Spectrum Proposals:
403–520 MHz

Proposals for future arrangements in the 400 MHz band
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Executive Summary

The 400 MHz band is one of the most important and heavily used parts of the spectrum. The replanning of this band is a unique opportunity and given its importance and heavy use the Australian Communications and Media Authority (ACMA) believes that a reform of the band is urgently needed.

This paper discusses planning options and presents a number of proposals for the future use of the radiofrequency spectrum in the range 403–520 MHz (the 400 MHz band). This band is predominantly used for the land mobile service, but also accommodates other services, including the fixed (point-to-point and point-to-multipoint), radiolocation and amateur services. The paper follows an initial consultation in April 2008 where a broad range of options were introduced.

The key drivers for the ACMA review of the 400 MHz band are:

- **Government spectrum harmonisation**: There is a need to identify an adequately dimensioned harmonised band for the exclusive use of government.

- **Congestion**: Much of this spectrum has become congested in the larger capital cities. There has been increasing pressure from prospective and current users of the band to accommodate additional services.

- **Future technologies**: There is a growing need to structure arrangements in the band to cater for technologies that make more efficient use of the spectrum.¹

The objectives of the review of the 400 MHz band are to:

- improve the harmonisation of spectrum use by certain government agencies to assist in radiocommunications interoperability objectives and the development of efficient government networks

- improve the allocative, technical and dynamic efficiency with which spectrum in the band is allocated and used, by reviewing the relevant frequency assigning and licensing mechanisms (including band plans, licensing instructions, licensing options and pricing)

- facilitate new technologies and possible complementary uses of the band

- implement arrangements that take advantage of the different spectrum management requirements and challenges between different geographic areas

¹ These technologies include both traditional land mobile and potentially wireless access services.
minimise the requirement for ongoing ACMA intervention in the band.

In addressing these review objectives the following proposals and planning options are put forward in this paper:

- identification of the 403–430 MHz range as a harmonised government band
- increase in apparatus licence taxes in high density areas as an incentive for the efficient use of the spectrum
- creation of a 6.25 kHz channel raster with aggregation to 12.5 kHz permitted
- prohibition over time of channels greater than 12.5 kHz in high and medium density areas (unless justification can be provided)
- changes to frequency assignment and coordination rules
- provision of a 10 MHz duplex frequency split segment in part of the 450–470 MHz band to facilitate flexible technology choices and options for the allocation of this spectrum
- no changes to arrangements in the 440–450 MHz band
- no change to duplex split arrangements in the 470–520 MHz band
- options to address the expiry of spectrum licence in the upper 400 MHz band (commonly referred to as the 500 MHz spectrum licences)
- retention of the spectrum embargo in the 518–520 MHz band to maintain options to change the bandwidth of UHF TV channel to 7 MHz
- changes to the bandwidth and number of channels in the Citizen Band Radio Service.

The outcomes of this paper will predominately determine the arrangements that will begin to be implemented at the conclusion of the review at the end of 2009. Migration strategies will be discussed in detail in a third discussion paper pending the outcomes of this consultation.

Economic allocation tools for the 400 MHz band are considered in a separate paper titled Opportunity Cost Pricing of Spectrum. ACMA is inviting comments separately on this topic.

**Consultation process**

ACMA invites comments and feedback on the issues discussed in this paper. Submissions are sought before close of business 29 May 2009.
Written submissions

Written submissions on the issues raised in this discussion paper may be made to the Australian Communications and Media Authority (ACMA) as follows:

By email: 400MHzreview@acma.gov.au

By mail:

Mr Andrew Stewart
Government Planning Section
Australian Communications and Media Authority
PO Box 78
Belconnen ACT 2616

The closing date for submissions is close of business 29 May 2009.

Electronic submissions in Microsoft Word or rich text format are preferred. Please direct any questions about this discussion paper to Adam Clash on telephone: 02 6219 5170, or email adam.clash@acma.gov.au.

Publication of submissions

In general, ACMA publishes all submissions it receives. However, ACMA will not publish submissions that it considers contain defamatory or irrelevant material.

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

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

When can ACMA be required by law to release information?

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

Sharing of information

Under the *Australian Communications and Media Authority Act 2005*, ACMA is able to disclose submissions to the Minister, Department including authorised officials,
Royal Commissions and certain Commonwealth authorities such as the Australian Competition and Consumer Commission and Australian Securities and Investment Commission.

If information is accepted by ACMA as confidential, ACMA will seek to consult with the submitter of the information where ACMA intends to share that information.
1 Introduction

The 400 MHz band is one of the most important and heavily used parts of the spectrum. Industry uses it to support a range of transport and dispatch activities. Government uses it to deliver vital services to the public, including emergency services such as police, fire and ambulance.

Using this band more efficiently and effectively is important to Australia’s future. But there is evidence that congestion and fragmentation of use is impacting adversely on this band. Parts of the band are heavily congested in the major cities. Government use of the band tends to be fragmented and uncoordinated.

ACMA believes that reform of the arrangements for this band is urgently needed to improve the efficiency and effectiveness with which it is used to deliver these services. While the existing arrangements have served Australia relatively well in the past, the increasing demand for spectrum in the band combined with the need for better coordination and harmonisation of government radiocommunications requires significant reform of spectrum management arrangements in the 400 MHz band. This paper is intended to highlight the challenges and to outline proposals for reform. In pursuing change, ACMA is committed to delivering improved efficiency, effectiveness and flexibility and is also committed to maximising the public benefit arising from use of this spectrum.

ACMA embarked on the review of the 400 MHz band in the knowledge that it would not be an easy task. However, ACMA also recognised that not only was the review necessary, in terms of relieving congestion in our major capital cities, it also provided some nation building opportunities.

The harmonisation of government emergency radiocommunications is perhaps the most obvious of these opportunities. Since Cyclone Tracy in 1974 successive spectrum regulators have recognised the need for harmonisation and through this review ACMA hopes to take the most proactive steps to date to facilitate harmonisation.

ACMA also recognises that industry is best placed to manage the spectrum it relies on. With this in mind this review lays the technical and regulatory stepping stones that will pave the way to industry management of the 400 MHz land mobile bands to enable certainty and flexibility into the future.

Finally ACMA understands that reform of existing spectrum management practices can pose significant challenges for its clients. ACMA therefore dedicated a team of
engineering specialists to the review and is undertaking considerable industry consultation to ensure that the ensuing plans are the right plans but also to ensure that the review is undertaken as quickly as possible so that the benefits can be realised as soon as possible. ACMA welcomes feedback on the proposals in the paper, and will continue to consult widely with users in the transition to, and implementation of, the new arrangements.

1.1 Background
On 18 April 2008 ACMA released the discussion paper, *Spectrum Options 403–520 MHz: Initial consultation on future arrangements for the 400 MHz band* (the Options Paper). This was the first formal step in a review of spectrum management arrangements in the 400 MHz band. The purpose of the discussion paper was to stimulate discussion and gather information from stakeholders to assist ACMA to develop future arrangements. The 400 MHz band is predominantly used by the land mobile service, but also accommodates other services, including the fixed (point-to-point and point-to-multipoint), radiolocation and amateur services.

Seventy five responses were received to the Options Paper—all but one confidential submission are available on the ACMA website. Subsequent analysis of the responses and additional work carried out by ACMA has resulted in the development of the refined options and proposals set out in this paper.

The Options Paper includes detailed background material and is a useful source of additional information when considering the proposals put forward in this paper.

1.2 Purpose
This paper is the second formal step towards establishing new arrangements in the 400 MHz band. Its purpose is to discuss detailed planning options and present a number of proposals for the future use of the 400 MHz band.

Stakeholder responses to this discussion paper will be used by ACMA to assist in the process of developing future arrangements in the 400 MHz band. Further consultation about detailed implementation issues is likely to be required in a number of cases.

1.3 Structure of the paper
Chapters 2–9 of this paper are dedicated the major issues identified in the review:

- measures to address congestion
- identification of a government band
- licensing alternatives for point-to-multipoint and single frequency applications
- UHF Citizen Band Radio Service
- arrangements in 450–470 MHz

• arrangements in 470–520 MHz
• expiry of 500 MHz spectrum licences
• 518–520 MHz and UHF TV channel 27 (520–526 MHz).

Each of these chapters use the following general structure:
• a summary of proposals
• introductory and background comments, including a statement of ACMA’s general objective for the issue
• a summary of the stakeholder response from the Options Paper
• identification of issues and analysis
• proposals, further options, and additional issues for comment.

Often there are linkages between topics, and where appropriate these linkages are cross-referenced to assist with developing an integrated and consistent view of an issue.

1.4 Scope

1.4.1 IN SCOPE: UHF CHANNEL 27 (519–526 MHz)

The issue of UHF television channel 27 was not within scope of the original consultation in the Options Paper. Because of developments since early 2008, ACMA has decided that future arrangements for 519–520 MHz need to be considered in the 400 MHz review consultation process because of the potential to make another UHF television channel available for digital television broadcasting.

However, given that the issue is intimately related to the digital dividend work, it should be noted that discussion of this issue in the context of the 400 MHz review in no way pre-empts the outcomes of the digital dividend work. The work of this review is intended to ensure options are retained, and not compromised, by the outcomes of the 400 MHz review.

1.4.2 OUT OF SCOPE: 380–400 MHz, 406–406.1 MHz, 430–440 MHz, 440–450 MHz

Changes to arrangements in the ranges 380–400 MHz, 406–406.1 MHz, 430–440 MHz and 440–450 MHz are not within the scope of this paper.

The 406–406.1 MHz range is used worldwide for Emergency Position Indicating Radio Beacons (EPIRBs). In undertaking the review of the 400 MHz band ACMA will ensure that EPIRB use will retain an appropriate level of protection from interference.

The 430–440 MHz range is used for defence radar and by the amateur service, including amateur satellite, in line with internationally harmonised allocations. In addition the Australian Radiofrequency Spectrum Plan does not specify that the fixed and mobile services may use the range 430–440 MHz and hence there is currently limited scope for these services to use this band.
The potential for changes to 380–400 MHz has been considered separately to the review of the 400 MHz band and is not within the scope of this consultation though 380–400 MHz issues are discussed in the overall context of identification of a government band.

The Options Paper included issues relating to potential additional use of the mobile service in the 440–450 MHz band. ACMA analysis based on submissions received on this issue has led to the conclusion that there is no scope for additional use of this band for the land mobile service. As a result this frequency range has been excluded from the scope of this paper and current arrangements will remain in place.

### 1.5 Spectrum Management Principles

ACMA’s Spectrum Management Principles are intended to guide its management of the radiofrequency spectrum within its existing legislative responsibilities and government policy settings. The key theme of the principles is that maximising the overall public benefit from use of the radiofrequency spectrum requires balanced application of both regulatory and market mechanisms.

The principles have been adopted by ACMA but will not (and cannot) override the law, such as the *Radiocommunications Act 1992* (the Act) and other relevant legislation. ACMA’s decision-making processes are conducted in accordance with statutory requirements and, in particular, are guided by the object of the Act. The principles therefore provide additional guidance to stakeholders about the approach that ACMA will take to decision-making.

ACMA decision-making is also subject to other law such as ministerial direction. For example, section 14 of the *Australian Communications and Media Authority Act 2005* provides that the Minister for Broadband, Communications and the Digital Economy (the Minister) may give written directions to ACMA in relation to the performance of its functions and the exercise of its powers. ACMA must perform its functions and exercise its powers in accordance with such a direction.

ACMA will take account of the principles of good regulatory process outlined in *Rethinking Regulation: Report of the Taskforce on Reducing the Regulatory Burden on Business* (Regulation Taskforce 2006)\(^4\). In accordance with those principles, ACMA recognises that effective consultation with affected parties at all stages of the regulatory cycle is an integral element of the spectrum management process.

ACMA will use a total welfare standard as its overarching framework for assessing the costs and benefits of different regulatory and market mechanisms for specific spectrum management issues, where appropriate. ACMA recognises that the assessment of costs and benefits using a total welfare standard approach will often need to take both quantitative and qualitative factors into account.

ACMA’s Spectrum Management Principles are consistent with the principles of good regulatory process. They provide directions that will generally result in welfare being

\(^4\) The Report can be accessed from:  
maximised and, together with use of a total welfare standard, articulate ACMA’s proposed standard approach to spectrum regulation.

1. **Allocate spectrum to the highest value use or uses**

The first paragraph of the object of the Act pays regard to maximising the overall public benefit derived from using the radiofrequency spectrum, by ensuring the efficient allocation and use of the spectrum (s.3(a)).

Public benefit will be maximised where spectrum is allocated to the highest value use or uses, that is, the use or uses that maximise the value derived from the spectrum by licensees, consumers and the wider community.

The second paragraph of the object of the Act explicitly requires that adequate provision of spectrum be made for use in the defence or national security of Australia, law enforcement or emergency services, and for use by public or community services (s.3b). In assessing the highest value use or uses of the spectrum, ACMA will also consider this paragraph of the object of the Act, the community benefits derived from these services and any other relevant matters.

2. **Enable and encourage spectrum to move to its highest value use or uses**

ACMA will seek to set conditions of use that will allow and encourage spectrum licensees to move spectrum to its highest value use or uses with a minimum of regulatory intervention.

The highest value use of spectrum will change over time as technology develops, consumer and social preferences evolve, and as the circumstances of licensees change. Allowing spectrum to move to the highest value use as quickly and easily as possible following its initial allocation will maximise the overall public benefit derived from the spectrum. This requires a regulatory system that has the flexibility to enable licensees to adapt spectrum access and usage to both market requirements and technological advances.

A change in use may be facilitated through trading or third-party authorisation, or by the same licensee employing its spectrum for a different use.

Allowing spectrum to move to the highest value use quickly and easily will ensure that associated benefits are realised quickly, without the delay and costs of regulatory intervention.

3. **Use the least cost and least restrictive approach to achieving policy objectives**

Planning, licensing, allocation and compliance measures should aim to minimise the total cost of achieving the objectives of spectrum management, including the cost to government, licensees and the community. Under good regulatory practice, all benefits and costs of regulations, including compliance costs, are rigorously assessed. The least cost and least restrictive approach will reduce regulatory burdens and allow greater freedom for spectrum licensees to optimise their use of the spectrum.
ACMA will operate as efficiently as possible to minimise the total cost of spectrum management.

Equally importantly, minimising the total cost of spectrum management will require a focus on regulatory effectiveness, taking into account developments in technology and conditions in affected markets. Only regulations that generate the greatest net benefit for the community, taking into account all the impacts, will be adopted.

4. **To the extent possible, promote both certainty and flexibility**

ACMA will promote both certainty and flexibility. If there is any conflict between these two objectives, ACMA will seek an outcome that provides the greatest net benefit for industry, consumers and the wider community.

Licensees need stable and predictable regulatory arrangements and sufficient certainty about tenure to be confident about investing in equipment and services. This maximises the public benefit from spectrum use by reducing the risk of market failures arising from uncertainty and risk aversion. This need for certainty may at times conflict with the necessity for ACMA to change regulatory arrangements to facilitate innovation and allow access to new or expanded uses for spectrum.

Licences also need to be flexible to allow licensees or third party users to change their use of the spectrum or to facilitate the trade of spectrum to another licensee for a different use. This need for flexibility may at times conflict with the desire of other licensees for certainty, particularly in relation to interference management.

These are examples of the types of issues that ACMA may encounter as it seeks to accommodate both certainty and flexibility in its management of the spectrum.

5. **Balance the cost of interference and the benefits of greater spectrum utilisation**

ACMA will balance the cost of interference and the benefits of greater spectrum utilisation to ensure the most efficient result that maximises total welfare.

Where spectrum utilisation can be increased by amending regulatory rules, and is accompanied by levels of interference that are not harmful, ACMA will consider relaxing measures for frequency coordination and interference mitigation.

The point at which the cost of interference outweighs the benefits of greater spectrum utilisation will differ for various applications. There is no radiofrequency environment with a complete absence of potentially interfering signals. The point at which interference becomes harmful depends on the service type, application and user.

Figure 1 illustrates ACMA’s spectrum management decision framework. It shows the use of the Spectrum Management Principles and other filters used in making decisions on spectrum management. More information about the principles is available from the ACMA website.\(^5\)

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ACMA has used these principles to develop a number of strategies in the 400 MHz band, which are intended to achieve the objectives in the most efficient way. These strategies and how they relate to some of the specific proposals are set out below. Analysis of options later in the paper is also done within the framework of the Spectrum Management Principles.

### 1.6 Review objectives

The broad objectives of the review of the 400 MHz band are to implement measures to:

- improve the harmonisation of spectrum use by certain government agencies to assist in radiocommunications interoperability objectives and the development of efficient government networks
- improve the allocative, technical and dynamic efficiency with which spectrum in the band is allocated and used, by reviewing the relevant frequency assigning and licensing mechanisms (including band plans, licensing instructions, licensing options and pricing)
- facilitate new technologies and possible complementary uses of the band
- implement arrangements that take advantage of the different spectrum management requirements and challenges between different geographic areas
- minimise the requirement for ongoing ACMA intervention in the band.
The importance of the 400 MHz band was illustrated in the response of stakeholders to the questions in the Options Paper regarding other spectrum and services that could provide substitutes for spectrum and services in the 400 MHz band.

In regards to spectrum, a majority of respondents believed the 400 MHz band was the only suitable band for many current applications. Some respondents discussed the advantages and disadvantages of potential alternative spectrum, including the VHF and 900 MHz bands. However, the overall conclusion was that other spectrum could be used as a complement to the 400 MHz band but not as a replacement.

Similarly, a majority of respondents believed there are currently no replacement services that can be provided using the 400 MHz band with the cost of alternatives named as a major disincentive. Cellular services were generally not favoured as an alternative by most respondents with many outlining concerns regarding coverage, support for security critical or safety of life services, reliability, congestion and lengthy set-up delays.

There was support from some respondents for CDMA450 to be rolled out in the 400 MHz band. Alternative technologies such as GSM-R and TETRA were also discussed.

There was also some support for moving point-to-point fixed links currently in the 400 MHz band to frequencies above 1 GHz and also moving trunked systems to other spectrum such as the 800 MHz band.

In undertaking any review of spectrum management arrangements, ACMA always takes into account the impact any changes will have on incumbent users of the spectrum. This is particularly important in this case as the 400 MHz band is heavily encumbered by many disparate users and uses within the spectrum for a range of important and often critical purposes.

ACMA acknowledges that any review of spectrum management arrangements can be a source of uncertainty for incumbent users. ACMA seeks to minimise uncertainty while still providing an appropriate review and consultation process to facilitate change.

The potential for different spectrum management requirements and challenges in different geographic areas of Australia is also an important part of ACMA’s spectrum management activities. This is particularly relevant to the 400 MHz band where many challenges are focussed in high population density areas and not in more regional and remote areas. Consistent with ACMA’s Spectrum Management Principles, particularly that of balancing the risk of interference with the cost of regulation, ACMA will also consider approaches on a regional basis where spectrum is not congested.

Some outcomes of the review of the 400 MHz band may lend themselves to being implemented independently of other changes in the band. Where these opportunities are identified, ACMA will consider their independent implementation as a means to reduce uncertainty to stakeholders and achieve benefits from the review as early as possible.
1.7 Strategies

ACMA’s Spectrum Management Principles have been applied to develop a range of strategies to achieve the objectives of the 400 MHz review. These strategies are discussed below:

Use both economic and technical tools to achieve highest value use

As outlined earlier, a key objective of ACMA in this review is to improve the allocative, dynamic and technical efficiency with which the band is used. Achieving these efficiencies should result in each part of the band being used for its highest value use and the maximum public benefit being derived from the band.

A key enabler of improved technical efficiency in the band is the proposed reduction in bandwidth of narrowband channels to 12.5 kHz and 6.25 kHz. A driver of moving to narrower bandwidths will be setting a price that will encourage each user to move to the bandwidth delivering the most efficient outcome in terms of technical and economic efficiency.

To achieve the optimum price, ACMA is proposing to base apparatus licence taxes on opportunity cost. However, ACMA recognises that licensees would prefer prices to be predictable over time, providing a more stable environment in which to invest. Therefore the price needs to be set at a level that optimises overall efficiency in the long term, and this is likely to be lower than the price needed for a rapid movement to smaller bandwidths.

However, efficiency of spectrum use in this band will be greatly facilitated by a more rapid movement to narrower bandwidths. Therefore, ACMA is proposing a range of technical measures to encourage users to move to narrower bandwidths more rapidly than would occur using pricing signals alone. The faster move to smaller bandwidths will create free channels in most segments and facilitate the re-coordination required to achieve other objectives of this review.

The combination of economic incentives and technical planning rules to move equipment to reduced bandwidth is designed to enable and encourage users to move spectrum to its highest value use. They have been designed to be the least cost and least restrictive ways to achieve the policy objective of more efficient use.

Provide a harmonised government band

A key strategy in this paper is to consolidate government security, law enforcement and public safety operations in the 403–430 MHz segment of the band. This is to facilitate efficient use of the spectrum and to facilitate interoperability and hence gain higher value from use of the spectrum. The establishment of a government band will allow the lowest cost and maximum flexibility for state, territory and federal governments and enable improved interoperability.

Provide flexibility

Another key strategy for the band is to provide the maximum flexibility in choice of equipment and service particularly between 450–470 MHz where the widest range of different technologies is available. This gives maximum opportunity for users to move
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spectrum to a higher value use and satisfies the principle of facilitating the lowest cost and most flexible solution in spectrum management.

In the 450–470 MHz band, the current 9.5 MHz frequency split precludes the use of some technologies. Moving to a 10 MHz split will increase the range of technologies that can be deployed in the band. The availability of more choices in technology would enable users to move spectrum to its highest value use.

Under the principle of balancing certainty and flexibility, it was judged that certainty for existing users outweighed any benefits of changing frequency splits above 470 MHz as technologies available in this part of the band are currently facilitated.

Provide sufficient time for transition

In order to provide the least cost approach to achieve policy objectives, ACMA will allow time for users to adjust their use of the spectrum. Any increase to apparatus licence taxes will be phased in. Other proposals such as changes to frequency splits, channelisation or consolidating government use in a designated part of the band will have, as a major consideration, migration issues for users who will potentially be required to change aspects of their operations.

Recognise geography and demographics

In the 400 MHz band, the areas of Sydney and Melbourne are very congested. The Brisbane area is also quite congested. Congestion is much less of a problem in other areas. As a result, it may well be that different arrangements in different regions of Australia will better facilitate productive use of the 400 MHz band and maximize benefits for all Australians.

When designing transitional arrangements ACMA will consider different arrangements in different geographic locations with a view to enable the least cost approach in each area, within an overall common framework.

Optimise technical assignment and coordination rules

To enable ACMA to balance the cost of interference and the benefits of greater spectrum utilisation, ACMA proposes optimising assignment and coordination rules in conjunction with a stakeholder working group.

1.8 Process for new arrangements in the 400 MHz band

The process of arriving at new arrangements in the 400 MHz band is notionally split into review and implementation phases. This delineation recognises the distinction between identifying what the revised arrangements in the band ultimately should be (e.g., where we want to be) and determining the steps to take to implement such arrangements (e.g., how we will get there).
1.8.1 REVIEW PHASE
The release of the Options Paper and this Proposals Paper are the key elements of the review phase and the process of establishing new arrangements in the 400 MHz band.

ACMA intends to release its definitive, complete proposal for the future of the 400 MHz band for final comment by the end of 2009. This document will include details of changes to associated documentation (such as the 400 MHz Plan, licensing documents and Radiocommunications Assignment and Licensing Instructions (RALIs)).

1.8.2 IMPLEMENTATION PHASE
For a variety of reasons, including the large number of licensees, likely financial cost associated with some changes and the critical importance of many of the services provided in the 400 MHz band, ACMA expects that many of the changes to the band identified in the review phase will need be to be implemented over a substantial period of time.

The expiry of spectrum licences in the 500 MHz band in 2012 is likely to influence the implementation time frame for some potential changes in the band.

1.9 Other relevant ACMA activities and papers
In parallel to the review of the 400 MHz band, ACMA and other areas of government are undertaking activities with relevance to the 400 MHz band.

Opportunity–cost pricing
ACMA is currently exploring opportunity–cost pricing as an option for encouraging efficient spectrum use consistent with the object of the Act and with the ACMA’s Spectrum Management Principles. The 400 MHz band has been used as a case study in an ACMA consultation paper on opportunity cost pricing. For more information on this and more detail on the 400 MHz case study please refer to ACMA’s consultation paper on opportunity cost pricing available on the ACMA website www.acma.gov.au.

Digital dividend
The government has announced that the switch-off of terrestrial analog television services will be completed by the end of 2013. This will free up significant amounts of spectrum which may open up opportunities for alternative uses or the enhancement of exiting services or coverage. The opportunity to introduce new or improved services is known as the ‘digital dividend’.

The Department of Broadband, Communications and the Digital Economy (DBCDE) is undertaking work on the digital dividend and is expected to release a paper on the issue later in 2009.
**Independent Review of Government Spectrum Holdings**

To assist it in undertaking its spectrum management responsibilities, ACMA commissioned an Independent Review of Government Spectrum Holdings (IRGSH) in 2006. The intention of the IRGSH was to assist ACMA to better achieve an appropriate balance between government use of the radiofrequency spectrum and its use by the broader community.

The final report of the IRGSH and ACMA’s Preliminary Response were released in April 2008.⁶

A number of recommendations identified in the IRGSH concerned the identification of a harmonised government band around 400 MHz.

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2 Measures to address congestion

In this chapter ACMA develops detailed proposals on measures to address congestion which include:

- implementation of a 6.25 kHz compatible channel raster for all land mobile segments
- the ability to aggregate channels to achieve bandwidths greater than 12.5 kHz on a case by case basis based on the spectral efficiency of the proposed use
- prohibition of the use of 25 kHz systems (unless justification can be provided) in high and medium density areas
- reduction in the minimum channel size for all narrowband fixed segments to 12.5 kHz with aggregation of channels permitted
- no adoption of mandatory channel sharing or loading obligations on land mobile services
- implementation of revised changes to assignment and coordination procedures
- identification of spectrum for a 10 MHz duplex split in 450–470 MHz

No changes are proposed for:

- wideband systems
- minimum data rates for narrowband systems
- duplex splits in 470–518 MHz

As outlined in the Options Paper, one of the drivers behind the review of the 400 MHz band is the difficulty that some existing or potential users have in gaining access to the band in certain geographic areas. A range of options to address congestion were identified in the Options Paper and are considered here in further detail.

These options address the broad objectives of improving efficiency, including technical efficiency, and facilitating new technologies and possible complementary uses of the band.

ACMA’s standard approach to congestion is to use a range of economic and technical tools to allow spectrum to move to the highest value use. Technical tools set a framework to manage interference and provide for technically efficient operations.
Economic tools encourage licensees to use spectrum efficiently and facilitate spectrum moving to the highest value use.

ACMA also has an interest in maximising dynamic efficiency, a measure of spectrum’s ability to move to different uses over time.

The main economic tool discussed in this chapter is the annual tax on apparatus licences.

Technical efficiency and flexibility measures include:

- reduction in channel bandwidths
- channel sharing and loading
- assignment and coordination rules
- duplex split issues.

### 2.1 Reduction in channel bandwidth

The use of 25 kHz channels for narrowband land mobile and fixed equipment is well established in the 400 MHz band. The Options Paper established that systems carrying analog voice were suitable candidates for bandwidth reduction: systems carrying digital data were unlikely to be able to accommodate bandwidth reduction. A high percentage of both land mobile and point-to-point systems are recorded as analog voice systems in the ACMA licence register.

Of all land mobile assignments in the 400 MHz band, 63.1 percent are to systems using 25 kHz or greater bandwidth. For the fixed (point-to-point) service, 97.7 percent of assignments are to systems using 25 kHz or greater bandwidth. In other areas of the world where congestion has become an issue administrations have mandated or strongly encouraged the use of 12.5 kHz or narrower bandwidths for these systems in the 400 MHz band.7

Overall growth in the number of radio systems in congested areas can be assisted by the implementation of systems using narrower channels that provide the desired capability. There appears to be scope for migration of all narrowband land mobile and some fixed (point-to-point) systems from 25 kHz to at least 12.5 kHz per communications channel by moving towards increased use of equipment that utilises the equivalent of 12.5 kHz or lower per voice channel.

Equipment using 12.5 kHz channels is readily available and offers comparable performance to 25 kHz equipment. Equipment using 6.25 kHz channels is also becoming more prevalent. Systems utilising 25 kHz channels but carrying four communications channels are also available (that is, they are operationally equivalent to four 6.25 kHz channels).

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7 Or technologies that facilitate the use of equivalent, or narrower, bandwidths
Other administrations, including the United States, have already prepared for and are encouraging the use of 6.25 kHz equipment by specifying 6.25 kHz channels in their band plans.8

A move to more prevalent use of narrower bandwidths in Australia is therefore consistent with overseas trends and aligns domestic arrangements with current and emerging technologies.

A number of options to support a migration to narrower channels were outlined in Section 6.1 of the Options Paper. These were:

- The ‘Interleave’ method, which interleaves 12.5 kHz channels with the existing 25 kHz raster. A new 12.5 kHz channel is assigned to the same centre frequency as the current 25 kHz channel. When an adjacent channel is converted to 12.5 kHz, an extra 12.5 kHz channel can be inserted between the two on the 12.5 kHz raster.
- The ‘Offset’ method, which divides a current 25 kHz channel in two so that two 12.5 kHz channels can immediately be inserted with centre frequencies offset by 6.25 kHz to the original 25 kHz raster.
- An additional option is for a group of 25 kHz channels to migrate into a block of 12.5 kHz channels, thus freeing up contiguous blocks of spectrum for other purposes.

Australian arrangements in the 400 MHz band also support some wideband (150–750 kHz) fixed operations in limited parts of the band, only in areas outside of 200 km from capital cities.

The overall ACMA objective is to enable, encourage or mandate channel usage in the band that takes advantage of contemporary technology in order to improve spectrum productivity and assist in relieving congestion. ACMA intends to utilise approaches that acknowledge the differences between congested urban and uncongested rural and remote areas. These objectives are in line with ACMA’s Spectrum Management Principles, particularly the following:

- To the extent possible, promote both certainty and flexibility: It is important that ACMA provides flexibility for users to adapt to changing technology. Facilitating the use of narrow bandwidth technologies and different rules for urban and rural and remote areas achieves flexibility, which is balanced against giving licensees the certainty of continued operation, advance notice and sufficient time to reorganise their operations.
- Enable and encourage licensees to move spectrum to its highest value use or uses: By facilitating the use of narrowband and other spectrally efficient technologies, ACMA is enabling spectrum to be used more efficiently.

2.1.1 STAKEHOLDER RESPONSE

In the Options Paper, ACMA outlined a proposal to migrate to 12.5 kHz assignments. Almost all respondents supported the proposal to migrate to 12.5 kHz land mobile
channels. However, there was some opposition from users that argued for the retention of the larger channels. Some users in rural users did not support migration to 12.5 kHz when spectrum is not congested.

Stakeholders with interests in data equipment presented a case for maintaining 25 kHz channels, and even a need for 50–100 kHz channels to cater for existing and future data rates. Aggregation of channels was put forward as a way of achieving the desired channel width. Additionally, users of fixed (point-to-point) links for high throughput data applications argued for their continuing need for larger bandwidths.

Significantly, support for 6.25 kHz channels was strong. Respondents felt this would be the best way to ‘future proof’ the band and avoid another review of arrangements in the near future. Respondents believed a migration beyond 12.5 kHz to 6.25 kHz channelling would reduce long terms costs by avoiding the need for further replanning of the band in the near future.

In addition a number of respondents requested that spectrum users should have the option to aggregate channels (up to 100 kHz was suggested) with adequate justification.

Sufficient time frames for migration were also requested, and it was suggested that users in rural areas be given longer to migrate than those in metropolitan areas.

The proposal to remove or restrict 25 kHz analog FM land mobile equipment from the 400 MHz band was given broad support across the submissions and considered feasible given an appropriate time frame. A number of respondents suggested that existing 25 kHz systems should continue to operate until the attrition of the equipment. Time frames of up to 15 years were suggested for the phase out of 25 kHz analog FM land mobile systems.

**Migration approaches**

A number of approaches were suggested to facilitate migration away from the use of 25 kHz analog FM systems in the 400 MHz band. A common suggestion was the encouragement of an early adoption of digital equipment using 12.5 kHz or 6.25 kHz channelling by offering financial incentives in the form of reduced licence fees or a licence fee free period.

Overall, in discussing bandwidth reduction migration paths, the main goal of respondents was cost minimisation. To that end a majority of respondents preferred the ‘interleaved’ approach for bandwidth reduction migration described in the Options Paper. This would allow the operating frequencies of equipment to be maintained and equipment replacement or modification would not necessarily need to occur all at once.

The ‘offset’ method was believed to be more disruptive by the majority of respondents. Some stakeholders indicated that in practice, the use of a mixed approach to migration may be necessary so the different needs of different users can be met throughout the band.

The cost of migration was also said to be influenced by other factors including the age of current systems with most new systems operating at 25 kHz bandwidth already
being capable of operating on 12.5 kHz channels with little modification and hence little additional cost.

Government users also flagged their need for duplicated spectrum for migration so that there is no system down time during migration.

The monetary costs quoted for migration to 12.5 kHz channelling varied across the submissions depending on the systems being used and the number of devices in operation. Costs from $100,000 to $250,000 per system were quoted by the smaller users (one or two base stations) whereas larger users quoted costs in the tens of millions of dollars for large elaborate systems consisting of many base stations.

Several respondents commented that costs of migration would be minimal as they are already using 12.5 kHz channelling, and hence only minor changes would be envisioned.

2.1.2 ISSUES

ACMA has identified the following core issues in the consideration of reduced channel bandwidths:

- whether to reduce channel bandwidth to 12.5 kHz or 6.25 kHz
- determining if this reduction should apply to:
  - land mobile: two frequency and single frequency
  - fixed: point-to-point and point-to-multipoint.
- determining the need for the aggregation of channels to support:
  - trunking (e.g., supporting larger bandwidth that carry multiple users)
  - high-throughput applications (e.g., high data rate applications that require larger bandwidths).
- the appropriate migration strategy and time frame to be used in reducing channel bandwidth
- the varying need for reduction in channel bandwidths in high and medium density areas compared with rural and remote areas, and the opportunity for relaxed requirements in rural and remote areas
- incentives to support and encourage migration to reduced channel bandwidths
- it is noted that some technologies achieve multiple communications channel within their bandwidth (e.g., TETRA provides four communications channels per carrier), and ACMA acknowledges this in the concept of channel equivalence. For example, a TETRA carrier, although occupying a 25 kHz bandwidth is regarded as being equivalent to a 6.25 kHz system in terms of channel size.

2.1.3 ANALYSIS

Reduction in channel bandwidth

To ensure new arrangements are resilient and to minimise congestion in the foreseeable future, ACMA believes that it is prudent to facilitate the use of 6.25 kHz equipment through the implementation of a 6.25 kHz compatible channel raster.
Facilitating access for 6.25 kHz equipment seems appropriate and consistent with overseas trends.

While 6.25 kHz channelisation appears ideal from a spectrum efficiency perspective, ACMA is of the view that the equivalent of 12.5 kHz per voice channel is an appropriate medium-term target for efficient use of the spectrum given contemporary technology. To achieve this, ACMA considers that for the land mobile service use of:

- 6.25 kHz channels should be **enabled** and **encouraged**

- 12.5 kHz channels should be:
  - **enabled**, **encouraged** and **mandated** over time in high density areas (HDAs) and medium density areas (MDAs)\(^9\)
  - **enabled** and **encouraged** in all other areas.

- 25 kHz channels should:
  - **not be permitted** in the long term in HDAs and MDAs
  - **be permitted** in all other areas.

- Justification for use of bandwidths greater than 12.5 kHz in the long term in HDAs and MDAs would be considered case by case. Exceptions would be granted based on a demonstrated need to facilitate spectrally efficient technology, for example systems that utilise 25 kHz channels to support four voice channels. 25 kHz analog assignments would not be supported.

- While time will be allowed for the transition of current 25 kHz assignments in HDAs and MDAs, no new assignments will be permitted

Closer alignment with the opportunity cost of the spectrum is considered one appropriate mechanism for encouraging reduced channel bandwidths of 6.25 kHz and 12.5 kHz. In addition to freeing up spectrum for new users, pricing signals may assist in creating vacant spectrum to aid transitioning approaches to restructure the band. Pricing incentives for migration are discussed below.

While over time appropriate pricing signals could be expected to be sufficient to encourage spectrally efficient technology approaches, these signals may not be strong enough to effect these changes rapidly enough to address the near term congestion issues in HDAs and prevent similar congestion issues in MDAs in the near future. This is due, at least in part, to the small size of licence fees relative to the cost of equipment.

Accordingly ACMA proposes to prohibit some types of assignments in HDAs and MDAs. Analog FM 25 kHz systems in particular are not considered spectrally efficient and would not be expected to be supported post the transition period in HDAs and MDAs.

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To allow existing 25 kHz equipment to be phased out and replaced with more spectrally efficient equipment a transition period where this equipment could continue to be used would be appropriate. A transition period of up to 5 years may be appropriate.

ACMA also believes that the minimum channel size for all narrowband fixed segments, for both point-to-point and point-to-multipoint services, should be reduced to 12.5 kHz. Aggregation of channels up to 25 kHz will be facilitated in the short term to allow for transition, and in the long term 25 kHz channels (or greater) may be permitted where sufficient justification can be provided.

ACMA proposes that arrangements for wideband fixed services should be considered separately.

**Apparatus licence tax**

The apparatus licence tax is used by ACMA to encourage the efficient use of spectrum where a price-based allocation system such as an auction is not used. Setting apparatus licence taxes at an appropriate level fulfils the second of ACMA’s *Spectrum Management Principle*—to enable and encourage licensees to move spectrum to its highest value use.

Economic efficiency is maximised when the annual tax on administratively priced spectrum is set at the opportunity cost. The existence of congestion in the 400 MHz band is prima facie evidence that the current price is less than opportunity cost in congested areas. The ACMA expects it will release a paper on opportunity cost issues in Q2 2009 providing a detailed rationale of this principle.

ACMA recently conducted a pricing study of the 400 MHz band for Sydney (representative high density area) and Perth (representative medium density area). The results of the study indicated that the price in Perth was found to be a good estimate of opportunity cost but the price in Sydney was found to be substantially lower than the market price. The most typical calculations for Sydney resulted in an opportunity cost of $269 (per kHz per year per assignment) compared with the current apparatus licence tax of $90.\(^\text{10}\)

Consistent with evidence of excess demand and with the results of the pricing study, ACMA proposes that the apparatus licence taxes in medium and low density areas should be maintained, but should increase in high density areas (Sydney, Melbourne and Brisbane) in equal annual increments over five years to a target price. The pricing study suggests the target price should be around two to three times the current price. If it was observed that demand was equalising with supply at one of the interim increments, the price would be kept at that level—until demand once again started to outstrip supply.

An increase in tax of this magnitude should provide an incentive to move to smaller bandwidth channels. Details on ACMA’s proposal to facilitate licensees to use 6.25 kHz and 12.5 kHz channels in the 400 MHz band are discussed above.

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\(^\text{10}\) See the Plum report on the ACMA website for more detail: [www.acma.gov.au](http://www.acma.gov.au)
Migration

Submissions to the first discussion paper indicated that the preferred bandwidth reduction migration path from 25 kHz to 12.5 kHz for a majority of respondents was the ‘interleaved’ approach. This was mainly because this approach achieved the stakeholders’ prime goal of cost minimisation. For some existing licensees this approach will not impose any change.

As the migration paths described in the Options Paper focused on moving from 25 kHz to 12.5 kHz channels, the options for migration need also to be assessed for a move to 6.25 kHz channels.

There are currently very few systems operating at 6.25 kHz bandwidth in the 400 MHz band. Therefore, in terms of channel arrangements, the greatest overall benefit would be to structure the band so that initially, two 6.25 kHz channels can be aggregated as a single 12.5 kHz channel with the same centre frequency as current 25 kHz channels. This is illustrated in Figure 2.

![Figure 2: Offset with aggregation 25 kHz to 6.25 kHz reduction path](image)

Under the new arrangements, users would be able to aggregate channels to use systems with bandwidth greater than 6.25 kHz.
2.1.4 PROPOSALS

Land mobile

1. ACMA proposes to:

- implement a 6.25 kHz compatible channel raster for all land mobile segments (both single and two frequency segments) in the 400 MHz band
- permit aggregation of channels to 12.5 kHz unconditionally
- permit aggregation of channels greater than 12.5 kHz. Justification would be required in HDAs and MDAs with the spectral efficiency of the proposed use (25 kHz analog systems would not be supported) and the availability of alternatives as key considerations.
- prohibit 25 kHz systems in HDAs and MDAs within 5 years.

Fixed

2. ACMA proposes:

- to reduce the minimum channel size for all narrowband fixed segments (point to point and point to multipoint) in the 400 MHz band to 12.5 kHz with aggregation of channels permitted where justified
- to prohibit 25 kHz analog voice point-to-point systems in HDAs and MDAs within 5 years
- no change for wideband systems.

These changes would be implemented in various planning assignment documents including the 400 MHz Band Plan and RALIs LM8, FX16 and FX17. Australian Standards may also need to be reviewed.
2.2 Sharing and channel loading

As discussed in the Options Paper, channel sharing and increasing channel loading are two potential ways of promoting efficient use of spectrum. The Options Paper sought views on time-sharing channels and on imposing minimum channel loading requirements as a way of fostering appropriate usage rates of spectrum.

Although not explicitly stated in the Options Paper, trunking in particular is a way to share spectrum in a way that is largely transparent to the user. This method is especially useful for services that require high availability but have low channel loading. At present the 400 MHz Plan provides approximately 2x2.5 MHz of paired spectrum for trunking systems.\textsuperscript{11} The 400 MHz Plan does not explicitly support the use of trunked systems in other segments.

With the exception of the spectrum allocated to trunking systems, there are currently no prescribed channel loading requirements in the 400 MHz band.

Efficient use of the spectrum, by sharing, is a core objective of ACMA and is supported by its Spectrum Management Principles. Sharing is a way of moving spectrum to a higher value use, and can be introduced in a way that balances any increased cost against the benefits of greater spectrum utilisation.

2.2.1 STAKEHOLDER RESPONSE

Spectrum sharing, in any form, was not supported in many submissions. The majority of respondents stated that it was not at all possible for simple channel sharing to occur with their systems. Trunking was advocated as a more effective method of time sharing opposed to the temporal channel sharing described in the Options Paper, and currently used informally.

A large number of respondents stated they would consider moving to a trunked system if more spectrum was dedicated for use by trunked systems. Some respondents believed that by providing more spectrum for trunking, spectrum for non-trunking would be further limited and therefore users would be encouraged to move to trunked systems, which would increase overall spectrum utilisation. However, some submissions expressed opposition to dedicated trunking bands with the view that trunking provides lower quality and expensive solutions especially to small users or users in rural areas.

Minimum channel loading requirements were not favoured by law enforcement, public safety and other organisations because there are times when such users require high channel availability. However, operators of telemetry/telecommand systems were in support of minimum data rate requirements and believed that mandating minimum data rates would improve overall spectrum utilisation.

Many respondents raised questions about the practicalities of monitoring and enforcing minimum channel loading requirements. Additionally, several respondents commented that channel loading requirements should be relaxed in rural and remote areas.

\textsuperscript{11} Paired segments E and M in the frequency bands 406.1-408.6375 MHz and 415.5625-418.0875 MHz.
2.2.2 ISSUES

The core issues identified are:

- What forms of sharing and/or channel loading are appropriate in the 400 MHz band?
- How should the use of trunking technologies be encouraged, that is:
  - Should dedicated spectrum for trunking be identified or should it simply be permitted in general two frequency bands?
  - If dedicated trunking spectrum is desired, how much spectrum is needed?

2.2.3 ANALYSIS

The issues of sharing and channel loading are complex, with a broad range of user requirements, possible geographic dimensions and implementation considerations. The main objective for ACMA on this issue is to promote effective use of the spectrum, in line with the Spectrum Management Principles.

Low channel loading does not necessarily equate to ineffective use of spectrum. For some critical uses where high channel availability is required and network capacity varies considerably (e.g., police, where an emergency situation may cause peaks in communications requirements) availability of spectrum, and not necessarily active use of spectrum, can be regarded as constituting effective use of that spectrum.

While some forms of channel sharing and loading appear possible, practically they generally appear to impose onerous obligations on both ACMA and users. However, trunking is considered a viable and useful form of sharing in many circumstances. Generally, trunking systems make very efficient use of spectrum.

In addition, an investigation of changes to minimum data rates for data applications is considered appropriate.

Trunking

The current trunking segment in the 400 MHz band is heavily used. For example, within the Melbourne area 174 out of a possible 200 channels are licensed, and in Sydney 191 of the 200 available channels are licensed.

The VHF High Band Frequency Band Plan\(^\text{12}\) caters for trunking by providing dedicated trunking segments. Additional trunking is facilitated in segments not dedicated to trunking by the inclusion of a clause to the effect that channelling arrangements other than those specified may be authorised where such arrangements provide for more efficient use of the spectrum. This provision adds flexibility to deploy trunking systems in segments not dedicated to trunking.

Current major trunking systems that are available include, but are not limited to, the APCO Project 25 Phase 1 (P25) standard and Terrestrial Trunked Radio (TETRA). Both of these systems can operate on a variety of bands with P25 able to operate throughout the Australian 400 MHz band (primarily in 406–512 MHz) while TETRA,

without a tailored solution\textsuperscript{13} operates exclusively in the frequencies and splits shown in Table 1.

<table>
<thead>
<tr>
<th>Emergency systems</th>
<th>Civil systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number</strong></td>
<td><strong>Frequency pair (MHz)</strong></td>
</tr>
<tr>
<td>:</td>
<td>:</td>
</tr>
<tr>
<td>1</td>
<td>380–383</td>
</tr>
<tr>
<td>2</td>
<td>383–385</td>
</tr>
<tr>
<td>3</td>
<td></td>
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<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Frequency bands for TETRA operation

The next versions of both P25 and TETRA are expected to reduce the differences between the two systems. While both systems seem to be converging in some respects, TETRA remains restrictive in its standardised requirement for set duplex splits and site sense.\textsuperscript{14} It is feasible that a TETRA manufacturer may supply equipment with non-standard duplex splits and site sense but this would come at a cost and would limit choice in the Australian radio market.

To provide technology flexible spectrum arrangements, it is preferable to implement a 10 MHz split for dedicated trunking spectrum. This would accommodate virtually all known trunking technologies, including both TETRA and P25 systems. Currently, TETRA equipment is not able to operate in the dedicated trunking segments in the 400 MHz band.

The requirement for a 10 MHz split will require changes to duplex splits in the current 400 MHz Band Plan. However, if these changes do not occur, technology flexibility in dedicated trunking segments will be limited as TETRA would not be supported.

Proposals to dedicate spectrum in the 450–470 MHz band to trunking are discussed in Chapter 6.

Potential options for facilitating a 10 MHz split for technology flexible solutions and trunking in the proposed harmonised government band is discussed in Chapter 3 on identification of a government band.

**Channel loading**

Another measure which would encourage appropriate usage rates of spectrum is minimum channel loading requirements. One of ACMA’s Spectrum Management Principles is to use the least cost and least restrictive approach to achieving policy objectives. If channel loading requirements were more broadly introduced ACMA would need to consider the cost of enforcing these requirements. A higher degree of spectrum monitoring would be required and enforcement activity would need to increase. There is therefore a significant cost to ACMA in implementing and enforcing channel loading requirements.

\textsuperscript{13} A tailored solution would involve the use of non-standard equipment. Manufacturers state this would come at a cost and potential users state that the associated costs and limited availability of equipment make this option unviable for the Australian market.

\textsuperscript{14} Duplex splits of 7, 8 and 10 MHz are provided for in the TETRA ETSI Standard. 10 MHz appears to be preferred by manufacturers.
For telemetry/data systems, implementing minimum data rates for a given bandwidth may be a practical way to impose a form of minimum channel loading on the point-to-point and point-to-multipoint system in the 400 MHz band. The minimum data rates suggested in the responses to the Options Paper were 9 600 bps for 12.5 kHz and 19 200 bps for 25 kHz systems.

These rates are consistent with those specified in the United States. However, Australian standards, upon which spectrum assignment rules depend, do not generally support equipment capable of these speeds. This is due primarily to Australia’s tighter adjacent channel emission requirements (consistent with European arrangements). Practical minimum data rates under these standards are therefore 4 800 bps for 12.5 kHz channels and 9 600 bps for 25 kHz channels.

While changes to minimum data rates are in some ways attractive, ACMA considers that the pricing incentives outlined in this paper are the most appropriate mechanisms to encourage appropriate loading of data systems.

2.2.4 PROPOSALS

*Land mobile sharing and channel loading*

3. ACMA does not propose to adopt mandatory channel sharing or loading obligations on land mobile services.

*Land mobile trunking*

4. ACMA proposes to identify additional segments within the 400 MHz band to be used exclusively for trunking. This proposal is discussed further in Chapter 6.

*Channel Loading Requirements for Fixed Service Data Applications*

5. ACMA does not propose to vary the existing minimum data rates for narrowband fixed service data applications.

These proposals would be implemented through changes to various planning assignment document including the 400 MHz Band Plan, RALIs LM8, FX 17 and 18.
2.3 Assignment and coordination rules

The Options Paper sought advice on the potential for variations/changes to the licensing and assignment rules to better facilitate the use of the band.

ACMA’s objective on this issue is to maximise the utility possible in the band by facilitating and in some cases mandating improved coordination/assignment processes. Additionally these improvements should also follow ACMA’s Spectrum Management Principles, for example to allow the least cost and least restrictive approach to achieving policy objectives, and to the extent possible, promote both certainty and flexibility in the use of the spectrum and to balance the cost of interference and the benefits of greater spectrum utilisation.

An issue raised in the Options Paper was the use of high power single frequency systems and whether or not spectrum access for this type of system should be restricted or removed. The Options Paper explained that these high power services do not use spectrum efficiently, and deny the use of many channels at each site they are located.

2.3.1 STAKEHOLDER RESPONSE

Licensing and assignment rules for land mobile, point-to-point and point-to-multipoint

Major stakeholder responses included the use of flexible re-use distances, or more generally a relaxation of the ‘100 km rule’, and the use of topographical data in re-use calculations.

Alternatives to the use of re-use distances for coordination were suggested in several responses including the use of minimum carrier to interference ratio (C/I) for coordination, the use of a two service area model (in which ACMA sets a maximum service area then assigners can assign anything up to that distance) and the ability to facilitate cellular design.

Other suggestions for improvements to ACMA’s assignment and coordination rules included mutually agreed sharing/re-use, limiting transmitter power, dynamic power control, encouraging use of antenna down-tilt and the use of more efficient antenna patterns. Overall, a desire for more flexible licensing instructions was apparent in the majority of responses.

Single frequency systems

There was conflicting opinion on the possible restriction of high power single frequency systems (SFS). A number of stakeholders, including those from the rail industry and emergency services, were in favour of retaining high power for some ambulatory services and systems that required large coverage areas. Rural users also supported the retention of high power SFS in rural and remote areas where infrastructure is limited.

Conversely, there were submissions supporting the restriction of high power SFS. Several respondents suggested that SFS power be restricted to 8.3W, citing the amount of spectrum denial caused by higher power systems as the significant issue.
Spectrum Proposals: 403–520 MHz

Other Single Frequency Applications

ACMA has also identified a number of applications that are currently not well supported by existing arrangements. For example, wide-area data systems (e.g., differential GPS\textsuperscript{15}) do not fit in well with most other applications under current spectrum arrangements.

2.3.2 ISSUES

ACMA has identified the following key issues on assignment and coordination rules:

- a lack of flexibility
- reliance on a ‘one size fits all’ approach
- missing information (e.g., some frequency-distance tables missing)
- the potential for regional variations
- a lack of currency.

Land mobile service (LM8)

RALI LM8 defines two service models, which provide either a large or small coverage area, with clearly defined frequency-distance relationships and frequency re-use distances for most circumstances. Situations not explicitly catered for are generally dealt with by use of ‘good engineering practice’.

Key issues raised about LM8 were:

- a reduction in re-use distance for situations that warrant it
- use of topographical data in re-use distance calculations
- impact on the ability to cover large service areas for emergency services if the re-use distance is relaxed.

Point-to-multipoint services (FX16)

The predominant use of FX16 is for the coordination of data transmission systems; typical applications include telemetry, supervisory control and data acquisition (SCADA) systems, computer networking and alarm systems.

Potential changes to LM8 could also be applied to FX16 in:

- flexibility in re-use distance; and
- use of topographical data in re-use calculations.

In addition, the service model used in FX16 does not align well with current implementations of point-to-multipoint systems.

Point-to-point services (FX17)

RALI FX17 could also implement a terrain based interference calculation model, as opposed to the current interference calculations which are based on the Longley Rice model and an unobstructed line-of-sight path.

\textsuperscript{15} Global Positioning System
**Single frequency systems**

Issues identified with SFS in the 400 MHz band are:

- the large amount of spectrum denial caused by SFS
- a lack of spectrum for the operation of ‘special’ SFS like DGPS given its operational requirements and high duty cycle.

**Area-wide systems**

Assigning spectrum for area-wide systems presents particular challenges. These systems typically operate at a semi-permanent fixed location or move around day-to-day to suit operational requirements. Voice systems, typically operating at a low duty cycle, can usually share channels with other systems: data systems often operate almost continuously, and hence cannot share channels with other systems within an area, and provide a reasonable grade of service.

### 2.3.3 ANALYSIS

**Land Mobile, Point-to-Point and Point-to-Multipoint**

ACMA is currently seeking input from the Radiocommunications Consultative Committee (RCC) 400 MHz Working Group, equipment manufacturers and frequency assigners about potential changes for RALIs FX16, FX17 and LM8.

In considering the implementation of frequency assignment procedures, ACMA must consider whether arrangements can be readily implemented. If propagation models are to be used as part of the frequency assignment process, a recognised method or range of methods needs to be prescribed—typically methods defined in ITU recommendations satisfy this requirement. The main reason for this requirement is that any frequency assignment processes devised by ACMA should be able to be readily implemented by both ACMA and external accredited frequency assigners, without undue impost.

There are several terrain based propagation models for UHF, two ITU methods are ITU BT.1546–3 and ITU P.452. Both are implementable with freely or commercially available computer based software. The Terrain Integrated Rough Earth Model (TIREM) is another readily available computer based RF propagation tool.

If the use of a computer based propagation model becomes mandatory, frequency assigners (both ACMA and external) will need to have the ability to operate and own this type of software to assign frequencies. The use of a terrain based model will mean that the complexity of making these assignments will increase, but as the responses to the Options Paper put forward, the increased spectrum utilisation offered by the use of these types of propagation models can mean that assignments can be made that would otherwise have been impossible.

**Single frequency systems**

There are around 12,700 SFS in operation, with only 3% (381) assigned as high power. Of these 381, 26% are government owned with a further 3% being solely for rail. The rest of the high power SFS are made up of 8% personal use and remaining 63% company owned licences.
Considering the responses to the Options Paper were mainly concerned with rail and emergency services, government users could operate single frequency high power systems adjacent to their own services (as may occur in a ‘government’ band). It is then in their own interest to balance spectrum denial issues with operational requirements. Considering this, along with the limited number of affected licenses and the fact that each of these services denies up to 30 channels at each site, a restriction or quarantining of other high power SFS is considered necessary.

Regional variations are another possibility, in that the use of high power SFS could be allowed after consultation with ACMA and the use of high power SFS would only need to be restricted in high density areas (HDAs) and medium density areas (MDAs).

*Area-wide data systems*

A viable solution for area-wide data systems is to provide them with dedicated channels. ACMA work with frequency assigners, industry and the RCC 400 MHz Working Group suggests that a suite of five or so channels would adequately cater for this requirement.

**2.3.4 PROPOSAL**

In parallel with a process of aligning assignment procedures with current practice, ACMA proposes the use of the following approaches to improve the assignment and coordination instructions. ACMA believes that the proposed assignment changes represent a balance between increased spectrum utilisation, impost on frequency assigners and the risk of possible interference.
6. ACMA proposes to undertake a process to implement revised changes to assignment and coordination procedures based on the following core concepts, for:

**Land mobile**
- a review of re-use distances with a view to reduction
- the option to use topographical information in the assignment process

**Point-to-point**
- the option to use topographical information in the assignment process

**Point-to-multipoint**
- the option to use topographical information in the assignment process

**Single frequency systems**
- restricting or quarantining high power single frequency systems
- permitting high power single frequency in exceptional cases only
- regional variations to allow the use of high power SFS in some areas

**Area-wide high duty cycle data systems**
- identification of dedicated channels for area-wide, high duty cycle data systems.

These proposals would be realised through changes to various planning assignment document including, the 400 MHz Band Plan, RALIs LM8, FX16 and FX17, and other regulatory and administrative documents.

### 2.4 Duplex split issues

The Options Paper sought comment on preferred frequency splits and site sense for various equipment types and technologies. Currently the 400 MHz band provides transmit/receive frequency splits of 5.2 MHz, 9.45 MHz, 9.5 MHz and 10 MHz for two frequency operation. Most, but not all, equipment supports these frequency splits.

ACMA’s objective on this issue is to maximise the technology options supported by planning arrangements in the long term, balanced with the potential impact of any changes in frequency splits on incumbents. The increased flexibility to choose from a greater range of equipment will enable licensees to move to higher value uses of spectrum.
2.4.1 STAKEHOLDER RESPONSE

The general stakeholder response was that duplex frequency splits should be aligned with best use of the spectrum and reasonably affordable infrastructure. Three themes emerged:

- Technologies such as TETRA should be catered for and therefore a band split of 10 MHz is needed.\(^\text{16}\) Those that specifically supported catering for TETRA also commented on the need for reverse band splits in some parts of the 400 MHz band.

- Retain spectrum to cater for existing duplex splits so that existing radio systems can still be used.

- ACMA should consider the current international trends and industry standards when determining band splits as the majority of the equipment used in the 400 MHz band is imported.

2.4.2 ISSUES

The Australian market: Global perspective

One of ACMA’s broad objectives is to make best use of the spectrum available within a technology-flexible framework. ACMA’s frameworks are usually aligned with global equipment standards, ensuring a wide variety of equipment is available at competitive prices and also facilitating local manufacturers’ entry into global markets. If Australian arrangements are not compatible with the equipment generally used and available overseas, then non-standard equipment will need to be sourced. Choice is likely to be limited and costs are likely to be higher. It is therefore beneficial for Australia to cater for the capabilities of globally common equipment wherever possible. The 400 MHz framework should be consistent with this approach.

The impact of changing duplex splits

Any change to duplex splits in the 400 MHz band creates significant issues for incumbents: re-tuning and/or replacement of equipment would normally be necessary. Any change in split in an encumbered band will result in some unusable spectrum while the migration to the new split is underway. The costs incurred by any change to duplex splits needs to be balanced against any potential long term benefit.

Benefits

Commercially available technologies that significantly improve spectrum efficiency are not well supported by the current duplex splits, while existing technologies are, in general, able to support proposed changes to the splits. Changing the duplex splits therefore provides uses with a greater choice of equipment which should lead to better spectrum efficiency and reduced equipment prices in the longer term. It also expands the options available to local manufacturers by creating a local market for a technology that addresses a global market.

\(^{16}\) The TETRA standard also provides for an 8 MHz split, but 10 MHz seems prevalent.
2.4.3 PROPOSAL
In reaching these proposals ACMA considers its *Spectrum Management Principles*, particularly:

- allocate spectrum to the highest value use or uses
- use the least cost and least restrictive approach to achieving policy objectives
- to the extent possible, promote both certainty and flexibility.

7. ACMA proposes:
- the identification of spectrum for a 10 MHz duplex split in 450-470 MHz (refer to Chapter 6)
- no duplex split changes in 470-518 MHz.
3 Identification of a harmonised government band

Throughout this chapter ACMA provides detailed analysis on the identification of a government band and proposes that:

- the 403–430 MHz band to be identified for the exclusive use of federal, state and territory governments
- this band be primarily used to enable interoperability between government agencies
- other government users be permitted to use the band contingent on the requirements of security, law enforcement and emergency services uses being adequately supported
- a segment of this band be identified for federal agency use provided interoperability can be demonstrated
- the entire block of spectrum should be made available on a state-wide basis as a single licence
- apparatus licensing be continued to be used to authorise use of the band initially and that spectrum licensing be explored later
- existing non-government licensees in the 403–430 MHz band transition out of the band within 5–8 years
- existing government arrangements outside of the 403–430 MHz band be removed no sooner than in 5 years time
- relevant national committees should determine solutions for interoperability.

Radiocommunication is vital to government in meeting a wide range of its responsibilities, including the provision of security, law enforcement and emergency services. The availability of sufficient spectrum for these services is therefore of key importance to government and to the wider community.

While voice communications have traditionally been the highest priority for these agencies, data communications is becoming increasingly important. The characteristics of the 400 MHz band make it well suited for voice and low data rate communications (such as the distribution of dispatch information), and not suitable for broadband data communications. Systems (either commercial or dedicated to government) operating in more appropriate alternate spectrum will be necessary to
provide a broadband compliment to the narrowband capabilities possible in the 400 MHz band.

The identification of harmonised, contiguous spectrum dedicated to government users (particularly law enforcement and emergency services) offers substantial scope to make the management of government spectrum more efficient and strategic, by:

● facilitating radiocommunications interoperability between government agencies (particularly those involved in law enforcement and emergency services) and jurisdictions
● providing improved opportunities for significant efficiencies in terms of both spectrum usage and infrastructure requirements for governments.

**Interoperability**

There is a longstanding and widely acknowledged requirement for improved radiocommunications interoperability between federal, state and territory agencies for emergency response coordination and law enforcement. The need for improved interoperability becomes paramount in government response to major incidents including natural disasters and terrorist attacks.

ACMA has broad spectrum management powers of relevance to interoperability. The identification of harmonised spectrum for government needs is an important enabler of interoperability, although it should be noted that harmonised spectrum arrangements alone do not lead to a complete interoperability solution. Broader support, guidance and commitment from Australian governments and individual government agencies is essential for comprehensive interoperability objectives to be realised.

Notwithstanding the above, ACMA is cognisant of the unique position its spectrum management responsibilities and powers under the Act provide to greatly assist the national interoperability agenda. It is ACMA’s preference that interoperability will occur, as it is clearly in the national interest for this to occur, and ACMA intends to pursue this objective, working in conjunction with governments, agencies and committees to maximise interoperability outcomes.

**Efficiency**

In addition to the goal of interoperability there are other advantages to realising a harmonised government band. Given the magnitude of governments’ radiocommunications requirements, they are excellent candidates to develop spectrally efficient, consolidated government networks. Typical existing networks are disparate in spectrum and technology, and are maintained by individual agencies. Consolidated networks can also offer significant financial benefits to governments through economies of scale, both during procurement and in ongoing maintenance. Significant progress has been made by several Australian governments in developing consolidated networks, and some savings have been realised. Even so, in some cases a lack of contiguous spectrum has limited the potential of such networks to fully realise the benefits that consolidated networks can bring.
Objectives in identifying a government band

Given the fundamental importance of the issue and the amount of spectrum required, identification of a candidate government band is a key element in the overall review of arrangements in the 400 MHz band. A decision on the size and location of a harmonised government band has a major impact on overall arrangements in the band.

While the needs of government in the 400 MHz band, particularly those agencies providing security, law enforcement and emergency services, are clearly important, continued access to the band for other parts of the Australian community is also important. The amount of spectrum made available specifically for government users, and its location in the 400 MHz band, needs to be critically considered: a balance needs to be reached between spectrum identified for government use and spectrum available for other uses.

A number of objectives have been identified to guide ACMA’s consideration on this issue:

- improve radiocommunications interoperability between government security, law enforcement and emergency services
- maximise technology and equipment options for governments/agencies
- maximise long term certainty in spectrum access for government users
- minimise restrictions on the federal, state and territory government use of the band provided certain minimum requirements are met supporting the needs of security, law enforcement and emergency services
- provide incentives for the consolidation of government spectrum use in the identified band and to use that spectrum efficiently
- provide sufficient transition time and appropriate migration arrangements to ensure continuity of access to spectrum and therefore provision of government services
- maximise the overall benefits to the broader Australian community that the formation of harmonised government spectrum in 400 MHz brings.

3.1 Background

Favourable radio coverage characteristics and good equipment availability has led to the 400 MHz band being heavily used by government in the provision of federal, state and territory government national security, law enforcement and emergency services as well as many other public good services. Radiocommunications interoperability is a key capability for these agencies.

The identification of dedicated harmonised, contiguous spectrum had been acknowledged as a critical element in achieving this aim. Spectrum in the 400 MHz
band is generally acknowledged as the most appropriate to achieve this harmonisation.\(^{17}\)

A number of committees and working groups have been established to consider interoperability and related spectrum issues. These include:

- National Coordinating Committee for Government Radiocommunications (NCCGR)\(^{18}\)
- Law Enforcement and Security Spectrum Committee (LESRSC)\(^{19}\)
- Australian Government Radiocommunications Working Group (AGRWG)\(^{20}\).

The NCCGR and LESRSC in particular are well established committees that have either completed or made significant progress towards strategic plans relevant to the identification of a government band and particularly interoperability requirements.

ACMA’s work towards identifying a government band is closely linked with the ongoing work of these committees.

### 3.1.1 INTEROPERABILITY

Interoperability between agencies and jurisdictions is a complex issue and can occur at multiple levels. Interoperability at the command and control level between high level agency and jurisdictional commanders may employ several communication methods, such as radiocommunication, telecommunication or physical co-location of staff. Interoperability at the command and control level may not be solely dependent on radiocommunications and therefore spectrum.

At the level of officers in the field, radiocommunications with the command and control centre is essential to the performance of their duties and interoperability may be desired directly with other field officers from different services or in some cases jurisdictions. In any event radiocommunications is essential in the field.

The focus of this discussion is therefore the adequate provision of spectrum for both the command and control and the field components of government radiocommunications.

Achieving this type of interoperability is substantially more than just a purely technology based problem with its associated spectrum management factors. Governments must fund and support agencies to migrate their radiocommunications networks to appropriately identified harmonised spectrum, and agencies themselves must develop and agree on compatible technology standards and operational arrangements to achieve genuine interoperability.

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\(^{17}\) It is acknowledged that these agencies continue to utilise other spectrum to address particular requirements, such as high frequency (HF) for long distance communications. Spectrum harmonisation discussions in this paper focus on the 400 MHz band only. No proposals are considered here to vary government spectrum use in other bands.

\(^{18}\) The NCCGR reports to the Council of Australian Governments (COAG) through the NCTC on counter-terrorism radiocommunication matters and through the jurisdictional First Minister’s representatives for radiocommunication matters of broader national importance.

\(^{19}\) The LESRSC reports to COAG through the Ministerial Council; for Police and Emergency Management – Police.

\(^{20}\) The AGRWG reports to the Australian Government Counter-Terrorism Policy Committee.
While developed in the US and therefore optimised for that environment, the ‘interoperability continuum’ shown in Figure 3 is a useful tool to understand the multifaceted issues associated with interoperability. While focused on the spectrum management aspects of the technology ‘continuum’, ACMA can assist and influence other aspects of the interoperability picture.

The ‘technology’ continuum in particular provides a general introduction to the various methods used to implant interoperability, ranging from the most basic level of simply swapping radios to the use of standards based, common technology shared network solutions.

### 3.1.2 SUMMARY OF CURRENT GOVERNMENT SPECTRUM USE IN THE 400 MHZ BAND

Historically, government radiocommunications have been the responsibility of individual jurisdictions and/or agencies within those jurisdictions. While this approach has proved adequate in the past for day-to-day requirements it has led to a relatively siloed approach to radiocommunications between jurisdictions and in some instances, within jurisdictions. This approach has often resulted in radiocommunications systems with a limited ability to interoperate. Improving interoperability is also a historically difficult task due to uncoordinated jurisdictional and agency procurement cycles and associated cost implications.

To illustrate these legacy approaches, an overview of existing voice radiocommunications used by the federal, states and territories agencies is provided in Attachment 2. Note that radiocommunications usage by government changes over time and it is often difficult to develop a comprehensive snapshot of current arrangements. This summary focuses on use of the 400 MHz band but does provide limited information on the use of other bands.
3.1.3 EXISTING ARRANGEMENTS SUPPORTING GOVERNMENT SPECTRUM HARMONISATION AND INTEROPERABILITY

ACMA and its predecessors have identified various harmonised spectrum bands dedicated for government use, in some cases specifically addressing national security, law enforcement and emergency services requirements.

The first attempt to provide a level of spectrum harmonisation came about in response to the deficiencies revealed by Cyclone Tracy in December 1974. By the late 1970s two paired 1.6 MHz blocks of 64 channels (each 25 kHz wide) had been identified in spectrum between 450 and 470 MHz in an attempt to redress the lack of interoperability among services attending on that occasion.

This spectrum was initially known as the ‘64 channel block’, but is now referred to as the Law Enforcement and Public Safety (LEPS) spectrum. The segments are preserved, by way of a spectrum embargo (Embargo 36), for use by government agencies involved in the national security of Australia, law enforcement or the provision of emergency services.

There are also frequencies around 480 MHz identified nationally for counter-terrorism (CT) purposes.

The LEPS spectrum lies in an area of spectrum that can be used by most land mobile equipment. That is, equipment with a switching range of 380/403–470 MHz or 450–520 MHz. Equipment capable of using the CT frequencies is generally capable of the higher band switching range only. This can lead to interoperability problems with organisations that have a requirement to use the lower part of the 400 MHz band as their equipment is generally only capable of switching to channels in the lower band.

After consultation with Defence (which previously had largely exclusive access to the band), ACMA, by way of the Australian Radiofrequency Spectrum Plan, has also preserved the mobile service allocation in the 420–430 MHz band (less three 500 kHz segments currently set aside for Defence requirements) for use for federal, state and territory government purposes.

This provided common and, at the time, virtually unoccupied spectrum for government. To date only the Victorian Government has availed itself of the opportunity to use this spectrum for a whole-of-government network, though other states and territories have, or intend to, make some use of this band.

These existing arrangements (LEPS, CT and 420–430 MHz) are not considered adequate in either the amount of spectrum available or the technical characteristics (such as frequency splits available) to completely address government spectrum harmonisation and interoperability issues.

3.1.4 THE INDEPENDENT REVIEW OF GOVERNMENT SPECTRUM HOLDINGS

To assist it in undertaking its spectrum management responsibilities, ACMA commissioned an Independent Review of Government Spectrum Holdings (IRGSH) in 2006. The intention of the IRGSH was to assist ACMA to better achieve an
appropriate balance between government use of the radiofrequency spectrum and its use by the broader community.

A key finding of the IRGSH (identified in Recommendations 5.1 and 5.2) concerned spectrum requirements for government radiocommunications supporting emergency services. Consideration of the specific bands proposed in the IRGSH are discussed below.

3.1.5 380–400 MHz

In a process related to the overall review of 400 MHz band (but not formally included in the Options Paper), ACMA facilitated discussions with Defence and the law enforcement and security community as to the possibility of increased non-Defence access to the 380–400 MHz band.

During this process, the law enforcement community sought substantial access to the band which was ultimately not supported by Defence.

Defence argue that they use the band both for operational and training purposes throughout Australia (including urban areas) which will increase with the growing dependence on radiocommunications for Defence activities (i.e., Network Centric Warfare).

Interest remains from some government agencies/jurisdictions in 380–400 MHz due to a perception that it represents a simple option with few incumbent issues thus facilitating a near term solutions to identification of a government band (i.e., without associated transitional and migration issues).

ACMA’s views on the broader non-Defence use 380–400 MHz are outlined in Section 3.3.3.

3.1.6 DEVELOPMENTS IN 450–470 MHZ

The International Telecommunication Union (ITU) 2007 World Radiocommunication Conference (WRC–07) identified the 450–470 MHz band for use by administrations wishing to implement International Mobile Telecommunications (IMT).21 The IMT standards family includes IMT-2000 (current generation digital cellular mobile telephone systems) and IMT-Advanced (emerging ‘4G’ and future systems).22 These are alternatively referred to as wireless access services (WAS) in Australia.

While an ITU IMT identification in 450–470 MHz in no way forces administrations to deploy IMT in the band, it can be expected to stimulate the development of harmonised wireless access products for the 450–470 MHz band, particularly suited to rural and remote areas.

In Australia, there has been sporadic interest in use of segments of the 400 MHz band for cellular mobile systems, mainly to service regional and rural markets. However, interest in WAS in the band may increase over time.

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21 Note that not all of the band needs to be used utilised by and IMT deployment.
22 Domestically IMT is generally considered as part of broader wireless access services.
In addition to the well publicised identification of 450–470 MHz for IMT, this band is also in high demand for more traditional land mobile applications. This is brought about by the overlap in European and US land mobile band use, resulting in the wide availability of equipment (this includes identification as a standard TETRA band).

Prudent choice in the location of a government band, taking into account potential further demand for spectrum such as WAS and other technology options (including TETRA) in 450–470 MHz will maximise the opportunity for stable long term arrangements for government users.

Further discussion on 450–470 MHz are outlined in Section 3.3.3.

3.1.7 POTENTIAL FOR GOVERNMENT-ONLY USE OF 403–420 MHz: SUMMARY OF OPTIONS PAPER

The Options Paper raised the option of government spectrum harmonisation in 403–430 MHz along with the already identified 420–430 MHz band and how this spectrum might be managed. Harmonisation in the 403–430 MHz range (or alternative spectrum) would mean that availability of the LEPS spectrum and CT channels would be phased out with the expectation that the newly identified harmonised government spectrum would be used for these roles.

Overall frequency assignments in the 400 MHz band are split fairly evenly between government and commercial/private use. However, government is the predominant user in the 403–420 MHz band, accounting for around 80% of the frequency assignments.

Given the existing dominance of assignments to government in 403–420 MHz next to the already government identified 420–430 MHz band, some or the entire lower band was identified as a candidate for consolidating government services. Other reasons for this option are outlined in Section 3.3.3.

3.2 Stakeholder response

The topic of government spectrum harmonisation raised in the Options Paper solicited considerable comment. Respondents generally supported a block of spectrum for government use, whether it is in 403–420 MHz or elsewhere in the 400 MHz band.

Many respondents expressed concern over the lack of a clear definition of the term ‘government’ and therefore which organisations would be permitted to operate in a ‘government band’.

Additionally, some respondents commented on the use of spectrum either side of the 403–420 MHz band, that is, 380–400 MHz and 420–430 MHz.

Overall, a majority of respondents supported the use of 403–430 MHz as an exclusive government band. Many respondents urged ACMA to consider the long term usage of the band and ensure that the current and future needs of government users were met.

Respondents also commented on the current spectrum for LEPS and CT. A majority of respondents agreed that LEPS and CT spectrum could be moved provided there was adequate spectrum in an exclusive government band. However, there was some
concern that the suggested government band of 403–430 MHz would not be adequate and 450–470 MHz would be required to accommodate future use.

Several respondents also commented on the overlap between current US, European and Australian LEPS spectrum and the inherent synergies in equipment procurement this provides.

Questions were also raised regarding transition of government services into a government band and relocation of incumbent services out of the band. The NCCGR was nominated by several respondents as the most appropriate body to coordinate migration from LEPS and CT spectrum. There was a high level of support for current arrangements to be kept in place until there is a replacement band for LEPS and CT spectrum.

Many respondents believed ACMA should manage spectrum use in government bands or that ACMA should, at the very least, oversee the management and allocations in government bands. Additionally, issues relating to government access to spectrum outside the government band were also raised.

3.3 Issues
The range of issues to be addressed in determining a harmonised government band can be summarised in the following questions:

- Which government agencies should be part of a government band?
- What amount of spectrum is considered necessary?
- Where should this spectrum be identified (including how should the spectrum be made available, such as the ACMA prescription of technical arrangements)?
- How and when questions associated with transitioning to new arrangements.

3.3.1 DEFINING USERS FOR A GOVERNMENT BAND
Articulating permitted users of a government band is a critical issue with clarity and flexibility being key. As there is a finite amount of spectrum available in the congested and high demand 400 MHz band, determining which users will be permitted to use the government band will be a trade off between flexibility and utility. In any event, government users not accommodated or permitted in the government band will be allowed to access other parts of the band on the same basis as other users.

ACMA would like to strike a reasonable balance regarding prescription and intervention on the agencies that should operate in a government band. ACMA would also like to see a flexible arrangement to allow for changes in the needs of government over time.

ACMA, in consultation with government users, has developed the concept of a ‘tier 1’ or ‘core’ group of users that would have priority access to government band. This would include federal, state and territory government services such as security, law enforcement and emergency services (such as fire, ambulance and state emergency services) enabling harmonised spectrum to facilitate interoperability requirements.
Other government users would be considered ‘tier 2’ or ‘non-core’ users and their access to the government band would be permitted contingent on tier 1 uses being adequately provided for in the spectrum. Once tier 1 spectrum requirements were met, use of remaining spectrum in the government band would be determined and prioritised by the states/territories individually.

The intention is to adequately/comfortably dimension a government band to support the tier 1 group with the remaining spectrum to be used at the discretion of government to support broader networks where necessary. See the section below for further discussion on this topic.

It appears prudent that tier 1 access should be determined not by specific users but by specific services. This allows for a more flexible solution that could adapt as government and circumstances change (for example if the provision of government agency communications services by a private company).

In its liaison with government stakeholders and committees, a substantial degree of consensus has been achieved with this approach.

It has been suggested that the list of services could be based on work done by the NCCGR which defined services into user groups. The categories of public safety, law enforcement/security, and rescue appear to be a sound basis to define tier 1, or core spectrum users for a government band.

**3.3.2 SIZE OF A GOVERNMENT BAND**

ACMA has formed the view that a government band would need to be sufficiently dimensioned to adequately meet the spectrum requirements of tier 1 users (to address the ‘adequate provision of spectrum for government users’ objective of the Act). Any additional spectrum available in a government band could then be used to support users at the discretion of government to create even larger government radio networks (to support the ‘efficiency’ element of the object of the Act).

Jurisdictions seeking to establish larger whole-of-government networks than would be possible within a government band alone would need to seek additional spectrum on the same basis as all other spectrum users in other parts of the 400 MHz band.

Determining the appropriate amount of spectrum is difficult and sensitive to the variability of a wide range of parameters, including the number of users on the system, quality of service requirements, coverage targets, growth expectations, voice vs. data splits and technology assumptions.

In Australia the combined requirements of federal agencies and the NSW government (as the largest state user) are likely to determine the maximum amount of spectrum required.

A general estimate by ACMA based on currently licensed spectrum indicates that around 19 MHz may be sufficient for the highest density areas of Sydney using current technology assumptions.

Preliminary spectrum claims have been made by federal agencies (2 by 1.25 MHz) and the NSW government (2 by 12.5 MHz) for their respective networks. These claims are slightly larger than estimates developed internally by ACMA.
hopes to consult further with these agencies to better understand their spectrum requirements.

The NSW government estimates are based on the spectrum required for a comprehensive GRN (utilising existing technology) supporting more than just the needs of security, law enforcement and emergency services agencies (i.e., the tier 1 users outlined above). While it has been acknowledged that these tier 1 users constitute the majority of these spectrum needs the specific fraction has not been identified.

Overall it can be summarised that agreement on the appropriate size of a government band is emerging though has not yet been achieved. ACMA is of the view that 25 MHz will comfortably meet the needs of tier 1 government users in the areas of maximum spectrum demand and enable the formation of comprehensive GRNs in most, if not all, jurisdictions.

### 3.3.3 LOCATION AND STRUCTURE OF A GOVERNMENT BAND

#### Location

As outlined previously, the existing legacy approach of identifying three separate segments (LEPS, CT and 420–430 MHz) of the 400 MHz band for government use is considered sub-optimal. The identification of a contiguous and harmonised government band is the preferred outcome as it will permit the establishment of robust regulatory arrangements and offer improved certainty for all users of the 400 MHz band.

In the Options Paper, ACMA sought comment on the possibility of making spectrum available in 403–430 MHz for a government dedicated band. ACMA has continued to assess other potential candidate government bands with the results of the analysis summarised in Attachment 3.

Overall, ACMA has not identified a solid counter option or received any strong arguments for a consolidated government band to be located elsewhere in the 400 MHz band. ACMA therefore remains of the view that the identification of spectrum in 403–420 MHz band combined with the existing 420–430 MHz arrangements is the best solution for a contiguous and harmonised government band of the necessary size.

A substantial degree of consensus on this band has been achieved, though there continues to be interest from some groups for access to other parts of the spectrum (such as 450–470 MHz and 380–400 MHz).

#### Structure

Issues associated with the structure of a government band and the ability to support flexibility in technology choices are complex.

A general objective is to maximise flexibility in technology and vendor choices and economies of scale for users of the spectrum.

Central to this issue is the use of the two predominant competing technology solutions for government networks: TETRA and P25 systems. The advantages and disadvantages associated with replanning the 403–430 MHz band to accommodate
TETRA systems (requiring duplex splits currently unavailable within Australian spectrum planning arrangements) are the source of considerable debate. Accordingly, flexibility sometimes comes at the price of disruptions to users.

A summary of these technologies, focussing on the spectrum management aspects, is briefly outlined in Table 2 below.

<table>
<thead>
<tr>
<th></th>
<th>TETRA 1</th>
<th>APCO P25 Phase 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of operation</td>
<td>Trunked</td>
<td>Trunked or Conventional</td>
</tr>
<tr>
<td>Modulation scheme</td>
<td>Digital</td>
<td>Digital or analog</td>
</tr>
<tr>
<td>Operating bands</td>
<td>De facto standardisation on:</td>
<td>Primarily 406–512 MHz in the USA but manufacturers in Australia support up to 520 MHz</td>
</tr>
<tr>
<td></td>
<td>380–400 MHz</td>
<td></td>
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<tr>
<td></td>
<td>410–430 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>450–470 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other frequency bands would require customised solutions and therefore provide reduced economies of scale and vendor choice benefits</td>
<td></td>
</tr>
<tr>
<td>Channel bandwidth</td>
<td>25 kHz</td>
<td>12.5 kHz</td>
</tr>
<tr>
<td></td>
<td>1 voice channel per 6.25kHz equivalent (4 slot TDMA)</td>
<td>1 voice channel per 12.5 kHz</td>
</tr>
<tr>
<td>Multiple access</td>
<td>TDMA</td>
<td>FDMA</td>
</tr>
<tr>
<td>scheme</td>
<td>Predominantly 10 MHz</td>
<td>Large degree of flexibility apparent.</td>
</tr>
<tr>
<td></td>
<td>Other splits would incur reduced economies of scale and vendor choice benefits</td>
<td>5, 9.45, 9.5, 10 MHz used</td>
</tr>
<tr>
<td>Transmit sense</td>
<td>Base transmit high</td>
<td>unspecified</td>
</tr>
</tbody>
</table>

Note: Some improvements in future standard evolutions:
- TETRA 2: increased cell sizes
- P25 Phase 2: 6.25 kHz voice channel equivalent through FDMA/TDMA hybrid

**Table 2: Spectrum management characteristic of P25 and TETRA**

There are also a range of differences in features available between TETRA and P25 that are relevant to their usefulness for security, law enforcement and emergency services applications. Some literature indicates that TETRA is a more ‘feature rich’ technology. However, given that P25 is currently used by a wide range of security, law enforcement and emergency services agencies both in Australian and internationally (particularly the US), it does not appear to be a dominant issue in the technology discussion.

There are also minor coverage differences between TETRA and P25 system. Being TDMA based TETRA has timing limitations affecting achievable coverage which are not a problem for the FDMA based P25. However, the power control abilities of TETRA can assist with frequency reuse.

Currently, the major spectrum management related advantage of TETRA is its spectrum efficiency through the provision of 6.25 kHz equivalent voice channels. Band and frequency split flexibility and backwards compatibility appear to be the main benefits for P25. The fact that P25 technologies are already well established within Australia also provides a de facto advantage to P25 based solutions.
Ultimately it appears that the future of evolutions of TETRA and P25 will reduce the spectrum management difference of the two systems, though it appears that P25 will continue to have advantages in backwards compatibility with earlier version of P25. This could be a substantial advantage in the practical implementation of evolving networks and enabling differing jurisdiction to optimise their technology choice based demographics.

Generally there seems to be interest from larger jurisdictions with higher user densities for use of TETRA in the future. However, smaller jurisdictions indicate that they may never need to use a TETRA system and therefore the cost of replanning their current systems to support TETRA is not warranted in their areas.

It is clear that different technology solutions may be optimal for different scenarios/jurisdictions and that there is not yet a coordinated strategy or consensus on this issue amongst government jurisdictions for the future.

This creates the substantial challenge of establishing spectrum planning arrangements that permit maximum technology flexibility (so that jurisdictions can use the optimal technology for their requirements), while minimising unnecessary planning disruption and critically still facilitating interoperability.

The issue of enabling interoperability remains key in decisions on the future structure of a government band. Technology choices are critical to efforts to improve and ultimately achieve a high degree of interoperability. Once common operating spectrum is identified, compatible technology is required. Common, standardised technology choices obviously provide an optimal solution to interoperability though other technological solutions have been identified to enable interoperability between differing technologies.

These approaches include the use of gateways to interconnect differing technologies at the network level (e.g., linking a TETRA network with a P25 network) and the possibility of dual mode handsets that can be dynamically reconfigured to be compliant with different technologies.

Network level gateways are in existence and are understood to be used widely in the complex US interoperability environment. The ultimate problem with this approach is the need for multiple networks to be in existence. For example if one jurisdiction opted for TETRA while all other jurisdictions utilised P25, a P25 network infrastructure with a suitable gateway would need to be available in the TETRA jurisdiction to enable some inter-jurisdictional interoperability. Independent spectrum would need to be available for both networks.

Dual mode handsets have been mooted for sometime as part of a multiple technology solution, though they do not yet appear to be available. The concept of software defined radio (SDR) is consistent with the concept of dual mode radios and may facilitate their development. It is however unclear what strong international drivers exist for the development of dual mode handsets compatible with both TETRA and P25 networks given that much of the world appears to have essentially moved to a preferred technology option (TETRA in Europe and P25 in the US, for example).

Accordingly while such handsets may become available there is a substantial possibility that there will be an associated financial and vendor choice penalty.
It appears that at least in the short to medium term, a common technology choice is likely to offer the most viable solution to substantially improved interoperability.

Given the frequency band and duplex split flexibility available in P25 solutions, most, if not all of the 420–430 MHz band (less the Defence segments) could be ultimately made available for P25 government networks. Importantly the existing planning arrangements in the 403–420 MHz segments of the 400 MHz band support P25 solutions and can be readily integrated with the 420–430 MHz segment to maximise the utility of the overall 403–430 MHz block.

Being more restricted in terms of frequency bands and duplex splits for readily available equipment, enabling TETRA (or more generally any technology requiring duplex splits currently unsupported in existing planning arrangements) will be more disruptive and challenging. Given that 1.5 MHz of the 420–430 MHz band is unavailable due to Defence usage, a maximum of 17 MHz would be available with readily available products.\(^{23}\)

While the availability of 17 MHz of spectrum for a 6.25 kHz/voice channel equivalent technology is unlikely to be an issue (this amount of spectrum should be more than adequate to support high density area requirements), the process of achieving these arrangements would be complex and more time consuming than using established arrangements.

Providing smaller amounts of ‘TETRA enabled’ spectrum should be easier to achieve and doing this may facilitate a transitional or interim implementation of TETRA.

ACMA is of the view that provided inter-jurisdictional interoperability can be viably demonstrated, jurisdictions should be able to choose the optimal technology choice for their needs in the identified government band. Established committees, particularly the NCCGR are well placed to consider such issues, and if the NCCGR were to settle on particular technology choices then ACMA would consider implementing such decisions in relevant technical and regulatory arrangements if warranted.

ACMA will work with jurisdictions to identify the necessary spectrum planning arrangements to support their networks solutions (again provided that viable interoperability can be demonstrated).

*Federal agency issues*

ACMA is aware that there is interest from federal agencies to have a segment of a government band identified for their specific use. ACMA understands that these agencies are investigating the potential for an integrated federal agency network. While such an approach is an improvement from the existing implementation of largely disparate agency networks it is not the ideal situation, i.e.a single integrated nationwide federal, state and territory government network.

\(^{23}\) 410-430 minus 2 x 1.5 MHz
Pragmatically a federal agency segment within the broader government band, provided interoperability can be demonstrated with the states and territories, is likely to be a viable way forward.

3.3.4 TRANSITION ISSUES
Despite the fact that around 80% of land mobile users in the 403–420 MHz band already belong to government organisations, there are still significant migration issues with identifying it exclusively as a government only band. These issues will need careful consideration and represent a major challenge in establishing a large government band in 403–430 MHz. For example the amateur service holds a secondary allocation in 420-430 MHz and the impact of any changes will need to be considered in consultation with this group.

Not only is there the substantial issue of transitioning non-government users out of the band, there is the equally challenging issue of establishing revised planning arrangements within the government band (such as duplex splits) to support new technologies if required.

Detailed transitional arrangements can only be considered and determined once agreement has been achieved on where the band should be and how it should be structured. However, it is possible to identify some broad potential transitional approaches and mechanisms.

The standard approach to band clearance and restructure is the use of sufficiently long transition times prior to mandatory band clearance. This allows migrating users time to phase transition with procurement cycles and minimise or reduce associated financial costs.

A further approach, if possible, is the identification of a lightly used ‘transition’ band where government users can temporarily deploy networks while waiting clearance or restructure of the government band.

It is likely that a combination of both of these approaches will be useful in the establishment of a government band and both will be considered by ACMA.

3.3.5 LICENSING AND PRICING
Apparatus and spectrum licensing approaches are both considered viable in authorising use of a government band.

Spectrum licences would give government users the greatest flexibility of use of their spectrum. This would require ACMA to develop a technical framework. However, if there was one Australia-wide spectrum licence or state based licences over the entire 403–430 MHz band, the spectrum boundary and area boundary issues could be minimised. As an alternative, area-wide apparatus licences could provide similar flexibility and almost as much certainty despite the shorter licence term.

An interim approach of continuing apparatus licensing with a change to spectrum licensing after non-government users are transitioned out of the 403–430 MHz band may be practical.
There is a question about who should hold the licences. If there was an Australia-wide licence, then it would need to be a representative body, which would include interests from each state and territory as well as the Commonwealth. However, due to the differing requirements of the states, state-based licences are likely to be the most practical approach to licensing the government band. Each state government would need to determine who would hold the licence. Some state governments currently operate government radio networks, which may provide a model. Separate licensing arrangements would be required for a federal agency part of the band.

Under either licensing solution, the band would need to be priced administratively. A price based on opportunity cost of the amount of bandwidth in the band would give governments the right price signals to reduce the amount of bandwidth if it was excess to its needs. On the other hand, ACMA is keen to see as much government use concentrated in the government band as possible to encourage greatest efficiency within the band and maximise opportunities for interoperability. This may be facilitated in the short term by governments retaining all of 403–430 MHz until operations are firmly established in a consolidated band.

ACMA wishes to see as much government activity in the government band as possible. This would be facilitated by charging each government for the government band as a block payment, possibly annually, as paying for a 15-year spectrum licence upfront may not be practical for governments. Individual agencies would have the choice of operating in the government band at no additional spectrum charge or using licences in other bands and paying the apparatus licence tax. The proposal to increase the apparatus licence tax to opportunity cost levels will provide a powerful incentive for individual agencies to seek consolidation in the government band.
3.4 Proposals

8. ACMA proposes:

- the 403-430 MHz band (less Defence and EPIRB segments) be identified for the exclusive use of federal, state and territory governments
- this band be primarily used to enable interoperability between government agencies providing security, law enforcement and emergency services
- that other federal, state and territory government users be permitted to use the band contingent on the requirements of security, law enforcement and emergency services uses being adequately supported. This use of the spectrum would be determined and prioritised by the states/territories individually without ACMA prescription.
- a segment of this band be identified for federal agency use provided interoperability between government agencies providing security, law enforcement and emergency services can be demonstrated
- the entire block of spectrum should be made available on a state-wide basis as a single licence, with fees payable at an annual amount, independent of the number of devices operated under the licence
- that apparatus licensing be continued to be used to authorise use of the band initially and that spectrum licensing be explored later
- that existing non-government licensees in the 403-430 MHz band transition out of the band within 5 years in high and medium density areas and 8 years in the rest of the country
- that existing government arrangements outside of the 403-430 MHz band be removed no sooner than in 5 years time
- relevant national committees, primarily the NCCGR and LESRSC, determine solutions for interoperability and identify mechanisms that can be used by ACMA to further enhance interoperability objectives via spectrum management arrangements.
4 Licensing alternatives for point-to-multipoint and single frequency applications

This chapter contains discussion on the future of point-to-multipoint systems and ACMA proposes that there will be no change to existing licensing arrangements supporting point-to-multipoint applications.

In the Options Paper, ACMA signalled the possibility of more flexible and potentially lower cost licensing arrangements for point-to-multipoint and single frequency applications, sometimes referred to ‘light licensing’.

The range of options available for a light licensing regime include:

- class licence, which authorises fee-free use of designated segments of spectrum for use on a shared basis with no protection from interference
- apparatus licence, where a fee applies and spectrum use can be coordinated to achieve a level of protection from interference. A light licensing approach may involve user self-coordination using a simple set of rules.
- Private Park, which controls the level of spectrum sharing so that risk is managed, and also provides the opportunity for user self-coordination according to rules set by ACMA or the occupants.

The trade-off for more flexible and lower licence cost arrangements would potentially be a reduced level of protection from interference and hence a lower grade of service for systems operating under these arrangements.

ACMA’s objective on this issue is to explore, and where appropriate adopt, innovative flexible licensing arrangements for certain applications as an appropriate balance between flexibility and certainty in spectrum access. The exploration of licensing alternatives for point-to-multipoint and single frequency applications is consistent with ACMA’s Spectrum Management Principles, particularly principles three to five:

- Use the least cost and restrictive approach to achieving policy objectives: The licensing alternatives presented are designed to provide a more cost effective approach (for both ACMA and users) in authorising use of spectrum. These
licensing methods impose minimal restrictions on usage, which ACMA hopes will promote innovative use of the spectrum.

- *To the extent possible, promote both certainty and flexibility:* The nature of the systems that ACMA envisages will be used in ‘light licensed’ spectrum, such as non-critical systems, suits circumstances where minimal certainty in terms of interference risk is provided but maximum flexibility.

- *Balance the cost of interference and the benefits of greater spectrum utilisation:* ACMA envisages that the systems that will be used in ‘light licensed’ spectrum will be able to operate interference free basis but that this spectrum will be well utilised.

## 4.1 Stakeholder response

### Point-to-multipoint

The submissions to the Options Paper offered a range of views on the possibility of identifying spectrum for point-to-multipoint applications where a ‘light licensing’ arrangement would apply. Support was generally contingent upon:

- retention of the option for reasonable levels of protection from interference being available through, at a minimum, ‘user-coordination’ rather than ‘no interference, no protection’ inherent in traditional class licensing
- traditional coordinated spectrum (apparatus licensed) continuing to be available in the band.

Opposition to the concept cited:

- the potential for a detrimental increase in the noise floor in the band, and
- the inappropriateness of the regime for the grade of service required for systems.

There was also disagreement from a number of SCADA operators with the comment in the Options Paper that point-to-multipoint applications are resilient to interference, claiming that time critical systems have limited resilience.

In summary, the responses suggested that the concept of light licensing is good but most stakeholders believe it is not suitable for them.

### Single frequency applications

A majority of respondents supported the proposal to continue to identify spectrum for low power single frequency applications, but not necessarily under a ‘light licensing’ scheme. Some respondents believed that a class licence regime would be desirable for non-critical single frequency systems, but not for their systems.

There were a number of submissions opposed to identification of a class licensed band for low power single frequency applications. This included government and emergency service users with systems requiring protection from interference. It was also suggested that the proposed changes to the UHF Citizen Band would cater for any requirement for ‘low end’ systems.
4.2 Issues

ACMA has identified the following core issues:

- Stakeholders generally want a licensing option that provides a high quality of service.
- Stakeholders want sufficient spectrum to deploy systems.

There are also technical difficulties with using a segment of a band under a light licensing arrangement—successful coordination of frequencies relies at least in part in avoiding intermodulation components falling on other receivers, and causing interference. Hence a light licensed frequency segment populated by uncoordinated or partially coordinated services can result in intermodulation products falling on receivers outside of the band. Intermodulation can be mitigated against by reducing the power of transmitters. For example, itinerant devices in the UHF Citizen Band are limited to 4 Watts, which reduces intermodulation to acceptable limits. High power repeaters are fully coordinated, thus intermodulation is accounted for.

4.3 Analysis

4.3.1 LIGHT LICENSING

A light licensing approach offers flexibility and low/no licence fees, at the expense of an increased risk of interference. Stakeholder response to a light licensing approach was that it is not appropriate for most services currently supported via apparatus licences as the current grade of service and protection from interference that these services experience is seen as a requirement now and into the future.

ACMA acknowledges the continued need for access to spectrum with an appropriate quality of service for some systems. The UHF Citizen Band is a potential home for the services that might be a good fit for a light licensing approach, and most likely is the spectrum some such services inhabit now. Hence the proposals for alleviating congestion in the UHF Citizen Band are likely to lead to spectrum that satisfies the requirement for spectrum for services that desire the flexibility that this class licensed spectrum provides.

4.4 Proposal

9. ACMA proposes no change to existing licensing arrangements supporting point-to-multipoint applications.

Proposals applicable to single frequency networks are discussed in Chapter 2.
5 UHF Citizen Band Radio Service

In this chapter, a number of ACMA’s proposals for improvements to the UHF Citizen Band Radio Service are outlined, including:

- reduction to 12.5 kHz channels for CBRS simplex channels
- retention of 25 kHz channels for repeater channel pairs (including the emergency channels) and telemetry/telecommand channels
- review of the coordination and assignment rules for repeater channels.

The existing UHF Citizen Band (CB) Radio Service (CBRS) in the frequency range 476.4125–477.4125 MHz (40 25 kHz channels for a total of 1 MHz) are well utilised by private, commercial and government users in Australia.

The extensive use of the CBRS, with access being authorised under a class licence regime where no guaranteed protection from interference is provided, demonstrates that the existing regulatory approach in the band has been effective.

Importantly, arrangements in the UHF CBRS are consistent with ACMA’s Spectrum Management Principles, particularly principles three to five:

- Use the least cost and restrictive approach to achieving policy objectives: Class licensing is a particularly cost effective approach (for both ACMA and users) in authorising use of spectrum and imposes few restrictions on usage, which in turns promotes innovative uses.
- To the extent possible, promote both certainty and flexibility: The substantial use of the band under circumstances where minimal certainty in terms of interference risk is provided indicates that the balance is largely correct in this case.
- Balance the cost of interference and the benefits of greater spectrum utilisation: Again the extensive use of the band in which interference free use is not guaranteed and in many cases is unlikely demonstrates an appropriate balance has been reached.

The Options Paper explored ideas to address congestion and improve the overall arrangements in the band by increasing the number of channels available through the reduction in channel bandwidth from 25 kHz to 12.5 kHz and adding additional channels within the currently identified UHF CB frequency range.

ACMA’s objective on this issue is to improve the utility of the UHF CBRS class licensing regime through reviewing and updating as necessary current arrangements (such as channel bandwidths). Balancing future flexibility with the impact on existing users (in light of the extensive user base) is a particularly crucial consideration in this situation.

5.1 Stakeholder response

Increasing the number of available CBRS channels by reducing channel bandwidth to 12.5 kHz was widely supported in responses to the Options Paper. Many respondents
reported heavy congestion in the band and a desire for more channels to alleviate this congestion. However, there was also consistent comment that it would be difficult to phase out 25 kHz equipment in a controlled manner.

The affordability and quantity of equipment were also identified as dictating the speed at which the band can migrate—an estimate of around 5 years was suggested as a reasonable time frame for the full implementation of any changes.

Some stakeholders queried the current coordination and assignment rules for repeater channels. There was also some interest in additional telemetry/telecommand channels.

Stakeholders advised that migration to any new arrangements for the emergency and telemetry/telecommand channels should be considered carefully.

### 5.2 Issues

ACMA has identified the following core issue in reviewing arrangements in the UHF Citizen Band:

- whether to proceed with a reduction in channel bandwidth to 12.5 kHz, including what channels should and shouldn’t be reduced in bandwidth
- whether to increase the size of the CBRS to allow an additional channel
- the appropriate technical migration strategy to be used in reducing channel bandwidths (i.e., the interleave or offset method)
- whether additional channels should be set aside for telemetry/telecommand
- transitional considerations and implications associated with a migration to new arrangements (e.g., timeframe where continued use of legacy channel arrangements is permitted).

### 5.3 Analysis

#### 5.3.1 REDUCTION IN CHANNEL BANDWIDTH

Given the existing and expected future congestion issues evident within the CBRS and the general level of support from respondents to the Options Paper, ACMA considers the general concept of the reduction in channel bandwidth, with a corresponding increase in channels, to be a prudent approach.

However, given the importance and usage characteristics of certain CBRS channels, ACMA also considers it important to minimise the impact of any changes on those channels/uses. Uses where ACMA is of the view that no change in channel bandwidth (i.e., retention at 25 kHz) is appropriate are the:

- eight (8) existing repeater channel pairs (1–8 and 31–38), including the emergency channels (5 and 35)
- two (2) existing telemetry/telecommand data channels (22 and 23).

All simplex channels, including the Calling channel (11), are suitable to be transitioned to 12.5 kHz bandwidths.
CBRS planning arrangements that utilise both 25 kHz and 12.5 kHz would ultimately require the use of equipment that can operate on both bandwidths. Discussions with equipment manufacturers indicate that the manufacture of such equipment with minimal additional cost impact is feasible.

While there may be some interest in the identification of additional repeater channels (possibly at 12.5 kHz) beyond the eight 25 kHz channels already identified, ACMA is not at this stage considering the identification of additional repeater channels. ACMA analysis indicates that the lack of repeater channel availability can be addressed by a relaxation in the coordination rules determining their assignment.

While there was some stakeholder interest in the identification of additional telemetry/telecommand channels, ACMA is not intending to immediately pursue this issue. However, ACMA agrees that the current duty cycle limitations should be reviewed.

The reduction in channel bandwidths along the lines outlined above would see the number of simplex channels available increase from 21 to 41, with the number of repeater and telemetry/telecommand channels remaining unchanged (refer to Table 3 for more details). However, the CBRS band would need to be increased by 6.25 kHz to facilitate a full 12.5 kHz channel at the top of the band. This is considered viable due to the limited usage of the spectrum immediately adjacent to the upper edge of the CBRS band (approximately 10 licences Australia wide).

5.3.2 MIGRATION

If a change to 12.5 kHz bandwidth channels is implemented it is likely that legacy equipment will be in use for a substantial period. Even if ACMA mandated a date beyond which 25 kHz bandwidth UHF CB equipment could not be used, the sheer volume of equipment currently in use would mean that a significant degree of non-compliance with any new rules could be expected. Hence any new arrangements and associated migration approaches need to acknowledge this reality and have a degree of compatibility with legacy arrangements.

Accordingly the interleaved channel approach is considered an appropriate method of migration. It is acknowledged that this method combined with the retention of some 25 kHz channels will result in a number of orphaned 6.25 kHz segments within the CBRS band at the conclusion of the overall migration process. However, given the substantial gains to be achieved in reducing many channels to 12.5 kHz within the band, ACMA considers this to be worthwhile. In addition, given that the period of migration needed to effect any change, these orphaned segments will remain utilised for some time.

5.3.3 TRANSITIONAL ARRANGEMENTS

A transition period in the order of five (5) years is thought to be appropriate to facilitate a change of CBRS equipment. This five year transition period would commence at a time when equipment is commonly available, that is, some time after regulatory instruments and standards were amended. Compatibility between

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24 Typically these changes take 6-12 months to implement.
12.5 kHz and 25 kHz equipment is considered feasible and will facilitate a transition to reduced bandwidth equipment.

5.4 Proposal

10. ACMA proposes to undertake a process to implement revised arrangements for the UHF CBRS based on the following core concepts:
   - extension of the CBRS band by 6.25 kHz at the top edge of the band
   - the reduction to 12.5 kHz channels for CBRS simplex channels
   - the retention of 25 kHz channels for the eight (8) existing repeater channel pairs, including the emergency channels and the two (2) existing telemetry/telecommand channels
   - review the coordination and assignment rules for repeater channels.

This proposed approach is summarised in Attachment 4. A summary of the number of channels available under the existing and proposed arrangements is provided in Table 3.

A review of CBRS arrangements may ultimately result in changes to the Radiocommunications (Citizen Band Radio Stations) Class Licence 2002 (the CB Class Licence) and associated administrative frequency allocation processes. Any changes to the CB Class Licence will be subject to mandatory consultation processed in addition to the process that has been undertaken here as part of the broader review of the 400 MHz band.

Given the minimal impact of changes to the CBRS band on the rest of the 400 MHz band under review, ACMA will pursue further work on the CBRS separately to that of the overall 400 MHz Review.
<table>
<thead>
<tr>
<th>Channel use/type</th>
<th>Existing Arrangements</th>
<th>Proposed Arrangements</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simplex voice only</td>
<td>25 21 12.5 41</td>
<td></td>
<td>All now 12.5 kHz</td>
</tr>
<tr>
<td>General purpose voice</td>
<td>25 14 25 14</td>
<td>25 14</td>
<td>No changes, still 7 x 25 kHz repeater pairs that can be used as simplex outside of repeater area</td>
</tr>
<tr>
<td></td>
<td>Repeater</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency only</td>
<td>25 2 25 2</td>
<td>25 2</td>
<td>No changes still 25 kHz simplex on Ch 5 &amp; 35 or use as a repeater pair</td>
</tr>
<tr>
<td>Telemetry and Telecommand</td>
<td>25 2 25 2</td>
<td></td>
<td>No changes still 25 kHz channels 22 &amp; 23</td>
</tr>
<tr>
<td>Calling</td>
<td>25 1 12.5 1</td>
<td></td>
<td>Channel 11 now 12.5 kHz</td>
</tr>
</tbody>
</table>

Table 3: Summary of proposed changes to CBRS
6 Arrangements in 450–470 MHz

This chapter details ACMA’s proposals for changes to the 450–470 MHz band including:

- establishment of a minimum of $2 \times 5$ MHz, 10 MHz split segments to facilitate use of a greater range of technologies
- identification of 3 MHz paired of the 10 MHz split spectrum for trunking systems.

No changes are proposed for existing single frequency and fixed point-to-point and point-to-multipoint segments in the band.

In the Options Paper, ACMA sought comment on the possibility of making spectrum available in the 450–470 MHz band for wireless access services (WAS), including International Mobile Telecommunications (IMT). The World Radiocommunication Conference, 2007 (WRC–07) identified the 450–470 MHz band for use by administrations wishing to implement IMT.

While this global identification is expected to stimulate the further development of harmonised wireless access products for the 450–470 MHz band, individual administrations create their own spectrum arrangements and have the discretion not to use this spectrum for IMT. Australia supported the identification and has implemented it in the new Australian Radiofrequency Spectrum Plan\(^\text{25}\).

Several major administrations, including the United States, have indicated that they will not be using 450–470 MHz for IMT in the foreseeable future. However, a number of developing countries and developed countries with large rural areas have allocated, or indicated that they may exercise the option to use all, or parts of the 450–470 MHz band for IMT. IMT can be used to provide mobile telephony (voice), mobile data communications, public access mobile radio services and wireless local loop services and is particularly suited to rural and remote areas.

Beyond the recent identification of the band for IMT applications, the 450–470 MHz segment of the 400 MHz band is one of the most attractive for traditional land mobile and fixed uses due to the excellent equipment availability due to both Europe and the USA allocating this band for land mobile uses.

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The 450–470 MHz band is heavily used, currently hosting around 20 000 assignments. Any change to this band will impact a large number of licensees, and hence the long-term benefit needs to be weighed against the impost on existing users.

ACMA’s primary objectives in considering alternatives for 450–470 MHz is to facilitate the band moving to its highest value use over time without substantial ACMA intervention, while balancing certainty and flexibility.\(^\text{26}\)

### 6.1 Stakeholder response

There were differing views expressed in the submissions to the Options Paper on the possibility of making spectrum available in the 450–470 MHz band for WAS. Submissions that supported it noted that demand for data services is likely to increase in the future and that spectrum for WAS in this band would be particularly useful in rural areas. CDMA450 was named by a number of respondents as their preferred technology for WAS in the band.

Some respondents supported WAS in 450–470 MHz provided that new systems did not cause interference to existing systems in adjacent bands. Also, respondents, particularly users of LEPS spectrum, stated that incumbents in the band would need adequate time to relocate to another part of the 400 MHz band. Time frames from 4 to 10 years were suggested as adequate for relocation by these users.

Submissions that opposed the introduction of WAS in the 450–470 MHz band asserted that cellular and other WAS systems have adequate spectrum in other bands. There was also concern that the removal of this spectrum from other services would exacerbate congestion in the band.

In submissions to the Options Paper, those respondents who supported use of IMT in the band demonstrated a preference for the paired frequency bands 452.5–457.475 MHz and 462.5–467.475 MHz for IMT. In these frequency bands there are currently around 5,000 assignments.

There was stakeholder interest in enabling the use of alternate land mobile technologies in the band—these technologies are not currently supported by existing planning arrangements.

### 6.2 Issues

In submissions to the Options Paper, those respondents who supported use of IMT in the band demonstrated a preference for the paired frequency bands 452.5–457.475 MHz and 462.5–467.475 MHz for IMT. In these frequency bands there are currently around 5,000 assignments.

### 6.3 Analysis

Internationally, CDMA450 Band subclass A (452.5–457.475 MHz and 462.5–467.475 MHz) is the most widely used band for 400 MHz WAS. However,

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\(^\text{26}\) In line with ACMA’s Spectrum Management Principles 2 and 4.
CDMA450 deployments have been accommodated in other sub-bands in various countries.

However, should WAS be deployed in Australia, the greatest potential economies of scale would arguably be achieved by accommodating the CDMA450 band subclass A (452.5–457.475 MHz and 462.5–467.475 MHz) arrangement. Countries with current or planned networks in the CDMA450 band subclass A frequency bands include Argentina, China, Lithuania, Russia and Sweden. These networks have been deployed to provide cellular services, wireless local loop services, or a combination of the two. ACMA is not aware of UMTS/WCDMA systems utilising 3.84 MHz emissions/5 MHz channels being developed this band. However, arrangements supporting a 5 MHz arrangement are likely to support possible future evolution of UMTS/WCDMA in the 450–470 MHz band.

While a number of countries around the world have networks in the 450–470 MHz band, large countries, including the United States, do not have plans to use the band for WAS. In Europe, a number of countries have WAS in the band. However, the European Conference of Postal and Telecommunications (CEPT), the coordinating body from European radiocommunications, has decided that the band 450–470 MHz would not be used on a harmonised basis within CEPT and that no Electronic Communications Committee (ECC) decisions will be developed for this band. This means that large scale coordinated use of WAS in this band in Europe is highly unlikely, and therefore potential global economies of scale for equipment manufacturing are unlikely to be achieved.

As well as WAS, the 450–470 MHz band could be replanned to better accommodate new and existing spectrally efficient land mobile technologies providing flexibility in technology choices for users. TETRA is the prime example of this technology and prefers a 10 MHz frequency split.

Therefore, spectrum replanned in this band with a 10 MHz frequency split would be compatible with TETRA and other land mobile technologies as well as WAS.

ACMA is exploring replanning all or part of the 450–470 MHz band to better enable spectrally efficient land mobile technologies in the near term and also prepare the band for the possible use of WAS services in the longer term. This involves changing the duplex frequency splits in at least part of the band identified for two frequency land mobile to 10 MHz from the current 9.5 MHz.

The consequence of changing a duplex frequency split is that existing licensees will have to re-tune equipment or relocate to a different part of the band. The impact on licensees could be minimised by limiting the spectrum adjusted to accommodate new technologies to metropolitan areas or limiting the arrangement to only part of the 450–470 MHz band, specifically:

Create $2 \times 5$ MHz on a 10 MHz split with the 452.5–457.5 MHz and 462.5–467.5 MHz bands with $2 \times 0.5$ MHz single frequency segments (or potentially paired for point-to-multipoint or fixed use), as shown in Figure 4.

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27 ITU-R Document 5D/297-E
An alternative would be to immediately establish $2 \times 7.4875$ MHz on a 10 MHz split with a 0.5 MHz single frequency segment, as shown in Figure 5. This option involves changing the use of segment Y.\textsuperscript{28}

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\textsuperscript{28} Currently, Segment Y is use for single frequency land mobile applications but is paired with Segment CC for Fixed services in non-HSD areas. In this segment there are currently around 50 two frequency licences and around 2 800 single frequency licences.
Figure 5: Potential band plan for 450–470 MHz if applying the rearrangement to the segments assigned to the Land Mobile service in the band (i.e., segments S, T, W and X) to create $2 \times 6.9875$ MHz on a 10 MHz split with $2 \times 0.5$ MHz single frequency segments.

Table 4 shows the number of assignments affected in each scenario. The table also shows an estimate of the number of assignments that would be affected if the change were limited to metropolitan areas. The numbers shown in brackets in Table 4 represent an estimate of the number of assignments that would be permitted to operate in 403–430 MHz under the proposals presented in Chapter 3. The holders of these assignments would have additional incentives to relocate to that spectrum.

Limiting at least the initial transition to a 10 MHz split to the 5 MHz option has the advantage of not impacting on the LEPS spectrum. This would facilitate the transition of LEPS spectrum requirements to elsewhere in the 400 MHz band over time.

<table>
<thead>
<tr>
<th>Frequency Band (MHz)</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Australia Wide</td>
</tr>
<tr>
<td>450–469.9875 MHz</td>
<td>20,000 (8,500)</td>
</tr>
<tr>
<td>452.5–459.9875 MHz and 462.5–469.9875 MHz with one 0.5 MHz single frequency segments</td>
<td>11,000 (5,000)</td>
</tr>
<tr>
<td>452.5–457.5 MHz and 462.5–467.5 MHz with two 0.5 MHz single frequency segments</td>
<td>5,000 (1,700)</td>
</tr>
</tbody>
</table>

Table 4: Number of assignments that may be required to relocate to another part of the band$^{30}$

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$^{29}$ The estimated number of licences that may be required to relocate should spectrum licensing be introduced in metropolitan areas will vary depending on the particular areas selected for spectrum licensing and is simply provided as an indication.
By restructuring the band, blocks of spectrum, designated as unpaired spectrum in Figures 4 and 5, are created. This provides the opportunity to accommodate specialised applications into band arrangements. The unpaired blocks of spectrum could potentially be designated for specialised single frequency applications. These applications could include wide-area data services (e.g., DGPS). See Section 2.3 for a detailed proposal on spectrum for area-wide applications.

6.3.1 LICENSING AND ALLOCATION OPTIONS

Regardless of whether 10 MHz split segments of $2 \times 5$ MHz or $2 \times 7.4875$ MHz are adopted, ACMA needs to consider how the new split will be implemented. These arrangements will have implications for incumbents in the band.

The main possible uses for the new 10 MHz split segment are land mobile, two frequency fixed systems or WAS. Class licensing is unsuitable for such applications, so the choice is between spectrum licensing and apparatus licensing.

**Spectrum licensing**

The advantages of spectrum licensing are that the users have greater flexibility with the services to be deployed, assignment of devices and interference management. The longer 15 year licence term and compensation provisions in the Act give greater certainty to licensees.

The key advantage of spectrum licensing in this segment is that users can change the service offered in the band. ACMA does not have sufficient information to accurately judge whether land mobile, fixed or WAS is currently the highest value use of the band. Or if, as seems probable, land mobile is currently the highest value use of the band, it is difficult for ACMA to determine if and when in the future WAS might become the highest value use. If spectrum licensing is offered, it will be done on the basis that the licensee can use the band for fixed, land mobile or WAS, and can change from one to the other without regulatory intervention from ACMA.

In line with the earlier analysis that spectrum licences should be in blocks of at least 1.25 MHz wide, if ACMA is to implement spectrum licensing it proposes that it be done by a re-allocation rather than a conversion of existing licences. This has considerable implications for incumbent users.

**Apparatus licensing**

If apparatus licensing is adopted for the 10 MHz duplex frequency split in the 450–470 MHz band, it would be on the basis of 6.25 kHz channels with aggregation to 12.5 kHz as described in Section 2.1. The alternative of large spectrum blocks such as 1.25 MHz blocks is similar to spectrum licensing discussed above, but with less certainty of tenure.

Fees and charges would be set at the same level as other apparatus licences in the band.

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The numbers in brackets represent the number of licences in the band discounting those held by agencies that are likely to be permitted to operate in 403-430 MHz.
If apparatus licensing is adopted for the 10 MHz duplex frequency split, part of the spectrum could be identified for trunking systems. As discussed in Section 2.2, trunking is a way to share spectrum in a way that is largely transparent to the user. Implementing trunking spectrum in the 400 MHz band on a 10 MHz duplex frequency split would allow for maximum technology flexibility. As current trunking spectrum is heavily used, ACMA would consider identifying a significant part of the spectrum on a 10 MHz duplex frequency split for trunking to ensure use of this spectrum is maximised.

Apparatus licensing using narrow channels would seem to preclude a transition to CDMA450 technology. However, there are two ways for this transition to be achieved. One would be by ACMA making a judgement some time in the future that CDMA450 is now the highest value use in the band and advise the Minister to re-allocate by spectrum licensing. However, contemplating this at this stage would make tenure for apparatus licences in the 10 MHz duplex frequency split very uncertain. Therefore, if ACMA issued traditional apparatus licensing for the proposed 10 MHz duplex frequency split it would not contemplate recommending a re-allocation declaration in the foreseeable future. However, there is a second way of allowing CDMA450. Trading is allowed in apparatus licences. If an organisation accumulated enough contiguous channels over a wide enough area, ACMA could allow CDMA450 to be deployed, and would consider converting the apparatus licences to a spectrum licence should the licensee desire. 31

**Analysis**

There are four options analysed below. The first three require the Minister to make a re-allocation declaration in part of the 450–470 MHz band to implement a 10 MHz split allocated by spectrum licensing. If this is not done, traditional apparatus licences could be issued with the proposed 10 MHz duplex frequency split:

1. Spectrum licensing with a re-allocation period of two years, the minimum allowed under the Act. Incumbent licensees have 2 years before their apparatus licence is cancelled.

2. Spectrum licensing with a re-allocation period of two years, but include a licence condition that the spectrum licensee must allow continued access in the band for a period, say five years for incumbent users. The incumbent users would pay the spectrum licensee for access at a rate equivalent to the apparatus licence fee at the time. Access could be allowed under a trunked system operated by the licensee, or with the incumbent’s equipment. ACMA is currently exploring the legal feasibility of such a scheme.

3. Spectrum licensing with a re-allocation period of 5 years to allow time for incumbent apparatus licensees to plan other arrangements for their displaced services.

4. Apparatus licences in the proposed 10 MHz duplex frequency split with 12.5 kHz channels with the option of 6.25 kHz channels. ACMA would allow CDMA450 to be deployed if an organisation accumulated sufficient contiguous channels over an area to allowed efficient operation.

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31 Transaction costs may diminish the attractiveness of trading, and some licensees may prefer to hold on to their apparatus licences.
An analysis of the licensing options under the *Spectrum Management Principles* is as follows.

**Allocate spectrum to the highest value use or uses**
Allocation by spectrum licence would allow the spectrum licensee to judge the highest value use for their licence. In general each licensee would have a more accurate valuation of the licence to them than ACMA can make, and they can use their licence to in a way that is of highest value to them.

On the other hand, it may be that the highest value use would be for a large number of relatively small land mobile systems. This would be accommodated by the apparatus licensing option or under each of the spectrum licensing options if the spectrum licensees managed the band and allowed access to the small systems. However, if this private band management was less than successful, allocation to the highest value use may be more successfully done under traditional apparatus licensing.

The second option above is designed to facilitate private management of the incumbent users. The period during which incumbents must be allowed access will build up a relationship between users and the spectrum licensee, who will set up systems to manage these users. At the end of the mandated period, the spectrum licensee could make an assessment of whether to continue this arrangement, or change use of the band, for example to CDMA450.

**Enable and encourage spectrum to move to its highest value use or uses**
A spectrum licence allows users to change use of the spectrum, subject to the technical framework, to the use that is of highest value to the licensee. If there were some guarantee for incumbents, this would be constrained until the period of guarantee finished.

If the spectrum with a 10 MHz duplex frequency split was apparatus licensed, there would be much less opportunity for licensees to change use of the spectrum. For example, CDMA450 technology (which requires 1.25 MHz channels) would only be achievable if a licensee accumulated sufficient contiguous channels over a large enough area. This may be difficult, especially if one or two licensees with licences in a strategically placed channel refused to trade their licence.

**Use the least cost and least restrictive approach to achieving policy objectives**
Spectrum licensing part of the 450–470 MHz band is likely to be of high cost to incumbent licensees unless continued access can be mandated for a period. However, if incumbents need to move, there are alternatives including VHF bands, other parts of the 400 MHz band (especially if there is a rapid move to 12.5 kHz bandwidths), or buying services on a trunked band operated by a service provider.

There would also be costs on licensees with apparatus licensing the 10 MHz duplex frequency split. They would need to move to the 10 MHz duplex frequency split on a staged basis by retuning or possibly by buying new equipment. There would also be high costs on ACMA if it were to closely manage the staged move.
To the extent possible, promote both certainty and flexibility

Spectrum licensing options for the 450–470 MHz band involve a trade-off between flexibility for the new licensees and certainty for incumbents. Providing greater certainty for incumbents will reduce the flexibility for the spectrum licensees.

However, even if apparatus licensing were retained, there still would be reduced certainty for incumbents, so long as a 10 MHz duplex frequency split was introduced.

Following the move to the 10 MHz duplex frequency split, there is more certainty of tenure for spectrum licences than apparatus licences as they can have a 15-year term with compensation provisions for resumption. However, following any changes resulting from the current set of proposals ACMA would be unlikely to visit re-planning arrangements in the 400 MHz band in the short to medium term, which would make apparatus licences also quite certain.

Allocation options

If the proposed 10 MHz duplex frequency split were allocated by spectrum licensing, then ACMA would auction the licences. The auction lots would be of a reasonable size. They would be at least 2x1.25 MHz wide and state-wide (with the ACT included with NSW).

If the 10 MHz duplex frequency split were allocated by apparatus licensing, then the allocation options are much more difficult. At this stage it is proposed that channels on the 10 MHz duplex frequency split initially be available only to existing licensees on a one-to-one basis. One existing 12.5 kHz or 25 kHz channel would entitle the licensee one 12.5 kHz channel in the 10 MHz duplex frequency split.

Once sufficient space has been created, by licensees not renewing or moving to narrower bandwidths, then existing non-government licensees in 403–430 MHz band would be allowed to apply for licences. Once the band has been substantially re-structured, other organisations would be allowed to apply for licences in the 10 MHz duplex frequency split.

Under the arrangements outlined above, licences in the 10 MHz duplex frequency split in 450–470 MHz would be closed to new licensees for some time. Possibly three to five years in Sydney and Melbourne, two years in Brisbane, and one year in other areas.
6.4 Proposal

11. ACMA proposes:
   - establishing a minimum of $2 \times 5$ MHz, 10 MHz split segments to facilitate use of a greater range of technologies: 452.5–457.5 MHz paired with 462.5 – 467.5 MHz (supporting a range of future options)
   - leaving existing single frequency and fixed point-point and point multipoint segments in this band untouched
   - maintaining 9.5 MHz duplex splits in remaining segments.

In addition the ACMA seeks comment on:
   The possibility of maximising the spectrum available for 10 MHz split by identifying additional 10 MHz split spectrum beyond the proposed $2\times5$ MHz up to a maximum of $2\times7.4875$ MHz, as shown in Figure 5.
Licensing and allocation options

Option 1
- ACMA recommends that the Minister makes a declaration that the proposed 10 MHz split spectrum is subject to re-allocation by issuing spectrum licences.
- ACMA will auction the spectrum licences in state-wide blocks of 2x1.25 MHz.
- The reallocation period would be 2 years, with ACMA imposing a licensing condition that incumbent licensees must be allowed access to the band for a period of 5 years from the Minister’s declaration.

Option 2
- ACMA recommends that the Minister makes a declaration that the proposed 10 MHz split is subject to re-allocation by issuing spectrum licences.
- ACMA will auction the spectrum licences in state-wide blocks of 2x1.25 MHz.
- The reallocation period would be 5 years, with ACMA not imposing any licensing condition that incumbent licensees must be allowed access to the band.

Option 3
- ACMA licenses the proposed 10 MHz split spectrum by issuing apparatus licences.
- Channels on the proposed 10 MHz duplex frequency split would initially be available only to existing licensees on a one-to-one basis (one existing 25 kHz or 12.5 kHz channel for one new 12.5 kHz channel).
- Once sufficient space has been created by licensees not renewing or moving to narrower bandwidths, existing non-government licensees in 403–430 MHz band would be allowed to apply for licences.
- Once the band has been substantially re-structured, other organisations would be allowed to apply for licences in the proposed 10 MHz duplex frequency split.
- Under this option, ACMA would propose 3 MHz paired of the 10 MHz split spectrum be identified for trunking systems.

12. ACMA seeks comment on preferred licensing and allocation options for the proposed 10 MHz duplex frequency split spectrum in the 450-470 MHz band.
7 Arrangements in 470–520 MHz

The band 470–520 MHz is a relatively heavily used part of the overall 400 MHz band, hosting around 35% of the frequency assignments in the band. Within this band a number of changes are proposed. These include measures to address congestion including proposals to reduce channel bandwidth, change assignment and coordination rules, modifications to pricing arrangements and potential changes to licensing in some segments. Some of the proposals relate to specific segments of the band, such as the UHF Citizen Band and the current 500 MHz spectrum licensed segments.

The changes proposed for 470–520 MHz offer existing users of the overall 400 MHz band a substantial area of spectrum where change is less extensive than in other parts of the band as there are no alterations in duplex frequency splits. However, channel bandwidth reduction will be applicable to the band. Overall, around 25% of users in the 470–520 MHz band are already operating on 12.5 kHz channels and may not need to make any changes at all.

ACMA’s Spectrum Management Principles one, four and five, are of key relevance to this band, that is:

- to allocate spectrum to the highest value use or uses
- to the extent possible, promote both certainty and flexibility
- to balance the cost of interference and the benefits of greater spectrum utilisation.

Proposals detailed elsewhere in this paper, but of particular relevance to the 470–520 MHz band are:

- additional channels for UHF CBRS (Chapter 5)
- the expiry of 500 MHz spectrum licences (Chapter 8)
- the use of 518–520 MHz pending outcomes of a decision on UHF television channel 27 (Chapter 9).
8 Expiry of 500 MHz spectrum licences

This chapter details three alternative proposals for the future of the 500 MHz spectrum licences. These are:

- continuing spectrum licensing in the 500 MHz band following an update of the technical framework applied to these licences and possible consolidation of the spectrum into larger lots
- expanding spectrum licensing in the 500 MHz band
- reverting to apparatus licensing in the 500 MHz band, and potentially using this spectrum to assist with overall migration issues in the 400 MHz band.

In the Options Paper, ACMA sought the view of stakeholders regarding arrangements for the spectrum licences in the upper 400 MHz band from 500.99375–504.99375 MHz paired with 510.99375–514.99375 MHz (the 500 MHz band spectrum licences). As discussed in the Options Paper, ACMA has three options for expiring spectrum licences:

1. re-allocate the spectrum under new spectrum licences by an auction, tender, or predetermined or negotiated price
2. renew the expiring licences under public interest grounds
3. re-allocate the spectrum under a different licensing system such as apparatus licences

It is possible under the Radiocommunications Act 1992 (the Act) for some licences to be renewed as per option 2 with the remainder re-allocated as per option 1. Also it would be possible for the licensing system to be changed in some areas but not others, leaving the option open for different licensing systems in metropolitan and rural and remote areas.

8.1 Stakeholder response

Overall responses to questions addressing licensing, pricing and trading varied significantly depending on the magnitude and nature of the respondent’s use of the band. Generally, the use of a mixed licensing approach where a range of options are available to suit different needs was promoted in submissions. For example, while some respondents supported apparatus licensing as the most effective licensing mechanism for the band, others stated that spectrum licensing used in conjunction with efficient equipment (digital systems and time division multiple access (TDMA) technologies) would facilitate the most effective use of the spectrum.

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32 Under section 60 of the Radiocommunications Act
33 Under section 82 of the Radiocommunications Act
34 Which will require the original spectrum designation under section 36 of the Radiocommunications Act to be revoked by the Minister
Responses on the specific issue of the 500 MHz band spectrum licences was provided by only a small number of stakeholders with the majority of their submissions in favour of reverting to apparatus licensing in this band. However, current users of these spectrum licences demonstrated concern over the future of their systems and arrangements for replacement spectrum and sought certainty about future licensing arrangements.

In addition to submissions to the Options Paper, ACMA directly approached each of the 500 MHz spectrum licensees about the use of their licences. Of those that chose to speak with ACMA, few sought the continuation of spectrum licensing in the upper 400 MHz band. Many spectrum licences have no devices registered against them and most licensees confirmed that they were not using their spectrum. All licensees that had devices registered expressed a preference for a move to apparatus licensing.

8.2 Issues

8.2.1 RE-ISSUE SPECTRUM LICENCES

The default option for expiring spectrum licences is for ACMA to update the technical framework and reallocate the licences using a price-based allocation system which generally occurs via an auction.

The stakeholder response in favour of reversion to apparatus licensing is not, of itself, sufficient to establish that apparatus licensing would constitute the highest value use of the affected spectrum. Given the success of spectrum licensing in some other frequency bands, it may be that the implementation of spectrum licensing in the 500 MHz band is not optimal. This could be because the 500 MHz spectrum licences were the first to be developed and issued.

To re-issue the frequency band under spectrum licences ACMA must determine:

- whether the technical framework needs to be updated and what changes are desirable. This will include a review of core licence conditions such as bandwidths and geographic coverage areas, interference standards and advisory guidelines.
- whether any of the existing licensees would qualify for licence renewal. As the default option is a reallocation by a price based method, a renewal would require ACMA to determine if the licence was used in the provision of a service for which the Minister for Broadband, Communications and the Digital Economy (the Minister) determines renewal to incumbents would be in the public interest or if special circumstances exist as a result of which it is in the public interest to renew licences to the incumbents.
- prices for licences that are renewed in the public interest
- the best method or methods with which to allocate licences that are not renewed in the public interest. These must be by auction, tender, or a predetermined or negotiated price. ACMA has normally used an auction to allocate spectrum licences.
So far, the Minister has not made a declaration of a class of service for which it would be in the public interest to renew licences.

In the past, ACMA has normally allocated spectrum licences by a simultaneous multi-round auction, although a traditional open outcry auction has also been used. Since the last major round of auctions, there have been advances in auction methodology, and many diverse auction formats have been used in Europe that promise to most appropriately address different market situations—not to maximise revenue, but to obtain the best overall outcome. In the light of these developments, ACMA is currently conducting a study on auction methodology.

ACMA is releasing a discussion paper on the possible changes to the technical frameworks of spectrum licensing in parallel with this paper. Any framework for spectrum licensing in the 500 MHz band beyond 2012 will be informed by the results of this consultation and subsequent specific consultation on the framework for this band.

Under the current provisions of the Act, ACMA must issue a notice under s.78 regarding the spectrum licences that expire within two years, and essential tasks are dependent on this milestone. For the 500 MHz spectrum licences, this notice cannot be issued before 31 May 2010, meaning that finalisation of reissue, whether or not by spectrum licence, is unlikely to be completed before the end of 2010. Before this notice is issued and responses analysed, ACMA cannot make any final decisions regarding advice to the Minister on public interest renewal or reallocate any licences.

Stakeholders have sought assurances from ACMA about the continuation of access to spectrum after 2012. ACMA and DBCDE are aware of the cost of uncertainty to spectrum licensees in this and other bands and are working to resolve the issue.

8.2.2 REVERSION TO APPARATUS LICENSING

If the frequency band is to be reallocated under apparatus licences ACMA may choose to use it as a transition band for users that are required to move from other parts of the band affected by the replan. This would be particularly useful in metropolitan areas such as Sydney and Melbourne where the 400 MHz band is highly occupied and would enable the replanning of the band to be completed sooner.

Returning spectrum licensed spectrum to an apparatus licensed regime requires Ministerial action to revoke the original designation of the 500 MHz band for spectrum licensing under subsection 36(1) of the Act. This revocation can only occur after the Minister consults with ACMA. Under subsections 36(3) and (4) of the Act, ACMA may make recommendations to the Minister proposing such a revocation, but only after giving members of the public reasonable opportunity to make representations to ACMA about such a recommendation.

This consultation paper is intended to give members of the public sufficient information and the opportunity to make representations to ACMA about the recommendation it should make to the Minister. In particular, ACMA seeks

35 For a copy of the paper, see the ACMA website: www.acma.gov.au (Note: This paper is scheduled for release a few days after this paper)
submissions about whether it should recommend to the Minister that he revoke the original designation of the 500 MHz band for spectrum licensing under subsection 36(1) of the Act.

Should the spectrum licensing regime be removed from this part of the band, ACMA will have the option of applying alternative licensing regimes in the band. For example, apparatus licences which could be based on relevant RALIs consistent with the usage of the rest of the 400 MHz band.

8.3 Analysis

8.3.1 SPECTRUM UTILISATION

The 500 MHz spectrum licences are lightly utilised compared with adjacent apparatus licensed segments of the band, with most licences having no devices registered, and so presumed unused. In particular, in the high density areas of Melbourne and Sydney where there is excess demand for spectrum in the 400 MHz band there are significant portions of unused spectrum in the spectrum licensed bands—over 4.5 MHz in Melbourne and 7 MHz in Sydney. This degree of use of spectrum contrasts with the otherwise high demand in these areas.

It is notable that successful spectrum licence implementations in the 800 MHz and 1 800 MHz bands offered spectrum parcels substantially wider than even the largest of the 500 MHz allocations, and also offered substantially more spectrum. For comparison:

- the 500 MHz allocation offered 2×4 MHz in total in duplex lots varying in size from 12.5 kHz to 1 MHz
- the 800 MHz allocation offered 2×20 MHz total in metropolitan areas (2×15 MHz outside metropolitan) in lots of 2×5 MHz
- the 1800 MHz allocations offered 2×45 MHz total in metropolitan areas (2×15 MHz outside metropolitan) in lots of 2×2.5 MHz.

Larger bandwidth lots and greater total spectrum availability may be essential to create the opportunity for substantial shared networks with a broad geographic footprint.

There may also be other factors that are pertinent to the 500 MHz spectrum licences that are able to be optimised for re-issue and could result in usage at least as valuable as apparatus licensing is achieving in nearby spectrum.

These uses could include an expansion of private band management (at least one 500 MHz spectrum licensee offers spectrum for lease), especially as this business model is just starting to be adopted in some advanced overseas markets, including the UK.

8.3.2 400 MHZ BAND MIGRATION CONSIDERATIONS

Successful implementation of the changes required to restructure the 400 MHz band relies heavily on finding a way to successfully migrate to any new arrangements. This
process is greatly facilitated by having vacant or lightly used areas of spectrum to use as temporary holding space, or ideally a permanent new home for displaced services. As the spectrum used by the 500 MHz band spectrum licences is relatively lightly used, with for example over 4.5 MHz in Melbourne and 7 MHz in Sydney unused, making use of this spectrum would help to increase the speed of change in the band.

8.3.3 SPECTRUM TRADING AND LEASING

Leasing and trading of spectrum is a mechanism to enable spectrum to move to its highest value use. Motorola is the major spectrum licensee in this band and acquired its licences from Simoco (in receivership).

ACMA has recently closed a consultation on spectrum trading, and is analysing the results.36

8.4 Proposals

Three alternative proposals are discussed below.

1. **Continue spectrum licensing in the 500 MHz band**

This is the default option for the handling of expiring spectrum licences, with the new spectrum licences being allocated via a price-based process such as an auction. ACMA must complete a number of decisions in order to re-allocate the expiring licences.

ACMA has a high degree of freedom to modify the core conditions and other elements of the technical framework of the licences. ACMA is releasing a discussion paper on the possible changes to the technical frameworks of spectrum licensing concurrently with this paper. ACMA proposes to consult on any changes to the current framework following consideration of responses to this consultation. However, any preliminary views on changes to the existing framework would be welcomed as part of this 400 MHz consultation, especially if changes could be made that would make the spectrum licences more valuable to licensees.

13. ACMA seeks preliminary views on the technical framework to apply to spectrum licences at the upper end of the 400 MHz band.

Lots could be allocated in bandwidths larger than those originally allocated at 500 MHz. For the existing 500 MHz spectrum licensed band, there could be one lot of 2 x 4 MHz, or multiple paired lots of 2 x 2 MHz or 2 x 1 MHz. These would be Australia-wide or at least state-wide. The intention of using larger lot sizes is to increase the value of the spectrum licences by allowing more flexibility in the use of the spectrum and a greater range of opportunities for spectrum licensees.

14. ACMA seeks views on the appropriate lot size for the continued operation of the 500 MHz spectrum licences.

ACMA is legislatively required to inform the public of the impending expiry of the spectrum licences no more than two years prior to expiry. The allocation of the new licences can then be conducted at any time after that notification.

For the 500 MHz spectrum licences, the notification must not happen prior to 1 June 2010. ACMA proposes to publish that notification during June 2010 and to conduct the allocation prior to the end of 2010.

15. ACMA seeks stakeholder’s views on the timing of reallocation of the 500 MHz spectrum licences.

Under the Act existing licensees have no automatic legislative rights or advantages in the new allocation process unless it is determined that renewal of licences would be in the public interest under section 82.

- Under section 82(3) the Minister can declare a class of service for which it would be in the public interest to renew the spectrum licence
- Under section 82(1) ACMA may renew licences used to provide services declared by the Minister under section 82(3); and it may also renew licences if there are special circumstances such that that renewal is the public interest.

16. ACMA seeks views on whether it should recommend to the Minister that a class of service should be declared under section 82(3), and what this class of service should be.

ACMA seeks views on what criteria it should apply when determining under section 82(1) whether any renewal should be offered.

2 Expand spectrum licensing in the 500 MHz band

There are a number of potential advantages in expanding the amount of spectrum allocated under spectrum licensing at the top of the band, for example, from 500–519 MHz. It would potentially provide a much greater and more flexible spectrum space for the licensees to manage. Spectrum licensees may be able to act as private suppliers and managers of spectrum for both new users and those displaced from changes in 403–430 MHz.

This alternative proposes the same technical frameworks and lots sizes as the first proposal but with increased amount of spectrum made available through spectrum licensing.

ACMA is not able to expand the total amount of spectrum available for spectrum licensing—the Minister must make the additional spectrum available for spectrum licensing under a new s.36 Designation or s.153B Declaration. If it is decided to further investigate this proposal, ACMA will hold separate, more detailed, public consultations.
17. ACMA seeks views on the types of uses that might be commercially attractive under spectrum licensing if the total bandwidth available to spectrum licensing at the upper end of the 400 MHz band is increased.

ACMA seeks views on whether the total bandwidth available for spectrum licensing at the upper end of the 400 MHz band should be increased.

3 Revert to apparatus licensing in the 500 MHz band

Given the need to find vacant spectrum for licensees displaced elsewhere in the 400 MHz band together with the low level of spectrum utilisation of the 500 MHz spectrum licences compared with adjacent apparatus licensed bands, ACMA has an alternative proposal that the 500 MHz spectrum licences be re-allocated as apparatus licences after expiry. This proposal therefore has broader benefits than just for the 500 MHz spectrum licensed bands.

The decision to revert to apparatus licensing can only be made by the Minister after consultation with ACMA. It will require him to revoke the original s36 designation that established spectrum licensing in the band and this will require ACMA to make a recommendation to the Minister.

18. ACMA seeks views on whether it should recommend to the Minister that the original s.36 Designation be revoked on the expiry of the licences and that the spectrum be re-allocated under apparatus licences.

ACMA seeks views on whether the new apparatus licences should be technically consistent with the apparatus licences in nearby frequency bands.

Specific proposals on allocation of apparatus licences

If spectrum licensing was discontinued the band could be allocated for apparatus licences under revised apparatus licensing arrangements discussed in other parts of this paper.

In line with adjacent segments, it is likely that there would be only excess demand in Sydney and Melbourne. Therefore outside these areas, over-the-counter allocation would be suitable.

19. ACMA seeks views on whether over-the-counter allocation of these new apparatus licences is suitable outside the high density areas of Sydney and Melbourne.

In Sydney and Melbourne, a competitive allocation method may be more suitable. However, in Sydney and Melbourne, in order to facilitate other changes in the band, ACMA is considering giving preference to applications from various stakeholders in order to facilitate the replanning process:

- **Existing spectrum licensees who are providing services.** Spectrum licences have no ongoing rights after licence expiry. As there is currently unused spectrum in the spectrum licensed 500 MHz bands in all regions, it may be reasonable to issue apparatus licences prior to expiry that would commence on expiry of the spectrum licences to enable current services to continue.
20. ACMA seeks views on the proposal to allow 500 MHz spectrum licensees who are providing spectrum for significant active networks to apply for apparatus licences prior to acceptance of other applications, noting that ACMA may need to change the operational frequencies, or may choose to defer individual applications to a later allocation.

- Non-government licensees currently occupying channels in 403–430 MHz. ACMA would like to encourage non-government licensees in the 403–430 MHz band to move out of the band as quickly as possible to enable quick consolidation of government services. One way to encourage this migration would be to provide alternative spectrum. While 500 MHz is generally out of re-tuning range of equipment below 430 MHz, there is currently free spectrum in 500 MHz and migrating users could be allowed to apply for apparatus licences in this band prior to spectrum licence expiry. The licences would commence as soon as practicable.

21. ACMA seeks views on the proposal to accept applications for apparatus licences in this band from non-government licensees in the 403–430 MHz band prior to the acceptance of other applications. Applicants would be offered 12.5 kHz channels.

- Licensees currently occupying channels in 450–470 MHz. Licensees affected by the proposed change in frequency split could desire apparatus licences in other segments of the 400 MHz band, depending on the licensing options adopted for the new frequency split.

22. ACMA seeks views on the proposal to accept applications for apparatus licences in this band from current licensees in the 450–470 MHz band prior to the acceptance of other applications. Applicants would be offered 12.5 kHz channels.

ACMA seeks views on whether this should be a temporary transition or a permanent relocation.

Irrespective of whether all or any of the above are granted preferential access to the new licences at least some of the frequency band will remain unallocated.

- In areas where there is no excess demand, it is proposed that licences be offered over the counter. We expect this will be the case in all areas expect Sydney and Melbourne.
In Sydney and Melbourne, if there are any channels remaining after any preferential licensing discussed above, licences would be allocated by auction of each channel in each city. Winning bidders would be subject to normal planning rules. If there are fewer applications than there are channels available, all applications will be accepted and the remaining channels will be allocated over the counter.

23. ACMA seeks views on the option to perform an auction for remaining apparatus licences in Sydney and Melbourne.
9 518–520 MHz and UHF TV channel 27 (520–526 MHz)

In this chapter, ACMA seeks comment on:

● whether or not wireless microphone and biomedical telemetry users operate devices in the 520–526 MHz range under the LIPD Class Licence
● the technical specifications (especially the tuning range) of wireless microphone and biomedical telemetry devices that operate in the band.

In Australia the frequency range 520–820 MHz is designated by the Minister as primarily for the purpose of broadcasting (broadcasting services bands (BSB)). Australian UHF television channels are 7 MHz wide, commencing with channel 28 (526–533 MHz) and ending with channel 69 (813–820 MHz). This arrangement leaves 6 MHz of spectrum unused below channel 28. This 6 MHz gap between channel 28 and other services (loosely referred to as channel 27) helped manage the potential for interference to the vestigial side band of analog television services operating on channel 28.

The government has announced that the switch-off of terrestrial analog television services will be completed by the end of 2013. This will free up significant amounts of spectrum which may open up opportunities for alternative uses such as new mobile services, additional television services and wireless broadband services. Existing services may also benefit from enhanced services or coverage. The opportunity to introduce new or improved services is known as the ‘digital dividend’.

Australia has yet to determine its approach to the digital dividend. If the spectrum vacated following the cessation of analog terrestrial broadcasting remains part of the BSBs, ACMA must continue to manage that spectrum in accordance with the Broadcasting Services Act 1992. ACMA will assist the Minister and his department in their consideration of the issues.

The size and nature of the dividend will depend on government decisions on:

● whether, and if so to what extent, digital television services are replanned so as to make available a contiguous block of spectrum (referred to as restacking); and
● the uses to which the vacated spectrum can be put.
Given digital dividend considerations, it is timely to consider future use of the spectrum immediately adjacent to channel 27 in the range 518–520 MHz. If channel 27 was expanded by 1 MHz, an additional 7 MHz wide television channel could be created. However, this is only one of several possible options.

On 6 October 2006, ACMA placed a spectrum embargo (Embargo 45) on 518–520 MHz. The embargo requires that no new assignments may be made in the embargoed frequency range, including assignments for existing licensees seeking to expand or modify their communications systems in the embargoed band. The embargo applies Australia-wide.

The purpose of the embargo on the upper 1 MHz (519–520 MHz) is to preserve options for the possible expansion of UHF television channel 27 to a full 7 MHz TV channel. The purpose of the embargo on the lower 1 MHz (518–519 MHz) is to preserve planning options for adjacent channel sharing.

The future of channel 27 is related to ongoing digital dividend activities. It is therefore premature and inappropriate for ACMA to make any decision or proposals on future of this spectrum.

Until government policy on Digital Dividend is determined ACMA will maintain options for the spectrum adjacent to channel 27 in order to maximise flexibility and choices for future decisions related to the digital dividend. ACMA will therefore maintain the existing embargo in the 518–520 MHz band to preserve future planning options associated with digital dividend outcomes.

### 9.1 Potential options

In order for ACMA to ensure future flexibility for possible future uses of 520–526 MHz and the adjacent 518–520 MHz band, it is useful to identify potential future options for use. Possible options include:

1. maintaining the status quo with services as determined by the digital dividend occupying 526–820 MHz and fixed and land mobile operating below 520 MHz
2. permitting the creation of a 7 MHz wide channel 27 (519–526 MHz) for use for services as determined by the digital dividend
3. making 520–526 MHz available for services requiring a 6 MHz channel only (such as mobile television) as determined by the digital dividend
4. making the spectrum 520–526 MHz available for the fixed and mobile services.

Methods of allocating spectrum under options 2, 3 and 4 will require further consideration.

---

9.2 Issues

It may be feasible that the spectrum could be used for both expanded broadcasting or expanded fixed and mobile use on a geographically shared basis—most likely broadcasting in urban areas and for the fixed and mobile services in rural areas. However, there is no identified requirement for additional spectrum for fixed and mobile in rural areas (noting that existing land mobile congestion is concentrated in higher population density areas).

Creating a new broadcasting channel 27 down to 519 MHz would mean that incumbent fixed and mobile services in the 519–520 MHz range would need to cease operation or migrate elsewhere. There are currently around 500 frequency assignments in this spectrum, including wideband links. A range of issues surrounding licensing and how a newly created 7 MHz channel 27 might be used would need to be addressed.

Land mobile and fixed radio equipment availability in the 400 MHz band tapers off in above 512 MHz. This is because the spectrum arrangements in Europe and the United States cater for use by the land mobile and fixed services up to 470 and 512 MHz respectively, hence this equipment is not specifically designed to operate above 512 MHz. Hence equipment availability constrains the value of 520–526 MHz for non-broadcasting purposes.

Although the spectrum from 520–526 MHz is not currently used for broadcasting, it is potentially in use for wireless audio transmitters and biomedical telemetry applications, as permitted by the Radiocommunications (Low Interference Potential Devices) Class Licence 2000 (the LIPD Class Licence). Under the LIPD Class licence these devices operate on a ‘no interference, no protection from interference’ basis. Possible use of these devices within this spectrum range, and the extent to which planning would need to consider potential migration requirements, would however need to be considered when exploring other potential uses for this spectrum.

9.3 Questions

24. ACMA seeks comment from wireless microphone and biomedical telemetry users on whether or not they operate devices in the 520–526 MHz range under the LIPD Class Licence.

What are the technical specifications (especially tuning range) of wireless microphone and biomedical telemetry devices that operate in the band?
10 Summary

This paper prompts discussion on a number of issues pertaining to use of the spectrum between 403 and 520 MHz. The objectives that are presented in the initial section of this paper, which range from the determination of a government band to improving efficiency in the band, are met by the proposals that are outlined in this summary. ACMA hopes that new arrangements encourage market forces to work more freely in the band which will allow ACMA to minimise its role in management of the band and provide certainty to users regarding the long term future of the band.

Responses to this paper will be used to develop detailed strategies for future use of this spectrum. After developing these strategies a further public consultation will be conducted and a third discussion paper developed. This will cover key areas not covered in this paper such as migration and implementation strategies and detailed information on:

- the migration of users to smaller channel bandwidths
- the migration of incumbent users to other parts of the band
- the migration of government users into consolidated spectrum
- time frames associated with various migration strategies
- changes to licence fees
- regional and metropolitan variations regarding migration and time frames
- changes to the 400 MHz Band Plan and RALIs LM8, FX16 and FX17.

Comment is sought on the issues raised in this paper (consolidated below) and any others considered relevant to stakeholders.

Summary list of proposals

The list below is a summary of questions raised in this paper.

1. **ACMA proposes in the 400 MHz band to:**
   
   - implement a 6.25 kHz compatible channel raster for all land mobile segments (both single and two frequency segments) in the 400 MHz band
   - permit aggregation of channels to 12.5 kHz unconditionally
   - permit aggregation of channels greater than 12.5 kHz. Justification would be required in HDAs and MDAs with the spectral efficiency of the proposed use
(25 kHz analog systems would not be supported) and the availability of alternatives as key considerations.

- prohibit 25 kHz systems in HDAs and MDAs within 5 years.

2. ACMA proposes in the 400 MHz band:

- to reduce the minimum channel size for all narrowband fixed segments (point to point and point to multipoint) in the 400 MHz band to 12.5 kHz with aggregation of channels permitted where justified
- to prohibit 25 kHz analog voice point-to-point systems in HDAs and MDAs within 5 years.
- no change for wideband systems.

3. ACMA does not propose to adopt mandatory channel sharing or loading obligations on land mobile services.

4. ACMA proposes to identify additional segments within the 400 MHz band to be used exclusively for trunking. This proposal is discussed further in Chapter 6.

5. ACMA does not propose to vary the existing minimum data rates for narrowband fixed service data applications.

6. ACMA proposes to undertake a process to implement revised changes to assignment and coordination procedures based on the following core concepts, for:

- **Land mobile**
  - a review of re-use distances with a view to reduction
  - the option to use topographical information in the assignment process

- **Point-to-point**
  - the option to use topographical information in the assignment process

- **Point-to-multipoint**
  - the option to use topographical information in the assignment process

- **Single frequency systems**
  - restricting or quarantining high power single frequency systems
  - permitting high power single frequency in exceptional cases only
  - regional variations allowing the use of high power SFS in some areas.

- **Area-wide high duty cycle data systems**
  - identifying dedicated channels for area-wide, high duty cycle data systems

7. ACMA proposes:

- the identifying spectrum for a 10 MHz duplex split in 450–470 MHz (refer to Chapter 6)
- no duplex split changes in 470–518 MHz
8. ACMA proposes:

- the 403–430 MHz band (less Defence and EPIRB segments) be identified for the exclusive use of federal, state and territory governments
- this band be primarily used to enable interoperability between government agencies providing security, law enforcement and emergency services
- that other federal, state and territory government users be permitted to use the band contingent on the requirements of security, law enforcement and emergency services uses being adequately supported. This use of the spectrum would be determined and prioritised by the states/territories individually without ACMA’s prescription
- a segment of this band be identified for federal agency use provided interoperability between government agencies providing security, law enforcement and emergency services can be demonstrated
- the entire block of spectrum should be made available on a state-wide basis as a single licence, with fees payable at an annual amount, independent of the number of devices operated under the licence
- that apparatus licensing be continued to be used to authorise use of the band initially and that spectrum licensing be explored later
- that existing non-government licensees in the 403–430 MHz band transition out of the band within 5 years in high and medium density areas and 8 years in the rest of the country
- that existing government arrangements outside of the 403–430 MHz band be removed no sooner than in 5 years time
- relevant national committees, primarily the NCCGR and LESRSC, determine solutions for interoperability and identify mechanisms that can be used by ACMA to further enhance interoperability objectives via spectrum management arrangements.

9. ACMA proposes no change to existing licensing arrangements supporting point-to-multipoint applications.

10. ACMA proposes to undertake a process to implement revised arrangements for the UHF CBRS based on the following core concepts:
- extension of the CBRS band by 6.25 kHz at the top edge of the band
- the reduction to 12.5 kHz channels for CBRS simplex channels;
- the retention of 25 kHz channels for the eight (8) existing repeater channel pairs, including the emergency channels and the two (2) existing telemetry/telecommand channels
- review the coordination and assignment rules for repeater channels.
11. ACMA proposes:
   - establishing of a minimum of $2 \times 5$ MHz, 10 MHz split segments to facilitate use of a greater range of technologies: 452.5–457.5 MHz paired with 462.5–467.5 MHz (supporting a range of future options)
   - identifying 3 MHz paired of the 10 MHz split spectrum for trunking systems
   - leaving existing single frequency and fixed point-to-point and point-to-multipoint segments in this band untouched
   - maintaining 9.5 MHz duplex splits in remaining segments.

In addition ACMA seeks comment on:
   - The possibility of maximising the spectrum available for 10 MHz split by identifying additional 10 MHz split spectrum beyond the proposed $2 \times 5$ MHz up to a maximum of $2 \times 7.4875$ MHz, as shown in Figure 5.

12. ACMA seeks comment on preferred licensing and allocation options for the proposed 10 MHz duplex frequency split spectrum in the 450–470 MHz band.

13. ACMA seeks preliminary views on the technical framework to apply to spectrum licences at the upper end of the 400 MHz band.

14. ACMA seeks views on the appropriate lot size for the continued operation of the 500 MHz spectrum licences.

15. ACMA seeks stakeholder’s views on the timing of reallocation of the 500 MHz spectrum licences.

16. ACMA seeks views on whether it should recommend to the Minister that a class of service should be declared under section 82(3), and what this class of service should be.

ACMA seeks views on what criteria it should apply when determining under section 82(1) whether any renewal should be offered.

17. ACMA seeks views on the types of uses that might be commercially attractive under spectrum licensing if the total bandwidth available to spectrum licensing at the upper end of the 400 MHz band is increased.

ACMA seeks views on whether the total bandwidth available for spectrum licensing at the upper end of the 400 MHz band should be increased.

18. ACMA seeks views on whether it should recommend to the Minister that the original s.36 Designation be revoked on the expiry of the licences and that the spectrum be re-allocated under apparatus licences.

ACMA seeks views on whether the new apparatus licences should be technically consistent with the apparatus licences in nearby frequency bands.

19. ACMA seeks views on whether over-the-counter allocation of these new apparatus licences is suitable outside the high density areas of Sydney and Melbourne.
20. ACMA seeks views on the proposal to allow 500 MHz spectrum licensees who are providing spectrum for significant active networks to apply for apparatus licences prior to acceptance of other applications, noting that ACMA may need to change the operational frequencies, or may choose to defer individual applications to a later allocation.

21. ACMA seeks views on the proposal to accept applications for apparatus licences in this band from non-government licensees in the 403–430 MHz band prior to the acceptance of other applications. Applicants would be offered 12.5 kHz channels.

22. ACMA seeks views on the proposal to accept applications for apparatus licences in this band from current licensees in the 450–470 MHz band prior to the acceptance of other applications. Applicants would be offered 12.5 kHz channels.

ACMA seeks views on whether this should be a temporary transition or a permanent relocation.

23. ACMA seeks views on the option to perform an auction for remaining apparatus licences in Sydney and Melbourne.

24. ACMA seeks comment from wireless microphone and biomedical telemetry users on whether or not they operate devices in the 520–526 MHz range under the LIPD Class Licence.

What are the technical specifications (especially tuning range) of wireless microphone and biomedical telemetry devices that operate in the band?

Submissions on the issues raised in this discussion paper may be made to ACMA as follows:

By email: 400MHzreview@acma.gov.au

By mail:

Mr Andrew Stewart
Government Planning Section
Australian Communications and Media Authority
PO Box 78
Belconnen ACT 2616

Electronic submissions in Microsoft Word or rich text format are preferred.

Contact Andrew Stewart on telephone 02) 6219 5238, or email andrew.stewart@acma.gov.au, for general questions or clarification, should you wish to discuss any matter within the scope of this discussion paper.
Attachment 1: 400 MHz Plan Narrowband Services Diagram

- Land mobile (two frequency, 25 kHz channeling).
- Land mobile (two frequency, 12.5 kHz channeling).
- Land mobile (single frequency, 25 kHz channeling).
- Land mobile (single frequency, 12.5 kHz channeling).
- Land mobile and fixed (single frequency, 25 kHz channeling).
- Land mobile and fixed (single frequency, 12.5 kHz channeling).
- Mobile-satellite (Earth to space).

Key:
- ST = Base station transmit segment
- SR = Base station receive segment
- P = Paired segments

Note: This diagram should be read in conjunction with Section 2.1 and Table 1 (including Notes) of the Plan.
### Attachment 2: Overview of existing voice radiocommunications used by federal, state and territory agencies

<table>
<thead>
<tr>
<th>State</th>
<th>Agency</th>
<th>VHF 403–420 MHz</th>
<th>420–430 MHz</th>
<th>450–470 MHz (LEPS)</th>
<th>480 MHz (CT)</th>
<th>500–520 MHz (Spectrum Licence)</th>
<th>800 MHz</th>
<th>Comments</th>
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<td>New P25 emergency services network planned for 2010+ 403-430 MHz</td>
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### Technology
- **Trunked**
  - Smartzone P25
  - Smartzone 4.1
  - Smartzone 3.0
  - EDACS
  - MPT1327
  - Astro 25

### Glossary
- GRN: Government Radio Network
- SMR: State Mobile Radio
- MMR: Metropolitan Mobile Radio
- IDAS: ICOM Digital Advanced System
- P25: APCO Project 25
- EDACS: Enhanced Digital Access Communication Systems
# Attachment 3: Government Band Scenario Assessment

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Status quo     | LEPS 2 by 1.6 MHz in 450–470 MHz  
11 CT Channels around 480 MHz  
Government band 420–430 MHz (less 3 by 500 kHz Defence segments)  
Use of other 400 MHz band spectrum as available | Flexibility in spectrum choice  
420–430 MHz is used lightly in most areas  
Some compatibility between Police systems/spectrum by the 450–470 MHz segment. | Interoperability difficult due to spectrum and equipment constraints  
Disparate spectrum inhibits creation of large efficient networks. | Sub-optimal solution |
| 380–400 MHz    | Used principally for defence: Defence would normally be consulted in non-defence use | One principal stakeholder (Defence)  
Band available for TETRA | Highly valued by Defence with substantial existing and future use: substantial non-Defence use is considered problematic  
Band insufficient in size for a non 6.25 kHz equivalent solution. | Defence have advised no additional capacity to share this band |
| 403–430 MHz    | Spectrum used for government purposes in the US and Europe | Potential for stable long term use.  
Capacity to meet core Govt needs using contemporary 12.5 kHz equivalent technology.  
Currently approx 80% Govt use hence reduced disruption to other users.  
A number of jurisdictions have, or intend to, deploy networks operating in this band. | May not be sufficient for all Govt services in the highest density areas using 12.5 kHz technology solutions.  
Non-govt users would need to migrate. | Most practical solution |
| 450–470 MHz    | Internationally common spectrum for land mobile | Equipment cheaper and a wide range of manufacturers LEPS spectrum currently dedicated to government use. | Heavily congested  
IMT identification makes future uncertain.  
Band insufficient in size for a non 6.25 kHz equivalent solution.  
Migration of incumbents a major task | Popular band for commercial use: both existing land mobile technologies and potential future WAS. |
### Attachment 4: Channel arrangements for proposed changes to CBRS

<table>
<thead>
<tr>
<th>Centre Frequency (MHz)</th>
<th>Existing Arrangements</th>
<th>Proposed Arrangements</th>
<th>Comments</th>
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<td></td>
<td>Old Channel Identifier</td>
<td>New Channel Identifier</td>
<td>Channel Bandwidth (kHz)</td>
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<td>1</td>
<td>1</td>
<td>25 kHz</td>
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<td>12.5 kHz</td>
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<td>9B</td>
<td>12.5 kHz</td>
<td>New simplex 12.5 kHz</td>
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<td>476.6500</td>
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<td>10A</td>
<td>12.5 kHz</td>
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Note 1: There are 6.25 kHz guard segments between new channels 8 & 9A, 21A & 22, 23 & 24A, 30A & 31 and 38 & 39A, hence there are no channels at 8B, 21B, 23B and 38B.

Note 2: Channel numbers without the postscript letters A or B are 25 kHz bandwidth and those channels with A or B postscripts are 12.5 kHz bandwidth.

Note 3: Channels 1–8 and 31–38 have been retained as 25 kHz bandwidth repeater paired channels which can be used as voice simplex outside of a repeater’s operational area.

Note 4: Channels 5 and 35 have been retained as 25 kHz bandwidth simplex emergency channels that can be licensed as emergency repeaters.

Note 5: The gazetted calling channel (11) has changed to 12.5 kHz bandwidth.