Australian Government | acma

Australian Communications and Media Authority

The ACMA's long-term strategy for the 803–960 MHz band

Decision paper

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Executive summary

The Australian Communications and Media Authority (the ACMA) commenced a review of arrangements in the 803–960 MHz frequency band (the review) in May 2011, with the release of the discussion paper *The 900 MHz band—Exploring new opportunities (Exploring new opportunities*). This was followed in 2012 with a second paper entitled, *The 803–960 MHz band: options for future change* (*Future options*).

The *Future options* paper sought comment on a range of specific band planning proposals, including options for re-farming the so-called '850 MHz expansion' band[1] for additional mobile broadband services, options for replanning the 900 MHz digital cellular mobile telephone band into 5 MHz blocks (or multiples thereof), facilitating the introduction of new and emerging low interference potential technologies and overall band planning options to implement these measures.

This paper contains a range of decisions on reforms to the structure of the 803–960 MHz band, as well as a detailed plan for the implementation of these reforms. These reforms will help ensure that the public benefit derived from the use of this band is maximised—a key driver for the ACMA in its spectrum management role. However, as is often the case, some operators will be adversely affected in the process. In particular, operators in the fixed and land mobile services will be affected by a reduction of the overall bandwidth allocated to these services, and many will be required to retune their equipment. To help mitigate this, the reforms will be implemented over a long period to provide notice well in advance of future changes, and allow for better alignment of these necessary changes with normal technology refresh cycles.

One of the key issues in the *Future options* paper related to ongoing deliberations on spectrum requirements to support a Public Safety Mobile Broadband (PSMB) capability, for which the ACMA had previously agreed to set aside spectrum from the reconfigured 800 MHz band. The government has been considering the best approach to providing mobile broadband capacity for public safety agencies and the matter is currently being studied by the Productivity Commission. Different options under consideration may have differing implications for the 800 MHz band.

The ACMA has previously foreshadowed that frequency arrangements for cellular services in the 900 MHz 'GSM' band (890–915/935–960 MHz, so named for its historic use for the delivery of 2G Global System for Mobile services, or GSM) would be reconfigured as part of the review. However, identifying the best option or options for achieving this reconfiguration is a complex issue and will require further consideration before any long-term decisions are made.

While both of these issues remain important, in order to progress the review and provide long-term certainty to other users of the band, it has been decided to:

> Progress planning for additional spectrum for mobile broadband, but reserve any decisions on allocation of this spectrum until government policy on spectrum for PSMB is settled. Depending on the response of the government to the recommendations of the Productivity Commission, all of the spectrum in question may ultimately be made available to commercial interests, or some made available for (non-commercial) PSMB use. As these different outcomes have different

[1] '850 MHz expansion' band refers to the harmonised International Mobile Telecommunications (IMT) frequencies that are frequency lower-adjacent to the existing 850 MHz mobile phone band and standardised by 3GPP for 3G and 4G technologies (under the band numbers 26 and 27).

implications for some of the incumbent services in the bands, this paper describes some potential contingencies that would flow from any decision to allocate spectrum for PSMB use. This exploration of contingencies is intended to maximise certainty for incumbent services in the band and ensure a clear way forward when decisions are made following the Productivity Commission's report—it is not intended to anticipate or influence government consideration of PSMB.

- 'Decouple' the replanning of the 900 MHz GSM band from the other reforms set out in this paper, for consideration as part of a separate, dedicated process.

The key planning decisions that are contained in this paper include:

- new spectrum for mobile broadband
- new spectrum to support low power, low duty cycle communications suitable for some types of machine-to-machine communications such as smart infrastructure, metering and control
- new frequency arrangements for the trunked land mobile service (TLMS), including changes to bandwidth allocations
- new frequency arrangements for two-frequency fixed links, including changes to bandwidth allocations and frequency duplex splits
- a general 'defragmentation' of the 800 MHz band (to improve efficiency) and red tape reduction through a simplification of fixed link sub-types and associated licensing and assignment instructions.

Glossary

Term	Definition
2G	Second generation or 2G is the generation of standards that includes GSM technologies.
3G	Third generation or 3G is the generation of 3GPP standards that includes UMTS and technologies that provide both voice and mobile broadband access services.
3GPP	3rd Generation Partnership Project is the international body responsible for the standardisation of (cellular) mobile (including broadband) telecommunications.
4G	Fourth generation or 4G is the generation of 3GPP standards that includes LTE technologies that provide broadband data access services.
800 MHz band	The frequencies covered by the 800 MHz band plan, being 803–890 MHz.
850 MHz band	The frequency segments within the 800 MHz band currently licensed via spectrum licence to Telstra and Vodafone Hutchison Australia (VHA) for the provision of 3G and 4G services (825–245/870–890 MHz).
850 MHz 'expansion' band	The FDD-paired frequencies lower-adjacent to the 850 MHz band that are standardised by the 3GPP for 4G technologies (3GPP bands 26 and 27).
900 MHz band	The frequencies covered by the 900 MHz band plan, being 890-960 MHz.
900 MHz 'GSM' band	See 'GSM band'
Allocation	For the purposes of radiofrequency spectrum planning, an allocation is a specific range of frequencies allocated for use by one or more radiocommunications services within a band plan or spectrum plan.
Apparatus licence	An apparatus licence authorises, under the *Radiocommunications Act 1992*, the use of a particular service type, in a particular frequency range and at a particular geographic location for a period of up to five years.
Band plan	Either an administrative or legislative instrument that sets out the allocations of frequencies to services within a specific radiofrequency band.
Cellular	A cellular network is a network of radiocommunications services distributed over land areas called cells. Each cell is serviced by a base station, each of which is inter-connected via a core network. User devices connected to cellular networks can be seamlessly passed between cells. 2G, 3G and 4G mobile networks are examples of cellular networks.
Class licence	A class licence, issued under the *Radiocommunications Act 1992*, authorises users of designated spectrum to operate on a shared basis using a common set of conditions. For example, the LIPD Class Licence authorises access to a large number of low interference potential devices that conform to the conditions contained within that licence.
Co-primary status	When used in this paper, co-primary status has the same meaning as primary status, with the addition that co-primary services are entitled to protection from other co-primary services.

Term	Definition
CMTS	Cellular Mobile Telephone Service—an outdated allocation term contained in band plans setting aside spectrum specifically for the deployment of mobile (i.e. 2G, 3G or 4G) services by commercial operators.
CTS	Cordless Telephone Service
Duplex	Duplexing can be achieved by using separate frequencies (frequency division duplex) or dividing receive/transmit into discrete time blocks (time division duplex) for transmission and reception of information between two radiocommunications stations (e.g., defining separate channels between the information sent from a mobile phone to a base station and the information sent from a base station to a mobile phone).
DSRR	Digital Short Range Radio—a superseded radio technology.
Embargo	A spectrum embargo is a notice of intent by the ACMA to restrict the issuing of new licences in a particular frequency range to support replanning of that frequency range. Spectrum may still able to be accessed on an exceptions basis through an application for an exemption to the embargo.
FDD	Frequency Division Duplex—using two discrete frequency blocks for duplexing. The frequency separation between these blocks is known as the FDD 'split' (e.g., the FDD split between mobile services operating in the 803–960 MHz band is 45 MHz).
Fixed service/Fixed link	When used in this paper, a fixed service means the operation of a radiocommunications service to allow communications between two locations that do not move, i.e. those points are fixed at a particular location on or near the surface of the Earth. When used in this paper, a fixed link is a specific link used to provide interconnection between two locations that do not move. A fixed service is made up of one or more fixed links. In this paper, 'fixed' does not refer to a telephone or similar device for voice based communications—it refers to wireless rather than wired communications.
GSM	Global System for Mobile Communications, a 2G cellular standard.
GSM band	Informal name for the frequency range 890–915/935–960 MHz, a subset of the 900 MHz band, which has historically been used for the delivery of 2G GSM services, but now also used for 3G and 4G services.
Guard band	A frequency band that is either deliberately vacant or has specific operating conditions to minimise intra-band interference between the two bands on either side (analogous to a 'buffer').
International spectrum harmonisation	International spectrum harmonisation is the generally desirable outcome where radiocommunications services operate throughout the world in a similar spectrum band. This facilitates lower cost equipment due to the economies of scale.
International Telecommunication Union (ITU)	The ITU is a specialised agency of the United Nations that is responsible for issues that concern information and communication technologies. The ITU coordinates the shared global use of radio spectrum and assists in the development of spectrum harmonisation arrangements.
IMT	International Mobile Telecommunications (IMT) encompasses IMT-2000 and IMT-Advanced, and defines the requirements of 3rd generation (3G) and 4th generation (4G) technologies.

Term	Definition
LIPD	Low Interference Potential Device. Also refers to the LIPD Class Licence, which is a standing authorisation for ubiquitous consumer and industrial LIPDs (including Wi-Fi and Bluetooth devices, garage door controllers, smart metering devices etc.).
LMS	Land Mobile Service—as distinct from 'cellular' mobile, is the general name given to narrowband, predominantly push-to-talk radio where a single site covers a broad area.
LTE	Long Term Evolution—a 3GPP technology standard for wireless communications including high-speed data for mobile devices
Machine-to-machine (M2M)	Machine-to-machine is a concept that allows communications between devices of the same type for the purposes of monitoring or providing sensor capabilities
Mobile broadband	Mobile broadband means the variety of ways an internet service is delivered via a mobile network, typically comprising mobile wireless internet services provided via a dongle, USB modem or data card service, or mobile phone handset internet services.
Mobile service	When used in this paper, a mobile service means the operation of a radiocommunications service to allow communications between two locations that move, i.e. those points are mobile and are not limited to a particular point on or near the surface of the Earth.
Primary status	When used in this paper, primary status means a radiocommunications service is operating within a particular frequency range as specified in the Australia Radiofrequency Spectrum Plan and that service is required to not cause interference to other services. That service is also afforded protection from interference from non-primary services.
PSMB	Public Safety Mobile Broadband—a proposed cellular mobile broadband capability for public safety agencies.
RALI	A Radiocommunications Assignment and Licensing Instruction (RALI) is a technical document made by the ACMA that outlines frequency assignment and information pertaining to coordination and interference management.
Secondary status	When used in this paper, secondary status means a radiocommunications service is operating within a particular frequency range as specified in the Australia Radiofrequency Spectrum Plan and that service is required to not cause interference to other services. That service is not afforded protection from interference from services with primary status in that frequency range.
Radiocommunications service	A grouping of radiocommunications types involving the transmission, emission and/or reception of radio waves for specific telecommunication purposes. Examples include *fixed*, *mobile* and *satellite* services.
Smart infrastructure	Smart infrastructure refers to a system of infrastructure that can monitor, analyse, communicate and act based on information captured from sensors. Some smart infrastructure systems will utilise radiocommunications to communicate with the wider world.
Smart meter	A smart meter is a particular type of smart infrastructure and usually refers to an electronic device that records consumption of electrical energy and communicates this information back to the utility provider's central system via a radio interface.

Term	Definition
SOB	Sound Outside Broadcast—a link established to facilitate temporary radio broadcasting coverage of an event remotely located from the broadcasting studio.
Spectrum licence	A spectrum licence authorises the use of a particular frequency band within a particular geographic area for a period of up to 15 years. The geographic area can vary in size up to and including the entire country.
STL	Studio-to-transmitter Link—a wireless audio link from the studio of a radio station to the broadcast transmission point (can also be achieved by fixed line, IP links etc.).
TLMS	Trunked Land Mobile Service
Trunked radio	An efficient, centrally-controlled type of LMS system, whereby channels are dynamically allocated to users as needed.

1. Introduction

The 800 MHz and 900 MHz bands—comprising the frequency ranges 803–890 MHz and 890–960 MHz respectively—are highly complex, and accommodate a wide range of services and technologies. In physical terms, they are in the so-called coverage 'sweet spot' for a range of services, including cellular mobile services, owing to the relationship between the propagation characteristics of these frequencies and the ideal trade-offs between cell sizes (which is relevant to capital expenditure on networks) and the amount of capacity that can be delivered to consumers within a given geographic area.

As a result, they are part of a number of sub-1 GHz bands that are harmonised (through the International Telecommunication Union, or ITU) for International Mobile Telecommunications (IMT – ITU parlance for mobile broadband communications) and standardised (through the 3rd Generation Partnership Project, or 3GPP) for 2nd, 3rd and 4th generation mobile technologies.

1.1 Background

In May 2011, the ACMA commenced a review of the 803–960 MHz band with the release of *The 900 MHz band—Exploring new opportunities* paper.[2] It was proposed at the time that substantial improvements could be made to the band to facilitate introduction of new and emerging technologies. This would be the first such review of the band since the Radiocommunications 900 MHz Band Plan 1992[3] was made.

The release of the *Exploring new opportunities* paper coincided with the release of ACMA's *Towards 2020—Future spectrum requirements for mobile broadband* (*Towards 2020)* paper.[4] The papers were complementary and both considered medium- and long-term options to fulfil the need for additional spectrum for mobile broadband services.

In December 2012, the ACMA released *The 803–960 MHz band: Options for future change*[5] paper, which sought input on a range of broad themes:

- options for expanding the 800 MHz band to include spectrum in the upper part of the digital dividend that was not included in the 700 MHz band allocation (that is, expanding the scope from 820–960 MHz to 803–960 MHz)
- consideration of the technical and licensing arrangements in the digital cellular mobile telephony service segments (890–915 MHz paired with 935–960 MHz, often referred to as the 900 MHz GSM band)
- opportunities for facilitating new technologies or expanding existing services in underutilised parts of the 803–960 MHz band
- consideration of the overall structure of the 803–960 MHz band.

The ACMA received 32 submissions[6] in response to the *Future options* paper, which have been considered carefully in developing a long-term plan for the band. The cross section of user groups that made submissions to this review, which included licensed

[2] Available on the ACMA website.
[3] Available on the ACMA website.
[4] Available on the ACMA website.
[5] Available on the ACMA website.
[6] Submissions to the *Future options* paper are available on the ACMA website.

operators, equipment manufacturers, industry bodies and government users, among others, demonstrated the diverse range of services and applications that rely on access to this frequency band.

1.2 Drivers of the review

The drivers for the review of the 803–960 MHz band were identified in the *Exploring new opportunities* and *Future options* papers. The major driver continues to be centred on maximising the public benefit derived from the use of the 803–960 MHz band, as per the object of the *Radiocommunications Act 1992* (the Act).[7] Parts of the band are not efficiently or heavily used due to allocations to outmoded technologies or to what are by current standards inefficient planning and allocation processes—a lack of demand for spectrum, which is evident in some parts of the band, can be the result of planning and allocation arrangements that are no longer efficient or effective.

In addition to segments that are allocated for a particular use, the 803–820 MHz segment is unallocated. In June 2010, the Minister for Broadband, Communications and the Digital Economy announced that 126 MHz of spectrum from 694–820 MHz would be realised as the digital dividend. Although the band 803–820 MHz formed part of the digital dividend, it was not included in the harmonised arrangements for the APT 700 MHz band[8], and as such, was not included in the April 2013 auction of the 700 MHz band. Consequently, the band 803–820 MHz remains unallocated and essentially unutilised.

The 803–960 MHz band's physical characteristics make it 'prime spectrum' for cellular mobile technologies. The demand and value of these services are well known: a 2014 report[9] commissioned by the ACMA and undertaken by The Centre for International Economics attributed an estimated $33.8 billion (some 2.28 per cent of GDP) increase in economic activity in Australia to mobile broadband. While it is generally agreed that the growth in demand for mobile broadband spectrum is increasing year-on-year at a greater-than-linear rate, recent analyses and auction results have shown that the demand crisis that was once perceived to loom over mobile broadband spectrum forecasts may not materialise if managed well. So while it remains the case that current planning needs to be targeted towards future demand estimates, there is an opportunity to implement reforms over a longer period than previously apprehended, which will help in reducing the transition burden on potentially affected users.

Despite this recent cooling in growth expectations for mobile broadband demand in the short-to-medium term, there remains a consistent worldwide projection of a steady growth in demand for mobile data. The ACMA recently commissioned Analysys Mason to undertake a mobile network infrastructure forecast to examine the mobile infrastructure required for a given amount of mobile spectrum. A key part of this study was to provide traffic forecasts of data carried by mobile networks out to 2025. While recognising forecasting traffic growth is challenging and subject to considerable uncertainties, Analysys Mason projected that mobile data traffic in Australia will increase from around 15–20 petabytes (PB) per month in 2013, to around 140 PB per month in 2020, and up to around 280 PB per month in 2025.[10]

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[7] The object of the *Radiocommunications Act 1992* is to provide for management of the radiofrequency spectrum, to achieve the goals set out in paragraphs 3(a) to 3(h).

[8] The FDD pair of 703–748 and 758–803 MHz.

[9] The Centre for International Economics (CIE) (research report prepared for the ACMA), *The economic impacts of mobile broadband on the Australian economy, from 2006 to 2013*, April 2014, page 2.

[10] Available on the ACMA website.

The ACMA has recently released its proposed strategy for addressing the growth in mobile broadband capacity in Australia. The paper *Beyond 2020—A spectrum management strategy to address the growth in mobile broadband capacity* (*Beyond 2020*) highlights that Australia is not alone in developing strategies to address the ongoing demand for mobile broadband capacity, with other countries such as the United Kingdom, the United States and Canada publishing details of their respective strategies. Typically, these strategies combine a number of aspects, including identifying and allocating additional spectrum for mobile broadband services, implementing spectrum-sharing arrangements, and encouraging the use of more efficient mobile broadband technologies.

1.3 Purpose of this paper

This paper is the third and final paper on spectrum planning arrangements in the 803–960 MHz band. Its purpose is to set out:

- planning decisions that have been taken after considering submissions that responded to the *Exploring new opportunities* and *Future options* papers
- a long-term implementation plan that details timelines for transition to new arrangements, while deferring any decision on how/to whom new mobile broadband spectrum is allocated
- the ACMA's intention to reorganise the 900 MHz GSM band into 5 MHz lots as part of a separate process.

1.4 Scope

As specified in the *Exploring new opportunities* and *Future options* papers, the frequencies that are subject to this review are 803–960 MHz. This includes the 803–820 MHz frequency range, which was part of Australia's 126 MHz digital dividend but was not part of the digital dividend auction.[11]

Within this broader frequency range, the allocations within the spectrum licensed[12] segment in the 850 MHz band (825–845/870–890 MHz) were effectively out of scope of the review, noting that these arrangements cannot be varied prior to expiry of the spectrum licences in 2028 without the consent of licensees. For the reasons canvassed in Chapter 4, the *Future options* paper considered the desirability of an eventual 1 MHz shift downwards of the entire 850 MHz band.

Given the complexity of implementing a 1 MHz downshift of the 850 MHz band, both in terms of 'when' and 'how,' and the considerable role that will need to be played by future licensee decisions, particularly if this is to occur prior to the 2028 expiry of the current spectrum licences, the ACMA is not proposing to make decisions on when or how the downshift would be executed in the present process. Rather, this paper confines itself to putting in place a key precondition to the downshift, namely, the clearance over an extended period of the services currently occupying the two blocks of 1 MHz of spectrum into which the downshift would ultimately occur.

In addition, no decisions on the proposed rearrangement of the 900 MHz GSM band are made in this paper. Any decision to implement regulatory and allocative reform in this band will require further consideration by government, given the significant and complex policy, economic and technical factors. Further engagement with industry is also required.

[11] Details of the results of the digital dividend auction are available on the ACMA website.

[12] Details of the 850 MHz band spectrum licences are available on the ACMA website.

While Chapter 4 contains some discussion of the rationale for these reforms, it is the ACMA's intention to pursue them as part of a separate process. Separating the process into two parts enables government (and affected industry players) further opportunity to ensure the best approach is taken to these reforms with the least impact on incumbent spectrum licensees.

1.5 Review objectives

As set out in the *Future options* paper, the objectives of the review were revised after considering submissions received in response to the *Exploring new opportunities* paper. The objectives of the review are to:

- improve the allocative, technical and dynamic efficiency of arrangements in the band by reviewing the relevant planning and licensing mechanisms
- align planning and licensing arrangements with current and anticipated demands, consistent with international spectrum harmonisation and the latest technology standards
- incorporate spectrum in the upper part of the digital dividend, which was not included in the initial 700 MHz band allocation, to expand services in the 800 and 900 MHz bands
- improve the utility and flexibility with which the band is used.

1.6 Legislative and policy framework

All decisions and proposals detailed in this paper are guided by the object of the *Radiocommunications Act 1992* (the Act) and informed by the ACMA's *Principles for Spectrum Management*. Relevant extracts of these texts are contained in Attachment 1.

1.7 The Spectrum Review

In May 2014, the Minister for Communications announced[13] that the then Department of Communications (the Department) would conduct a review of Australia's spectrum policy and management framework in conjunction with the ACMA.

Under the Terms of Reference[14] of this review, the Department would consider ways to *improve the flexibility of the [spectrum management] framework* by *simplifying the framework to reduce its complexity and impact on spectrum users* whilst ensuring *efficient allocation, ongoing use and management of spectrum*.

On 25 August 2015, the government released its response, agreeing to implement the recommendations of the Spectrum Review.[15]

The government will implement the three main recommendations of the review:

1. Replace the current legislative arrangements with new legislation that removes prescriptive process and streamlines licensing, for a simpler and more flexible framework.

[13] The Hon Malcolm Turnbull MP, Minister for Communications, Spectrum reform to drive future innovation and productivity, media release, 23 May 2014.

[14] Available on the Department of Communications website.

[15] The Hon Malcolm Turnbull MP, Minister for Communications, Next stage of spectrum reform to commence, media release, 25 August 2015.

2. Better integrate the management of public sector and broadcasting spectrum to improve the consistency and integrity of the framework.
3. Review spectrum pricing to ensure consistent and transparent arrangements to support the efficient use of spectrum and secondary markets.

The government has set a target date mid-2017 for implementation of the Spectrum Review recommendations.

The proposed reforms presented in this paper have been made under the existing legislation as the current spectrum management framework. Any commentary on licensing or regulatory options in this paper uses the terminology and assumptions of the current Act. While the ACMA, in implementing the outcomes of its review of the 803–960 MHz band, is constrained to administer the law as it currently exists, it notes that other licensing or regulatory options may become available as a result of Spectrum Review outcomes during the course of implementation. Though it is too early to speculate in detail, there may be additional or improved regulatory 'tools' available for the regulator to tackle issues, such as those identified in Chapter 4 as being outside the scope of the present paper. Other implications may become apparent once amending legislation has been developed.

2. Changes in approach since previous consultation

This paper signals the ACMA's intention to progress the critical restructure of the 800 and 900 MHz bands in the absence of final decisions on the reconfiguration of the 900 MHz GSM band and allocation of the 850 MHz expansion band, but over a longer transition period than was foreshadowed in previous rounds of consultation. Doing so in an uncertain environment necessitates a contingency-based approach to planning that seeks to meet industry needs—including all-important planning certainty—and also retains some flexibility to accommodate a range of potential contingencies, in the most efficient and transparent manner possible.

The implementation plan contained in Chapter 3 sets out the timetable for when action will need to be taken by the ACMA and incumbent licence holders to put into effect the transition to new arrangements. The long-term nature of this plan will afford affected incumbents ample time to make the necessary arrangements for transition.

The proposed reconfiguration of the 900 MHz GSM band and related downshift of the 850 MHz band (discussed in Chapter 4) will be pursued separately from the implementation plan set out in this paper. These remain important reform objectives for the ACMA, however as these issues are largely 'self-contained[16]' within the abovementioned frequency ranges, they can be dealt with in isolation from other aspects of this review.

Lastly, regarding nomenclature, the *Future options* paper signalled a change in naming conventions for the frequency bands within the scope of this review. Specifically, the 803–890 MHz band was referred to as the '800 MHz band', and 890–960 MHz as the '900 MHz band'. These conventions are reflected in the two new band plans made for the 800 and 900 MHz bands (see Section 3.1.1).

Additionally, the frequencies historically spectrum-licensed as part of the '800 MHz' band (825–845/870–890 MHz) will be referred to as the 850 MHz band for consistency purposes and to avoid confusion with the *broader* 800 MHz band. Lastly, for the purposes of this paper, the spectrum from 703 to 803 MHz will be referred to as the 700 MHz band. This band includes the 90 MHz that was reconfigured to harmonise with the APT 700 MHz band plan[17] and offered for sale as spectrum licences at the 'digital dividend' auction in 2013.

[16] The proposed reforms do not have any technical interrelationships with the frequency segments affected by the implementation plan. The exception to this is that, as part of the implementation plan, the 2 x 1 MHz lower adjacent to the 850 MHz band will be cleared to facilitate the separate work to be undertaken on the downshift/GSM band replan.

[17] Asia–Pacific Telecommunity (APT) 700 MHz band plan details can be found in Reports 14 and 24 at http://www.apt.int/AWG-RECS-REPS.

3. New arrangements for the 800 and 900 MHz bands

The new arrangements in the 800 and 900 MHz bands will be implemented over a lengthy period between now and mid-2024. The implementation plan contained in this chapter differentiates between **key dates**, which identify actions on the ACMA to enact the changes when they occur, and **milestones**, which are actions on industry in the form of either:

- clearance or retuning action by incumbent operators in a given frequency segment; or
- start dates for new services in a given frequency segment.

Section 3.1 provides an overview of the administrative/preparatory arrangements that will be put in place to underpin this strategy, while Section 3.2 details the specific changes to be made, both by user group and holistically, and describes the implications for affected users. Section 3.3 details an implementation plan to bring the new arrangements into effect. It lists the milestones for industry action and key dates for ACMA action, as part of a long-term process for implementation. Any clearance or retuning action must be completed within one year after the relevant milestone date.[18]

3.1 Laying the foundations for a flexible transition strategy

3.1.1 A more flexible band planning regime

The first step towards transitioning to the new arrangements in the 800 and 900 MHz bands was the development of two administrative band plans to replace the 900 MHz Band Plan, a legislative band plan that was made in 1992. This was the subject of a separate consultation process[19] and the changes took effect at 'Key date 1' in the implementation of the review's outcomes (see Section 3.3.2 for list and description of key dates).

Band plans can be issued in two forms—legislatively under the Act or administratively in the form of a policy document. Although the two types of plan serve similar purposes, administrative plans are a statement of policy rather than a statement of law, which affords the ACMA greater flexibility to make revisions or exceptions to the plan when required.

While the ACMA is able to revise statutory band plans, it is a more onerous task than it is for administrative plans, requiring formal changes to a legislative instrument. Conversely, the chief advantage of a legislative band plan is the higher degree of certainty it affords industry about the uses of a band (although the ACMA remains able to change a band plan following due process).

In considering the choice between legislative and administrative approaches in the context of the 800 MHz and 900 MHz bands, the ACMA believes the greater flexibility of administrative plans is the decisive consideration. Flexibility is becoming more and more necessary given the dynamic nature of the radiocommunications landscape.

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[18] *Ex-post* compliance regime, similar to the 400 MHz implementation process. See Section 3.3 for explanation).

[19] Available on the ACMA website.

Comment was sought on these measures in the *Exploring new opportunities* paper and the proposition was generally well received, with the exception of fixed service (including studio-to-transmitter link) operators who preferred the greater certainty of a legislative plan.

The 900 MHz Band Plan was made in 1992 (last amended in 1999), and sunsetted (that is, was automatically revoked) on 1 October 2015. While not a function of the review itself, the sunsetting was timely as it has provided an opportunity to replace the current legislative band plan with two administrative band plans, which is a necessary step in implementing the review outcomes.

The two new band plans contain only minor changes to existing allocative arrangements:

- the frequencies covered were split into two administrative band plans covering the frequency ranges 803–890 MHz (800 MHz band) and 890–960 MHz (900 MHz band) respectively, which reflect accepted nomenclature on the frequency limits of these bands
- the currently unallocated spectrum 803–820 MHz was incorporated into the 800 MHz band
- some typographical and grammatical errors were corrected.

The reasons for splitting into two separate band plans are twofold:

- to provide greater flexibility to enable future, incremental revisions of the plans, noting that individual stages of the transition process will in most cases only affect one or the other of the two-frequency ranges
- to align with the revised nomenclature for the 803–960 MHz band, which was announced in previous consultation and is described in Section 2.1.

In terms of actual frequency allocations in the new band plans, the allocations in the 900 MHz Band Plan were replicated in the new administrative band plans. That is, there were no new or amended allocations. Instead, changes to the band plans will be made incrementally, in accordance with the implementation plan set out later in this chapter.

The new 800 MHz and 900 MHz band plans are contained in Radiocommunications Licensing and Assignment Instructions (RALIs) MS40 and MS 41 respectively.[20]

3.1.2 Simplification of planning for fixed services

One historic source of the current inefficiency in the band has been the separate consideration of various different sub-types of fixed links. The current plan has all permutations of ‘single frequency’, ‘two-frequency’, ‘single channel’, ‘low capacity’ and ‘studio-to-transmitter’ (a subset of single frequency) links, which is a legacy of a less constrained spectrum environment that once allowed their separate consideration for ease of assignment.

While there are obvious reasons for maintaining a distinction between single frequency and two-frequency links (which themselves are different ways of saying ‘simplex’ and ‘duplex’ links), providing for separate frequencies for single channel (typically 25 kHz) and low capacity (multiples of 25 kHz) fixed links is clearly less than optimal from a spectrum efficiency perspective.

[20] Available on the ACMA website.

Given that, as a result of this review, there will be a necessary rationalisation of the amount of spectrum provided for both single frequency fixed links (including studio-to-transmitter links (STLs)) and two-frequency fixed links in the 800 MHz band, the new band plans (post implementation) will no longer distinguish between single channel and low capacity links for planning purposes. The intent is that the new band plans will simply contain provisions for single and two-frequency fixed links. The convention of not distinguishing between single channel and low capacity links (and simply referring to them collectively as 'fixed links') will apply in this paper.

Another legacy issue is the unwieldy proliferation of planning documents that govern licensing and assigning of fixed links in the band. At present, the following documents are all applied in some form or another to fixed links (or related services such as point-to-multipoint (P-MP), STLs or sound outside broadcast (SOB)):

- Radiocommunications Assignment and Licensing Instruction (RALI) FX 10: Management of the short range point-to-multipoint service
- RALI FX 11: Studio to transmitter links and sound outside broadcasting services in the 900 MHz band
- RALI FX 16: Frequency assignment requirements for the point-to-multipoint service in the 400 MHz and 900 MHz bands
- RALI FX 17: Frequency assignment requirements for narrowband single channel two-frequency point-to-point services in the 400 MHz and 900 MHz bands
- SPP 4/93: Coordination Procedures for the Licensing of Services Sharing the 857–861 MHz Band
- SPP 6/93: Frequency assignment procedures for low capacity two-frequency fixed services in the 820–960 MHz band.

This proliferation of both licence types and governing documents has been a source of confusion over many years. Consistent with the government's deregulation agenda, the ACMA sees a strong case for simplification. In order to remove the current distinction between single channel and low capacity links, and to simplify/rationalise documents governing the assignment of links in the band, a new single RALI for fixed links operating in the 800 MHz band will be created (denoted as RALI FX [NEW] for the purposes of this paper). This RALI will include:

- a 12.5 kHz-based channel raster for single and two-frequency fixed links, which permits aggregation to accommodate a variety of operating bandwidths (so as to allow for existing services currently operating under the auspices of 'single channel' or 'low capacity')
- assignment instructions for P-MP services, including short range P-MP, which will no longer be considered independent from general P-MP services (for practical purposes, assignments with the parameters specified for short range P-MP, except operating frequency, will still be possible)
- assignment of STLs in the band will also be governed by the new RALI to reflect its status as a fixed link for all practical and assignment purposes, but with existing STL-specific protection requirements retained in the new RALI.

The legacy documents listed above will be supressed where possible. In documents covering multiple bands or services that won't be entirely subsumed by the new RALI (RALI FX 11, FX 16 and FX 17), the relevant components of those documents will be removed. Ordinary consultation processes on new and amended RALIs will apply—Section 3.3.2 lists dates by which new RALIs will be released and amendments to existing RALIs will be made. Consultation on each of these changes will occur prior to those dates.

3.2 Overview and implications

3.2.1 Overview of arrangements

The decisions that have been taken by the ACMA as a result of the review are as follows:

- Identification of 2 x 15 MHz of spectrum from the 850 MHz expansion band that is optimised for mobile broadband.[21] Details of when and how this spectrum would be allocated are unknown, pending resolution of a way forward on PSMB. Under the implementation plan, the full 2 x 15 MHz would not be cleared of existing services until mid-2024, however, options exist that could see parts of this spectrum available much sooner. Thus, in a scenario where spectrum is dedicated for PSMB use—which, to varying extents, is a component of some of the delivery options being considered by the PC—it may be possible to accommodate access for this purpose well before this date. This allocation scenario is discussed in Section 3.2.3.3.
- New spectrum for low interference potential devices (LIPDs), including low power, low duty cycle devices suitable for machine-to-machine (M2M) uses such as metering and control devices to support smart infrastructure initiatives. These provisions are described in Section 3.2.3.4.
- Reduction from a 2 x 5 MHz to a 2 x 3 MHz (with potentially an additional 2 x 3 MHz in low demand areas—see below) allocation for trunked land mobile services (TLMS) and a change in frequency within the band. The specific implications of this decision are discussed in Section 3.2.3.2.
- Reduction from a 2 x 5 MHz to a 2 x 2 MHz (with potentially an additional 2 x 2 MHz in low demand areas) allocation for two-frequency fixed links, a change in frequency within the band and a transition to standard 45 MHz duplex split. The specific implications of this decision are discussed in Section 3.2.3.1.
- Reduction from 11 MHz to 4 MHz for single frequency fixed links (including STLs). The specific implications of this decision are discussed in Section 3.2.3.7.
- Reduction from 3 MHz to 1.5 MHz for SOB on a primary basis. The specific implications of this decision are discussed in Section 3.2.3.6.
- Removal of allocations to the cordless telephone service (CTS) and digital short-range radio (DSRR), which are outmoded and no longer in demand. The specific implications of this decision are discussed in Section 3.2.3.5.
- A general ‘defragmentation’ of the 800 MHz band, including a rearrangement of frequency bands for fixed and land mobile services.
- A consolidation of fixed link sub-types and associated licensing and assignment instructions to simplify assignment and deployment processes (as described in Section 3.1.2).

Of course these outcomes will necessitate action to be taken by some operators, potentially including retuning/acquiring new equipment and/or a rationalisation of overall bandwidth allocated to that particular service in the band plan. The intent of the implementation plan set out in Section 3.3 is to bring the above reforms into effect with the minimum possible disruption and to provide operators with sufficient notice and long lead times where possible.

[21] Note that the technical frameworks governing access to the band will be a spectral envelope only and will not specify any type of technology or service. Other services (e.g., TLMS) will have an opportunity to compete for access to these segments, depending on how they are allocated.

Figure 3.2.1 provides a high-level overview of how the 800 and 900 MHz bands will ultimately look once the abovementioned changes have been fully implemented. The top and middle diagrams provide an overview of the current and post-transition (that is, mid-2024 onwards) configuration of the bands (includes potential options for accommodating a PSMB allocation in the 850 MHz expansion band, if that ultimately reflects government policy on PSMB).

The lower diagram shows the abovementioned additional provisions for two-frequency fixed links in areas not identified for TLMS coverage (up to 2 x 3 MHz), and additional provisions for TLMS (up to 2 x 2 MHz extra) in areas not identified for PSMB coverage (if allocated). In this diagram, it is assumed that an allocation will been made for PSMB in the lower part of the 850 MHz expansion band—again this is the subject to outcomes of government consideration of the final recommendations of the PC, which is not expected until 2016.

3.2.2 Services not affected

The following is a list of services currently allocated under the 800 MHz and 900 MHz band plan for which no action will be required by incumbent users:

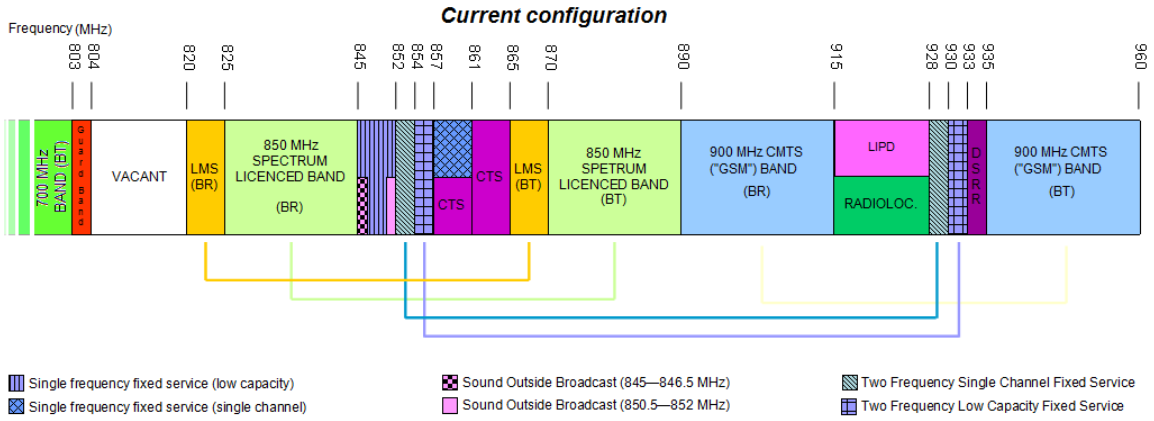
- while the new plans will no longer support DSRR in 933–935 MHz, there are no current licences for this technology so no current users will be affected
- the new plans will continue to support operation of the primary radiolocation service in 915–928 MHz and other radiolocation services operating on a secondary basis and subject to the AUS29 footnote to the Australian Radiofrequency Spectrum Plan (ARSP)
- the new plans will continue to support LIPDs operating in 915–928 MHz.

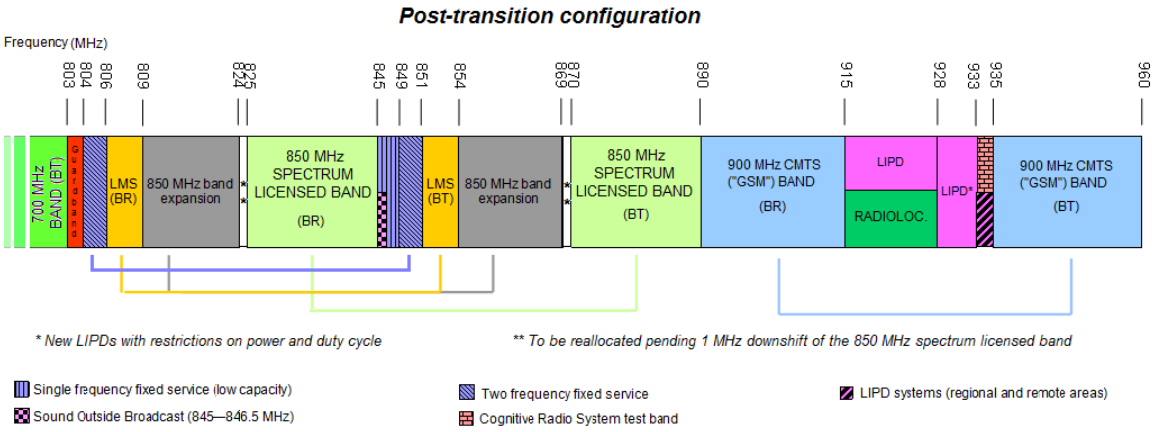
3.2.3 Implications for affected users

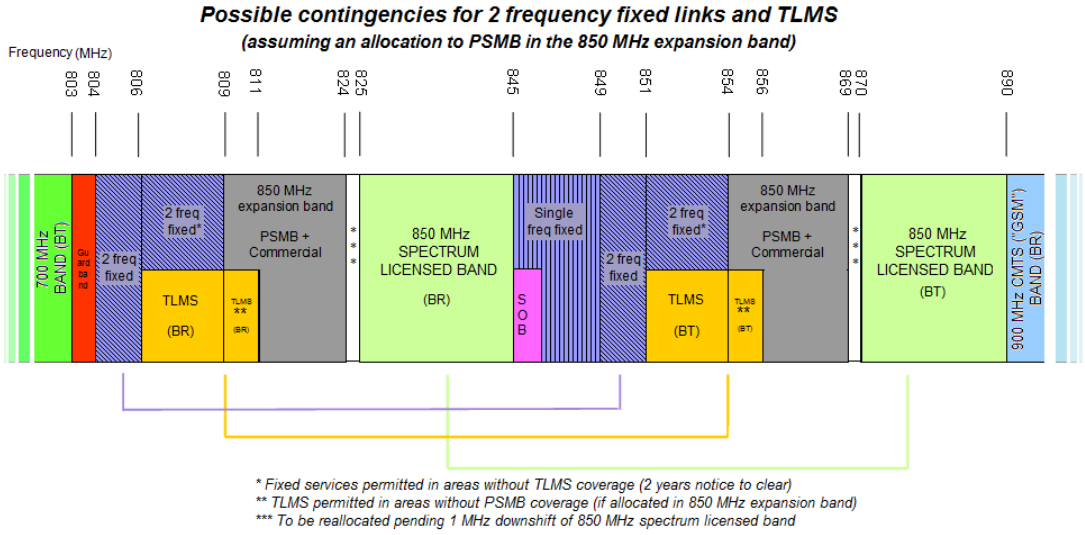
Implications for each affected service are summarised in the following sections, noting that dates of effect of the below changes will differ between services. Section 3.3.2 details the administrative actions to be taken by the ACMA to enact these changes. Where overall spectrum for a specific service has been reduced, new assignment rules will be introduced to ensure that access is as fair and equitable as possible while optimising the efficiency of use of the band. This will take into account factors such as physical characteristics that might make access to this particular band more critical for some users than others.

Furthermore, the impact on affected TLMS and fixed service licensees will also be reduced by providing them with priority access to the new respective allocations in the 803–960 MHz band, which is likely to reduce the complexity of the frequency assignment process.

Figure 3.2.1: Current and final arrangements for the 803–960 MHz band.







3.2.3.1 Fixed links

In practical terms, the new arrangements will have the following effects on operation of fixed links:

> Two-frequency fixed links will need to change to a 45 MHz duplex split (lower edge at 804/849 MHz).

> An overall reduction in dedicated spectrum for single frequency links—11 MHz down to 4 MHz (operations above 849 MHz will eventually be required to cease).

- An overall reduction in dedicated spectrum for two-frequency fixed links, including single channel and low capacity links, in TLMS coverage areas (mostly urban)—2 x 5 MHz down to 2 x 2 MHz.
- No change to allocated bandwidth for two-frequency fixed links (that is, to remain at 2 x 5 MHz) outside TLMS coverage areas, on a secondary basis. This means that, in such geographic areas, two-frequency fixed links will be able to access 804–809/849–854 MHz, with the upper 2 x 3 MHz allocated on a secondary basis with respect to TLMS. In areas identified for new TLMS coverage, two-frequency fixed links will have two years to vacate this upper 2 x 3 MHz.

How the provisions described in this latter point are implemented will require further thinking by the ACMA; however, it is likely that these arrangements will be captured in new/updated RALIs. While this adds a level of complexity—for the ACMA, frequency assigners and service planners alike—it will help to optimise the efficient use of the band and is intended to prevent some users from being unnecessarily displaced when there is vacant spectrum in an adjacent frequency segment. Similar arrangements are proposed for TLMS accessing upper-adjacent spectrum, in a future scenario where dedicated spectrum could be set aside for—but not used by—PSMB services (see Section 3.2.3.2).

Responses to the *Future options* paper indicated a preference from some operators for retaining the legacy 76 MHz duplex split, as the introduction of a standard 45 MHz split will require replacement of some equipment, at a cost. One industry representative group supported the 45 MHz split for reasons given by the ACMA, including international harmonisation (resulting in longer-term economies of scale) and alignment with adjacent TLMS, which will allow fixed links to operate in areas where TLMS is not in high demand. It was requested that a transition period of not less than five years be provided to enable purchase and installation of new equipment, where necessary, which the ACMA has agreed to factor into the transition strategy (see Section 3.2.2).

It is understood that many of the links currently used in this band carry control and automation applications such as SCADA[22], metering and other M2M applications. Reduced overall bandwidth for fixed links in the 800 MHz band will have some effect on these services, although the impact will be, at least partially, offset by a range of factors and new provisions, including:

- New spectrum for low power, low duty cycle links in 928–935 MHz (on a non-dedicated basis) to be included in an update to the Low Interference Potential Devices (LIPD) Class Licence (see Section 3.2.3.4) will remove the need for some users to take out dedicated licences (for example, to support some SCADA applications).
- More efficient assignment instructions for fixed links in the band, to be captured in a new RALI (see Section 3.3), including an amalgamation of low capacity and single channel links, is expected to yield spectrum efficiencies.
- A reduction in spectrum for two-frequency links is likely to only affect operations in high/medium density areas, given that fixed services will still have access to up to 2 x 5 MHz in non-TLMS covered areas. The 800 MHz band is more suited to ‘long hop’ fixed links which are, in general, likely to be more necessary in non-urban areas.

[22] Supervisory Control and Data Acquisition.

> New mobile broadband spectrum (850 MHz expansion band—see Section 3.2.3.3) will increase available data capacity for LTE networks, including greatly increased scope for M2M applications over cellular networks in the medium/long term.

Expanding on the latter point, it is predicted that M2M-type applications will form an increasingly large component of mobile broadband traffic, as both demand for M2M and provisions in relevant standards grow. M2M applications are already in use within various parts of industry, including in the mining and utility industries, for the purposes of better management of remote sites.

Although current commercially available LTE services are considered 'over specified' for low data rate machine type communications (MTC—3GPP nomenclature for M2M communications) applications, there is considerable focus (with significant operator and manufacturer input) on establishing better MTC provisions within LTE standards, including lowering device costs.

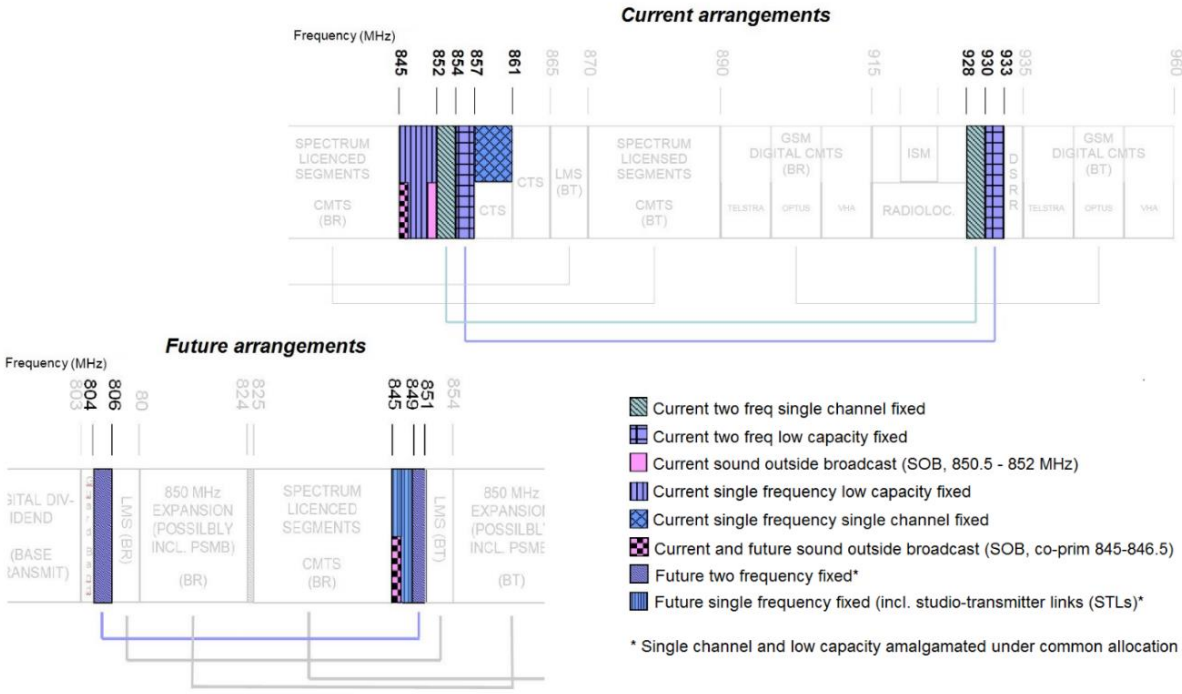
3GPP has made significant recent progress on the inclusion of features conducive to MTC in LTE standards, with significant content contained in Release 11 relating to service requirements, architecture and security issues. Release 12 contained further provisions for MTC applications, including provisions for the abovementioned cost savings in MTC device production, as well as specific signalling protocols for MTC and optimisation methods for handling the large numbers of devices that would result from MTC-over-LTE deployments.

A report published by the 3GPP on producing low cost MTC equipment operating over LTE networks (published in June 2013[23]) described the benefits of using LTE-based MTC over older technologies (including the obvious spectrum efficiency benefits) and discussed the potential cost benefits to be realised from the development of developing purpose specific MTC-over-LTE hardware (including simplified/scaled down LTE UE), which is gaining support in parts of industry.

Figure 3.2.3.1 depicts the new arrangements for fixed services.

[23] 36.888 V12.0.0 (2013-06) - Study on provision of low-cost Machine-Type Communications (MTC) User Equipments (UEs) based on LTE.

Figure 3.2.3.1: Current and new arrangements for the fixed service and sound outside broadcast (SOB), including the amalgamation of single channel and low capacity sub types



3.2.3.2 Trunked Land Mobile Services (TLMS)

In practical terms, operation of TLMS will be affected by the new arrangements as follows:

- An overall reduction in dedicated spectrum for TLMS in the band—2 x 5 MHz down to 2 x 3 MHz.
- TLMS networks will need to change frequencies down to 806–809/851–854 MHz.
- Depending on the outcomes of the government's consideration of PSMB, in a scenario where the relevant part of the 850 MHz expansion band was made available for this purpose but PSMB users had no immediate intention or capacity to provide services in a particular area, the ACMA would permit TLMS to access that spectrum until such time as it was needed for PSMB. In other words, there would be no change to allocated bandwidth for TLMS (it would remain at 2 x 5 MHz) outside PSMB coverage areas. Depending on the model chosen for provision of PSMB services, dedicated PSMB deployment may be phased-in over an extended period, potentially leaving large areas unencumbered for extended periods and therefore available for access by TLMS. It means that, in such geographic areas, TLMS will be able to access 809-814/854–859 MHz, with the upper 2 x 2 MHz allocated on a secondary basis with respect to PSMB. In areas identified for new PSMB coverage, two-frequency fixed links would have two years to vacate the upper 2 x 2 MHz.
- Also, in any scenario where spectrum licences are made available for price-based allocation in all of or any part of the 850 MHz expansion band, the ACMA's current expectation is that the spectral envelopes defined in technical frameworks for any new spectrum licences of the 850 MHz expansion band would also allow for the deployment of narrowband networks. This would enable TLMS operators to be able to compete in the market for this spectrum if additional spectrum were needed (likely to be allocated in 5 MHz blocks).

> The channel raster specified in RALI LM8 will be amended from 25 to 12.5 kHz minimum channel size, to increase flexibility and overall efficiency. Contiguous channel aggregation will enable accommodation of systems requiring a 25 kHz bandwidth.

Responses to the *Future options* paper from the TLMS sector were not in favour of any reduction in spectrum, and in some cases, advocated for more spectrum to support projected growth in the sector. Growth in demand for voice and data is well documented, however it is questionable how much of this demand will be met on narrowband platforms in the longer term. This is in part due to the expected proliferation of application-layer services that will be available on mobile broadband platforms delivered across a range of 3GPP-standardised bands (including the 850 MHz expansion band resulting from these reforms). The rise of alternative technologies is one of a number of factors that will influence the demand for trunked land mobile services in the 800 MHz band over time. Other factors will include:

> the anticipated migration of government users of voice services to the harmonised government allocations in the 400 MHz band[24]

> amendments to assignment rules and channel sizes will provide more flexibility in how the band is used and will provide some improvement in spectral efficiency

> the long transition time frame will help incumbent users align equipment/network procurement cycles with migration plans where possible.

Furthermore, arrangements in the 803–960 MHz band may mitigate some demand that would otherwise be served by TLMS in the band. This may include the migration of public safety data networks that operate in the TLMS band (such as the Victorian Metropolitan Data Network (MDN)[25] used by Victoria Police and Ambulance Victoria) onto an eventual PSMB network, or migration of voice applications onto mission-critical push-to-talk (PTT) over PSMB (being incorporated into 3GPP standards for public safety LTE networks).

IP-based (Internet Protocol-based) PTT services are currently available and the growth of these services is expected to increase. These include carrier-provided solutions (limited to particular carrier networks) and other over-the-top (OTT) and/or cloud-based applications that can offer increased flexibility (as they are not restricted to specific networks/devices) and greater coverage—generally at a lower cost.

Internationally, mobile network carriers already offer carrier-grade PTT services over their 3G and 4G networks[26]. While various types of OTT applications have been available for a number of years, the range of products available that can provide reliable communications for both business and mission critical communication users (either by expanding an existing land mobile network, or as a complete replacement) is

[24] More information relating the new arrangements in the 400 MHz band, including the harmonised government bands, is available at: http://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/400-MHz-band/overview.

[25] For example, Motorola plan to trial delivery of MDN data via 4G technologies, see here.

[26] For example, PTT solutions on mobile broadband networks offered by AT&T and Sprint in the United States.

growing.[27] Some recognised suppliers in the traditional LMS field are also providing IP-based PTT services.[28]

Furthermore, 3GPP is in the process of including a number of features for PTT-type applications on LTE networks, such as direct device-to-device mode and group call communications, which will improve interoperability and reliability. These features were included in Release 12 of the LTE standard, which was frozen in March 2015. Although there has historically been some lag between freezing standards and products becoming available, it is expected that these features will be available when the changes to TLMS spectrum arrangements take effect.

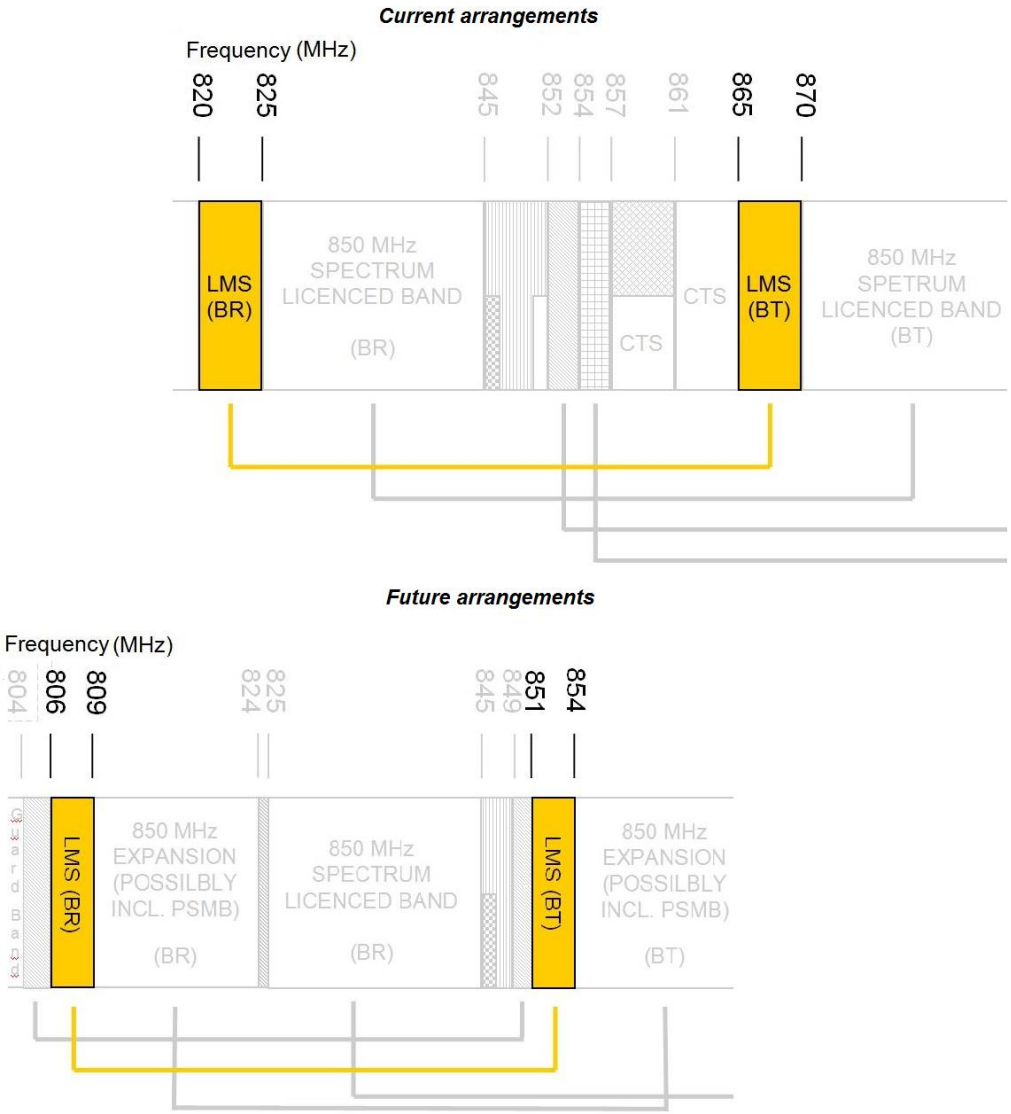
More broadly, operators in Australia and abroad are moving towards Voice-over-LTE (VoLTE) applications on their LTE networks, albeit not necessarily with PTT features specified for public safety use implemented. This means that voice services are likely to be available in the new mobile broadband spectrum in the 800 MHz band (see Section 3.2.3.3).

Figure 3.2.3.2 depicts the new arrangements for the TLMS.

[27] An example case study of the replacement of a police land mobile radio network with a full IP PTT solution is available at: http://www.twistpair.com/inc/data/case-studies/Sainte%20Anne%20Case%20Study.pdf

[28] For example, Twisted Pair Solutions (http://www.twistpair.com/index/broadband-push-to-talk, a subsidiary of Motorola Solutions) and Harris with their BeOn (http://www.beonapp.com/) product.

Figure 3.2.3.2: Current and new arrangements for the trunked land mobile service (TLMS)



3.2.3.3 Release of the 850 MHz expansion band

2 x 15 MHz will be made available from the 850 MHz expansion band (specifically 809–824/851–869 MHz):

- Technical frameworks will be optimised to reflect latest 3GPP standards, and at this stage, the ACMA's presumption is that the band would be allocated in 5 MHz blocks.[29]
- Decisions on how/to whom this is allocated will be made once policy direction on PSMB spectrum requirements is clear, following government consideration of recommendations arising from the Productivity Commission's study.
- If a decision is ultimately made to allocate part of this band to support dedicated PSMB deployments, it will likely be upper-adjacent in frequency to the TLMS

[29] No particular technology will be mandated and there will be no barrier to deployment of narrowband services within a 5 MHz block, so long as the technical framework is complied with.

segment (that is, at the lower end of the band from 809/854 MHz upwards), with other use at the higher end of the band. The purposes for this are two-fold:

- to enable the 'spillover' access potential for TLMS (described in Section 3.2.3.2) in areas where dedicated PSMB coverage is not deployed
- to maximise frequency contiguity between commercial allocations in the 850 MHz and 850 MHz expansion bands.

In responses to the *Future options* paper, carriers were all in favour of implementing the 850 MHz expansion band, although TLMS responses were opposed to this occurring at the expense of spectrum they currently use. With that in mind, the ACMA expects there would be no barrier to TLMS operators competing with mobile broadband operators for licences in this band, where a market-based allocation is used.

3.2.3.4 Low interference potential devices

New arrangements for low interference potential devices (LIPDs) will be as follows:

- Additional spectrum will be made available for systems operating in the range 928–935 MHz (limited to 928–933 MHz in high and medium density areas):
  - limited to low EIRP and (very) low duty cycle technologies, suitable for supporting a range of applications, including some fixed links, M2M applications such as automation, switching, metering and control.
- The abovementioned provisions will be limited to devices intended for long-term operation in a fixed installation (operating for a period of not less than six months).
- 933–935 MHz will also be made available for research, development and testing of cognitive radio devices (all areas). Such access would not support ongoing deployments and commercialisation of these technologies. The ACMA will also consider access to this segment as a testbed for other emerging technologies on a case-by-case basis.
- The LIPD Class Licence[30] will be updated to incorporate the above changes. Specific parametric limits are detailed in Section 3.3.2 *Actions for implementation* under Action 6.1. To promote flexibility, these parameters will be limited to a minimum set of technical conditions, without specifying a particular technology.

Frequencies above 928 MHz are not internationally recognised as an 'unlicensed' band for ubiquitous consumer devices (as opposed to below 928 MHz), which will help to constrain the proliferation of devices that comply with the above conditions and therefore limit congestion in the band.

Fixed links that meet the technical conditions detailed in Section 3.3 could also be accommodated in this allocation, including existing devices operating in current fixed link allocations. These measures are also intended to support smart infrastructure (for example, SCADA) links that do not require exclusive spectrum (that they would otherwise pay licence fees for) and are thereby intended to partially offset the impact of the reduced spectrum allocations for fixed links.

Responses to the *Future options* paper from some utilities providers suggested that spectrum for mesh networks would be useful for smart metering applications, but not at the expense of existing smart metering systems operating under the LIPD Class Licence in the 900 MHz band. Updates to the LIPD Class Licence will not affect existing provisions for operation below 928 MHz. The expanded provisions above

[30] Available on the ACMA website.

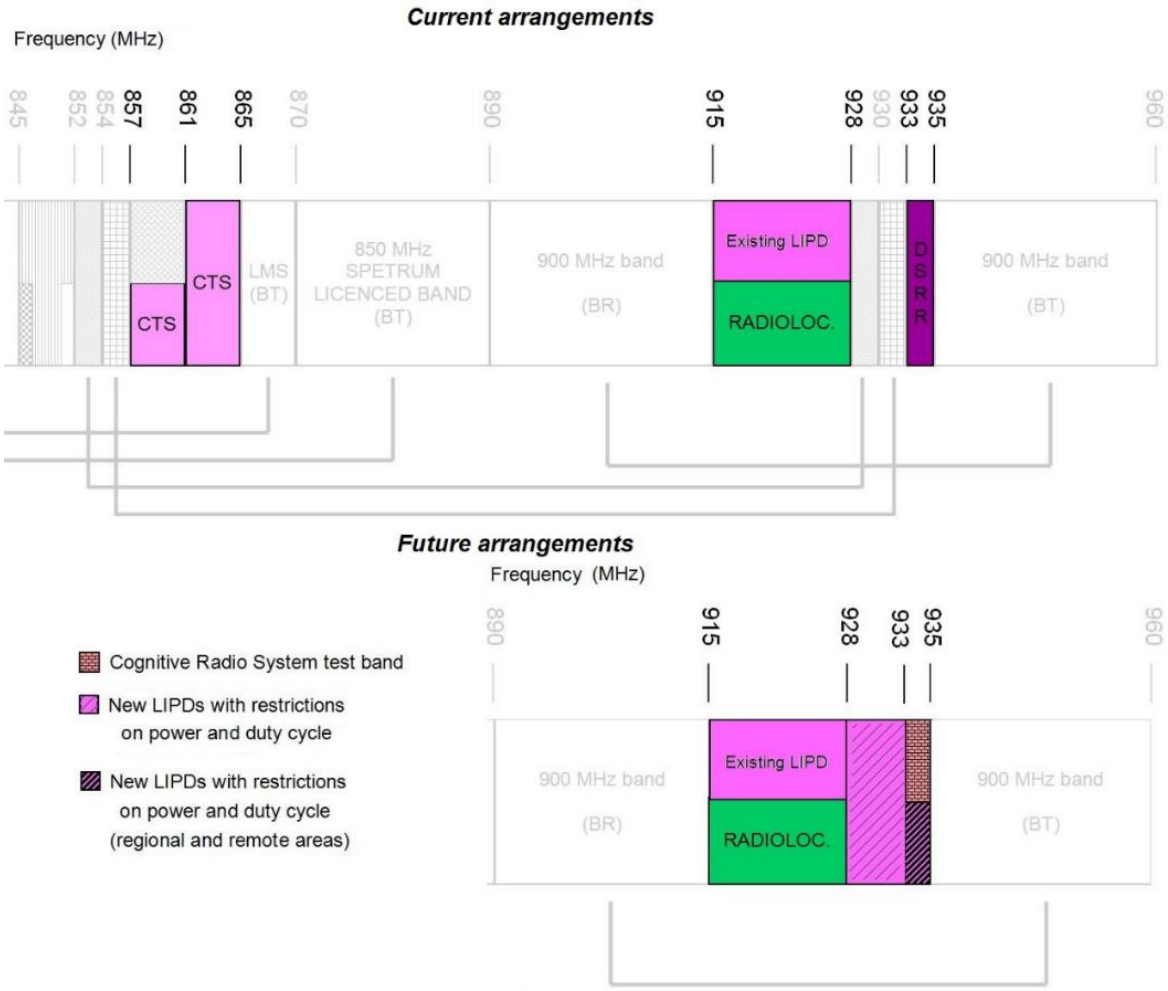
928 MHz will support operation of a range of systems, including the abovementioned mesh systems (subject to meeting the EIRP and duty cycle limitations).

It has also been separately canvassed that this band could be a candidate for a private band management regime, given the relative homogeneity of new applications to be accommodated in the 928–935 MHz band. Under such a regime, access to the band would be managed by a private entity that holds the licence(s) authorising access to the band. However, it was concluded that inclusion of the band in the LIPD Class Licence would be a more appropriate authorisation mechanism, for a range of reasons, including:

- fewer regulatory overheads/lower regulatory cost
- the technical nature of the devices to be accommodated means that coexistence is feasible without device-to-device coordination and can be achieved through setting parametric limits (consistent with the LIPD structure)
- a likely range of disparate users, some with competing interests, would make it difficult to identify an appropriate management entity
- better overall flexibility.

Figure 3.2.3.4 depicts the new arrangements for these devices. Cordless Telephone Systems (CTS, limited current use) and Digital Short Range Radio (DSSR, no current use) services will no longer be supported, and new provisions will be made for low power/short duty cycle systems and cognitive radio system (CRS) test and development.

Figure 3.2.3.4: Current and new arrangements for low interference potential devices



3.2.3.5 Cordless telephone service (CTS)

CTS operating in 857–865 MHz will no longer be supported; however, cordless telephony in 915–918 MHz and 926–928 MHz will continue to be provided for in the LIPD Class Licence.

3.2.3.6 Sound outside broadcast (SOB)

SOB operating in 850.5–852 MHz on a primary basis will no longer be supported, however SOB in 845–846.5 MHz will continue to be supported on a primary basis and the current secondary allocation in 846.5–850.5 MHz will be extended to 846.5–851 MHz (see Figure 3.2.3.6).

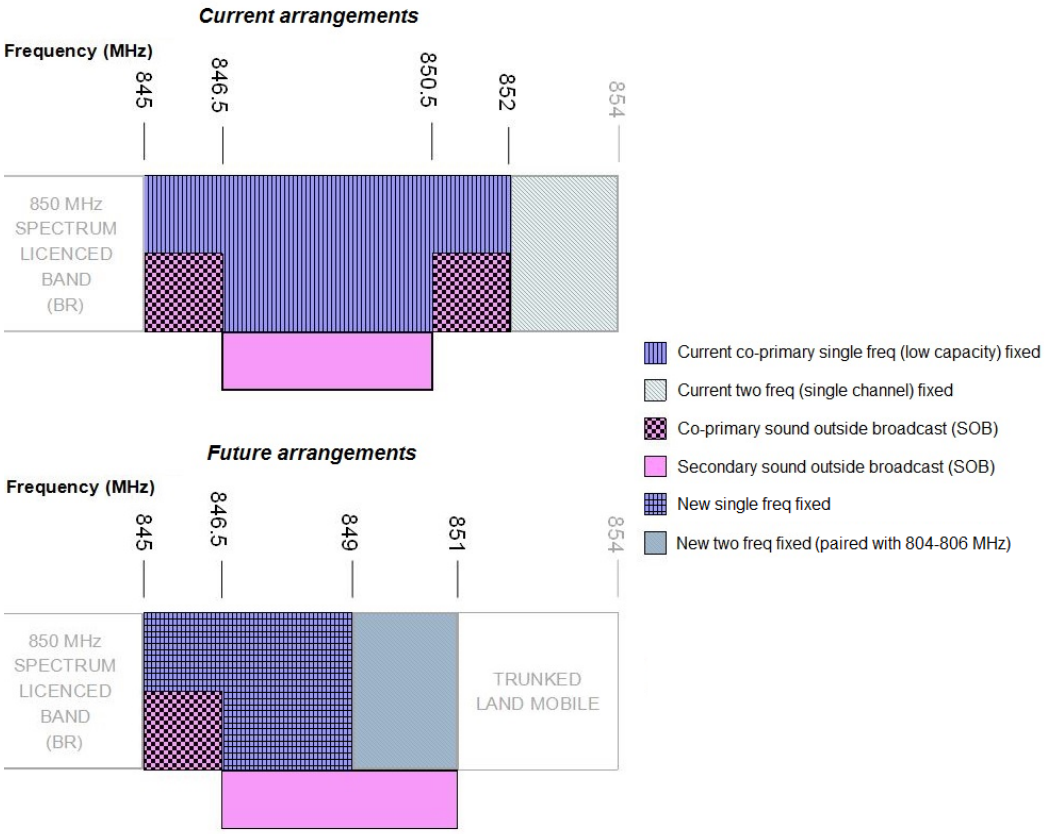
3.2.3.7 Studio-to-transmitter links (STLs)

STLs operating in 849–852 MHz will no longer be supported; however, STLs in 845–849 MHz will continue to be supported, resulting in a net reduction of spectrum allocated to STLs from 7 to 4 MHz. All STLs will operate on a co-primary basis with other fixed links in the band 845–849 MHz (see Figure 3.2.3.6) and licensing and assignment provisions will be transferred from RALI FX11 into a RALI FX [NEW] (including retention of existing protection requirements—as described in Section 3.2.2).

Responses to the *Future options* paper from STL operators indicated a preference to retain the existing 7 MHz spectrum provision. They are reluctant to shift to IP-based solutions as it would increase costs, which is felt particularly hard by community radio stations.

The ACMA believes that fixed line services offer a viable alternative to transferring media from studio to transmitter heads and, while acknowledging that they may cost more to implement than RF links, expects that some operators in the sector will be in a position to make this change in the medium to long term. It was also noted in responses to the *Future options* paper that most STL's can be re-tuned with a firmware upgrade down to 844 MHz.

Figure 3.2.3.6: Current and new arrangements for sound outside broadcasting (SOB) and studio-to-transmitter links (STLs)



3.3 Implementation plan

This section provides a timeline for actions to be taken by industry and operators at various implementation milestones, and by the ACMA at key dates throughout the process to put into effect the changes. Figures 3.3.2.1 and 3.3.2.2 depict these milestones and key dates together.

3.3.1 Actions to be undertaken by industry and operators

The transition sequence set out below lists milestones for *ex-post* compliance, that is, where compliance action is required (for example, cessation of operation or retuning), operators will have one year from the stated date to comply with the milestone requirements. For operators required to take clearance or retuning action, this notionally provides a one year window to do so, although as shown in Figure 3.3.2.1, the transition window is longer for some services (for example, two years for two-frequency fixed links, three years for TLMS).

Furthermore, it is understood that some operators may wish to commence transition before their transition window is 'open' for a number of reasons, for example, to align with technology refresh cycles. The ACMA is prepared to facilitate early transition where possible, subject to practical feasibility (for example, the ability to coordinate with services that have not yet cleared from the new frequencies) and should be contacted directly if this is desired.

Note that commencement of operation of new services is not a compliance action, so *ex-post* compliance does not apply to those actions. That is, new services can commence operation from the specified milestone date, rather than one year later.

Figure 3.3.1.1 shows the transitions to occur between the release of this paper and 30 June 2021 (ex-post compliance date for Milestone 2); and Figure 3.3.1.2 shows the transitions to occur between 30 June 2021 and the completion of the sequence in mid-2024.

Milestone 1 (30 June 2018—compliance date 30 June 2019):

> Single frequency fixed links and studio-to-transmitter links (STLs) will be required to have ceased operation between 849 MHz and 852 MHz. Legacy single frequency (single channel) links operating in 857–861 MHz will be permitted to continue operation until Milestone 5.

> Sound outside broadcast (SOB) services will be required to have ceased operation above 851 MHz. SOB operating on a primary basis in 850.5–852 MHz will no longer be supported; however, operation will be supported on a secondary basis between 850.5 and 851 MHz (this will effectively extend the current secondary allocation to SOB from 846.5–850.5 MHz to 846.5–851 MHz).

Milestone 2 (30 June 2019):

> Two-frequency fixed links, including point-to-point and point-to-multipoint links, may commence retuning to the lower part of the 800 MHz band on a 45 MHz split (804–806/849–851 MHz in areas currently serviced by trunked land mobile services (TLMS), or 804–809/849–854 MHz in areas not currently serviced by TLMS).[31] Completion of this transition will be required by 30 June 2021 (two-year transition window).

Milestone 3 (30 June 2020—compliance date 30 June 2021):

> Two-frequency fixed links, including point-to-point and point-to-multipoint links will be required completed transition to the lower part of the 800 MHz band on a 45 MHz split (804–806/849–851 MHz in areas currently serviced by TLMS, or 804–809/849–854 MHz in areas not currently serviced by TLMS).[32]

Milestone 4 (30 June 2021):

> TLMS operators may commence migration from current frequencies to the 2 x 3 MHz frequency-adjacent (above) two-frequency fixed links in the lower part of the 800 MHz band, maintaining the current 45 MHz split but with a new 12.5 kHz-based channel raster (channels will be able to be aggregated, so

[31] Two-frequency fixed links operating above 806/851 MHz in non-TLMS covered areas will have secondary status with respect to TLMS in the upper 2 x 3 MHz and may be required to vacate areas where future TLMS deployments are planned.

[32] Two-frequency fixed links operating above 806/851 MHz in non-TLMS covered areas will have secondary status with respect to TLMS in the upper 2 x 3 MHz and may be required to vacate areas where future TLMS deployments are planned.

25 kHz channels will still be supported). Completion of this transition will be required 30 June 2024 (three-year transition window).

> New low duty cycle services in 928–935 MHz, including a range of control, metering and other M2M applications as well as fixed links, may commence operation from Milestone 4 on a non-exclusive basis. Development and testing of cognitive radio devices in 933–935 MHz may also commence from this date. Operation of these services will be subject to conditions specified in the updated LIPD Class Licence (by Key date 6—parameters for access as listed under Action 6.1 in Section 3.3.2).

Milestone 5 (30 June 2023—compliance date 30 June 2024):

> TLMS will be required to have completed transition to the 2 x 3 MHz frequency-adjacent (above) two-frequency fixed links in the lower part of the 800 MHz band, maintaining the current 45 MHz split, but with a new 12.5 kHz-based channel raster (channels will be able to be aggregated, so 25 kHz channels will still be supported).

> Single frequency (single channel) fixed links will be required to have ceased operation in 857–861 MHz.

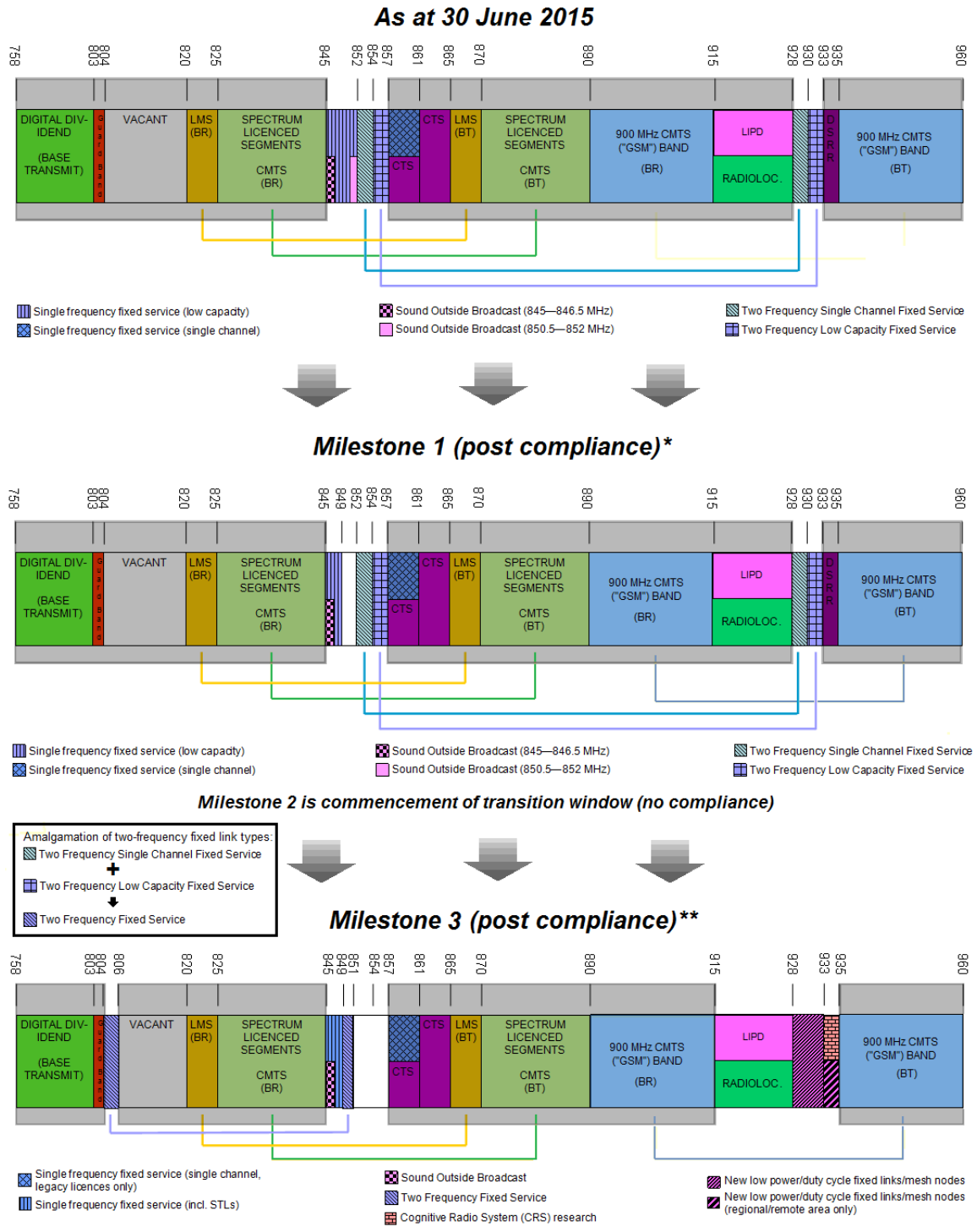
> Cordless telephone services will be required to have ceased operation in 857–865 MHz.

Milestone 6 (30 June 2024):

> Earliest date for commencement of operation of new services in the band 809–824/852–869 MHz. It should be noted that development of the technical framework and allocation of licences in the 850 MHz expansion band is anticipated to be completed prior to Milestone 6 and will be optimised for the provision of mobile broadband services, but would also be expected to enable use by narrowband TLMS.

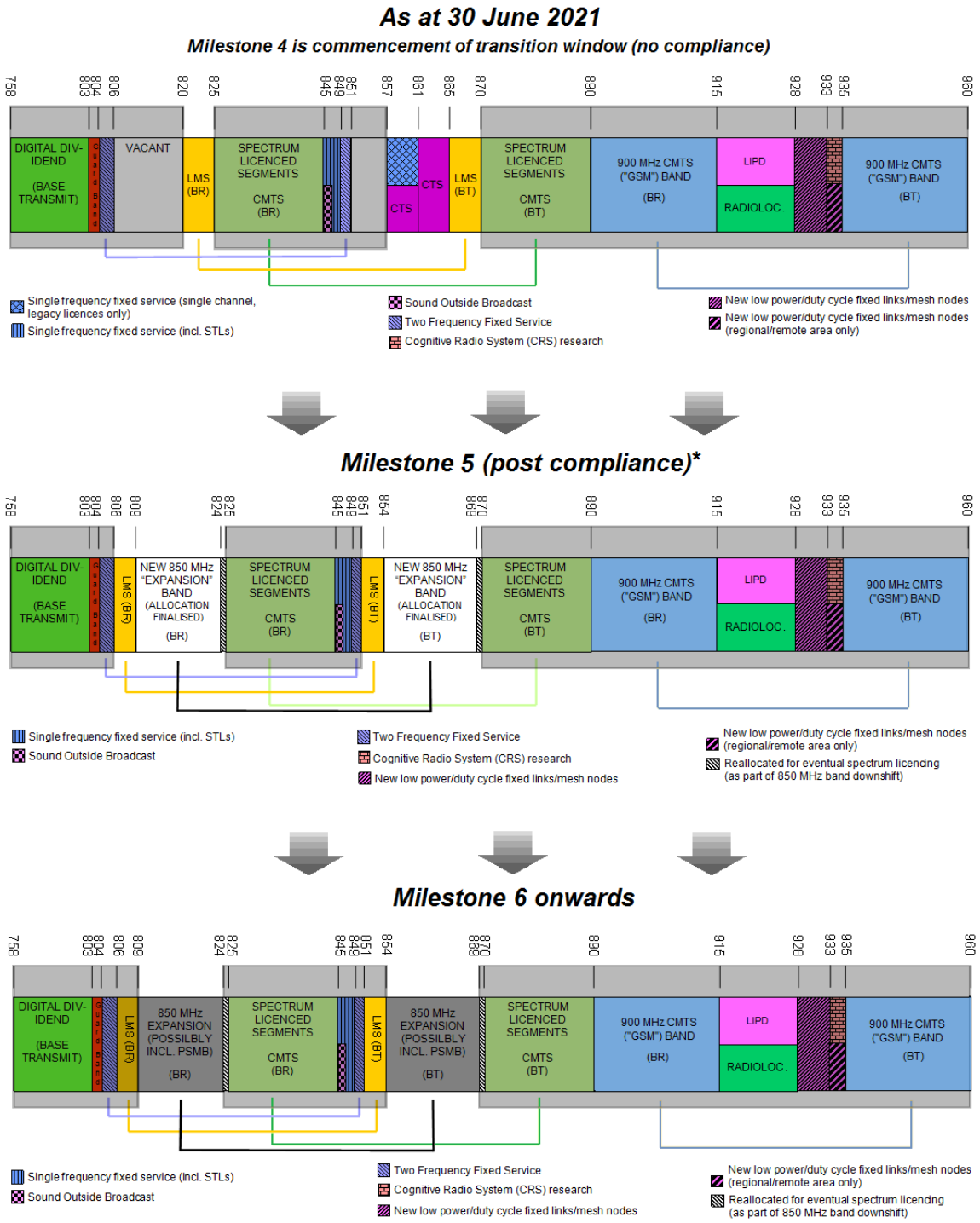
Concurrent with the above process, the ACMA will be working separately with licensees in the current mobile bands to enable the GSM band (890–915/935–960 MHz) to be used efficiently for current and emerging technologies and downshifting the entire 850 MHz band (825–845/870–890 MHz) by 1 MHz, to be directly frequency-adjacent the new expansion band (see Chapter 4). To facilitate this, 824–825/869–870 MHz will be cleared by Milestone 5.

Figure 3.3.1.1: Transitions from current arrangements to milestone 1 and 2 post compliance arrangements (one year after the milestone dates)—unaffected segments are greyed out



*Milestone date 30 June 2018; ex-post compliance date 30 June 2019
**Milestone date 30 June 2020; ex-post compliance date 30 June 2021

Figure 3.3.1.2: Transitions from Milestone 2 post-compliance arrangements (at 30 June 2021) to Milestone 3 post-compliance arrangements (one year after the Milestone 3 date) and then the final, post-transition state of the band—unaffected segments are greyed out



**Milestone date 30 June 2023; ex-post compliance date 30 June 2024*

3.3.2 Actions to be taken by the ACMA

This section lists the individual actions that the ACMA will need to take to enact the decisions listed in previous sections. These actions will put into effect the transition sequence described in Section 3.3.1 and will be made incrementally

in conjunction with the requisite modifications to the new 800 and 900 MHz band plans (RALI MS 40 and 41 respectively) to reflect the new arrangements. Actions listed are to be completed *by* the key dates identified (not ex-post as per the milestones for industry and operators).

Key date:	**1**
Date completed by:	October 2015 (completed)
Action to be taken by the above date:	Action 1: Allow the current 900 MHz legislative band plan to sunset and create two new administrative band plans: > 800 MHz band plan (803–890 MHz) > 900 MHz band plan (890–960 MHz).

Key date:	**2**
Date completed by:	30 June 2016

Action to be taken by the above date:	Action 2.1: Create new Radiocommunications Assignment and Licensing Instruction (RALI) FX [NEW]: > Include amalgamated *single frequency (low capacity)* and *single frequency (single channel)* fixed links under common *single frequency* fixed links terminology, with the following provisions: > 845–852 MHz allocated on a primary basis: > allocation from 849–852 MHz to be removed at Key date 3. > STLs permitted on a co-primary basis with standard fixed links, with the protection requirements contained in RALI FX11 incorporated. > 12.5 kHz based channel raster, with the following parameters: > channel aggregation permitted (up to 32 channels) > co-channel protection requirement of 50 dB > first adjacent protection requirement of 0 dB. > Minimum 20km path length for all assignments (exceptions may be approved by the ACMA on a case-by-case basis). > Incorporate relevant guidance from current documents as applicable, including: > protection ratios > cull distances/frequencies > intermodulation checks > site selection > assignment priorities > adjacent channel/band requirements > special conditions/advisory notes. This is intended to facilitate early compliance for operators that are able to do so. Action 2.2: Amend RALI FX-11: Studio to transmitter links and sound outside broadcasting services in the 900 MHz bands as follows: > Remove all provisions for STLs (have been moved into new RALI FX [NEW]), including removal of 'Studio to transmitter links' from the RALI title. > Maintain the provision that the STL channel plan in Attachment B can be used by SOB (i.e. retain the STL channel plan but rename accordingly). Action 2.3: Amend Embargo 64: > Remove 845–849 MHz from the scope of the Embargo.

Key date:	**3**
Date completed by:	30 June 2018

Key date:	3
Action to be taken by the above date:	Action 3.1: Amend RALI FX-11: Studio to transmitter links and sound outside broadcasting services in the 900 MHz bands as follows: > Change primary status for SOB operations in 850.5–852 MHz to secondary status in 850.5 to 851 MHz (primary status in 845–846.5 MHz will be retained). > Retain existing secondary allocation for SOB in 846.5–850.5 MHz (resulting in an overall secondary allocation in 846.5–851 MHz). Action 3.2: Amend RALI FX [NEW]: > Remove allocation of 849–852 MHz for single frequency fixed links/STLs (845–849 MHz to remain allocated on a co-primary basis with STLs).

Key date:	4
Date completed by:	30 June 2019

Action to be taken by the above date:	Action 4.1: Amend RALI FX [NEW]: > Add amalgamated *two-frequency (low capacity)* and *two-frequency (single channel)* fixed links under common *two-frequency* fixed links terminology, with the following provisions: > 804–806/849–851 MHz allocated on a primary basis > 806–809/851–854 MHz allocated on a secondary basis with respect to TLMS: > requirement to cease operation within two years of receiving notice of intended deployment of TLMS service within a prescribed radius of registered station (licensees may separately seek agreement from TLMS operator to continue operations on a coordinated basis). > 12.5 kHz based channel raster, with the following parameters: > Channel aggregation permitted (up to 16 channels) > Co-channel protection requirement of 50 dB > First adjacent protection requirement of 30 dB. > Minimum 20km path length for all assignments (exceptions may be approved by the ACMA on a case-by-case basis). > P-MP allocated in 805.5–806/850.5–851 MHz on a co-primary basis: > update channel plan in accordance with Attachment 2 of this paper. > Incorporate relevant guidance from documents superseded/suppressed (as applicable) as of key date 4, including: > protection ratios > cull distances/frequencies > intermodulation checks > site selection > assignment priorities > adjacent channel/band requirements > special conditions/advisory notes. Action 4.2: Amend Embargo 64: > Remove 804–806 MHz and 849–851 MHz from the scope of the Embargo.

Key date:	**5**
Date completed by:	30 June 2020

Action to be taken by the above date:	Action 5.1: Amend RALI FX-17: Frequency assignment requirements for narrowband single channel two-frequency point-to-point services in the 400 MHz and 900 MHz bands as follows: > Remove licensing and assignment provisions for all '900 MHz band' channels (i.e. all channels listed under 'Band 3' and 'Band 4' in the document). > New document heading: '*Radiocommunications Assignment and Licensing Instruction (RALI) FX-17: Frequency assignment requirements for narrowband single channel two-frequency point-to-point services in the 400 MHz band'.* Action 5.2: Amend RALI FX-16: Frequency assignment requirements for the point-to-multipoint services in the 400 MHz and 900 MHz bands as follows: > Remove channelling arrangements for P-MP services in the 900 MHz band (to be moved into new RALI—see below). > New document heading: '*Radiocommunications Assignment and Licensing Instruction (RALI) FX-16: Frequency assignment requirements for the point to multipoint services in the 400 MHz band*'. Action 5.3: Suppress RALI FX 10: Management of the short range point to multipoint service (SR P-MP): > While the provisions for SR P-MP will not be explicitly recreated in the new RALI, assignments that would conform to the parameters in RALI FX 10 (except specific frequencies, which will change) will be permissible under the general provisions for P-MP in the new RALI. Action 5.4: Suppress SPP 6/93: Frequency assignment procedures for low capacity two-frequency fixed services in the 820–960 MHz band.

Key date:	**6**
Date completed by:	30 June 2021

Action to be taken by the above date:	Action 6.1: Amend the Radiocommunications (Low Interference Potential Devices) Class Licence 2000 to incorporate new provisions for: > Fixed links, telecommand or telemetry transmitters (including mesh devices) operating in 928–933 MHz: > as fixed installations (not less than six months) > authorised on a non-exclusive basis (i.e. no protection from other authorised devices, accordingly users will need to make their own assessment of the suitability of these arrangements for their proposed applications) > EIRP not to exceed 25 mW (14 dBm) > Radiated PSD not to exceed -14.5 dBm/kHz > duty cycle not to exceed 1% averaged over one hour on any given frequency. > Fixed links, telecommand or telemetry transmitters (including mesh devices) operating in 933–935 MHz: > as fixed installations (not less than six months); > authorised on a non-exclusive basis (i.e. no protection from other authorised devices—not suitable for critical infrastructure metering/control) > EIRP not to exceed 25 mW (14 dBm) > radiated PSD not to exceed -14.5 dBm/kHz > duty cycle not to exceed 1% averaged over one hour on any given frequency > operation limited to low and remote density areas (as defined in the ACMA's apparatus licence fee density area maps). > Cognitive radio devices operating in 933–935 MHz: > EIRP not to exceed 10 mW (10 dBm) > radiated PSD not to exceed -14.5 dBm/kHz > duty cycle not to exceed 1% averaged over one hour on any given frequency > for purposes of research, development and testing only. Action 6.2: Amend RALI LM-8: Frequency assignment requirements for the land mobile service as follows: > Amend frequency limits for the 800 MHz trunked land mobile band in Annex A (Table A1) from 820–870 MHz to 806–870 MHz. > Add new channel allocations for the 800 MHz trunking band in Annex B (in new Table B4.2a) to reflect: > add new frequency range of 806–809/851–854 MHz > 12.5 kHz channel spacing in new frequency range (with provisions to aggregate contiguous channels to create a 25 kHz channel if required)—this equates to 240 channels > assign channel numbers in new range as 201–440. > Add Table B4.1a to Annex B: > same block/group arrangement as Table 4.1, but with channel numbers from 201–440 (12 blocks instead of 10 to

accommodate 240 channels)

- minimum assignment size of one five-channel group, but no longer with the requirement to assign only full groups (i.e. not confined to five channel multiples).

- Amend Annex E to reflect changes to adjacent services:
  - remove E3 (no longer relevant).
- Amend Table C9 (frequency-distance constraints) to include 12.5 KHz channels.
- Retain existing technical parameters for intermodulation checking purposes.

Action 6.3: Amend Embargo 64:

- Remove 806–809 MHz, 851–854 MHz and 928–935 MHz from the scope of the Embargo.

Key date:	**7**

Date completed by:	30 June 2023
Action to be taken by the above date:	Action 7.1: Amend RALI LM-8: Frequency assignment requirements for the land mobile service as follows: > Amend frequency limits for the 800 MHz trunked land mobile band in Annex A (Table A1) from 806–870 MHz to 806–854 MHz. > Remove Table B4.2, rename Table B4.2a as Table B4.2 (which will put into effect the removal of the allocation at 820–825/865–870 MHz) and change channel numbers from 201–440 to 1–240. > Remove Table B4.1, rename Table B4.1a as Table B4.1 and change channel numbers from 201–440 to 1–240. > Amend Annex E to reflect changes to adjacent services and operating frequencies: > amend E4 to describe services conforming to technical frameworks to be developed for the 850 MHz expansion band, operating upper adjacent (i.e. at the 809/854 MHz boundary). > Retain existing frequency-distance constraints and technical parameters for intermodulation checking purposes. Action 7.2: Designation of relevant portions of the 850 MHz expansion band for spectrum licensing* (809–824/854–869 MHz)[33] and technical frameworks agreed (where applicable), to be effective from (or after) key date 7. Action 7.3: Designation for spectrum licensing* of 824–825/849–850 MHz (in readiness for downshift of the 850 MHz band), to be effective from (or after) key date 7. Action 7.4: Suppress SPP 4/93: Coordination Procedures for the Licensing of Services Sharing the 857-861 MHz Band. * Current nomenclature and process subject to change following implementation of the Spectrum Review.

Key date:	**8**
Date completed by:	TBD (current projection 30 June 2024)
Action to be taken by the above date:	Action 8.1: Issue licences for new services in the 850 MHz expansion band (no earlier than Milestone 6). Action 8.2: Amend Embargo 64: > Remove 809–824 MHz and 854–869 MHz from the scope of the Embargo.

3.3.3 Embargo 64

As detailed in Section 3.3.2, incremental changes will be made to Embargo 64 throughout the implementation phase, specifically the removal of frequency segments

[33] Allocation of new commercial mobile broadband spectrum will be completed prior to Milestone 6. Allocation method to be determined as part of a separate process.

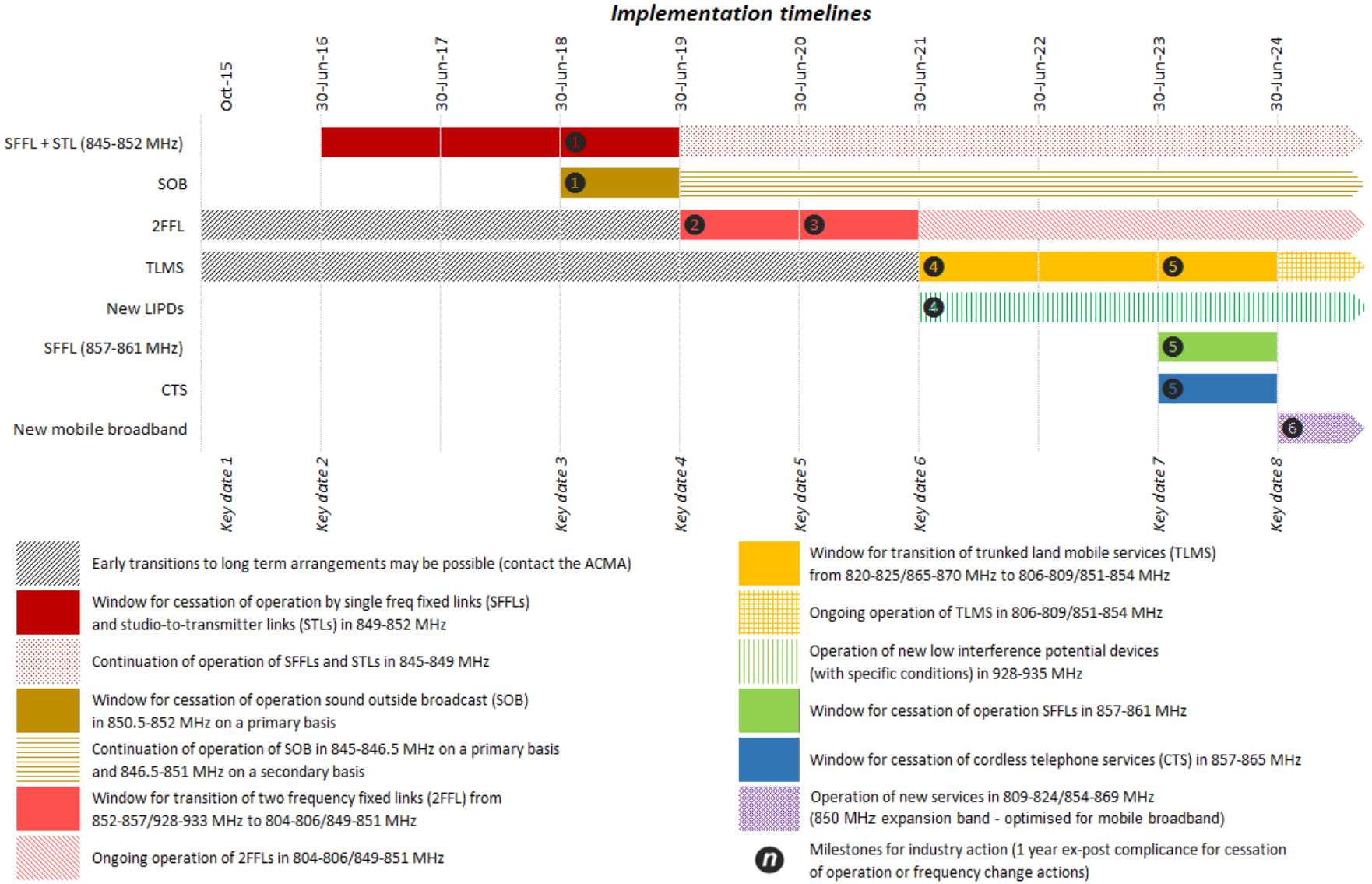
for which long-term arrangements have taken effect. The following frequency segments have not been identified for removal from Embargo 64 in Section 3.3.2:

- 803–804 MHz—guard band between services in the 700 and 800 MHz bands
- 824–825 MHz and 869–870 MHz—vacant pending downshift of the 850 MHz band (a separate body of work—see Chapter 4)
- 890–915 MHz and 935–960 MHz—pending replanning into 5 MHz block (a separate body of work—see Chapter 4).

Depending on the progress of the separate reform agenda described in Chapter 4, either of the frequency pairs listed in the latter two dot points above may be removed at any time during the implementation phase.

Throughout the implementation process, exemptions to Embargo 64 will continue to be considered on a case-by-case basis. In general, exemptions will be granted to extend the operating life of existing systems as long as such operation is consistent with the implementation plan. For example, a service identified for cessation of operation on a given frequency will generally have its licence renewed each year up until the relevant milestone (after which the licence will not be renewed, consistent with the requirement to clear within the year following the milestone date).

Figure 3.3.1.2: Timelines for implementation, including milestones for industry/operator action and key dates for action by the ACMA



4. Proposed amendments to existing mobile broadband spectrum arrangements

As described in Section 1.4 there are two major components of the review that require further consideration by the ACMA, government and industry for which no decisions have been conveyed in this paper. These issues are:

- implementation of a 1 MHz downshift of the 850 MHz band (noting that the decision to clear spectrum for the band to eventually shift down into is included in this paper)
- the reorganisation of the existing 900 MHz 'GSM' band (890–915/935–960 MHz).

This chapter provides a brief background on these issues, and discusses some of the complexities that need to be considered and resolved in order to progress these reforms.

4.1 Relationship to the review

The ACMA has previously foreshadowed its intention to reorganise the existing 900 MHz GSM band into 5 MHz blocks, to optimise its utility for 4G services. However, the ACMA intends to progress these reforms of the as part of a separate process. The reasons for taking this approach are:

- There are significant and complex policy, revenue and technical implications of undertaking this reform, including the desirability of shifting the entire lower-adjacent 850 MHz band (825–845/870–890 MHz) down by 1 MHz in order to maximise the utility of a GSM band reconfigured for LTE, which will need careful ACMA consideration and consultation across government and industry.
- Given that the affected spectrum, with the exception of the 2 x 1 MHz lower-adjacent the 850 MHz band[34], is already allocated for delivery of commercial mobile services, this issue can be 'decoupled' and treated in isolation from the broader review. This means that a proper exploration of the abovementioned complexities will not cause any delays to implementation of the 850 MHz expansion band and other decisions communicated in this paper.

That said, the ACMA understands that this issue is particularly important to some sectors and sees value in using this paper to provide some insight in how it is proposing to progress the matter.

In a submission to the *Future options* consultation paper, one incumbent operator in the GSM band indicated a preference for the proposed replanning to be the subject of a further round of consultation.

4.2 Rationale

The ACMA expects the 850 MHz band and the 900 MHz GSM band will continue to be used for cellular mobile (including broadband) services. The structure of the 850 MHz

[34] The 2 x 1 MHz segment will be cleared as part of the transition strategy detailed in this paper.

band is not within the scope of the present review, except for the issue of a 1 MHz downwards shift of the boundaries of the band. In considering the option of a 1 MHz downshift, the ACMA recognises the legal rights of existing spectrum licensees in the band.

The ACMA is committed to ensuring that the spectrum planning arrangements underpinning the operation of mobile broadband services are conducive to the optimal delivery of these services. This is best achieved by providing operators with the flexibility to be able to readily deploy the latest releases of standardised mobile broadband technologies, at present meaning 4G LTE based technologies. The ACMA recently released its *Beyond 2020* paper[35], which describes the relationship between spectrum, network topologies and adopted technology standards in delivering mobile broadband capacity.

The 900 MHz GSM band has long been a cornerstone in the delivery of cellular communications services in Australia, first through the deployment of the 2G Global System for Mobile (GSM, hence its colloquial name) and now 3G Universal Mobile Telecommunications System (UMTS) services. The latter requires 5 MHz spectrum blocks.

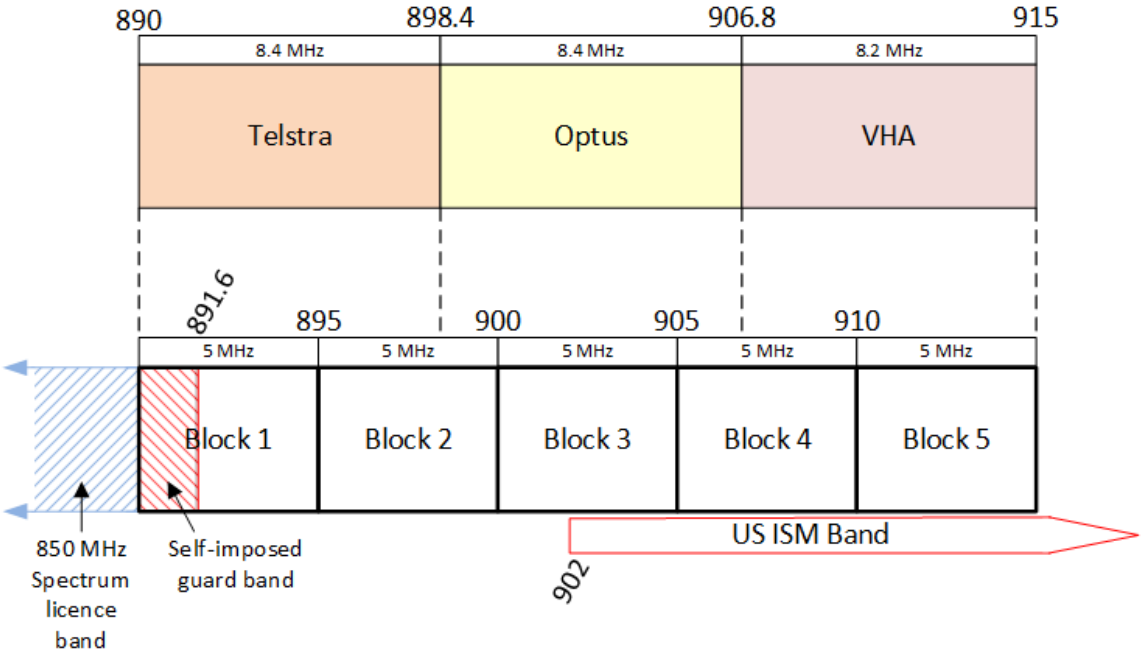
LTE technology can operate using a range of different channel sizes, being: 1.4, 3, 5, 10, 15, and 20 MHz, however LTE is more spectrally efficient in channels of 5 MHz or multiples thereof. Increases in channel size (in 5 MHz increments) up to a 20 MHz channel increases throughput but results in only incremental gains to spectral efficiency. While LTE can operate using channels smaller than 5 MHz, this is generally avoided as efficiency suffers and the level of throughput adds little to the overall capacity of a network. Therefore, bands for 3G and 4G technologies are predominately planned based on a minimum block size of 5 MHz.

The 900 MHz band (890–915/935–960 MHz) is currently apparatus licensed to Telstra, Optus and Vodafone Hutchison Australia (VHA) in 8.4 and 8.2 MHz blocks. Figure 4.2.1 shows the lower (base-receive) part of this band, with the current licensing arrangements shown at the top of the diagram.

The interference issues that arise from the overlap of non-compliant US ISM band (902–928 MHz) equipment with blocks 3, 4 and 5 currently affect the Optus and VHA apparatus-licensed segments. Incidences of such interference are not infrequent and are well known to these operators and the ACMA—they are the result of non-compliance rather than failure of planning. Regardless of the eventual band configuration, this is an issue that will continue to require ongoing compliance and enforcement action by the ACMA.

[35] Available on the ACMA website.

Figure 4.2.1: Current and proposed arrangements for the base receive component of the 'GSM' band



4.3 Technical considerations

The frequency arrangements for the 850 MHz band (825–845/870–890 MHz) and the 900 MHz GSM band (890–915/935–960 MHz) provide for key allocations to cellular mobile services that are standardised for use in Europe (GSM band) and the United States (850 MHz band). Australia's adoption of these internationally standardised bands has resulted in a conflicting 'reverse duplex' arrangement, where base station transmitter and receiver frequencies are immediately adjacent one another.

Allocating immediately adjacent frequencies for base station transmitters and receivers is usually avoided due to the difficulties in managing interference between services. This proximity has increasingly constrained efficient and effective use of the band, despite the band being progressively utilised for 3G and 4G technologies. In order to manage this incompatibility, the licensee for both band segments either side of the 890 MHz boundary has implemented an internal 1.6 MHz guard band at the lower edge of its GSM band licence—see bottom left corner of Figure 4.2.1.

This guard band facilitates coexistence between 2G and 3G services (rather than 3G and 4G services). However, this coexistence also requires a significant amount of base station filtering on both the transmit (850 MHz band) and receive (900 MHz band) sides. The introduction of excessive filtering can affect network performance. Given that GSM operates in 200 kHz physical channels, the 1.6 MHz guard band within the 900 MHz band represents a sacrifice of eight paired channels.

For reasons described in Section 4.2, a 5 MHz channel plan would be far more conducive to 3G/4G deployments than the current 8.2/8.4 MHz arrangements, and the ACMA sees a significant long-term benefit in transitioning to these arrangements. The lower part of Figure 4.2.1 shows the GSM band if it were instead divided into 5 MHz blocks (denoted here as Blocks 1–5) and what the potential technical issues associated with each block might be (there are no such issues with the base-transmit segment of the GSM band (935–960 MHz)).

In Block 1, the impact of the self-imposed 1.6 MHz guard band on the possible deployment of 4G services would be significantly amplified. It would no longer mean simply sacrificing some network capacity, as is currently the case, but would in fact preclude the deployment of a 5 MHz LTE channel in Block 1 (or a 10 MHz block across Blocks 1 and 2) altogether, without encroaching on the guard band and resulting in interference between the 850 MHz and 900 MHz GSM bands. Thus, the utility of Block 1 would be significantly degraded.

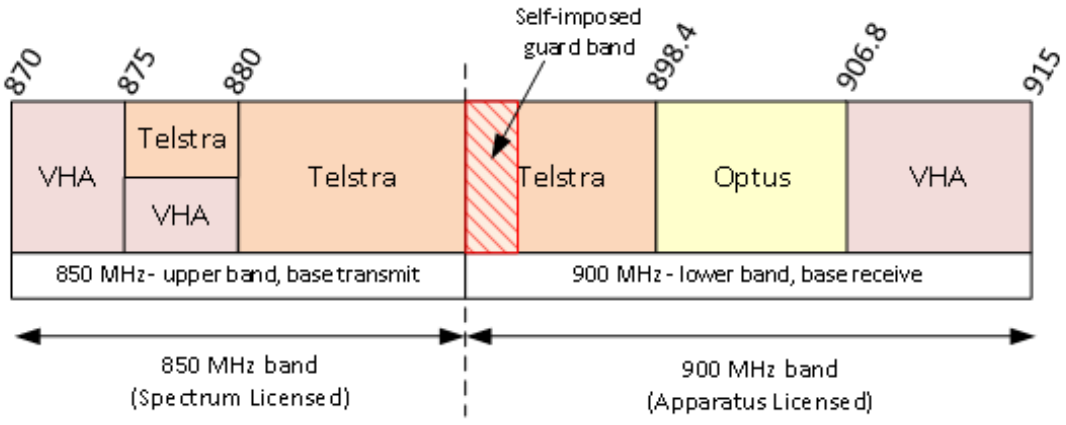
A 3 MHz LTE channel could be deployed in Block 1, however this would fail to realise the intended efficiency gains of moving to a 5 MHz block plan, and would also remove the possibility of deploying a single 10 MHz channel in Blocks 1 and 2 (in any scenario where ownership of the two blocks is consolidated). For example, if an operator were to secure licences for Blocks 1 and 2, they would only be able to deploy disparate, contiguous 3 and 5 MHz LTE carriers, resulting in a reduction in both single channel throughput and the throughput advantages achieved from deploying larger LTE carrier bandwidths (noting that 3GPP standards currently restrict carrier aggregation to two LTE carriers in disparate frequency bands).

The proposal to eventually convert to a 5 MHz block plan in the 900 MHz GSM band was generally well received in responses to the *Future options* paper. All three licensees responded favourably, although there was concern raised about the implications on broader spectrum holdings below 1 GHz and the effects on competition. This, while a valid consideration, is a broader issue than the configuration of the 900 MHz GSM band in isolation.

4.4 Proposal to downshift the 850 MHz band

The 850 MHz band is internationally standardised as ‘Band 5’ in 3GPP standards for UMTS and LTE operation in the frequency range 824–849/869–894 MHz. For historic reasons, in Australia this band has been operated in the 825–845/870–890 MHz range, which currently accommodates spectrum-licensed 3G and 4G services operated by VHA and Telstra. Figure 4.4.1 shows the current licensing arrangements for the frequency-adjacent base transmit and base receive segments of the 850 MHz and 900 MHz GSM bands respectively (associated base receive and base transmit frequencies can be extrapolated).

Figure 4.4.1: Current licensing arrangements for the 850 MHz base transmit and ‘GSM’ band base receive segments



In the long term, the ACMA intends to shift the boundaries of the 850 MHz band down by 1 MHz, so that it operates in 824–844/869–889 MHz band, in order to:

- realign with international standards, which may increase the availability of compatible devices for operation in some parts of the 800 MHz expansion band and improve economies-of-scale in the longer term
- ensure that the lower-adjacent 850 MHz expansion band to be released as a result of this review (as described in Chapter 3) is compliant with international standards
- introduce a guard band between the 850 MHz and 900 MHz GSM bands at 889–890 MHz, which will help alleviate the coexistence issues described in Section 4.2 and maximise the efficiency of the band by increasing the amount of spectrum capable of providing 4G services.

Responses to the *Future options* paper on this proposal recognised the differing impacts of the move on the current licensees in the 850 MHz and 900 MHz GSM bands. One carrier was of the view that it would need to occur to ensure the utility of the lowest 5 MHz block in the 900 MHz band. While not objecting to the proposal, another carrier was concerned about the potential implementation costs that might be incurred as a result. The ACMA notes that the common interest of government, the mobile carriers and their customers in maximising the efficient configuration and exploitation of existing internationally harmonised LTE allocations in both 850 MHz and 900 MHz GSM bands, is not in dispute.

4.5 Way forward

The ACMA would like to see the 1 MHz shift brought into effect within a time frame that maximises the utility of Block 1 of the replanned 900 MHz GSM band, thereby making the most efficient use of spectrum available for mobile broadband. However, spectrum licences for the 850 MHz band were renewed in 2013 and are not due for expiry until 2028.

Instead, the ACMA will work with government and industry stakeholders to identify potential options to bring about this change voluntarily and for the mutual benefit for all involved stakeholders. A separate consultation process (or processes) will be undertaken to work through these options and to propose potential allocation methodologies for a replanned 900 MHz GSM band.

Attachment 1—Legislative and policy framework: Relevant extracts

The Object of the *Radiocommunications Act 1992*

Section 9 of the *Australian Communications and Media Authority Act 2005* (the ACMA Act) sets out the spectrum management functions of the ACMA including:

- to manage the radiofrequency spectrum in accordance with the Radiocommunications Act
- to advise and assist the radiocommunications community.

Consistent with the spectrum management functions set out in the ACMA Act, the object of the Radiocommunications Act is to provide for management of the radiofrequency spectrum to achieve a number of goals, including to:[36]

- maximise, by ensuring the efficient allocation and use of the spectrum, the overall public benefit derived from using the radiofrequency spectrum
- make adequate provision of the spectrum:
  - for use by agencies involved in the defence or national security of Australia, law enforcement or the provision of emergency services
  - for use by other public or community services
- provide a responsive and flexible approach to meeting the needs of users of the spectrum
- encourage the use of efficient radiocommunication technologies so that a wide range of services of an adequate quality can be provided.

The analysis provided in this paper considers the additional public benefit that could be derived from improvements to arrangements in the 803–960 MHz band, and, in light of the object identified above, considers the development of regulatory arrangements that encourage efficiency and flexibility of spectrum use.

Principles for Spectrum Management

The ACMA developed its *Principles for Spectrum Management*[37] (the Principles) to guide its decision-making on spectrum management. The Principles are intended to guide the ACMA's management of spectrum within its existing legislative responsibilities and government policy settings.

[36] The object of the *Radiocommunications Act 1992* is to provide for management of the radiofrequency spectrum and is explained in paragraphs 3 (a) to 3 (h).

[37] http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/principles-for-spectrum-management

The Principles aim to:

- promote consistency, predictability and transparency in the ACMA's decision-making
- provide guidance for major planning and allocation decisions
- increase the ACMA's ability to respond to challenges, including the impact of new technologies and increasing demand for spectrum for advanced services.

The Principles recognise that a band's highest value use is not determined solely by an economic assessment, but also by consideration of the broader public good or social benefit achieved by that use. Therefore, a key theme of the Principles is to optimise the use of market mechanisms with minimal regulatory intervention to maximise the public benefit.

The Principles are:

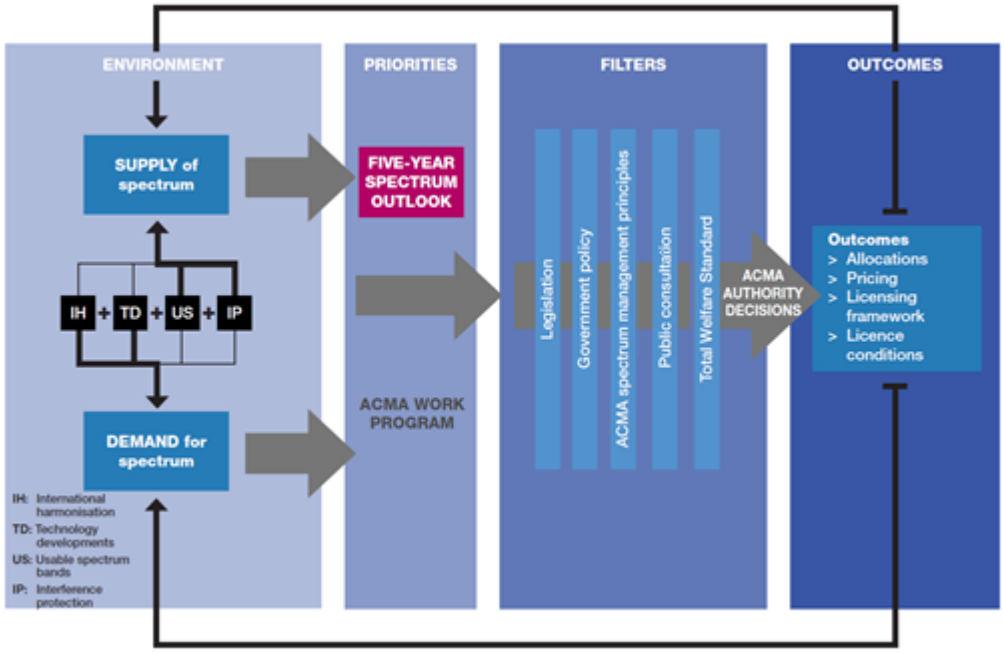
- **Principle 1**—Allocate spectrum to the highest value use or uses.
- **Principle 2**—Enable and encourage spectrum to move to its highest value use or uses.
- **Principle 3**—Use the least cost and least restrictive approach to achieving policy objectives.
- **Principle 4**—To the extent possible, promote both certainty and flexibility.
- **Principle 5**—Balance the cost of interference and the benefits of greater spectrum utilisation.

The ACMA has considered a range of other factors in addition to the Principles. These are identified in its spectrum management decision framework (see Figure A1.1). The international environment is a key factor in considering the arrangements in the 803–960 MHz band, particularly for mobile broadband services in the band, with a specific focus on spectrum harmonisation and developments in technology.

The review of the 803–960 MHz band was flagged in *Significant spectrum projects in 2015–16 and beyond* and in the work program in the ACMA's *Five-year spectrum outlook 2015–19*.[38]

[38] Available at the ACMA website.

Figure A1.1: Spectrum management decision framework



Attachment 2—Channel plan for relocated point-to-multipoint services

Table A2.1 contains the new channel plan for point-to-multipoint services operating in the 805.5–806/850.5–851 MHz band. These arrangements will be included in RALI FX [NEW] and will replace existing provisions for point-to-multipoint services currently detailed in RALI FX-16.

Table A2.1: New channel plan for point-to-multipoint

Centre frequency (MHz)					Centre frequency (MHz)				
Channel number	Master Tx		Master Rx		Channel number	Master Tx		Master Rx	
1	850.50625	850.5125	805.50625	805.5125	21	850.75625	850.7625	805.75625	805.7625
2	850.51875		805.51875		22	850.76875		805.76875	
3	850.53125	850.5375	805.53125	805.5375	23	850.78125	850.7875	805.78125	805.7875
4	850.54375		805.54375		24	850.79375		805.79375	
5	850.55625	850.5625	805.55625	805.5625	25	850.80625	850.8125	805.80625	805.8125
6	850.56875		805.56875		26	850.81875		805.81875	
7	850.58125	850.5875	805.58125	805.5875	27	850.83125	850.8375	805.83125	805.8375
8	850.59375		805.59375		28	850.84375		805.84375	
9	850.60625	850.6125	805.60625	805.6125	29	850.85625	850.8625	805.85625	805.8625
10	850.61875		805.61875		30	850.86875		805.86875	
11	850.63125	850.6375	805.63125	805.6375	31	850.88125	850.8875	805.88125	805.8875
12	850.64375		805.64375		32	850.89375		805.89375	
13	850.65625	850.6625	805.65625	805.6625	33	850.90625	850.9125	805.90625	805.9125
14	850.66875		805.66875		34	850.91875		805.91875	
15	850.68125	850.6875	805.68125	805.6875	35	850.93125	850.9375	805.93125	805.9375
16	850.69375		805.69375		36	850.94375		805.94375	
17	850.70625	850.7125	805.70625	805.7125	37	850.95625	850.9625	805.95625	805.9625
18	850.71875		805.71875		38	850.96875		805.96875	
19	850.73125	850.7375	805.73125	805.7375	39	850.98125	850.9875	805.98125	805.9875
20	850.74375		805.74375		40	850.99375		805.99375	