Ministry of Economic Development Manatu Ohanga | Radio Spectrum Management

Discussion paper

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Introduction

This discussion paper has been prepared to facilitate consultation on the potential introduction of digital land mobile radio (digital LMR) technologies in the VHF and lower UHF bands, following the implementation of digital LMR technologies in the 800 MHz trunked dispatch[1] band (the TS band).

The Ministry undertook a public consultation in 2007[2] to identify appropriate technical and administrative frameworks for the introduction of digital LMR in the TS band, due to the growing industry demand for digital technology in this band. The outcomes of this process included:

1. Identification of industry's preference for internationally defined digital standards (resulting in the adoption of the APCO and TETRA standards).
2. Expansion of the current technical frameworks to include specific engineering guidelines for digital LMR licensing to avoid potential interference issues between APCO, TETRA and legacy analogue LMR.
3. Implementation of a 12.5 kHz channel plan in the TS band, in addition to the existing 25 kHz channel plan. APCO and analogue services may be licensed for either channel spacing as appropriate, and TETRA may be licensed in the 25 kHz channels.

Digital LMR technologies provide greater spectrum efficiency, along with more robust communications, in comparison to existing analogue LMR technologies. Until recently, LMR technologies have been mainly driven by applications developed for public safety markets; however, there are now several technologies designed for the commercial digital LMR market. The New Zealand industry has expressed an interest in expanding the licensing of digital LMR systems so that stakeholders can take advantage of this new technology in all of the VHF and UHF LMR bands.

The Ministry supports the introduction of new technologies like this, where they provide technical efficiencies and economic benefits. It also recognises that the introduction of new technologies must consider the impact on the large number of existing licences employing analogue technology.

This discussion paper solicits the opinions of vendors, operators, suppliers, existing spectrum users and other stakeholders on the most appropriate licensing framework and technical standards for digital LMR in the VHF and UHF bands.

Footnotes

[1]Trunked dispatch mobile radio is a radio technology that uses a dynamic channel control scheme to allow multiple users within a network to communicate with each other by sharing a small number of frequency channels.
[2]The 2007 consultation paper can be found here.

Invitation for submissions

Comments on the proposals contained in this paper and on any related issues are invited from interested parties. Written submissions should be sent no later than 4 September 2009 to:

Digital Land Mobile Radio in VHF and UHF Bands

Radio Spectrum Policy and Planning

Ministry of Economic Development

PO Box 1473

WELLINGTON

or by email to:

radiospectrum@med.govt.nz (Preferred option)

Any party wishing to discuss the proposals with Ministry officials should contact, in the first instance, Cristian Gomez of the Radio Spectrum Policy and Planning Group on (04) 462 4241.

Posting and release of submissions

The Ministry intends to publish all submissions on this website. The Ministry will consider you to have consented to the publication of your submission, unless clearly specified otherwise in your submission.

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Glossary

Footnote

[3]See section 10.3, Appendix C, for details of this digital land mobile radio standard.

1. Scope

This discussion document considers the commercial land mobile bands in the VHF and UHF spectrum. These bands are listed in Appendix A.

1.1 Outside scope

Bands assigned for public safety and emergency services, maritime and aeronautical services are outside the scope of this discussion document.

In New Zealand, there are specific frequency allocations reserved for public safety and emergency services. The use of these bands is coordinated by the Public Safety Radio Frequency Management Group (PSRFMG), which includes the agencies responsible for public protection and disaster relief services (Police, Ambulance, Fire Service, Defence, Customs, Department of Conservation, Ministry of Fisheries and Ministry of Civil Defence and Emergency Management).

Similarly, Maritime New Zealand and the Civil Aviation Authority are responsible for coordinating the use of specific frequency allocations dedicated to their mobile communications services.

2. Spectrum management framework

2.1 Radio licensing regime

The VHF and UHF land mobile bands in New Zealand are administered under the framework of Part 13 of the Radiocommunications Act 1989, which establishes the radio licensing regime. Under the radio licensing regime, the spectrum is owned by the Crown and radio licences to use the spectrum are granted on a first-come, first-served basis under the control of the Ministry of Economic Development.

2.2 Security of tenure

The Radiocommunications Regulations 2001 set out the provisions for managing the radio licensing regime, including provisions for the revocation of radio licences when transitioning a band to a different allocation or channel plan. The minimum period for giving notice of revocation of a licence of undefined duration is five years, but may be less if a transition plan is agreed in consultation with the licensees. The Ministry follows guidelines for implementing such transition plans, which are set out in PIB 48[4].

Footnote

[4]PIB 48 can be found here.

2.3 Current licensing policy

The current operational policy for licensing LMR services in New Zealand is set out in the following documents:

- Policy Document 003: Licensing of Land Mobile Services[5]
- Spectrum Band Plans: 800 MHz Trunked Despatch Land Mobile System[6]
- PIB 38: Engineering Rules[7]
- PIB 23: VHF and UHF Land Mobile Services in New Zealand[8]

In summary, current policy only permits licensing of LMR systems using analogue modulation (angle, amplitude and frequency), with the exception of the 800 MHz TS trunked dispatch band in which digital modulation is also permitted.

In 1992, a policy was introduced to encourage LMR users to engineer their systems on the basis of 12.5 kHz channel spacing (excluding trunked dispatch systems operating with 25 kHz spacing). This policy addressed the increasing congestion issues arising from the continued use of legacy analogue 25 kHz channel plans. The licensing of 25 kHz analogue channels was only permitted under special circumstances.

It was expected that 25 kHz channel analogue land mobile systems would eventually become obsolete as a result of the growing international trend towards the use of more efficient 12.5 kHz channel systems. In most countries, 25 kHz channel spacing for analogue land mobile systems has not been phased out completely; but its use continues to decrease as countries transition to the more efficient 12.5 kHz analogue channels and digital LMR technologies.

In the case of digital LMR technologies, 25 kHz channels can be a spectrally efficient option because of the increased number of users per channel. Therefore in the 800 MHz TS band, digital technologies based on both 12.5 kHz and 25 kHz channel spacings have been introduced.

Question 1

Do you agree that the current policy and licensing framework should be expanded to permit digital LMR in the VHF and UHF bands (see section 10.1, Appendix A, for a table giving the frequency ranges for these bands), in addition to the 800 MHz TS band?

Footnotes

[5]POLDOC 003 can be found here.

[6]The band plan for trunked despatch LMR at 800 MHz can be found here.

[7]PIB 38 can be found here.

[8]PIB 23 can be found here.

3. Land mobile systems in other administrations

Worldwide, a number of digital LMR technologies are available, including the European TETRA (ETSI) platform, DMR (ETSI), the American APCO P25 (TIA) and proprietary equipment. Most countries have adopted 12.5 kHz channel plans to host digital technologies in the VHF and UHF bands, with the exception of those countries implementing TETRA (25 kHz) in the UHF band. There has also been a strong drive to open up the licensing of 6.25 kHz systems. In regards to channel plans, a mixture of approaches can be found across administrations, reflecting the legacy of band plans implemented for early analogue LMR technology using 25 kHz channel spacing in the VHF spectrum.

In the United States, the FCC mandated a deadline[9] in 2004 for 25 kHz land mobile systems operating between 150 MHz and 512 MHz to migrate to 12.5 kHz technology. The deadline was set to 1 January 2013. This decision was designed to promote the utilisation of more spectrally efficient technologies. The minimum requirements are one voice channel per 12.5 kHz of bandwidth, or a data rate of 4800 bps per 6.25 kHz (9600 bps for 12.5 kHz; 19.2 kbps for 25 kHz). New systems or modifications to existing 25 kHz systems are not permitted under this mandate from 1 January 2011. Digital LMR is already being licensed in the United States with channel widths of 12.5 kHz and 6.25 kHz (FDMA and TDMA formats).

In Europe, the EC decision of 7 July 2006 details the bands available for digital LMR in the VHF and UHF bands[10]. The decision specifies guidelines for the implementation of digital LMR systems using channel spacing of up to 25 kHz. It also specifies the applicable ETSI harmonised standards for the purpose of technical compliance (EN 300 113-2, EN 300 390-2, EN 303 035-1, EN 303 035-2). TETRA systems are also available in the lower UHF bands (400 MHz). However, by specification, TETRA technology requires a minimum transmit-receive frequency split of 10 or 45 MHz. The current configuration of the New Zealand trunked dispatch bands in the 400 MHz UHF spectrum provides a split of 8 MHz. This frequency split precludes TETRA services from being implemented in the 400 MHz spectrum in New Zealand, unless the bands are reconfigured for a wider split.

In Australia, ACMA has published a technical document entitled RALI LM 8[11], which specifies the licensing requirements and coordination procedures for single and two-frequency LMR systems. The document includes analogue and digital systems in the VHF and UHF bands. The only provision made regarding digital LMR is that new digital LMR systems are to be engineered and certified with appropriate consideration of interference protection for legacy analogue systems.

Question 2

Should New Zealand adopt a similar approach to that of the United States by planning a deadline for all 25 kHz analogue LMR systems to migrate to the more efficient 12.5 kHz channels? If yes, then what would be a reasonable timeframe?

Question 3

Do you foresee a need to accommodate TETRA systems in bands other than 800 MHz in New Zealand? If so, which bands and why?

Footnotes

[9]The FCC mandate, specified in Part 90 of the Code of Federal Regulations, can be found at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-292A1.doc.

[10]The EC decision can be found at: http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC0606.PDF.

[11]RALI LM 8 can be found at: http://www.acma.gov.au/WEB/STANDARD/pc=PC_2609.

4. Current use of land mobile services

4.1 Land mobile spectrum usage

Section 10.1, Appendix A, of this document provides a summary of the frequency ranges assigned to LMR in each band.

Some land mobile systems use the same channel to transmit and receive voice communications (push-to-talk). This system is known as simplex. Note that licences are no longer being issued for analogue simplex services operating with 25 kHz channels. This is because, internationally, simplex analogue technology has evolved to use 12.5 kHz channels. A 25 kHz simplex licence would be granted only in exceptional cases; POLDOC 003 provides further information on the specific cases where 25 kHz channels would be licensed.

Licensing statistics (as at December 2008) obtained from the New Zealand Register of Radio Frequencies show the degree of encumbrance of each of the LMR service bands by existing analogue licences. This is illustrated in Figure 1 below.

Figure 1: Volumes of land mobile (conventional) licences

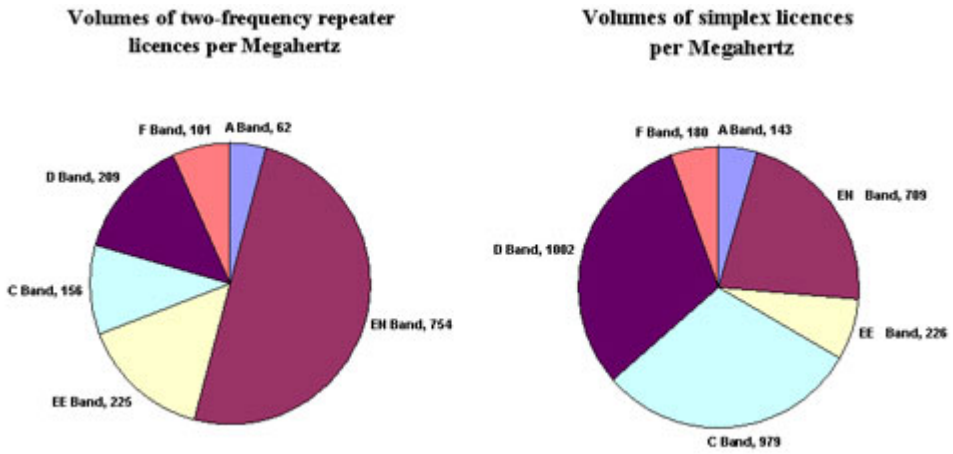
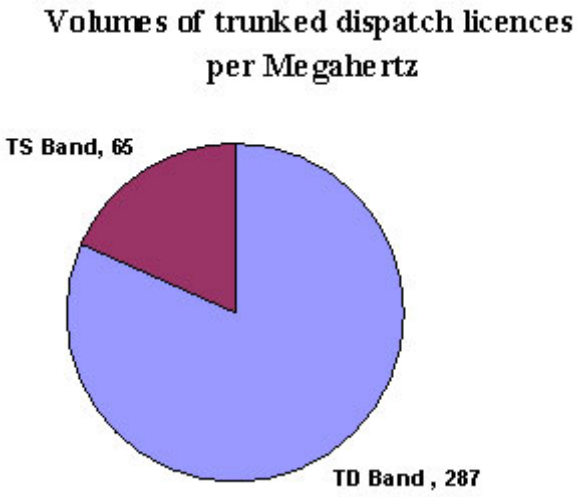


Figure 2: Volumes of land mobile (trunked dispatch) licences



The A band (81 MHz) currently has the lowest number of LMR licences. This low utilisation reflects the development and uptake of technology in higher frequencies, where the smaller antenna form factor is more practical, while a good propagation range is still possible. Currently, digital LMR equipment manufacturers are not targeting A band.

According to the statistics, the VHF E band (which includes the EN and EE bands) are the most congested two-frequency land mobile[12] bands. One of the reasons for this high demand is that these bands provide better coverage than other land mobile bands in the higher UHF bands. New licences are very difficult to coordinate in these bands due to the large number of existing licences requiring protection, especially when coordinating with legacy 25 kHz analogue voice services. The current number of 25 kHz licences in the E band is 626, of which 620 are

for analogue voice services.

This situation suggests that more spectrally efficient technologies are required in order to alleviate the current congestion in the E band. The congestion could be alleviated by migrating legacy analogue LMR services operating in 25 kHz channels to the more efficient 12.5 kHz channels.

Furthermore, the offset channel plan currently used in this band (discussed in the next section and illustrated in Figure 4) precludes the introduction of digital services in the short term due to the significant risk of adjacent channel interference. Migration to the more efficient 12.5 kHz channel spacing would therefore also enable digital LMR to be introduced into E band at the end of the migration period.

In the trunked dispatch bands (TD & TS), there is still a reasonable amount of spectrum available for new services, especially in the TS band (800 MHz). The TD band (400 MHz) shows greater usage, which could lead to congestion of the band, particularly in densely populated areas.

In the simplex land mobile bands, utilisation is mainly concentrated in the UHF bands (C and D simplex bands). These volumes of licensing reflect the use of simplex radio systems in more geographically confined operations, where UHF bands provide good coverage with lower power handset-to-handset communications. Simplex communication has a high demand as it enables basic voice communication capabilities for a large variety of business and other activities (i.e. motorsports, security companies, construction, transport and utility companies).

In regards to the issue of congestion in land mobile bands, it is important to note that congestion is more likely to occur in the main city centres throughout the country, where the demand for land mobile systems is highest.

Footnote

[12]Two-frequency land mobile systems use dedicated frequency channels for transmission and reception (duplex). Parties can listen and talk at the same time.

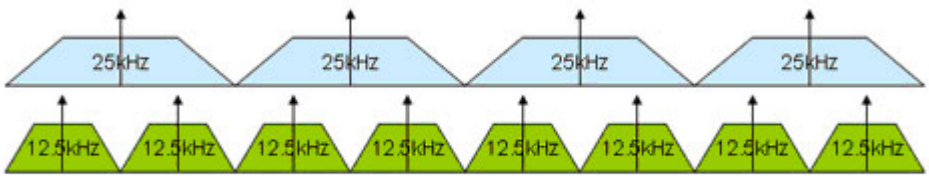
4.2 Digital LMR in the 800 MHz TS band

Currently, the policy for the 800 MHz trunked dispatch band allows analogue LMR with 25 kHz channel spacing, digital APCO LMR (25 kHz or 12.5 kHz configurations), and digital TETRA LMR (25 kHz) systems. In order to ensure the orderly and efficient allocation of 12.5 kHz APCO channels within the current 25 kHz channel plan, a 12.5 kHz band plan was laid over the existing 25 kHz band plan, as illustrated in Figure 3 below.

Future APCO systems may include 6.25 kHz channels, thus allowing a further increase in the number of available channels. However, the standards that specify these narrower bandwidths are yet to be defined. The Ministry will review the impact of such developments once the standards have been finalised.

In addition, engineering practices have been published in PIB 38 to address potential adjacent channel interference issues between TETRA, APCO and analogue emissions. These engineering practices were identified as being necessary to manage the wider emission characteristics of TETRA systems. Since the implementation of the TS band as a hybrid digital-analogue band in 2008, there has been considerable uptake of digital LMR in the band. The Ministry notes that, to date, no cases of inter-system interference have been reported.

Figure 3: 12.5 kHz channel plan (TS narrow channels or “TSN” channels) interleaved with legacy 25 kHz channels in TS band



Question 4

Do you agree with the Ministry's analysis of the utilisation of land mobile services in the VHF and UHF bands?

Question 5

Should A band (81 MHz) be considered in the planning for the introduction of digital systems? Do you foresee a demand for digital land mobile services in A band?

Question 6

In E band, do you agree that migrating legacy 25 kHz analogue channels to the more efficient 12.5 kHz channels is required to ease congestion? Should this approach also be applied to other land mobile bands using 25 kHz analogue LMR channels?

Question 7

Under the Radiocommunications Regulations 2001, a minimum of five years' notice must be given to incumbent licensees of the introduction of a new channel plan in the E band. However, this notice period may be less if a transition plan is agreed with licensees. Would you be willing to consider a transition period of less than five years to implement digital LMR in the E band?

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5. Suitability of current bands for the introduction of digital Land Mobile

5.1 Managing coexistence of analogue and digital emissions

Broadly, there are two approaches for managing the coexistence of analogue and digital emissions in the same band: the use of interleaved channel plans in the band, or segmentation of the band.

The approach taken in the implementation of digital services in the 800 MHz TS band was to interleave a new 12.5 kHz channel plan as illustrated in Figure 4. This has proven to be advantageous, as it has allowed existing licensees to maintain their current analogue services while new digital services have been licensed in interleaved channels. In addition, new channel plans (i.e. 6.25 kHz) can be accommodated if required.

Band segmentation would involve splitting the current band into two sections; one for analogue (incumbent analogue licensees can stay in this segment) and one for digital (incumbent analogue licensees must migrate to other band or take up digital technology). Segmentation of a band into digital and analogue bands is more difficult to achieve in heavily congested bands due to the coordination difficulties and costs associated with transitioning a large number of users to a new channel plan.

5.2 Current channel plans

5.2.1 Interleaved bands

All UHF LMR bands (TD, TDX, C, CX, CN, CNX, D, DX, DN and DNX bands) and some VHF bands (A, EE and EEX bands) currently have interleaved channel plans.

These bands could potentially include digital services designed to operate in 25 kHz, 12.5 kHz and 6.25 kHz channels without the need for band migrations (provided the selected technology standards are compatible with existing analogue equipment).

Figure 4: Interleaved bands

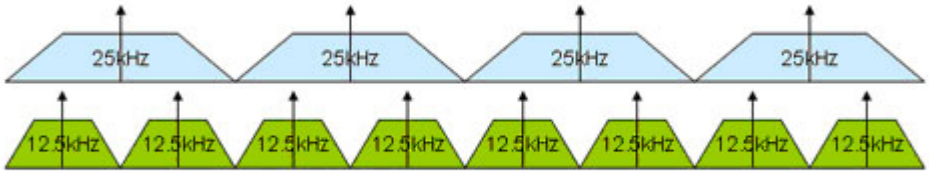
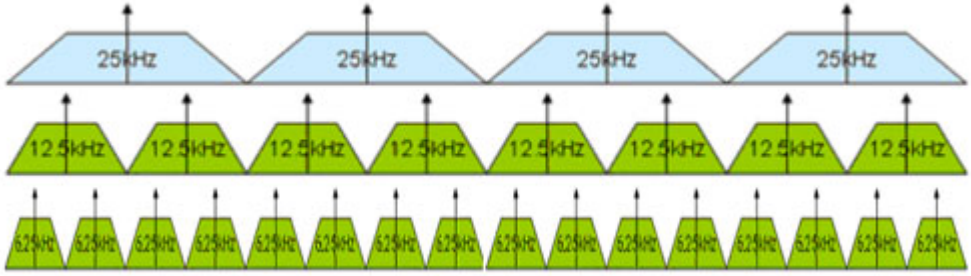


Figure 5: Interleaved bands including a 6.25 kHz channel plan



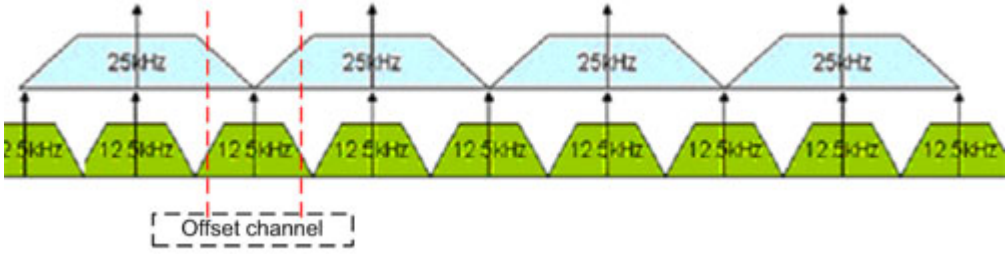
5.2.2 Offset bands

The remaining VHF bands (E, EN and ENX bands) have offset channel plans. The offset channel plan designed for these bands was a response to the band congestion arising from the use of 25 kHz channels for analogue services. By introducing an underlying offset channel plan for the newer 12.5 kHz analogue channels, channel re-use benefits were obtained by utilising the ‘white space’ spectrum between emissions from adjacent channels.

These benefits were applicable to analogue emissions; however, they are not applicable in the case of digital emissions due to the risk of adjacent channel interference. The reason for this is that analogue emissions tend to concentrate their power closer to the centre frequency and within a narrower bandwidth than the channel space assigned in the band (i.e. the effective emission bandwidth in a 25 kHz analogue LMR channel only occupies approximately 16 kHz). Since analogue LMR channels do not spread their power across the entire allocated channel space, its is possible to licence narrower 12.5 kHz analogue channels (which also concentrate their power in the same way) in the offset gap between 25 kHz analogue channels, without causing harmful interference (as shown in Figure 6).

Unlike analogue emissions, digital emissions tend to spread their power across the entire channel, and therefore mixing digital and analogue emissions in offset bands can cause adjacent channel interference (from digital into analogue). These offset bands would require either band segmentation or migration plans to be implemented in order to protect existing analogue services.

Figure 6: Offset bands



5.3 Conclusion

In summary, the Ministry is of the view that the introduction of digital LMR in bands using interleaved channel plans is more feasible and spectrally efficient than in bands using offset channel plans. The Ministry notes, however, that the feasibility and efficiency of introducing digital LMR into bands with interleaved channel plans is still dependent on the technical characteristics of the digital equipment to be introduced and those of the existing analogue equipment, such as the signal-to-noise ratio, and co-channel and adjacent channel emission limits. These characteristics are defined by the relevant standards for the technologies under consideration.

Question 8

Do you agree with the Ministry's assessment that bands with interleaved channel plans are suitable for the introduction of digital land mobile systems, while bands with offset channel plans will require segmentation or transition plans? If not, then please explain.

5.4 Comparison of digital LMR standards

The following table provides a comparison of the available standards for digital LMR (excluding the 800 MHz band) and some examples of proprietary standards. Further information on the standards is available in section 10.3, Appendix C.

Table 1: Comparison of different digital LMR standards

Standard type	Frequency bands (MHz)	Channel spacing (kHz)	Number of users per channel	Access mode	Analogue/ digital	Suitable for NZ bands?
Generic						
AS/NZS 4768.1:2006	29.7–45 70-87.5 148-174 403-520 520-1000	12.5 25	Not defined	Emissions must comply with emission masks	digital	Yes
Open						
APCO	136-174 403-512	12.5 (phase 1) 6.25 (phase 2)	1	FDMA	both	Yes
TETRA (ETSI) *excluding 800 MHz	410–420/420–430 450-460/460-470 385-390/395-399.9	25	4	TDMA	digital	No (see footnote 13, next page)
DMR (ETSI)	136-174 380-470 450-520	12.5 6.25	2	TDMA FDMA	digital	Yes
Proprietary (examples)						
EDACS	136-174 378-430 450-512 450-470	25 12.5	1	FDMA	both	Yes
NEXEDGE	136-174 400-470	25 12.5 6.25	1	FDMA	both	Yes

MOTOTRBO	136-174 403-470 450-512	12.5 25	2	TDMA	both	Yes

5.4.1 Generic standards

Generic equipment standards have the advantages of generally being more comprehensive in regards to the information they provide, and of being subject to regular reviews. These standards do not just cover technical specifications but they also provide guidance on system configuration and measurements (i.e. AS/NZS 4768.1:2006, described in Appendix C section 10.3).

5.4.2 Proprietary standards

Proprietary standards can be beneficial, as they tend to push technological development. On the other hand, adopting proprietary standards can lead to some economic penalties, since users may only be able to obtain equipment from a single manufacturer. There are a number of proprietary digital LMR standards available in the market.

5.4.3 Open standards

Open standards are standards made available to the general public and are developed by industry through a collaborative and consensus-based process (i.e. TETRA[13], APCO). Open standards are generally developed with the view of worldwide or regional adoption and users can benefit through the consequent economies of scale.

With respect to the available standards for digital LMR, it has been observed that APCO, TETRA (ETSI) and ETSI DMR open standards have been widely adopted abroad. Most of the proprietary digital LMR standards have been developed from the ETSI DMR set of standards, with modifications in areas such as encryption, network design and digital calling techniques. Since most of these products are ETSI DMR compliant, they would also comply with most of the parameters prescribed by the generic AS/NZS 4768.1:2006 standard, which is built upon ETSI standards.

In regards to the APCO standard, this has been designed specifically to coexist with legacy analogue land mobile systems and has been proven to meet this requirement. The ability of a new radio technology to interoperate and coexist with an existing technology is known as ‘backwards compatibility’. Users generally favour systems that are backwards compatible, since this allows them to gradually replace their existing radio hardware and therefore to spread the cost of replacement over time.

Question 9

In your opinion, which of the standards types (open, generic or proprietary) would be of most benefit to New Zealand?

Question 10

If your organisation moved to start using digital land mobile radio, then which standard/s would be favoured and why?

Footnote

[13]TETRA systems, by specification, require a minimum transmit-receive frequency split of 10 or 45 MHz. The current configuration of the New Zealand trunked dispatch bands in the 400 MHz UHF spectrum provides a split of 8 MHz. This frequency split would potentially

preclude TETRA services from being implemented in the 400 MHz band in New Zealand.

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6. Technical considerations

6.1 Land mobile systems using shared channels

Simplex services are licensed on a shared basis, allowing multiple mobile users to access the same simplex channel. In order to reduce interference between users, a Continuous Tone-Coded Squelch System (CTCSS) is assigned to each analogue simplex user in order to control potential co-channel collisions and alert operators when the channel is busy.

It is expected that new digital LMR equipment introduced into the market will be compatible with analogue simplex systems. In this regard, the ETSI standard EN 300 471 outlines the requirements for coexistence between digital and analogue systems in shared channels, requiring the digital radio to sense the channel first and only transmit if the channel is idle. This interference control technique can effectively reduce potential interference between digital LMR and analogue simplex users, in addition to the existing CTCSS analogue mode.

6.2 Engineering of analogue and digital LMR

When engineering digital systems, the signal quality objective is specified as a bit error rate (BER). The Carrier-to-Interference ratio (C/I) has the most significant impact on the BER of a practical digital radio system. While analogue systems do not use the BER parameter to establish the service quality threshold, C/I is a parameter common to both analogue and digital radio. For a practical system, the faded C/I must be greater than the co-channel receiver interference (blocking) ratio. Hence, it is common to specify a C/I corresponding to a pre-determined wanted BER when co-engineering digital and analogue systems.

Further, the re-use distance is the distance required to ensure a suitable grade of service between co-channel services. Generally, the re-use distance is constrained by topographic obstructions, and the coverage area of a base station is the area of service within which the licensee has a reasonable expectation of protection from harmful interference.

PIB 38 (section 3.6.1) defines the protection area for land mobile services in the 800 MHz trunked dispatch band as a continuous contour equivalent to a signal level of -106 dBm or a theoretical coverage radius of 58 km. However, in areas where the local topography may not provide sufficient obstruction loss to isolate co-channel services, the proposed service must protect existing services to a minimum C/I of 18 dB[14] at the edge of their coverage area.

Question 11

In the case of shared simplex channels, do you consider the current technical safeguards (such as CTCSS and the ETSI-prescribed channel sensing) to be adequate for coexistence between digital and analogue LMR systems in shared simplex channels?

Question 12

In regards to engineering guidelines, do you consider the current guidelines contained in PIB 38 to be appropriate for engineering digital LMR licences in the UHF and VHF bands?

Footnote

[14]The C/I level of 18 dB has been obtained considering dynamic conditions (fading) for analogue, APCO and TETRA systems. This figure takes into account the C/I requirements to maintain a Delivered Audio Quality (DAQ) grade of 3.4 (as specified in TSB88.1, table A-1). This value is also used in ITU-R SM.337-4 (table 1), where a calculation example is given for determining frequency and distance separation between land mobile services in the UHF band.

7. Proposals

In view of the earlier analysis in this paper, the Ministry proposes the following framework for the introduction of digital LMR in the commercial VHF and UHF bands:

1. Introduce licensing for digital LMR technologies in all those bands where an interleaved channel plan is currently available (EE, EEX, TD, TDX, TX, C, CX, CN, CNX, D, DX, DN and DNX bands). Currently, these bands cater for 25 kHz and 12.5 kHz channel bandwidths and will continue to offer these configurations. In addition, channel plans catering for 6.25 kHz technologies will be implemented.
2. Migrate legacy analogue LMR services operating in 25 kHz channels in E band to 12.5 kHz channels to relieve congestion. Those bands with an offset channel design (E, EN and ENX) will continue to operate under this design until the end of the migration period of five years (or less if agreed by licensees). At present, digital services cannot be introduced in these bands due to the risk of adjacent channel interference. At the end of the migration period, digital LMR can be introduced in these bands to occupy 12.5 kHz and 6.25 kHz channel spacing with an interleaved band arrangement. In regards to migration processes, the Ministry will follow the Radiocommunications Regulations and guidelines to provide security of tenure to existing licensees.
3. Introduce a moratorium in E band for new licensing of 25 kHz land mobile technologies employed to transmit data (SCADA). Existing services will remain operating in E band, but new 25 kHz services will no longer be licensed in E band. Instead, these services can take advantage of newer 12.5 kHz digital technologies in other VHF bands or UHF LMR bands.
4. Introduce a moratorium for new licensing of 25 kHz analogue land mobile systems in all VHF and UHF LMR bands (the Ministry recognises that this may be difficult for some users, therefore the aim of this specific proposal is to seek feedback).
5. Require digital LMR systems to comply with standards that ensure backwards compatibility with analogue LMR (i.e. APCO, AS/NZ 4768 and relevant ETSI standards in the case of proprietary equipment) in order to minimise interference risks to existing analogue LMR systems. As per current practice, TETRA systems will continue to be licensed in the 800 MHz TS band only, considering that the current frequency splits are not compatible with this system in the lower UHF bands.
6. Require engineering of digital LMR services to observe the relevant engineering guidelines prescribed in PIB 38 (section 3.6.1), which defines the protection area as a continuous contour equivalent to a signal level of -106 dBm or a geographically contained service area of 58 km. However, in areas where the local topography may not provide sufficient obstruction loss to isolate co-channel services, the proposed service must protect existing services to a minimum C/I of 18 dB at the edge of their coverage area.

Question 13

Do you agree with the Ministry’s proposals for the introduction of digital LMR in the VHF and UHF bands?

Question 14

In regards to the introduction of digital LMR in the VHF and UHF bands, are there any other issues you would like to raise?

8. Summary of questions

Question 1

Do you agree that the current policy and licensing framework should be expanded to permit digital LMR in the VHF and UHF bands (see section 10.1, Appendix A, for a table giving the frequency ranges for these bands), in addition to the 800 MHz TS band?

Question 2

Should New Zealand adopt a similar approach to that of the United States by planning a deadline for all 25 kHz analogue LMR systems to migrate to the more efficient 12.5 kHz channels? If yes, then what would be a reasonable timeframe?

Question 3

Do you foresee a need to accommodate TETRA systems in bands other than 800 MHz in New Zealand? If so, which bands and why?

Question 4

Do you agree with the Ministry's analysis of the utilisation of land mobile services in the VHF and UHF bands?

Question 5

Should A band (81 MHz) be considered in the planning for the introduction of digital systems? Do you foresee a demand for digital land mobile services in A band?

Question 6

In E band, do you agree that migrating legacy 25 kHz analogue channels to the more efficient 12.5 kHz channels is required to ease congestion? Should this approach also be applied to other land mobile bands using 25 kHz analogue LMR channels?

Question 7

Under the Radiocommunications Regulations 2001, a minimum of five years' notice must be given to incumbent licensees of the introduction of a new channel plan in the E band. However, this notice period may be less if a transition plan is agreed with licensees. Would you be willing to consider a transition period of less than five years to implement digital LMR in the E band?

Question 8

Do you agree with the Ministry's assessment that bands with interleaved channel plans are suitable for the introduction of digital land mobile systems, while bands with offset channel plans will require segmentation or transition plans? If not, then please explain.

Question 9

In your opinion, which of the standards types (open, generic or proprietary) would be of most benefit to New Zealand?

Question 10

If your organisation moved to start using digital land mobile radio, then which standard/s would be favoured and why?

Question 11

In the case of shared simplex channels, do you consider the current technical safeguards (such as CTCSS and the ETSI-prescribed channel sensing) to be adequate for coexistence between digital and analogue LMR systems in shared simplex channels?

Question 12

In regards to engineering guidelines, do you consider the current guidelines contained in PIB 38 to be appropriate for engineering digital LMR licences in the UHF and VHF bands?

Question 13

Do you agree with the Ministry's proposals for the introduction of digital LMR in the VHF and UHF bands?

Question 14

In regards to the introduction of digital LMR in the VHF and UHF bands, are there any other issues you would like to raise?

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9. Next steps

After analysing the submissions received on this discussion paper, the Ministry will:

- Report to the Minister for Communications and Information Technology on the outcomes of the consultation process and recommend a preferred approach for future licensing of digital LMR:
- Publish the submissions and outcomes; and
- Update the relevant Ministry documentation and implement the outcomes.

10. Appendices

10.1 Appendix A: Land Mobile Bands

VHF

A band	Base Tx range		Mobile Tx range		Channel Spacing
	81 MHz	83.5 MHz	84.98125MHz	87.46875 MHz	12.5 kHz
AX (simplex)	84.0375 MHz	84.975 MHz			12.5 kHz
EN band	Base Tx range		Mobile Tx range		Channel Spacing
	151.0125 MHz	153.4 MHz	153.60625 MHz	155.18125 MHz	12.5 kHz
ENX (simplex)	150.05 MHz	150.9875 MHz			12.5 kHz
	153.43125 MHz	153.59375 MHz			
E band*	151.025 MHz	153.4 MHz	155.20625 MHz	155.18125 MHz	25 kHz
EE band	Base Tx range		Mobile Tx range		Channel Spacing
	162.5875 MHz	165.325 MHz	167.1875 MHz	169.925 MHz	12.5 kHz
EEX (simplex)	165.7125 MHz	166.7875 MHz			12.5 kHz
	170.3125 MHz	174 MHz			

UHF

TD band	Base Tx range		Mobile Tx range		Channel Spacing
	414.1125 MHz	419.100 MHz	406.100 MHz	411.500 MHz	12.5 kHz
TDX (simplex)	414.000 MHz	414.100 MHz			12.5 kHz
C band	Base Tx range		Mobile Tx range		Channel Spacing
	455.3250 MHz	458.3250 MHz	450.2875 MHz	453.2875 MHz	25 kHz
CX (simplex)*	449.7625 MHz	449.9875 MHz			25 kHz
	453.3125 MHz	463.6125 MHz			
	454.9875 MHz	455.2875 MHz			
CN band	455.31875 MHz	458.3375 MHz	450.275 MHz	453.29375 MHz	12.5 kHz
CNX (simplex)	449.750 MHz	450.000 MHz			12.5 kHz
	453.30265 MHz	453.6250 MHz			
	454.975 MHz	455.30625 MHz			
D band	Base Tx range		Mobile Tx range		Channel Spacing
	461.825 MHz	464.800 MHz	467.01250 MHz	469.9875 MHz	25 kHz
DX (simplex)*	458.350 MHz	458.525 MHz			25 kHz
	458.625 MHz	458.650 MHz			
	461.4875 MHz	461.7875 MHz			
	464.825 MHz	465.175 MHz			
	466.6875 MHz	466.9625 MHz			
DN band	461.81875 MHz	464.80625 MHz	467.00625 MHz	470.000 MHz	12.5 kHz

DNX (simplex)	458.3375 MHz	458.5375 MHz			12.5 kHz
	458.6125 MHz	458.6625 MHz			
	461.475 MHz	461.80625 MHz			
	464.81875 MHz	465.1875 MHz			
	466.675 MHz	466.800 MHz			
	466.850 MHz	466.99375 MHz			
F band	Base Tx range		Mobile Tx range		Channel Spacing
	478.000 MHz	487.975 MHz	472.0125 MHz	493.9875 MHz	25 kHz
FX (simplex)*	470.500 MHz	470.975 MHz			25 KHz
	471.525 MHz	471.925 MHz			
	476.025 MHz	476.375 MHz			
	477.450 MHz	477.975 MHz			
	482.000 MHz	483.975 MHz			
	488.000 MHz	489.975 MHz			
FNX (simplex)	470.500 MHz	471.000 MHz			12.5 kHz
	471.500 MHz	471.99375 MHz			
	476.00625 MHz	476.400 MHz			
	477.425 MHz	477.98125 MHz			
	481.99375 MHz	483.98125 MHz			
	487.99375 MHz	489.99375 MHz			
FN band	477.99375 MHz	481.98125 MHz	472.00625 MHz	475.99375 MHz	12.5 kHz
	483.99375 MHz	487.98125 MHz	490.00625 MHz	494.000 MHz	
TX (simplex)	868.100 MHz	869.025 MHz			Channel Spacing
					25 kHz

	TS 858 MHz Band	864 MHz	813 MHz	819 MHz	25 kHz

10.2 Appendix B: Current LMR Standards in New Zealand

The Radiocommunications (Radio Standards) Notice 2008[15] details the technical requirements and standards for land mobile equipment in New Zealand. The following standards are currently applicable:

- AS 4295:2004: Analogue speech (angle modulated) equipment operating in land mobile and fixed services bands in the frequency range 29.7 MHz to 1 GHz
- ETS 300 086: VHF/UHF Land mobile - angle modulation - 12.5/25 kHz channels (30 - 1000 MHz)
- RFS 21: VHF Land mobile – amplitude modulation – 12.5 kHz channels (30 – 300 MHz)
- RFS 32: Specification for Radio Apparatus: UHF Trunked Dispatch Service Using Angle Modulation with 25 kHz Carrier Frequency Separation and a Maximum Deviation of ±5 kHz
- EN 300 394-1: Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 1: Radio
- EN 300 086: Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service
- CFR47 Part 90: FCC: Private land mobile radio services

Footnote

[15] Radiocommunications (Radio Standards) Notice 2008 can be found here.

10.3 Appendix C: Digital LMR Standards

AS/NZS 4768.1:2006

The generic standard AS/NZ 4768.1:2006 outlines the radio frequency aspects of digital land mobile equipment in the frequency range 29.7 MHz to 1 GHz (digital radio equipment operating in land mobile and fixed services bands in the frequency range 29.7 MHz to 1 GHz - radiofrequency requirements). This standard provides emission limits for land mobile transmissions and, according to the compatibility analysis performed for the TS 800 MHz band, the TETRA emissions did not meet these limits. However, this issue was addressed by providing engineering guidelines in PIB 38 to ensure harmonious coexistence between TETRA, APCO and legacy analogue systems.

TETRA (ETSI)

Terrestrial Trunked Radio (TETRA) is an open digital trunked mobile radio standard developed by ETSI. This is a high end digital LMR technology that allows up to four users to share one single 25 kHz channel (using TDMA). This technology is designed to meet the requirements of traditional Professional Mobile Radio (PMR) users. TETRA is generally implemented in bands reserved specifically for its use and not shared with radio systems using other standards. TETRA standard specifications are contained in ETSI TS 100 392-2.

Specific ETSI Standards

The European Telecommunications Standards Institute (ETSI) participates in the European Community regulatory activities to harmonise radiocommunications in Europe. ETSI has published the following standards applicable to digital LMR technologies:

EN 300 471:

Electromagnetic Compatibility and Radio spectrum Matters (ERM); Land Mobile Service; rules for access and the sharing of common used channels by equipment complying with EN 300 113; Part 1: Technical characteristics and methods of measurement.

TS 102 490:

Electromagnetic compatibility and Radio spectrum Matters (ERM); Peer-to-Peer Digital Private Mobile Radio using FDMA with a channel spacing of 6,25 kHz with e.r.p. of up to 500 mW.

EN 301 166:

Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment for analogue and/or digital communication (speech and/or data) and operating on narrow band channels and having an antenna connector; Part 1: Technical characteristics and methods of measurement.

EN 300 390:

Electromagnetic Compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment intended for the transmission of data (and speech) and using an integral antenna; Part 1: Technical characteristics and test conditions.

EN 300 113:

Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector; Part 1: Technical characteristics and methods of measurement.

APCO P25

P25 standards have been designed to meet public safety user needs by providing high quality digital, narrowband communications. Current APCO equipment allows backwards compatibility with analogue LMR systems by offering 25 kHz and 12.5 kHz analogue interfaces as well as 12.5 kHz digital interfaces. P25 equipment is also available for the requirements of commercial users, with P25 Phase 1 offering a spectral efficiency of two voice channels per 25 kHz channel bandwidth using FDMA. P25 Phase 1 equipment is backwards compatible with analogue equipment operating in 25 kHz channels. There is also a P25 Phase 2 currently under development. P25 Phase 2 will offer a spectral efficiency of at least one voice channel per 6.25 kHz (using FDMA and TDMA). The frequency split of APCO technology supports separations of 3, 5, 39 and 45 MHz and therefore current trunked dispatch bands in the 400 MHz UHF are suitable. The APCO P25 set of standards is specified by ANSI/TIA-102.

EDACS

EDACS is a two-way trunked radio system operating on 25 kHz or 12.5 kHz channels in VHF and UHF frequency bands, providing two voice channels in one 25 kHz channel (using FDMA). The development of the standards for the EDACS system has been carried out by the Telecommunication Industry Association (TIA) in the United States, a recognised standardisation organisation. Specifications based on EDACS technology provide backwards compatibility with existing proprietary EDACS equipment.

ETSI Digital Mobile Radio (DMR)

DMR is a set of standards that belong to the ETSI open standards family. This set of standards is comprised of the following specifications (available from the ETSI website[16]):

TR 102 398	Digital Mobile Radio (DMR) General System Design
TS 102 361	Digital Mobile Radio (DMR) Systems
TS 102 362	Conformance testing for the Digital Mobile Radio (DMR)
TS 102 490	Peer-to-Peer Digital Private Mobile Radio using FDMA with a channel spacing of 6,25 kHz with e.r.p. of up to 500 mW
TR 102 335-1	System reference document for harmonized use of Digital Mobile Radio (DMR); Part 1: Tier 1 DMR, expected to be for general authorization with no individual rights operation
TR 102 335-2	System reference document for harmonized use of Digital Mobile Radio (DMR); Part 2: Systems operating under individual licences in the existing land mobile service spectrum bands

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Footnote