is limited opportunity for the deployment of BWA in the 1.5 GHz band, where an extensive DRCS network of 822 assignments exists in regional and remote areas. The 1.5 GHz band is also shared by 1549 incumbent point-to-point links.

1710–1785 MHz & 1805–1880 MHz (spectrum-licensed)

These bands were sold as paired spectrum in the 1998 and 2000 auctions for PCS. The predominant use of these bands is for the provision of mobile telephony using GSM technology. The major telecommunications operators have rolled out extensive networks Australia-wide. In regional areas, only the bands 1710–1725 MHz and 1805–1820 MHz have been released for these services.

1900–1920 MHz (spectrum and apparatus-licensed)

This band was auctioned in 2000 as part of the 2 GHz (3G) spectrum licence offering in major city areas only. It is unpaired spectrum suitable for single frequency systems typically using TDD technology. The band is part of the spectrum identified by the ITU for the implementation of IMT-2000. In 2005 this band was released in regional areas for BWA using apparatus licensing⁴¹. Licence uptake was high and some wireless ISPs were

⁴⁰ Radiocommunications (Low Interference Potential Devices) Class Licence 2000:

http://www.acma.gov.au/ACMAINTER.131456:STANDARD:1975617973:pc=PC_297

⁴¹ For more information refer to RALI FX-19:

http://www.acma.gov.au/acmainterwr/radcomm/frequency_planning/frequency_assignment/docs/fx19.pdf

unable to gain a licence. This problem may be alleviated by issuing licences in the 1785–1805 MHz band (see subsection 7.1).

In regional and remote areas, the band remains designated for point-to-point fixed links on a secondary basis. There are currently 200 point-to-point assignments in or overlapping the band. Point-to-point licensees in regional and remote areas are not required to clear from the band unless they affect point-to-multipoint services.

1920–1980 MHz & 2110–2170 MHz (spectrum-licensed)

This band was also auctioned in 2000 as part of the 2 GHz (3G) spectrum licence offering in major city and regional areas. It is paired spectrum suitable for systems typically using FDD technology. The band is part of the spectrum identified by the ITU for the implementation of IMT-2000. Major operators have begun to roll out networks mainly in major capital cities to provide mobile telephony and broadband services.

This band also currently supports 301 fixed point-to-point links in regional and remote areas (outside spectrum-licensed areas). In addition, space research and space operation services operate at various locations around Australia.

2010–2025 MHz (declared for spectrum licensing)

The band 2010–2025 MHz was declared by the Minister for Communications on 4 April 2005 for re-allocation by issuing spectrum licences in capital city and regional areas. The band is also part of the spectrum identified by the ITU for the implementation of IMT-2000. The band will be auctioned in metropolitan and regional areas as wide-area licences (in 2006) but will continue to be available in remote areas via the assignment of apparatus licences. There are currently 56 point-to-point assignments in or overlapping the band. Under the re-allocation declaration, incumbent licensees have until 14 April 2007 to clear from the band within the declared spectrum-licensed areas.

In remote areas, the band remains designated for point-to-point fixed links on a secondary basis. Point-to-point licensees in remote areas have no obligation to clear from the band unless they affect point-to-multipoint services typically providing BWA⁴¹.

2.3 GHz (spectrum-licensed)

The band 2302–2400 MHz (previously known as MDS Band B) was used to provide analog pay television services. AUSTAR, the major licensee, held spectrum licences across many areas of regional Australia. AUSTAR also held spectrum licences in most capital cities with the intention of providing BWA services. They have since sold their capital city licences to Unwired.

MDS-delivered pay television services were transferred to a satellite-based delivery system because of the decreasing costs of providing such services. The transfer has enabled this spectrum to be considered for other purposes such as WAS. The spectrum licensing framework has also been updated to allow the provision of services other than MDS.

In 2005 spectrum licences were traded between AUSTAR and Unwired, resulting in AUSTAR controlling spectrum in most regional areas in the 2.3 GHz band and Unwired as the spectrum licensee for the major metropolitan areas.

Very few services exist in the 2302–2400 MHz band. However, on 7 July 2005 the major licensees announced an intention to roll out wireless broadband services in metropolitan and regional Australia using a WiMAX network.

2.4 GHz (class-licensed)

The band 2400–2483.5 MHz is included in the LIPD Class Licence. The band supports, amongst other things, RLAN equipment that conforms to the IEEE 802.11 b and g standards, commonly known as Wi-Fi. This technology is often deployed to provide so-called ‘hot-spots’ but is also used in city and regional areas to provide BWA. It is difficult to determine the number of existing users or networks, but considering the extensive deployment of Wi-Fi devices worldwide and that GSM handset manufacturers are beginning to incorporate Wi-Fi capability in their handsets, the use of the band can only increase.

This band provides a cheap entry point for new wireless ISPs; however, many operators either choose not to use the band, or establish their network and then seek licensed spectrum because of QoS issues that can result in class-licensed bands.

3.4 GHz (spectrum and apparatus-licensed)

WAS is being provided in the 3.4 GHz band using a mixture of spectrum and apparatus licensing. Spectrum licences in the 3.4 GHz band were allocated by means of auction in 2000. The geographic areas and frequency ranges that were allocated are as follows:

- two lots of 17.5 MHz from 3425–3442.5 MHz and 3475–3492.5 MHz (Block A) in 12 major cities and towns. Unwired and AUSTAR hold licences in Sydney and Melbourne, and Telstra holds licences in many of the other areas; and
- two lots of 32.5 MHz from 3442.5–3475 MHz and 3542.5–3575 MHz (Block B) in 12 major cities and towns as well as in regional areas. Unwired holds licences in major metropolitan areas and AUSTAR holds licences in regional areas.

In Block A in regional areas outside of spectrum-licensed areas, ACMA is continuing to issue apparatus licences and applications continue to be received from wireless ISPs wanting to deploy BWA. There are currently 354 point-to-multipoint apparatus licences assigned in the Block A band.

In general, there are a significant number of services licensed in the 3.4 GHz band, especially the Block A band in city and regional areas. Until now, spectrum services in Block B have only been deployed in Sydney and Melbourne. In addition, on 7 July 2005 the major licensees announced an intention to roll out wireless broadband services in metropolitan and regional Australia using a WiMAX network.

5.8 GHz (class and apparatus-licensed)

The band 5725–5850 MHz is included in the LIPD Class Licence and is also within one of the bands designated for use by ISM equipment. As with the 2.4 GHz band, the 5.8 GHz band also supports, amongst other things, RLAN equipment that conforms to the IEEE 802.11a standard, commonly known as Wi-Fi. However, the 5.8 GHz band is often used to provide low-cost point-to-point backhaul links to connect RLANs and BWA networks to other networks. Under the class licensing arrangements a maximum radiated power of up to 4 W is permitted.

In 2004 ACMA put in place a limited apparatus licensing arrangement to allow operation of point-to-point links with up to 200 W radiated power in this band. The arrangement expanded opportunities for the provision of regional and remote BWA services without significantly increasing interference risk to low power devices in the 5.8 GHz band. Across Australia, there are currently 16 assignments for 5.8 GHz point-to-point links.

WiMAX, an emerging application based on the IEEE 802.16 standards, aims to provide short to medium-range outdoor broadband data delivery in the 5.8 GHz band. Although WiMAX products are not in the marketplace yet, some industry observers have predicted that WiMAX could have a significant impact from 2007 onwards.

Larger operators are reluctant to use the 5.8 GHz band to provide extensive BWA networks because of QoS issues.

27 and 28/31 GHz (spectrum-licensed)

Spectrum licences have been issued in the 27, 28 and 31 GHz bands. These licences were marketed as being suitable for LMDS. This spectrum is suitable for WAS, including high-speed data applications such as internet access and a range of multimedia services. The main advantages of LMDS are that higher data rates are available from equipment in these bands and it allows for converged service providers.

An LMDS network has been established in the 28/31 GHz band in regional Victoria as well as certain CBD and broader metropolitan business areas. The network is capable of providing direct connectivity and services such as 2 Mbps data, voice and high-speed internet to business and government users requiring high-bandwidth access.

500 MHz of spectrum was allocated within the 26.85–27.35 GHz band with a view to establishing a business operating an LMDS network throughout Australia. A satellite company obtained 150 MHz in the 27.35–27.5 GHz band, which covers regional South Australia and Western Australia.

Approximately half of the 26.5–27.5 GHz band currently remains unallocated in most areas of Australia.

Presently the 27, 28 and 31 GHz bands have relatively few operational services.

Appendix D: An Example Alternative Framework—the ‘Private Park’

Introduction

The concept of a ‘private park’ for spectrum has been floated both in Australia and overseas as a way to increase the efficiency of spectrum use. 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.

Class licensing, as opposed to apparatus or spectrum licensing, allows multiple devices to share the same spectrum space through the imposition of certain restrictions. However, as there are no controls on the number of users that can deploy devices it can be difficult for providers of commercial services to guarantee QoS.

The development of a new type of device that avoids interference automatically through dynamic frequency selection and the use of contention-based protocols provides the potential to remove inefficiencies built into the traditional, exclusive-use licensing arrangements, and to avoid the QoS issues that may result under class licensing.

The private park framework is an attempt to gain the advantages of both the class licensing and exclusive-use licensing systems. A private park for spectrum would control interference in the same way as a class licence, by specifying conditions under which devices can use the park, which enables very efficient use of the spectrum.

To address QoS issues, entry to the private park would be controlled by issuing individual licences that authorise shared use, and requiring the registration of devices.

Possible Licensing Framework

For licensing purposes, the continent would be divided by demand for services into three areas (high, low and remote spectrum demand areas). Figure D1 gives a conceptual depiction of these areas based on currently-defined spectrum licensing areas. Adopting an ‘airline travel’ analogy to the proposal⁴², a key feature of the framework is the creation of

⁴² Only for the convenience of explanation in this paper.

three options that recognisably combine some of the features of class, apparatus and spectrum licensing:

1. ‘Business Class’—the ‘prime’ option, covering an entire state or territory. Recognising their value and the limited number that would be made available, these licences would be sold at auction.
2. ‘Economy Class’—covers low and remote spectrum demand areas in a state, but specifically excludes high density areas. The market value of these licences would be reduced in comparison to the ‘Business Class’ option, particularly as there may be no limit on the number of licences issued, and these licences would therefore be sold at a moderate fixed price.
3. ‘Discount Economy Class’—this option covers only the remote density areas and access rights would either be provided under a class licence, or licences would be sold on a cost recovery basis. The fee would be low to encourage (or not present barriers to) organisations wishing to service remote Australia.

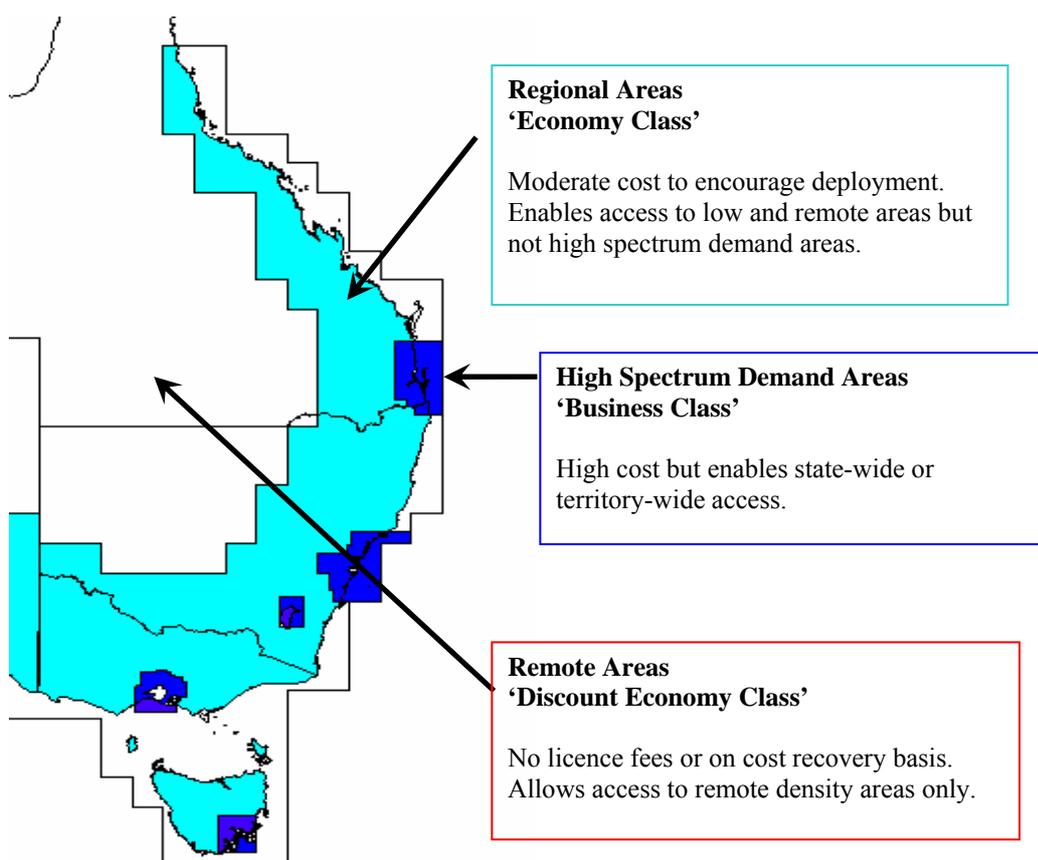


Figure D1: Conceptual private park licence areas

To ensure access to the band by multiple users, the ability to increase bandwidth as required, spectral efficiency and to promote competition, a multi-user licence is envisaged. This means that in each of the three defined areas a number of users would be

granted the right, either by auction or by payment of an over-the-counter fee, to use the band.

ACMA believes there would be significant interest in the ‘Business Class’ option. To ensure that all licensees would have access to sufficient spectrum, ACMA believes the number of ‘Business Class’ licences should be limited to between two and five in each state and territory.

There may be no limit on the number of ‘Economy Class’ licences issued in regional and remote areas, and there would be an unlimited number of ‘Discount Economy Class’ licences issued in remote areas. In practice, competition in the marketplace would limit the number of operators. To prevent QoS degradation from private use, it is envisioned that licensees would be required to hold a carrier licence under the *Telecommunications Act 1997*. This should serve as a natural threshold in terms of entry criteria. Equipment restrictions (for example, the requirement to use contention-based protocols) would prevent the band from becoming a ‘commons’ band.

Once allowed ‘entry’ to the band, licensees would be required to self-coordinate⁴³ and register devices in an online ACMA database. A simple set of guidelines would be developed for the self-coordination of devices.

The concept of device registration and interference evaluation by licensees is most useful when licensees do not use the process to deny spectrum access to others by making speculative device records. This can occur under traditional device registration arrangements because the ‘first-in-time’ principle is employed; that is, devices to be registered must first be coordinated with any other devices already registered in the database. The ‘capture’ of the band by false, bulk registrations could be avoided if the database gave no precedence to devices based on time of registration.

ACMA involvement in the device registration process would extend only to checking that a valid licence is held for the area in question and then maintenance of the licence and device database. Accordingly, the QoS issue could be addressed through the requirement to register devices and the consequent ability of the operators to self-evaluate interference levels.

In addition, ACMA believes there should be no ‘hard boundaries’ between licence areas, which will help to minimise or eliminate dead zones. If the base transmitter was geographically located within the licensed zone it would be considered to be legally deployed. ACMA is also considering mandating equipment with collision resolution capability⁴⁴, which would allow maximum flexibility and garner the maximum efficiency from the bandwidth provided.

⁴³ The FCC has specified ‘self coordinating’ equipment for the WiMax bands (http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-56A1.pdf). ACMA is likely to adopt a similar approach.

⁴⁴ Radio that self-coordinates by sensing whether a channel is free before transmitting.

Spectrum Pricing and Price-Based Allocation Issues

It is proposed that ‘Business Class’ licences be auctioned. Following consultation with interested parties, ACMA would specify the number of licences to be issued in each state and territory prior to the auction. All areas would be allocated at the same time using a simultaneous multi-round auction. This would enable operators to build up national licences or serve one or two states.

For operators wanting only to serve regional or remote areas, ‘Economy Class’ licences would be sold over-the-counter for a fee. There may be operators who would want to serve only one area and others who would want to build regional networks. Suitable fee structures for these arrangements would need to be determined.

It is envisaged that ‘Discount Economy Class’ licences, which would enable the establishment of a network anywhere in a remote density, would attract a token cost recovery fee. Alternatively, operations in remote areas could be permitted under a class licence with no fee paid.

ACMA is exploring whether the proposed multi-user private park licences could be provided under an apparatus or spectrum licensing regime. It is possible that either could be crafted appropriately.

In these circumstances, the primary differences between apparatus and spectrum licences are the licence terms and the renewal provisions. The maximum spectrum licence term is 15 years, with another priced-based allocation at the expiry of the licence, unless the Minister for Communications deems a price-based allocation not in the public interest. The maximum apparatus licence term is five years; apparatus licences are usually renewed on expiry, although legislation does not provide for a positive presumption of renewal.

Appendix E: Existing Arrangements in Candidate WAS Bands

E.1 Introduction

This appendix provides an overview of existing arrangements in candidate WAS frequency bands in the 1–4 GHz range as identified in section 7 of the discussion paper. The appendix is intended to assist assessment of the effect on existing services and viability of WAS services in the identified candidate bands to aid in the preparation of responses to the discussion paper.

For analysis purposes candidate WAS bands with related spectrum arrangements have been grouped together to assist understanding of spectrum interrelationships. Candidate bands have been grouped as follows:

Section E2: 1725–1785/1820–1880 MHz and 1785–1805 MHz

Section E3: 1920–1960/2110–2150 MHz and 2025–2110/2200–2300 MHz

Section E4: 2500–2690 MHz

Section E5: 3575–3710 MHz & 3710–4200 MHz

W.1.1 Methodology

Existing arrangements are summarised and references provided to relevant documentation. In candidate bands overlapping fixed point-to-point link bands link assignments are summarised by fixed link channel plan, by licensee, geographic distribution and fixed link spectrum occupancy.

Geographic distribution maps

Fixed link geographic distribution maps show the location of fixed links across Australia. They can be used to assist in assessing the effect of candidate bands on existing fixed links in various areas. There is no weighting for the number of links at a particular location and hence a single link assignment location may represent one or multiple assignments.

Spectrum occupancy graphs

Fixed link spectrum occupancy graphs show the number of services (density of assignments) in a frequency band in Australia. Occupancy graphs can be used to assess the effect of candidate bands on existing fixed links. They are determined from fixed link emission bandwidth (a measure of how much spectrum is occupied). Note that in viewing spectrum occupancy charts it is not always easy to discern the formal channel

arrangements due to a combination of a wide variation in emission bandwidth, assignment not conforming to published arrangements, overlapping channel plans, use of interleaving channels, assignments on discontinued plans and ad-hoc arrangements used in the management of band clearance and spectrum re-allocation programs.

Interpretation of fixed link data

Interpretation of fixed link data requires consideration of the bi-directional/paired nature of fixed point-to-point links. Changing spectrum arrangements for one channel will impact on the paired channel as well, irrespective of whether the spectrum arrangements for the paired channel are changed. For example, it may be no longer possible to use a single antenna for transmitting and receiving at a site if one link path is required to operate using a different frequency band.

Source of assignment data

Assignment information in this appendix is derived from ACMA's Record of Radiocommunications Licences (RRL) on CD-ROM as at 1 September 2005. Historical trends data is based on archive data as at 1 January of each year referenced. In fixed link bands only licensed services at a specific location have been considered.

Information on obtaining a copy of the RRL CD-ROM is on the register of radiocommunications licences section of the ACMA website at http://www.acma.gov.au/ACMAINTER:STANDARD::pc=PC_1613

E.2.1 Related reference material

Information on radiofrequency planning in Australia, including the spectrum plan and band plans, can be found on the frequency planning pages of the ACMA website (see http://www.acma.gov.au/ACMAINTER.65640:STANDARD:333439686:pc=PC_2705). ACMA has also produced a number of reports that may assist in understanding issues in the candidate bands including:

1. *From DC to Daylight—Accounting for Use of the Spectrum in Australia*, (particularly Appendix VI—Frequency Audit Table) Australian Communications Authority, June 2004 (see http://www.acma.gov.au/ACMAINTER.131456:STANDARD:532922567:pc=PC_1650)
2. ‘Utilisation of the Microwave Fixed Services Bands’, Spectrum Planning Report SP 04/03, Radiofrequency Planning Group, Australian Communications Authority, October 2003 (see http://www.acma.gov.au/ACMAINTER.131456:STANDARD:532922567:pc=PC_2628).
3. ‘Microwave Fixed Services: Descriptive Statistics and Parameters for use in Intra and Interservice Sharing Studies’, Spectrum Planning Report SP 07/01, Radiofrequency Planning Group, Australian Communications Authority, June 2001 (see http://www.acma.gov.au/acmainterwr/radcomm/frequency_planning/spps/0107spp.pdf)

4. 'Microwave Radio Spectrum Trends: Accommodating the Demands of Growth, New Technologies and Relocation', Radiofrequency Planning Group, Australian Communications Authority, February 2000. (see http://www.acma.gov.au/acmainterwr/radcomm/frequency_planning/radiofrequency_planning_topics/docs/fspaperall.pdf)

E.2 1725–1785/1820–1880 MHz and 1785–1805 MHz

E.2.1 Current arrangements

Services relevant to the consideration of candidate bands 1725–1785/1820–1880 MHz and 1785–1805 MHz include:

- 1.8 GHz spectrum-licensed services (1710–1785/1805–1880 MHz);
- fixed point-to-point links under the 1.8 GHz (1700–1900 MHz) and 2.1 GHz (1900–2300 MHz) channel plans for point-to-point links;
- cordless telecommunications services (1880–1900 MHz); and
- FWA services in rural and remote areas (1880–1900 MHz).

1.8 GHz spectrum-licensed services

The bands 1710–1785 MHz and 1805–1880 MHz are spectrum-licensed in the major capital cities (Adelaide, Brisbane, Melbourne, Perth and Sydney) and mainly used for GSM1800 mobile telecommunications systems. Use in regional areas is restricted to 1710–1725 MHz and 1805–1820 MHz. 1.8 GHz spectrum licences were auctioned in 1998 and 2000.

For more information see PCS spectrum auction results on the spectrum auction pages on the ACMA website (http://auction.acma.gov.au/auction_results/index.asp) and spectrum licensing legislation for the 800 MHz and 1.8 GHz bands at http://www.acma.gov.au/ACMAINTER.131456:STANDARD:249779931:pc=PC_1583.

Fixed point-to-point links

1.8 GHz fixed point-to-point links: The 1.8 GHz fixed point-to-point channel plan overlaps the bands 1725–1785/1820–1880 MHz and 1785–1805 MHz. Due to clearances to support 1.8 GHz spectrum licences, fixed link operation is mainly limited to regional areas. Use of the band 1880–1900 MHz is further restricted by cordless telecommunications services, FWA services in remote areas, and the 1.9 GHz band plan under which use is limited to fixed links that were authorised to operate before 14 March 1996 (see http://www.acma.gov.au/ACMAINTER.65640:STANDARD:1105710194:pc=PC_285).

The 1.8 GHz channel plan provides a total of 24 channels in a paired (12x2) configuration with a 14 MHz channel bandwidth, a go/return split of 119 MHz, 12 main and 12 interleaved channels. Main and interleaved channels are offset by 7 MHz. The band is designated for use by low to medium-capacity fixed links.

Based on September 2005 ACMA licensing data, the 1.8 GHz channel plan accommodates a total of 1913 point-to-point assignments with a predominance of

assignments on channels 1M, 2M, 2I, 3M, 3I and 4M, together with their associated upper band paired channels. Fixed link assignments in the 1.8 GHz channel plan are detailed in Table E.2. Breakdown of assignments with emission bandwidths in the 1785–1805 MHz and 1725–1785/1820–1880 MHz WAS candidate bands by geographic area and licensee are in sections E2.2 and E2.3 respectively.

2.1 GHz fixed point-to-point links: 2.1 GHz fixed link channel 1I (1907.5 MHz, 12 assignments) is adjacent to the potential WAS bands and adjacent channel coordination issues are the main consideration. 2.1 GHz fixed point-to-point channel plan arrangements are described in section E.3.

For more information on microwave point-to-point services see Radiocommunications Assignment and Licensing Instruction (RALI) FX3 ‘*Microwave Fixed Services Frequency Coordination*’ (http://www.acma.gov.au/ACMAINTER.131456:STANDARD:532922567:pc=PC_2599)

Cordless telecommunications services

Cordless telecommunications devices operating in the band 1880–1900 MHz are authorised to operate under the *Radiocommunications (Cordless Telecommunications Devices) Class Licence 2001*. For more information see http://www.acma.gov.au/ACMAINTER.131456:STANDARD:249779931:pc=PC_1267

FWA services

FWA services share the band 1880–1900 MHz with fixed point-to-point services and cordless telecommunications systems. For more information see RALI FX18 ‘*Frequency Coordination and Licensing Procedures for Fixed Wireless Access Services Sharing the 1.9 GHz Band with Fixed Links*’ at http://www.acma.gov.au/ACMAINTER.131456:STANDARD:532922567:pc=PC_2605

Illustration of services

Existing services, along with the candidate regional WAS bands 1725–1785/1820–1880 MHz and 1785–1805 MHz, are illustrated in Figure E.2.1. Also depicted is fixed link spectrum occupancy in the range 1700–1900 MHz. Represented in the occupancy graph are 1931 assignments, made up of 1913 1.8 GHz assignments and 18 2.1 GHz assignments (channel 1I, 1907.5 MHz).

Figure E.2.1: Band arrangements and fixed link spectrum occupancy in the range 1700–1900 MHz

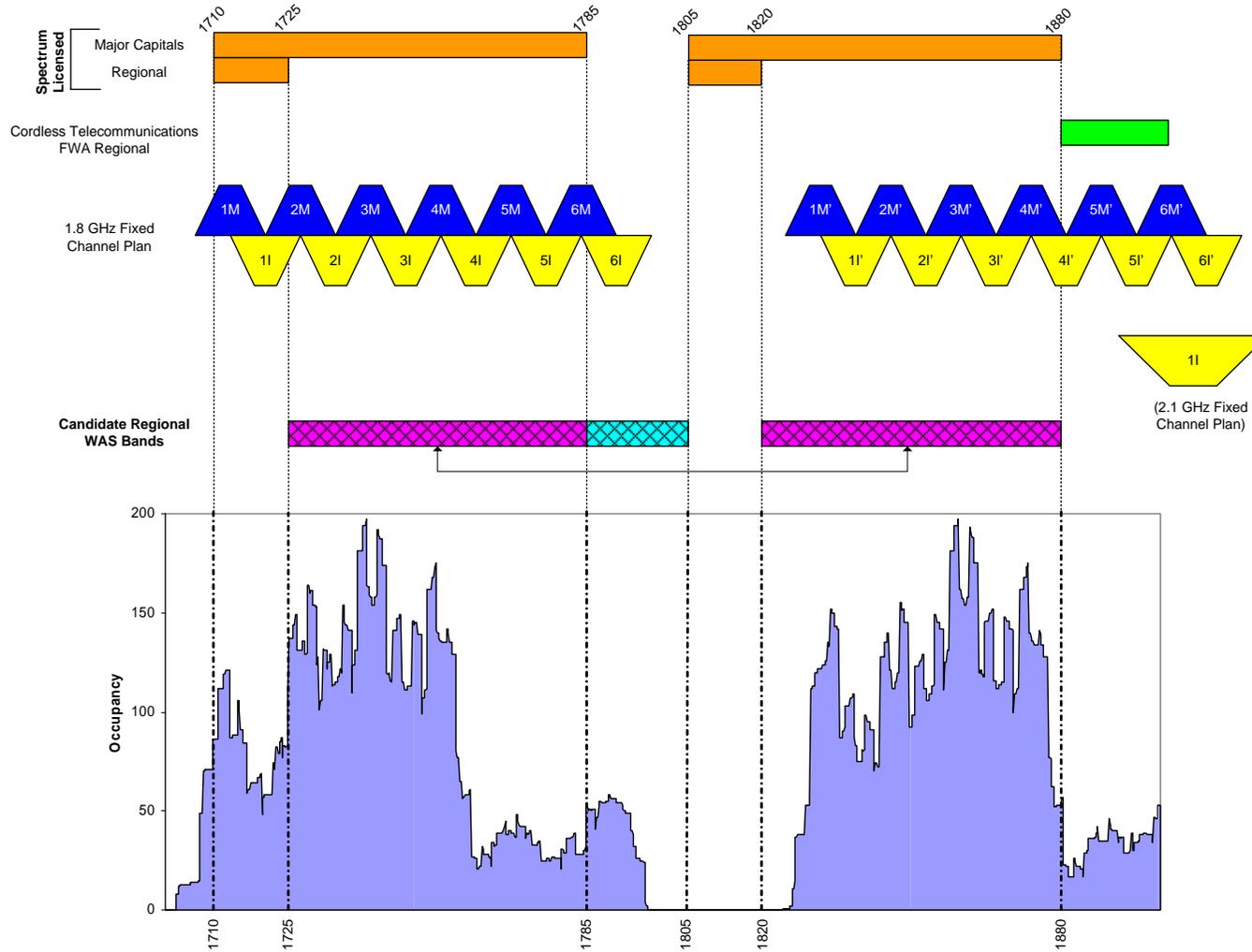


Table E.2.1: 1.8 GHz channel plan assignments

Channel Number	Assigned Frequency (MHz)	Number of Assignments	Channel Number	Assigned Frequency (MHz)	Number of Assignments
1M	1713.5	121	1M'	1832.5	124
1I	1720.5	68	1I'	1839.5	73
2M	1727.5	107	2M'	1846.5	108
2I	1734.5	105	2I'	1853.5	105
3M	1741.5	151	3M'	1860.5	151
3I	1748.5	106	3I'	1867.5	108
4M	1755.5	134	4M'	1874.5	134
4I	1762.5	20	4I'	1881.5	16
5M	1769.5	39	5M'	1888.5	35
5I	1776.5	24	5I'	1895.5	21
6M	1783.5	28	6M'	1902.5	27
6I	1790.5	54	6I'	1909.5	54
Totals		957			956
Total assignments: 1913					

Key	
	Overlapped: 1725–1785/1820–1880 MHz;
	Overlapped: 1725–1785/1820–1880 MHz and 1785–1805 MHz;

Table E.2.1 details assignments in the 1.8 GHz fixed link channel plan. The left side of the table lists the lower frequency block of channels ordered by assigned frequency, together with channel designators and number of fixed links on each channel. The right side of the table lists the same data for the upper frequency block of channels. Each row of the table illustrates both its lower band channel and its paired upper band channel. Shading has been used to indicate channels overlapped by WAS candidate bands.

E.2.2 1785–1805 MHz

Consideration of fixed point-to-point links within this subsection is restricted to fixed link assignments with emission bandwidth within the 1785–1805 MHz band. There are 80 fixed link assignments meeting this criteria, made up of all assignments in the 1.8 GHz channel 6I and assignments on channel 6M with emission bandwidths > 3 MHz.

Figure E.2.2: Location of fixed links in the band 1785–1805 MHz

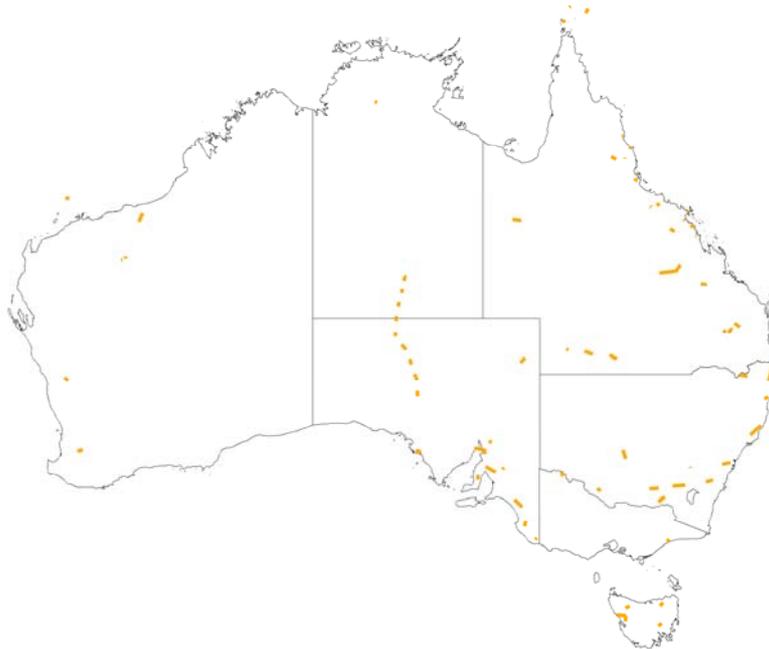


Figure E.2.2 illustrates the geographic distribution, throughout Australia, of fixed links with emission bandwidths in the 1785–1805 MHz band. The link locations are thinly distributed throughout Australia in both regional and remote areas.

Figure E.2.3: Fixed link assignments per licensee in the band 1785–1805 MHz

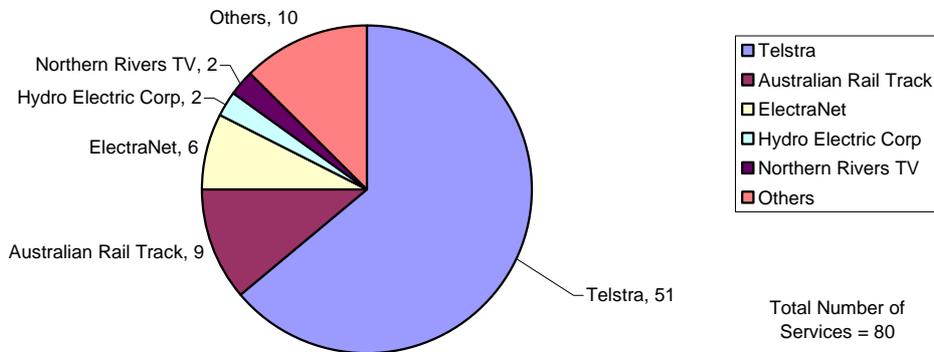


Figure E.2.3 illustrates the breakdown of the number of assignments per licensee for all licensees with fixed link assignments with emission bandwidths within the 1785–1805 MHz band.

E.2.3 1725–1785/1820–1880 MHz

Consideration of fixed point-to-point links within this subsection is restricted to fixed link assignments with emission bandwidth within the 1785–1805 MHz band. There are 1594 fixed link assignments meeting this criteria, made up of all assignments in the 1.8 GHz channels 2M, 2I, 3M, 4I, 5M, 5I, 6M, 1M', 1I', 2M', 2I', 3M', 4M' and 6I, and assignments in channel 1I with emission bandwidth > 9 MHz, channel 6I with emission bandwidth > 11 MHz and channel 4I' with emission bandwidth > 3 MHz.

Figure E.2.4: Location of fixed links in the bands 1725–1785/1820–1880 MHz

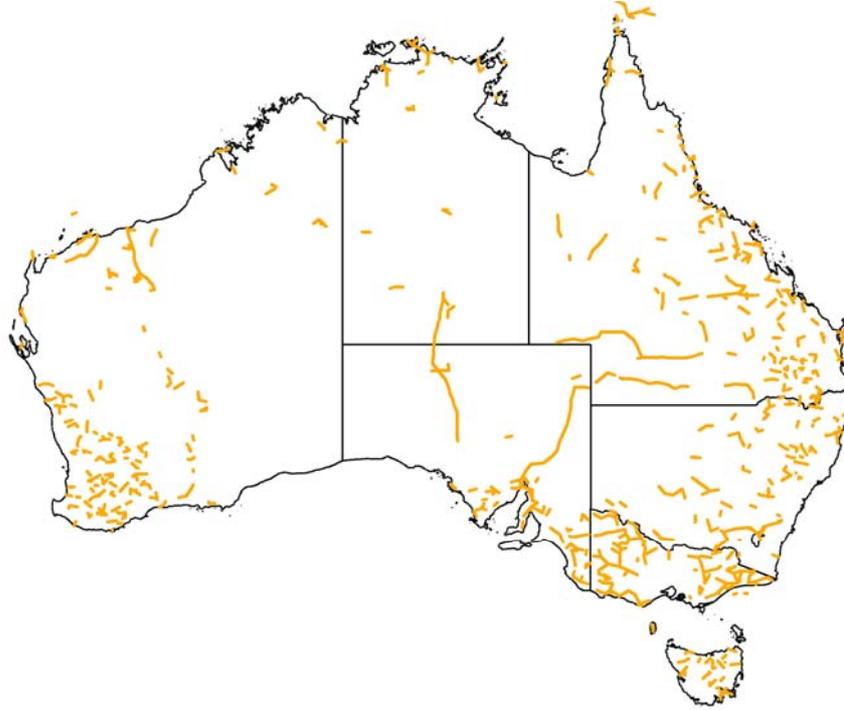


Figure E.2.4 illustrates the geographic distribution, throughout Australia, of fixed links with emissions bandwidths in the 1725–1785/1820–1880 MHz bands. The link locations are distributed throughout Australia in both regional and remote areas.

Figure E.2.5: Fixed link assignments per licensee in the 1725–1785/1820–1880 MHz bands

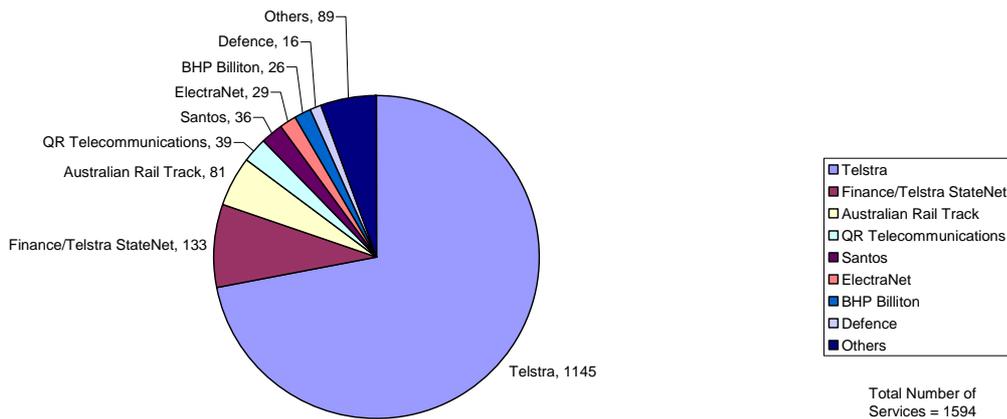


Figure E.2.5 illustrates the breakdown of the number of assignments per licensee for all licensees with assignments with emission bandwidth within the 1725–1785/1820–1880 MHz band.

E.3 1920–1960/2110–2150 MHz and 2025–2110/2200–2300 MHz

E.3.1 Current Arrangements

Services relevant to the consideration of candidate bands 1920–1960/2110–2150 MHz and 2025–2110/2200–2300 MHz include:

- spectrum-licensed services in the bands 1900–1980 MHz and 2110–2170 MHz (known as 2 GHz spectrum licensing) and 2010–2025 MHz;
- fixed point-to-point links under the 2.1 GHz (1900–2300 MHz) and 2.2 GHz (2025–2285 MHz) channel plans for point-to-point links;
- BWA services in the bands 1900–1920 MHz and 2010–2025 MHz in regional and remote areas;
- space research services and space operation services in the bands 2025–2110 MHz and 2200–2290 MHz, and space research (deep space) services in the bands 2110–2120 MHz and 2290–2300 MHz; and
- mobile-satellite services in the bands 1980–2110 MHz and 2170–2200 MHz.

Spectrum Licensing

2 GHz spectrum licensing: The 2 GHz spectrum licensing bands are:

- 1900–1920 MHz in capital cities;
- 1920–1935/2110–2125 MHz in capital cities except Canberra;
- 1935–1960/2125–2150 MHz in capital cities; and
- 1960–1980/2150–2170 MHz in capital cities and regional areas.

2 GHz spectrum licensing is typically used for 3G mobile telecommunications; the band 1900–1920 MHz is commonly used for WAS. 2 GHz spectrum licences were auctioned in 2001.

For more information see 3rd generation mobile spectrum auction results on the spectrum auction pages on the ACMA website at http://auction.acma.gov.au/auction_results/index.asp and spectrum licensing legislation for the 800 MHz and 2 GHz bands at http://www.acma.gov.au/ACMAINTER.131456:STANDARD:249779931:pc=PC_1583

2010–2025 MHz spectrum licensing: Spectrum licences for the band 2010–2025 MHz in capital city and regional areas are to be auctioned later this year to support BWA systems. For more information see the BWA section on the spectrum auction pages of the ACMA website at http://auction.acma.gov.au/current_projects/bwa/index.asp.

Fixed point-to-point links

2.1 GHz fixed point-to-point links: The 2.1 GHz fixed point-to-point link channel plan overlaps the bands 1920–1960/2110–2150 MHz and 2025–2110/2200–2300 MHz. Due to spectrum licensing and mobile-satellite services, fixed link operation is mainly limited to regional areas. Operation in the band 1900–1920 MHz in regional and remote

areas is on a secondary basis to BWA systems (please refer to the *1900–1920 MHz and 2010–2025 MHz Bands Frequency Band Plan 2004* at http://www.acma.gov.au/ACMAINTER.65640:STANDARD:1105710194:pc=PC_2574)

The 2.1 GHz channel plan provides a total of 24 channels in a paired configuration (12x2) with a 29 MHz channel bandwidth, a go/return split of 213 MHz, 12 main and 12 interleaved channels. Main and interleaved channels are offset by 14.5 MHz. The band is designated for used by medium-capacity fixed links.

2.2 GHz fixed point-to-point links: The 2.2 GHz fixed point-to-point link channel plan overlaps the bands 2025–2110/2200–2300 MHz and is adjacent to the band 2110–2150 MHz.

The 2.2 GHz channel plan provides a total of 12 channels in a paired configuration (6x2) with a 14 MHz channel bandwidth, a go/return split of 175 MHz. The band is designated for used by medium-capacity fixed links.

1.8 GHz fixed point-to-point links: 1.8 GHz channel 6I' (1909.5 MHz, 54 assignments) is adjacent to the candidate WAS band 1920–1960 MHz. 1.8 GHz point-to-point arrangements are described in section E.2.

Fixed link assignment details: Based on September 2005 ACMA licensing data, there are 872 fixed link assignments in the 2.1 GHz and 2.2 GHz channel plans. Of those assignments, 747 are in the 2.1 GHz channel plan and 125 in the 2.2 GHz channel plan. Assignments by channel plan are detailed in Table E.3.2. Breakdown of assignments with emission bandwidths in the 1920–1960/2110–2150 MHz and 2025–2110/2200–2300 MHz WAS candidate bands by geographic area and licensee are in sections E3.2 and E3.3 respectively.

For more information on microwave point-to-point services see RALI FX3 '*Microwave Fixed Services Frequency Coordination*' on the ACMA website at http://www.acma.gov.au/ACMAINTER.131456:STANDARD:532922567:pc=PC_2599.

BWA services

BWA services operate in the 1900–1920 MHz band in regional and remote areas and in the 2010–2025 MHz band in remote areas.

For more information see RALI FX19 '*Frequency Coordination and Licensing for Apparatus Licensed Broadband Wireless Access Services in the 1900–1920 and 2010–2025 MHz bands*' on the ACMA website at http://www.acma.gov.au/ACMAINTER.65640:STANDARD:1843860835:pc=PC_2972.

Space research and space operation services

The Spectrum Plan allocates:

- 2025–2110 MHz to space operation (Earth-to-space) and space research (Earth-to-space) services;
- 2110–2120 MHz to space research (deep space, Earth-to-space) services;
- 2200–2290 MHz the space operation (space-to-Earth) and space research (space-to-Earth) services; and
- 2290–2300 MHz to space research (deep space, space-to-Earth) service.

The candidate WAS bands 2025–2120 MHz and 2200–2300 MHz overlap the space operation and space research bands.

Earth stations in these bands typically operate at Landsdale (WA), New Norcia (WA) and Tidbinbilla (ACT). Based on September 2005 ACMA licensing data, there are 58 earth receive and 50 fixed earth assignments for earth stations in the space research and space operation services bands. Breakdown of assignments for space research and space operation services bands by licence type, licensee and location are in Table E3.1.

Table E.3.1: Breakdown of space research and space operations services assignments

Breakdown by Licensee			Breakdown by Location		
Licensee	Licence	Number	Location	State	Number
Australian Defence Force Academy	Earth Receive	1	ALICE SPRINGS	NT	3
Australian Defence Force Academy	Fixed Earth	1	BATTERY POINT	TAS	2
BAE Systems Australia Limited	Earth Receive	1	H M A S CERBERUS	VIC	2
Bureau of Meteorology	Fixed Earth	2	LANDSDALE	WA	62
California Institute of Technology	Earth Receive	1	MAWSON LAKES	SA	4
CSIRO	Earth Receive	8	MINGENEW	WA	2
CSIRO	Fixed Earth	3	MOUNT STROMLO	ACT	1
CSIRO Marine Research	Earth Receive	2	NEW NORCIA	WA	24
Geoscience Australia	Fixed Earth	2	TIDBINBILLA	ACT	7
Universal Space Network Inc.	Fixed Earth	1	YARRAGADEE	WA	1
Xantic BV	Earth Receive	45			
Xantic BV	Fixed Earth	41			
Total		108			108

Mobile-satellite services

The Spectrum Plan allocates:

- 1980–2010 MHz to the mobile-satellite (Earth-to-space) service; and
- 2170–2200 MHz to the mobile-satellite (space-to-Earth) service.

Under the *Mobile-Satellite Service (2 GHz) Frequency Band Plan 2002*, except for existing assignments, only mobile-satellite services can use the bands 1980–2010 MHz and 2170–2200 MHz. A copy of the band plan is available on ACMA website at http://www.acma.gov.au/acmainterwr/aca_home/legislation/radcomm/band_plans/mobsat2ghz_2002.pdf.

Illustration of services

These services, along with the candidate regional WAS bands 1920–1960/2110–2150 MHz and 2025–2110/2200–2300 MHz and candidate alternative ENG bands, are illustrated in Figure E.3.1.

Depicted in Figure E.3.2 is fixed link spectrum occupancy. For ease of reference, key band information is overlaid on the occupancy graph. Represented in the occupancy graph are 964 assignments consisting of 747 2.1 GHz assignments, 125 2.2 GHz assignments and 92 1.8 GHz assignments (54 assignments on channel 6I' 1909.5 MHz, 27 assignments on channel 6M' and 11 assignments on channel 5I' 1895.5 with emission bandwidths > 9 MHz).

Figure E.3.1: Arrangements in the band 1900–2300 MHz

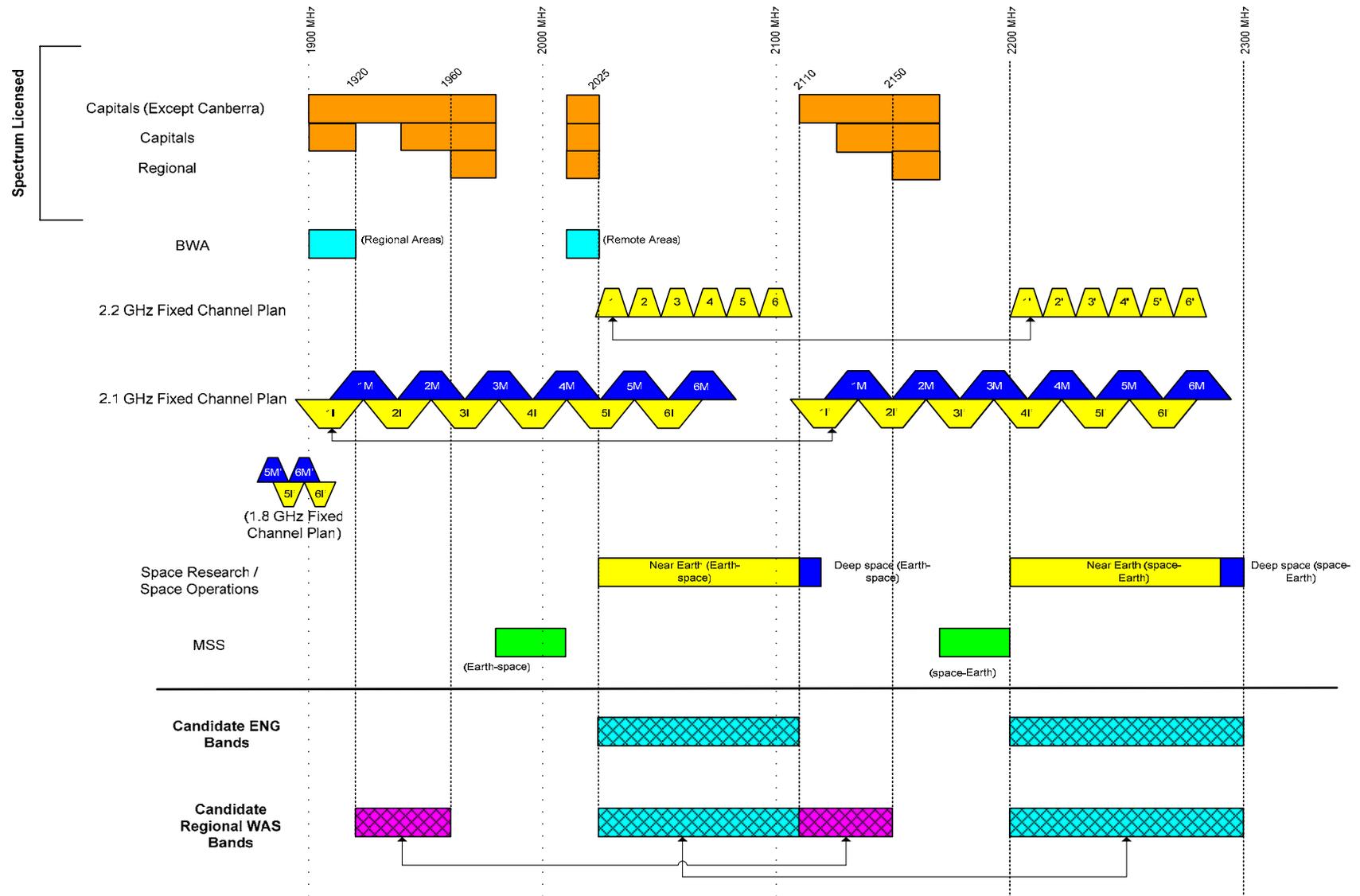


Figure E.3.2: Fixed link spectrum occupancy in the band 1900–2300 MHz

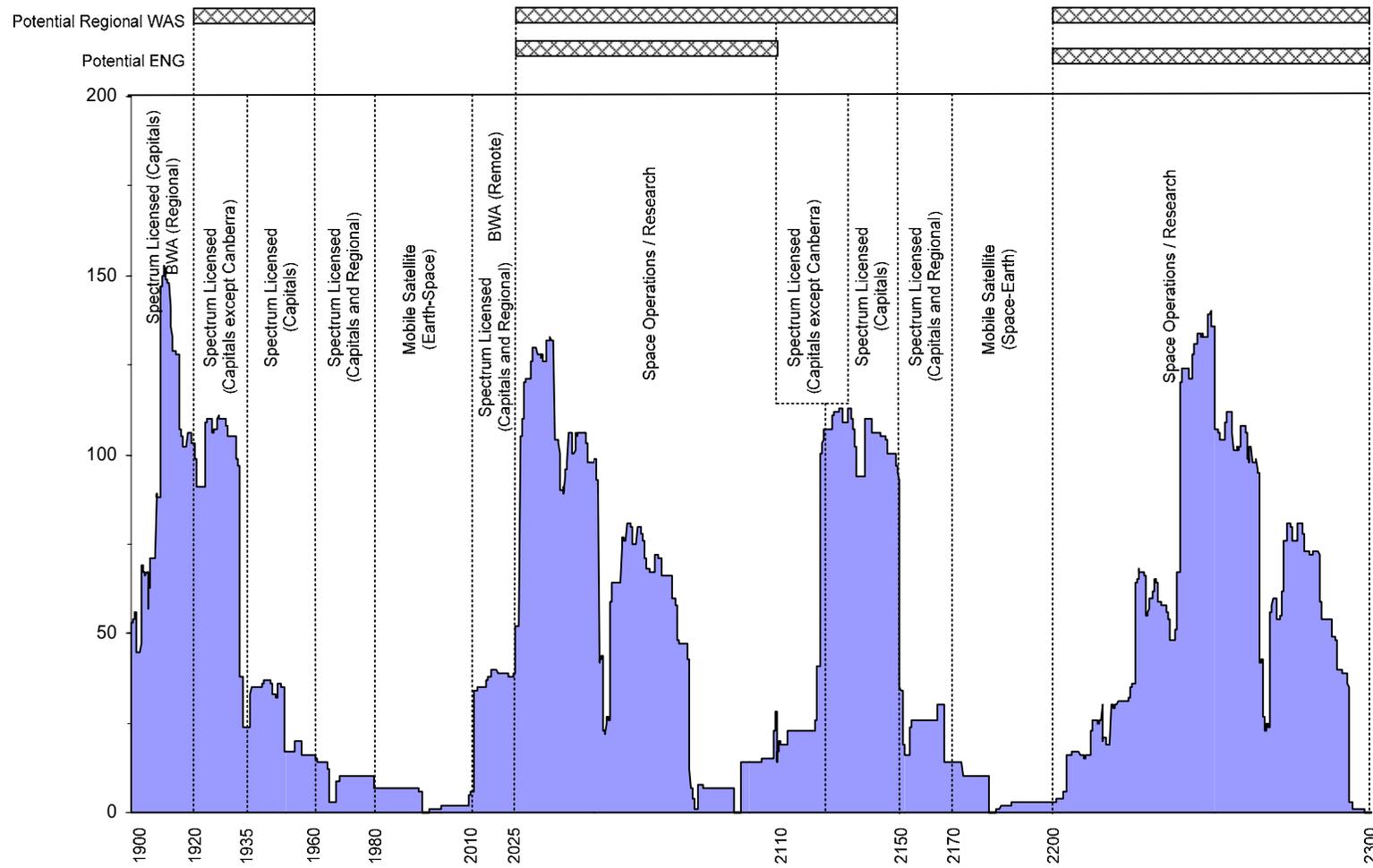


Table E.3.2: 2.1 GHz and 2.2 GHz plan assignments

(Plan): Channel Number	Centre Frequency (MHz)	Number of Assignments	Channel Number	Centre Frequency (MHz)	Number of Assignments
(2.1): 1I	1907.5	18	1I'	2120.5	23
(2.1): 1M	1922	91	1M'	2135	94
(2.1): 2I	1936.5	24	2I'	2149.5	16
(2.1): 2M	1951	17	2M'	2164	14
(2.1): 3I	1965.5	3	3I'	2178.5	0
(2.1): 3M	1980	7	3M'	2193	3
(2.1): 4I	1994.5	0	4I'	2207.5	2
(2.1): 4M	2009	2	4M'	2222	19
(2.1): 5I	2023.5	38	5I'	2236.5	40
(2.2): 1	2032.5	13	1'	2207.5	13
(2.1): 5M	2038	86	5M'	2251	94
(2.2): 2	2046.5	10	2'	2221.5	12
(2.1): 6I	2052.5	19	6I'	2265.5	16
(2.2): 3	2060.5	7	2'	2235.5	7
(2.1): 6M	2067	62	6M'	2280	59
(2.2): 4	2074.5	8	4'	2249.5	8
(2.2): 5	2088.5	7	5'	2263.5	11
(2.2): 6	2102.5	15	6'	2277.5	14
Totals		427			445
Total assignments: 872					

Key	
	Overlapped: 1920–1960/2110–2125 MHz
	Overlapped: 2025–2110/2200–2300 MHz
	Overlapped: 1920–1960/2110–2125 MHz and 2025–2110/ 2200–2300 MHz

Table E.3.2 details assignments in the 2.1 GHz and 2.2 GHz fixed link channel plans. The left side of the table lists the lower frequency block of channels ordered by assigned frequency, together with channel designators and number of fixed links on each channel. The right side of the table lists the same data for the upper frequency block of channels. Each row of the table illustrates both its lower band channel and its paired upper band channel. Note that there are 10 non-conforming assignments in this band and for convenience of illustration, these have been grouped together with the nearest designated channel. Shading has been used to indicate channels overlapped by WAS candidate bands.

E.3.2 1920–1960/2110–2150 MHz

Consideration of fixed point-to-point links within this subsection is restricted to link assignments with emission bandwidth within the 1920–1960/2110–2150 MHz bands.

There are 280 fixed link assignments meeting this criteria, consisting of all assignments in the 2.1 GHz channels 1M, 2I, 2M, 1I', 2M' and 2I', and assignments in channel 1I with emission bandwidth > 25 MHz, channel 3I with emission bandwidth > 11 MHz, channel 2M' with emission bandwidth > 28 MHz and channel 2I' with emission bandwidth > 1 MHz.

Figure E.3.3: Location of fixed links in the bands 1920–1960/2110–2150 MHz

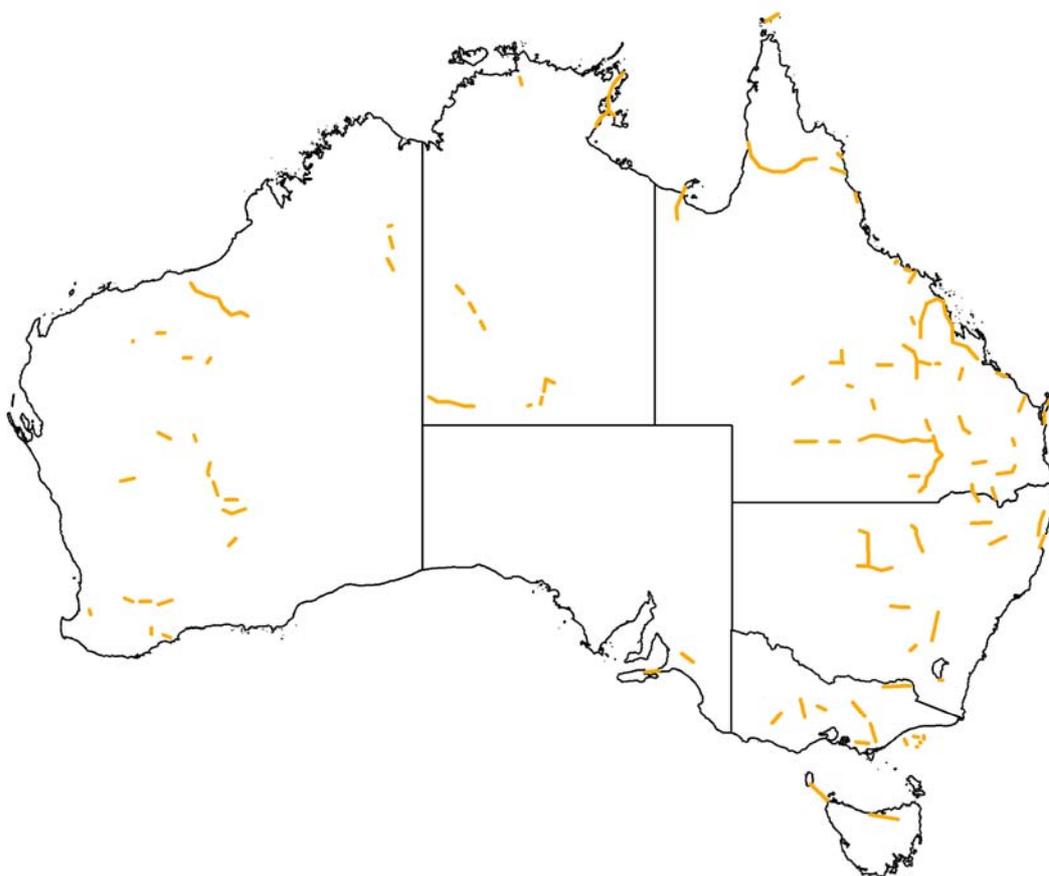


Figure E.3.3 illustrates the geographic distribution, throughout Australia, of fixed links with emission bandwidths in the 1920–1960/2110–2150 MHz bands.

Figure E.3.4: Fixed link assignments per licensee in the bands 1920–1960/2110–2150 MHz

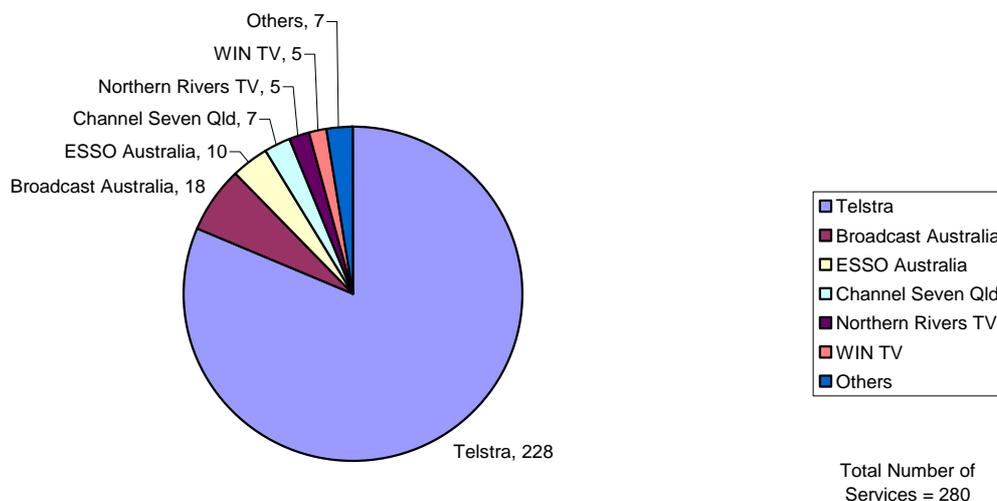


Figure E.3.4 illustrates the breakdown of the number of assignments per licensee for all licensees with assignments with emission bandwidth within the 1920–1960/2110–2150 MHz bands.

E.3.3 2025–2110/2200–2300 MHz

Consideration of fixed point-to-point links within this subsection is restricted to link assignments with emission bandwidth within the 2025–2110/2200–2300 MHz band. There are 582 fixed link assignments meeting this criteria, consisting of all assignments in the 2.2 GHz channels, 2.1 GHz channels 5M, 6I, 6M, 4I', 4M', 5I', 5M', 6I', 6M' and assignments in 2.1 GHz channel 5I with emission bandwidth > 3 MHz, 1I' with emission bandwidth > 21 MHz and channel 3M' with emission bandwidth > 14 MHz.

Figure E.3.5: Location of fixed links in the bands 2025–2110/2200–2300 MHz

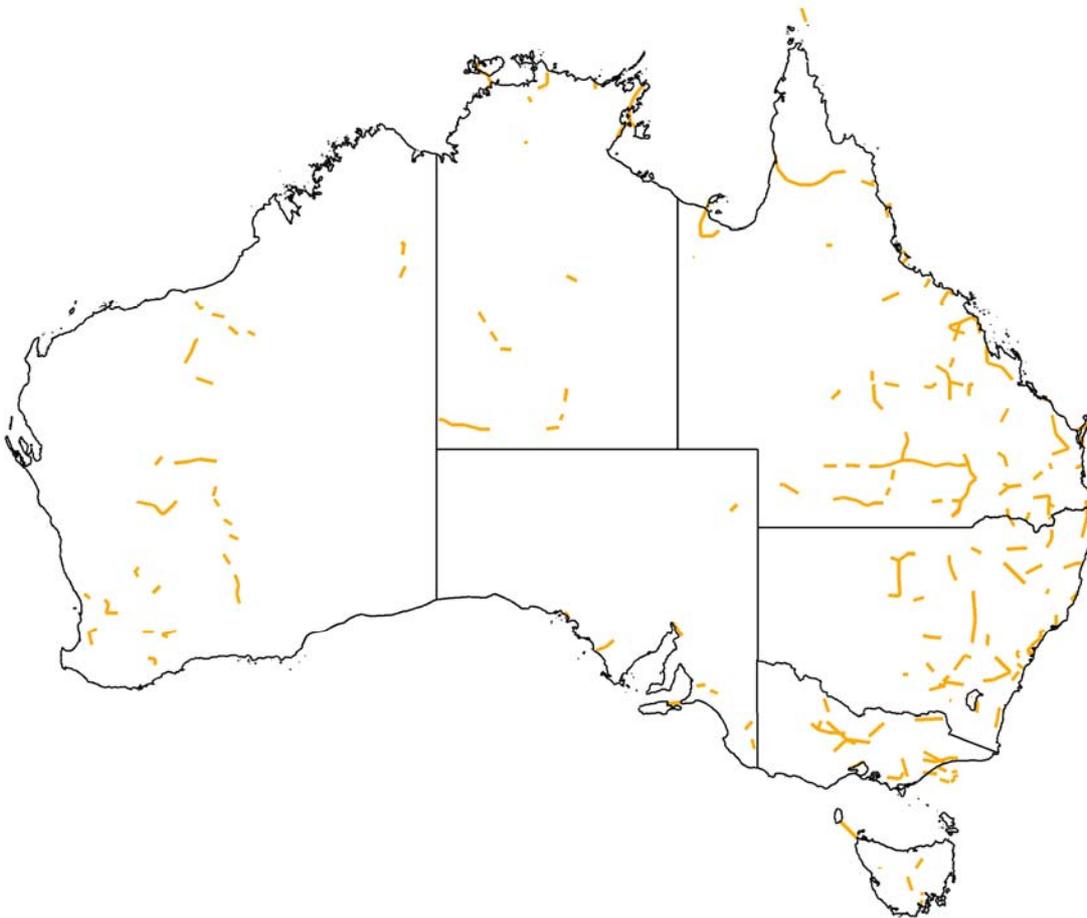


Figure E.3.5 illustrates the geographic distribution, throughout Australia, of fixed links with emission bandwidths in the 2025–2110/2200–2300 MHz band. The link locations are distributed throughout Australia in both regional and remote areas.

Figure E.3.6: Fixed link assignments per licensee in the bands 2025–2110/2200–2300 MHz

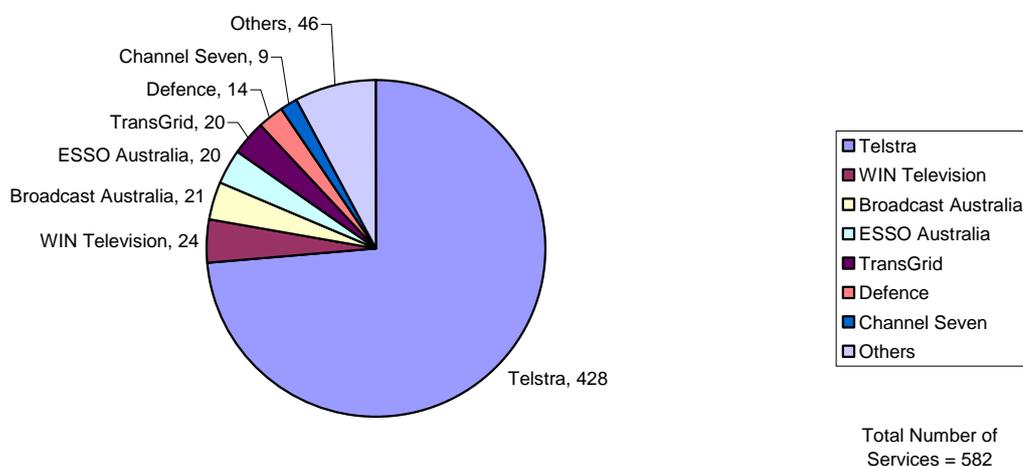


Figure E.3.6 illustrates the breakdown of the number of assignments per licensee, for all licensees with assignments with emission bandwidth within the 2025–2110/2200–2300 MHz bands.

E.4 2500–2690 MHz

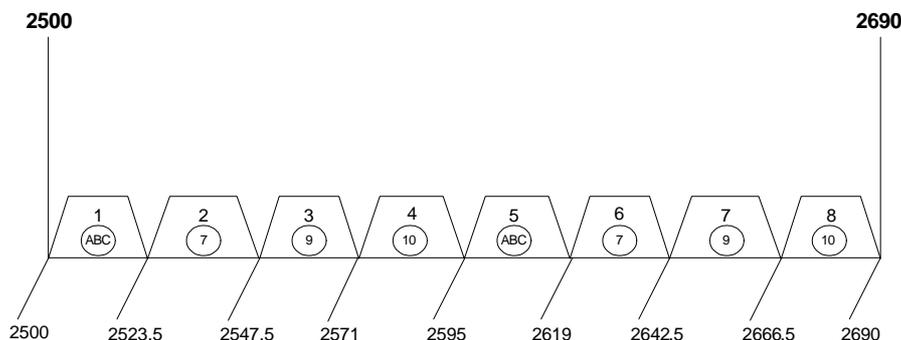
The band 2500–2690 MHz is presently identified primarily for use by television outside broadcast (TOB) services, particularly ENG applications. ENG services typically operate using a number of mobile or remote stations feeding a central coordinating point. Permanent sites for use as a coordinating point are normally established in the central business district of capital cities in order to provide better coverage of the metropolitan area. Temporary sites are established on an ad-hoc basis as required. There are also a few miscellaneous assignments including fixed links.

Figure E.4.1 illustrates the band arrangements in the band 2500–2690 MHz.

For more information see RALI FX3 ‘*Microwave Fixed Services Frequency Coordination*’ on the ACMA website at

http://www.acma.gov.au/ACMAINTER.131456:STANDARD:532922567:pc=PC_2599.

Figure E.4.1: Channelling arrangements in the band 2500–2690 MHz



TOB Network Licences : (7) =Seven Network , (9) =Nine Network , (10) =Ten Network , (ABC) =ABC Network.

Apart from ENG and TOB, few other services operate in the 2500–2690 MHz band. Breakdown of assignments by licence type and licensee are in Table E4.1.

Table E.4.1: 2500–2690 MHz assignments by licensee and licence type

Licensee	Licence	Number
Australian Broadcasting Corp	Television Outside Broadcast Network	3
Channel Seven Perth	Fixed Receive	2
Channel Seven Sydney	Television Outside Broadcast Network	4
Department of Defence	Point to Point	1
Network Ten (Sydney)	Television Outside Broadcast Network	3
Nine Network Australia	Television Outside Broadcast Network	4
WIN Television Vic	Television Outside Broadcast	1
Woodside Energy	Point to Point	3

E.5 3575–3710 MHz & 3710–4200 MHz

E.5.1 Current arrangements

Services relevant to the consideration of candidate bands 3575–3710 MHz and 3710–4200 MHz include:

- fixed point-to-point links under the 3.8 GHz (3580–4200 MHz) and the discontinued 4 GHz (3770–4200 MHz) channel plans for point-to-point links;
- FSS (space-to-Earth) on a primary basis in the band 3600–4200 MHz and a secondary basis in the band 3400–3600 MHz;
- radiolocation services in the band 3400–3600 MHz; and
- amateur services on a secondary basis in the band 3400–3600 MHz.

Fixed point-to-point links

3.8 GHz fixed point-to-point links: The 3.8 GHz fixed point-to-point link channel plan overlaps the bands 3575–3710 MHz and 3710–4200 MHz.

The 3.8 GHz channel plan provides a total of 14 channels in a paired (7x2) configuration with a 40 MHz channel bandwidth and a go/return split of 320 MHz. The band is designated for use by digital high-capacity fixed links.

4.0 GHz fixed point-to-point links: While the 4 GHz plan channel plan was discontinued a number of years ago, there are still a number of assignments that conform to this plan. The plan overlaps the bands 3575–3710 MHz and 3710–4200 MHz.

The discontinued 4 GHz channel plan provided a total of 24 channels in a paired (12x2) configuration with a 39 MHz channel bandwidth, a go/return split of 213 MHz, 12 main and 12 interleaved channels. Main and interleaved channels are offset by 14.5 MHz.

Assignments were also made on 4 non-conforming channels (known as 7I, 7M, 7I' & 7M') that fit the discontinued 4 GHz raster. For convenience of illustration both the conforming and non-conforming channels are considered in this section.

When available, the band supported analog medium-capacity fixed point-to-point links, typically for 1800 voice channel frequency division multiplexing (FDM) telephony.

Fixed link assignment details: Based on September 2005 ACMA licensing data, there are 1395 fixed link assignments in the band 3575–4200 MHz. Of those assignments, 799 are on the 3.8 GHz channel plan and 596 on the discontinued 4 GHz channel plan.

Assignments by channel plan are detailed in Table E.5.2. Breakdown of assignments with emission bandwidths in the 3575–3710 MHz and 3710–4200 MHz WAS candidate bands by geographic area and licensee are in sections E5.2 and E5.3 respectively. Long-term trends in band usage are illustrated in Figure E.5.2, which shows the number of fixed assignments in the band 3575–4200 MHz from 1 January 1994 to 1 January 2006.

For more information on microwave point-to-point services see RALI FX3 '*Microwave Fixed Services Frequency Coordination*' on the ACMA website at http://www.acma.gov.au/ACMAINTER.131456:STANDARD:532922567:pc=PC_2599.

Fixed satellite service (FSS)

The Spectrum Plan allocates the band 3600–4200 MHz to the FSS (space-to-Earth) on a primary basis and the band 3400–3600 MHz to the FSS (space-to-Earth) on a secondary basis.

Based on September 2005 ACMA licensing data, there are 103 earth station receive assignments for FSS stations in the band 3575–4200 MHz. A breakdown of earth receive assignments by licensee and location are in Table E5.1.

Table E5.1: Earth station receive assignments in the band 3575–4200 MHz

Breakdown by Licensee		Breakdown by Location	
Licensee	Number	State	Number
Optus Networks	30	ACT	5
New Skies Networks	22	NSW	33
Conoco Phillips	12	NT	12
Rebel Radio Network	12	QLD	17
Hughes Network Sys	12	SA	15
Latter Day Saints	5	TAS	1
Telstra Corporation	4	VIC	2
Reach Networks Aus	3	WA	29
Transmission Holdings	3	Offshore	12
Various	23		
Total	126		126

Radiolocation service

The Spectrum Plan allocates the radiolocation service the band 3400–3600 MHz on a primary basis. Use of the radiolocation service in that band is principally for the purposes of defence. There are three assignments for defence radiodetermination services in that portion of the band, which overlaps the 3575–3710 MHz band.

Amateur service

The Spectrum Plan allocates the amateur service the band 3400–3600 MHz on a secondary basis. There are three assignments in that portion of the band, which overlaps the 3575–3710 MHz band. The primary application is the amateur TV repeater service.

Information on the amateur service can be found in the apparatus licensing section of ACMA website at http://www.acma.gov.au/ACMAINTER.65640:STANDARD:1577814437:pc=PC_1256.

Illustration of Services

Existing services, along with the candidate regional WAS bands 3575–3710 MHz and 3710–4200 MHz, are illustrated in Figure E.5.1. Also depicted is fixed point-to-point link spectrum occupancy in the range 3575–4200 MHz. Represented in the occupancy graph are 1395 assignments, made up of 799 assignments on the 3.8 GHz plan and 596 assignments on the discontinue 4 GHz plan.

Figure E.5.1: Arrangements and fixed link spectrum occupancy in the 3575–4200 MHz band

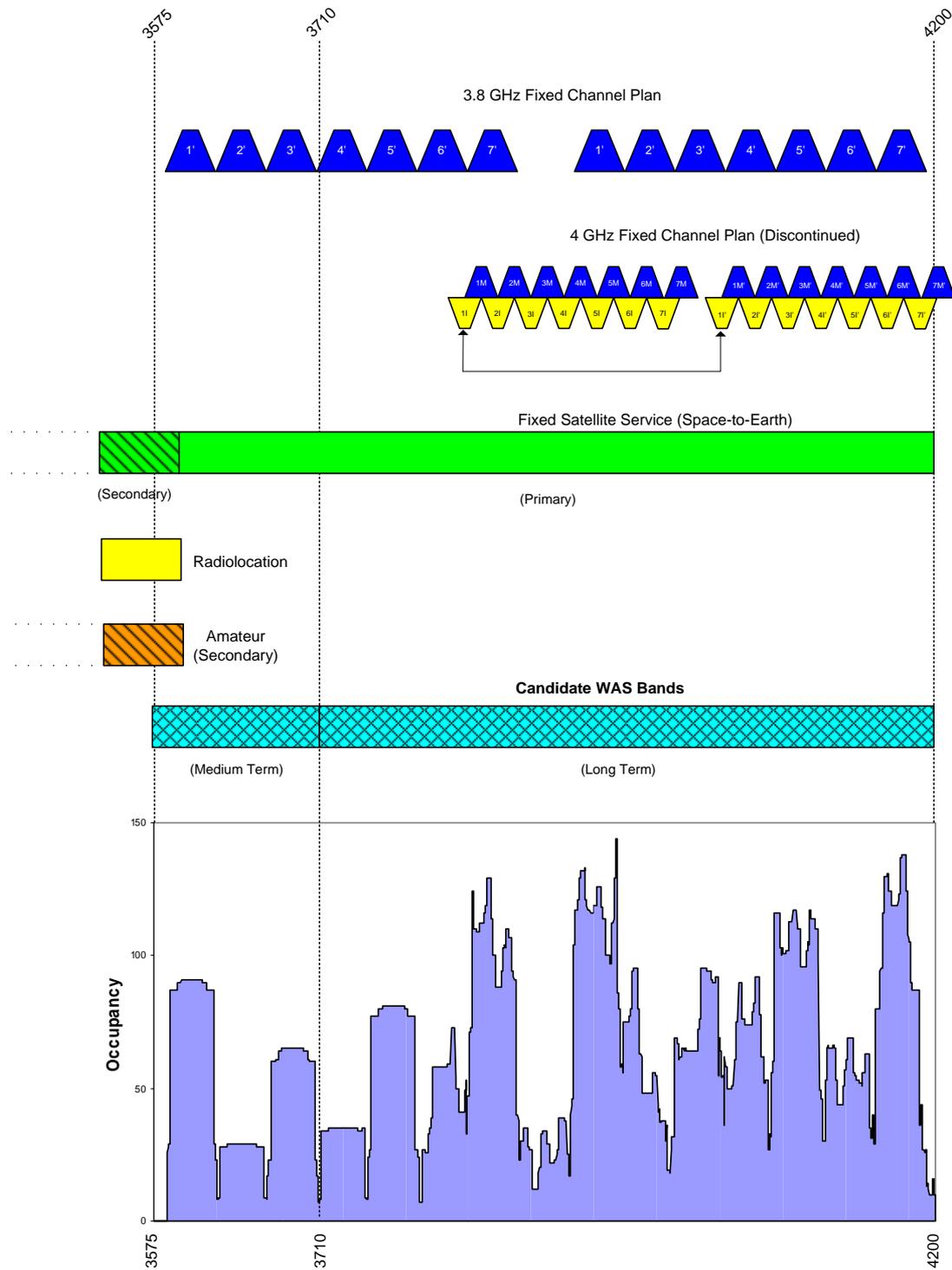


Table E.5.2: 3.8 GHz and discontinued 4.0 GHz plan assignments

(Plan): Channel Number	Centre Frequency (MHz)	Number of Assignments	(Plan): Channel Number	Centre Frequency (MHz)	Number of Assignments
(3.8): 1	3.61	91	(3.8): 1'	3.93	91
(3.8): 2	3.65	29	(3.8): 2'	3.97	29
(3.8): 3	3.69	65	(3.8): 3'	4.01	64
(3.8): 4	3.73	35	(3.8): 4'	4.05	35
(3.8): 5	3.77	81	(3.8): 5'	4.09	81
(3.8): 6	3.81	27	(3.8): 6'	4.13	27
(4.0): 1I	3.81	31	(4.0): 1I'	4.023	31
(4.0): 1M	3.8245	15	(4.0): 1M'	4.0375	16
(4.0): 2I	3.839	41	(4.0): 2I'	4.052	39
(3.8): 7	3.85	72	(3.8): 7'	4.17	72
(4.0): 2M	3.8535	16	(4.0): 2M'	4.0665	18
(4.0): 3I	3.868	23	(4.0): 3I'	4.081	21
(4.0): 3M	3.8825	12	(4.0): 3M'	4.0955	15
(4.0): 4I	3.897	22	(4.0): 4I'	4.11	22
(4.0): 4M	3.9115	17	(4.0): 4M'	4.1245	17
(4.0): 5I	3.926	25	(4.0): 5I'	4.139	25
(4.0): 5M	3.9405	10	(4.0): 5M'	4.1535	12
(4.0): 6I	3.955	47	(4.0): 6I'	4.168	47
(4.0): 6M	3.9695	19	(4.0): 6M'	4.1825	19
(4.0): 7I	3.9805	8	(4.0): 7I'	4.1935	8
(4.0): 7M	3.9915	10	(4.0): 7M'	4.2025	10
Totals		696	Totals		699
Total assignments: 1395					

Key	
	Overlapped: 3575–3710 MHz
	Overlapped: 3710–4200 MHz

Table E.5 details assignments in the 3.8 GHz and discontinued 4 GHz fixed link channel plans. The left side of the table lists the lower frequency block of channels ordered by assigned frequency, together with channel designators and number of fixed links on each channel. The right side of the table lists the same data for the upper frequency block of channels. Each row of the table illustrates both its lower band channel and its paired upper band channel. Note that channels 7I, 7M, 7I' & 7M' are non-conforming channels that fit the channel raster of the discontinued 4 GHz plan and have been used for convenience of illustration. Shading has been used to indicate channels overlapped by candidate WAS bands.

Figure E.5.2: Fixed links in the band 3575–4200 MHz (historical trend 1994–2006)

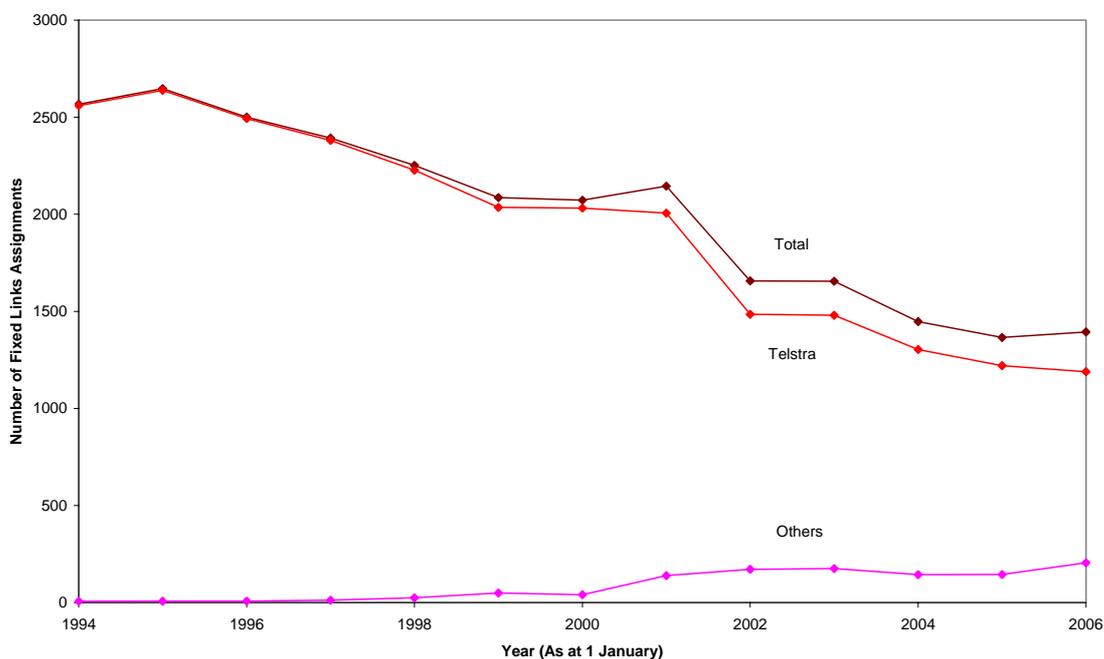


Figure E5.2 shows the number of fixed assignments in the band 3575–4200 MHz from 1 January 1994 to 1 January 2006. Note the decrease in use by Telstra and increase in use by other licensees.

E.1.1. E.5.2 3575–3710 MHz

Consideration of fixed point-to-point links within this subsection is restricted to link assignments with emission bandwidth within the 3710–420 MHz band. Under this criterion only links in 3.8 GHz channel 1, 2 and 3 are included; a total of 185 assignments.

Figure E.5.3: Location of fixed links in the band 3575–3710 MHz

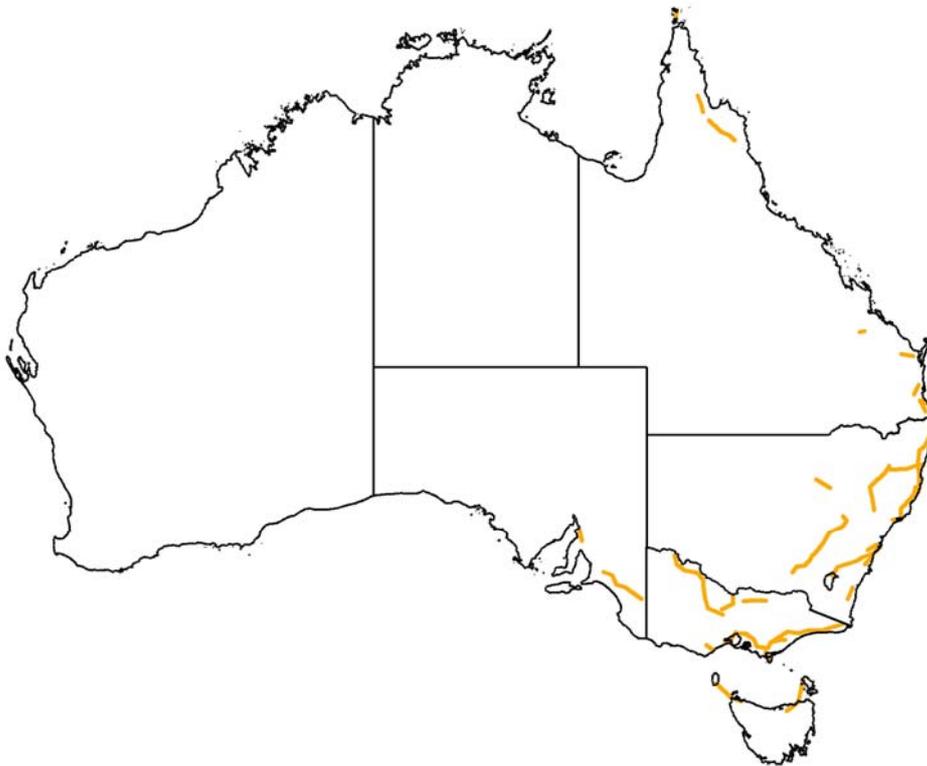


Figure E.5.3 illustrates the geographic distribution, throughout Australia, of fixed links with emission bandwidths in the 3575–3710 MHz band. The link locations are distributed throughout Australia in both regional and remote areas. The majority of links are concentrated along the coast of south-eastern Australia from Adelaide through to Maryborough, being portions of major metropolitan trunk routes. A large number of links also interconnect inland regional centres, being supplementary trunk routes. There are no fixed links in the 3575–3710 MHz band in Western Australia or the Northern Territory.

Figure E5.4: Fixed link assignments per licensee in the band 3575–3710 MHz

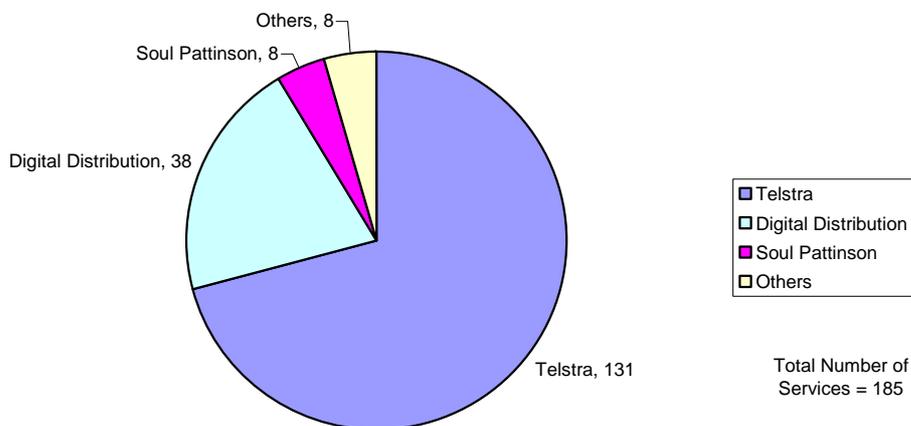


Figure E.5.4 illustrates breakdown of the number of assignments per licensee, for all licensees with assignments with emission bandwidth within the 3675–4200 MHz band.

E.1.2. E.5.3 3710–4200 MHz

Consideration of fixed point-to-point links within this subsection is restricted to link assignments with emission bandwidth within the 3575–3710 MHz band. Under this criterion all links on the discontinued 4 GHz plan and links in the 3.8 GHz channel 4, 5, 6, 1', 2', 3', 4', 5' and 6' are included; a total of 1210 assignments.

Figure E.5.5: Location of fixed links in the band 3710–4200 MHz

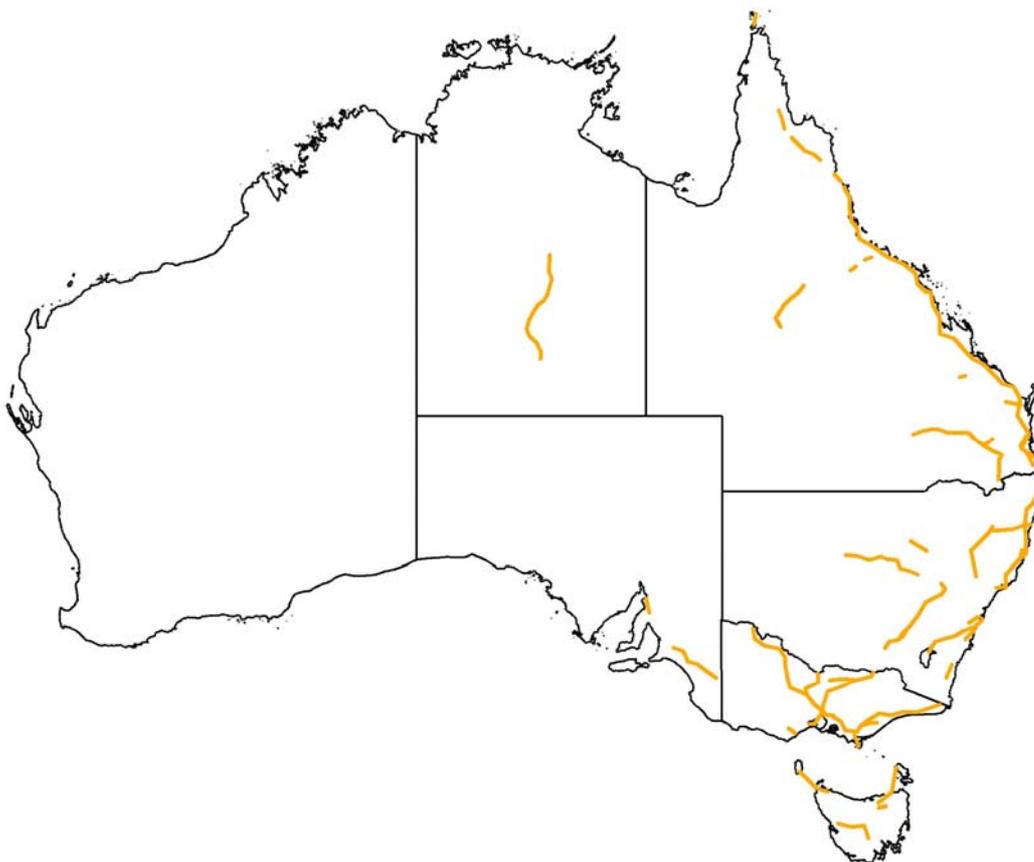


Figure E.5.5 illustrates the geographic distribution, throughout Australia, of fixed links in the 1725–1785/1820–1880 MHz bands. The link locations are distributed throughout Australia in both regional and remote areas.

Figure E5.6: Fixed link assignments per licensee in the band 3710–4200 MHz

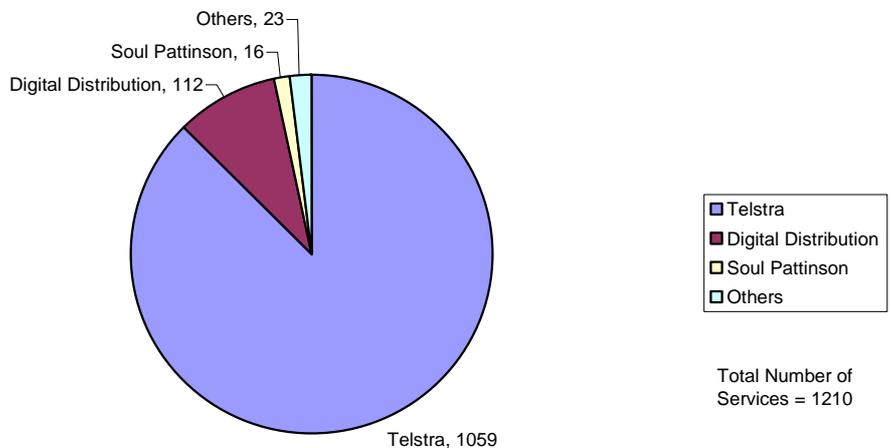


Figure E.5.6 illustrates the breakdown of the number of assignments per licensee for all licensees with assignments with included bandwidth within the 3710–4200 MHz band.

Glossary

Any detailed discussion of WAS requires the introduction of numerous specialised terms and acronyms. The following lists the majority of such terms and acronyms utilised in this paper, together with base words of the acronym and a brief explanation. A single URL is often provided to reference more detailed discussion and www.google.com will generate a wide-ranging list of references. Note that many such terms have various shades of meaning depending upon context. Generic meanings are generally provided together with specific meanings in the WAS context.

1xRTT	single carrier radio transmission technology A 3G wireless technology within the CDMA platform with both circuit switched and packet switched data and data rates up to 300 kbps. Also known as CDMA2000.
2G	second generation mobile telecommunications Second generation of mobile phone systems and associated technologies, utilising digital transmission (principally evolved GSM and CDMA platforms in Australia) and adding data transmission capability (albeit circuit-switched) at low data rates. www.iec.org/online/tutorials/umts
2.5G	second generation plus mobile telecommunications Enhancements to basic 2G mobile phone systems and associated technologies (principally to the evolved GSM platform in Australia) that provide packet-switched data and higher data transmission rates (includes GPRS and EDGE).
3G	third generation mobile telecommunications Third generation of mobile phone services and associated technologies (principally the evolved GSM and CDMA platforms in Australia) that provide greater voice capacity, higher data rates and support for broadband applications such as multimedia. www.iec.org/online/tutorials/umts
3GSM	A collective term for all 3G wireless technologies within the evolved GSM platform. www.gsmworld.com/technology/3g/index.shtml
ACA	Australian Communications Authority The former communications regulator in Australia. Merged with the Australian Broadcasting Authority to become ACMA on 1 July 2005.
ACCC	Australian Competition and Consumer Commission Independent Commonwealth statutory authority which administers the <i>Trade Practices Act 1974</i> and other acts. Promotes competition and fair trade in the marketplace and regulates national infrastructure services. www.accc.gov.au
ACMA	Australian Communications and Media Authority The communications regulator in Australia; commenced 1 July 2005. www.acma.gov.au

ARCEP	Autorité de Régulation des Communications Électroniques et des Postes The communications regulator in France. www.art-telecom.fr
ART	Autorité de Régulation des Télécommunications The predecessor to ARCEP, France's current communications regulator.
AWS	advanced wireless service Terminology used principally by the FCC and Industry Canada that is equivalent to WAS in Australia and elsewhere.
bandwidth	(1) In data communications, the maximum data transmission rate, measured in bits per second. (2) In radiocommunications, the amount of radiofrequency spectrum utilised by a service, measured in Hz.
bluetooth	A wireless technology to effect medium data rate WPAN interconnections. The initial standard in IEEE 802.15.1. www.bluetooth.com
BWA	broadband wireless access
cable	A data connection that is delivered to a subscriber through channels in a coaxial cable or optical fibre cable to a cable modem installed externally or internally to a subscriber's computer or television set.
CCIF	Coordinated Communications Infrastructure Fund An Australian Government program, part of the National Broadband Strategy, focused on improving delivery of health, education and government services in regional, rural and remote areas. www.dcita.gov.au/ie/broadband/programs/ccif
CDMA	code division multiple access A fundamental wireless technology which effects multiplexing by embedded codes. en.wikipedia.org/wiki/CDMA
CDMA2000	See 1xRTT
CEPT	Conférence Européenne des Administrations des Postes et des Télécommunications European Conference of Postal and Telecommunications Administrations A European forum addressing harmonisation of regulation of postal, telecommunications and radiocommunications. The latter is addressed by the ERC. www.cept.org
class licence	In Australia, class licences authorise users to operate certain radiocommunications devices, such as low interference potential devices, provided that the device is operated in accordance with the conditions of the class licence. These are typically low power transmitters providing short-range communications that do not require individual frequency coordination for interference management purposes. Internationally, such services are generally termed unlicensed. www.acma.gov.au/ACMAINTER.131258:STANDARD:1656861936:pc=PC_1612
ComCom	Federal Communications Commission The communications regulator in Switzerland. www.fedcomcom.ch/comcom/e/homepage/index.html
DAB	digital audio broadcasting Generic term for all sound broadcasting technologies utilising digital modulation of the transmitted signal.
DCITA	Department of Communications, Information Technology and the Arts Australian Government Department which addresses a wide range of policy areas including communications and the media. www.dcita.gov.au

Defence	Department of Defence Australian Government Department which addresses all matters pertaining to Australia's defence forces. www.defence.gov.au
DRCS	digital radio concentrator system An Australian-developed wireless technology utilising microwave frequencies to provide telephone services in rural and remote areas.
DSL	digital subscriber line An evolving group of wireline technologies and standards providing packet-switched high data rate transmissions over standard twisted pair telephone lines in the public switched telephone network between exchange and end-user equipment.
EC	European Commission An institution of the European Union. Represents the European interests of all member states. europa.eu.int/comm
ECC	Electronic Communications Committee A committee of CEPT which deals with radiocommunications and telecommunications matters. Replaced the ERC. www.ero.dk/ecc
EDGE	enhanced data rates for GSM evolution A 2.5G wireless technology within the evolved GSM platform providing packet-switched data and data rates up to 473 kbps.
embargo	In Australia, a specific term and process used to facilitate frequency planning. Embargoes place restrictions on frequency assignments for apparatus-licensed services in certain frequency bands and in certain geographical areas. Embargoes are necessary to minimise the dislocation of affected services and to allow for future developments. www.acma.gov.au/ACMAINTER.4849984:STANDARD:705149826:pc=PC_2712
ENG	electronic news gathering
ERC	European Radiocommunications Committee A previous committee of CEPT. Was replaced in September 2001 by the ECC.
ETSI	European Telecommunications Standards Institute The European telecommunications standards-setting body. www.etsi.org
EV-DO	evolution data only or evolution data optimised A 3G wireless technology within the CDMA platform with packet switched data and data rates up to 2.4 Mbps.
FCC	Federal Communications Commission The communications regulator in the United States of America. www.fcc.gov
FDD	frequency division duplex A fundamental technology which splits the total utilised bandwidth into several separate sub-bands and which further designates certain sub-bands for downlink and uplink respectively.
FSS	fixed-satellite service A satellite service to fixed terrestrial stations.
FWA	fixed wireless access
GHz	Gigahertz One billion hertz.
GPRS	general packet radio service A 2.5G wireless technology within the evolved GSM platform providing packet-switched data and data rates up to 171 kbps.

GSM	global system for mobile communication A European standard for digital cellular communications. Uses a time division multiple access technique to multiplex signals onto a single channel in a rotated sequence of time slots, with each user having exclusive access to a time slot.
GSM900	GSM services operating in the 900 MHz band.
GSM1800	GSM services operating in the 1800 MHz band.
Hertz	A measure of frequency; one cycle per second.
HiBIS	Higher Bandwidth Incentive Scheme An Australian Government initiative that gave funding for ISPs providing approved broadband services to consumers in regional, rural and remote areas. www.dcita.gov.au/tel/higher_bandwidth_incentive_scheme_hibis
HiperMAN	A proposed BWA standard being developed by ETSI, comparable in scope and likely compatible with IEEE 802.16. www.etsi.org/etsi_radar/cooking/rub1/hiperlan2_a.htm
HSDPA	high speed downlink packet access A 3G wireless technology within the evolved GSM platform with packet-switched data and download data rates up to 14 Mbps. An enhancement to WCDMA. www.umtsworld.com/technology/hsdpa.htm
IDA	Infocomm Development Authority The communications regulator in Singapore. www.ida.gov.sg
IEEE	Institute of Electrical and Electronics Engineers A USA-based organisation of international scope promoting the engineering process of creating, developing, integrating, sharing, and applying knowledge about electro and information technologies with major involvement in standards setting. www.ieee.org
IEEE 802	A group of standards addressing all aspects of computer networking. www.ieee.org/portal/pages/about/802std/index.html
IEEE 802.11	A sub-group of wireless standards within the IEEE 802 group primarily addressing RLANs. grouper.ieee.org/groups/802/11
IEEE 802.16	A sub-group of wireless standards within the IEEE 802 group primarily addressing broadband wireless metropolitan area networks. grouper.ieee.org/groups/802/16
IMT-2000	international mobile telecommunications 2000 Nominally a single standard, but inherently a group of standards addressing 3G wireless communications, including CDMA2000 and WCDMA for the CDMA and evolved GSM platforms. www.itu.int/home/imt.html
ISM	industrial, scientific and medical ISM devices are non-radiocommunications devices for industrial, scientific and medical applications that use electromagnetic energy, but do not intentionally radiate (for example, microwave ovens). They operate in frequency bands which are designated internationally for such purposes.
ISP	internet service provider Service provider offering internet access to the public or another service provider.
ITU	International Telecommunication Union United Nations agency that coordinates international telecommunications and radiocommunications matters. www.itu.int
ITU-R	ITU – Radiocommunication Sector ITU section dealing with international radiocommunications matters. www.itu.int/ITU-R

kbps	kilobits per second Data transmission rate of 1,000 bits per second.
kHz	kilohertz One thousand Hertz.
LAN	local area network A group of interconnected computers and associated devices, typically within a radius of a few hundred metres.
LIPD	low interference potential device The LIPD Class Licence authorises users to operate a wide range of low power radiocommunications devices in various segments of the radiofrequency spectrum. The class licence sets out the conditions under which many types of short-range devices may operate. These conditions always cover frequency bands of operation and radiated power limits. Other conditions are applied as necessary. www.acma.gov.au/ACMAINTER.131258:STANDARD:1656861936:pc=PC_1278
LMDS	local multipoint distribution system A broadband service capable of providing local loop services, interactive video, high speed internet access and a range of advanced multimedia applications.
local loop	The physical link or circuit that connects from the demarcation point of the customer premises to the edge of the carrier, or telecommunications service provider, network. http://en.wikipedia.org/wiki/Local_loop
MBC	Metropolitan Broadband Connect An Australian Government program focusing on improving access to broadband internet services in metropolitan areas. www.dcita.gov.au/tel/mbc
Mbps	Megabits per second Data transmission rate of one million bits per second.
MCMC	Malaysian Communications and Multimedia Commission The communications regulator in Malaysia. www.mcmc.gov.my
MDS	multipoint distribution system A one-way domestic public radio service rendered on microwave frequencies from a fixed station that usually transmits in an omnidirectional radiation pattern to multiple receiving facilities at fixed points.
MED	Ministry of Economic Development The communications regulator in New Zealand. www.med.govt.nz
MHz	megahertz One million hertz.
MIC	(1) Ministry of Internal Affairs and Communications The communications regulator in Japan. www.soumu.go.jp/english/ (2) Ministry of Information and Communication The communications regulator in the Republic of Korea. eng.mic.go.kr/eng
MMDS	multichannel (or multimedia) multipoint distribution system
narrowband	(1) Generically, a term used to indicate bandwidth less than the norm. (2) More specifically, a term used to indicate a technology which uses less bandwidth than the norm. (3) Most specifically, a term used to indicate data transmission rates typical of dial-up internet connections.
NWA	nomadic wireless access Portable services which regularly move and which must be capable of promptly effecting service once stationary, but which are not required to be usable while actually moving.

OFTA	Office of the Telecommunications Authority The communications regulator in Hong Kong. www.ofta.gov.hk
PCS	personal communications service A wireless technology which enables a wide range of service in a single user device including mobile phone, cordless phone, paging, internet and messaging. www.iec.org/online/tutorials/pcs
PPDR	public protection and disaster relief
QoS	quality-of-service
RA	Radiocommunications Agency The predecessor to Ofcom, the UK's current communications regulator.
RALI	radiocommunications assignment and licensing instruction In Australia, a specific term used by ACMA for published documents detailing procedures to be followed by ACMA staff and external accredited assigners in making specific service assignments. www.acma.gov.au/ACMAINTER.131258:STANDARD:1729046131:pc=PC_2705 www.acma.gov.au/ACMAINTER.131258:STANDARD:1729046131:pc=PC_2708
RLAN	radio local area network Short-range connections between networked computers (in office and home environments), without the need for interconnecting cables.
Spectrum Plan	Australian Radiofrequency Spectrum Plan 2005 Australian spectrum allocation arrangements are, at their broadest level, embodied in one statutory instrument known as the Australian Radiofrequency Spectrum Plan. The Plan is reviewed on a regular basis, in response to the Final Acts of each new WRC. www.acma.gov.au/ACMAINTER.4849984:STANDARD:315668218:pc=PC_2713
TDD	time division duplex A fundamental technology wherein a common carrier is shared between the uplink and downlink, the resource being switched in time. Users are allocated one or more timeslots for uplink and downlink transmission. The main advantage of TDD operation is that it allows asymmetric flow which is more suited to most data transmission requirements.
TDMA	time division multiple access A fundamental digital wireless technology that allows a number of users to access a single radiofrequency channel without interference by allocating unique time slots to each user within each channel. The TDMA digital transmission scheme multiplexes three signals over a single channel. Each caller is assigned a specific time slot for transmission. www.iec.org/online/tutorials/tdma
UMTS	universal mobile telecommunications system A 3G technology for the evolved GSM mobile phone network. www.iec.org/online/tutorials/umts
VoIP	voice over internet protocol A wireless and wireline technology for transmitting voice over packet-switched data networks. Also called IP telephony. www.tiaonline.org/standards/ip/
WAS	wireless access service End-user wireless connections to public or private core networks. Technologies in use today for implementing wireless access include mobile phones, cordless phones, and wireless local area network systems. http://www.itu.int/ITU-R/study-groups/was/index.html

WCDMA	wideband code division multiple access (1) Generically, a group of 3G wireless technologies and standards employing wideband CDMA modulation techniques including two particular technologies: CDMA2000 (within the CDMA platform) and WCDMA (within the evolved GSM platform). (2) Specifically and in most common usage, WCDMA is a 3G wireless technology within the evolved GSM platform with both circuit-switched and packet-switched data at data rates up to 384 kbps.
WiBro	wireless broadband A specific wireless broadband technology being developed by the Korean Telecommunications Industry expected to conform to IEEE 802.16 and be compatible with WiMAX. www.itu.int/ITU-D/imt-2000/documents/Busan/Session3_Yoon.pdf
Wi-Fi	wireless fidelity Most specifically a marketing term for the standard IEEE 802.11b, but also used generically to refer to wireless local area network (IEEE 802.11) technology providing short-range, high data rate connections between mobile data devices and access points connected to a wired network. http://www.wi-fi.org/OpenSection/index.asp
WiMAX	See WiMax Forum
WiMAX Forum	Worldwide Interoperability for Microwave Access Forum A trademarked USA-based industry group promoting interoperability standards for BWA focussing on the IEEE 802.16 and ETSI HiperMAN sub-groups of standards for broadband wireless metropolitan area networks. www.wimaxforum.org/home
wireless	Use of radiofrequency radiation to effect communication.
wireline	Use of radiofrequency propagation along physical wire to effect communication.
WLAN	wireless local area network See RLAN
WLL	wireless local loop Use of radiocommunications rather than cable to connect a fixed or mobile telephone handset and a telecommunications base station connected to a telecommunications network.
WRC	World Radiocommunication Conference An ITU conference to review and amend the international radio regulations, allowing for the introduction of new technologies and more efficient sharing of the radiofrequency spectrum. These conferences occur about every three years. www.itu.int/ITU-R/conferences/wrc
WRC-2000	The WRC held in Istanbul, Turkey 8 May to 2 June 2000 www.itu.int/ITU-R/conferences/wrc/wrc-00
WRC-03	The WRC held in Geneva, Switzerland 9 June to 4 July 2003 www.itu.int/ITU-R/conferences/wrc/wrc-03
WRC-07	The WRC to be held in Geneva, Switzerland 15 October to 9 November 2007 www.itu.int/ITU-R/conferences/wrc/wrc-07