

Ministry of **Economic  
Development**



*M a n a t ū   Ō h a n g a*

# **Allocation of 500 MHz Spectrum for Public Protection and Disaster Relief Services**

**A Consultation Paper**

November 2007

First published in November 2007 by the  
Radio Spectrum Policy and Planning Group  
Energy and Communications Branch  
Ministry of Economic Development  
PO Box 1473, Wellington, New Zealand  
<http://www.med.govt.nz>

ISBN 978-0-478-31621-6 (HTML)

ISBN 978-0-478-31622-3 (PDF)

## **Disclaimer**

The opinions contained in this document are those of the Ministry of Economic Development and do not reflect official government policy. Readers are advised to seek specific legal advice from a qualified professional person before undertaking any action in reliance on the contents of this publication. The contents of this discussion paper must not be construed as legal advice. The Ministry does not accept any responsibility or liability whatsoever whether in contract, tort, equity or otherwise for any action taken as a result of reading, or reliance placed on the Ministry because of having read, any part, or all, of the information in this discussion paper or for any error, inadequacy, deficiency, flaw in or omission from the discussion paper.

# Contents

---

<b>EXECUTIVE SUMMARY .....</b>	<b>4</b>
<b>1. GLOSSARY.....</b>	<b>5</b>
<b>2. PURPOSE.....</b>	<b>6</b>
<b>3. BACKGROUND.....</b>	<b>7</b>
<b>4. PPDR SPECTRUM REQUIREMENTS.....</b>	<b>8</b>
4.1 Existing Use.....	8
4.2 Planned Use.....	9
4.3 VHF Issues.....	9
4.4 UHF Issues.....	9
4.5 International Issues.....	10
4.6 Summary.....	10
<b>5. PROPOSED NEW ESC SPECTRUM BAND FOR PPDR SERVICES.....</b>	<b>11</b>
5.1 Working Group 2 Recommendation.....	11
5.2 Current Status of Proposed Band.....	11
5.3 Interface considerations with Neighbouring Bands.....	12
<b>6. METHOD OF ALLOCATION.....</b>	<b>14</b>
<b>7. SUBMISSIONS.....</b>	<b>15</b>
<b>APPENDIX A.....</b>	<b>17</b>
Potential Interference from Adjacent Transmitters.....	17
<b>APPENDIX B.....</b>	<b>19</b>
Potential Interference into TV Receivers from ESC Transmitters.....	19
<b>APPENDIX C.....</b>	<b>21</b>
Proposed ESC Band Draft Channel Plan.....	21

## Executive Summary

---

The Government agencies involved in Public Protection and Disaster Relief (PPDR) have a growing demand for mobile communications. This is driven by the increasing complexity of their roles and the need for greater security and interoperability with other agencies, both locally and internationally. This demand has increased their need for radio spectrum which cannot be met from their current allocations.

A working group addressing this issue has reported to the Ministry of Economic Development (MED) with a recommendation that the ESB (VHF, 138 - 144 MHz) and proposed ESC (UHF, 494 - 502 MHz) bands be allocated exclusively for emergency services use. If it is considered appropriate to accept the working group's recommendation then it will be necessary to identify the most appropriate method for the band to be allocated and managed.

The 494-502 MHz band is currently under a Ministerial Directive which places an embargo on the issue of any long-term licences. In releasing this band for emergency service mobile radio use, consideration must also be given to arrangements to manage interference at the band boundaries and with adjacent radio frequency bands.

These issues are discussed in detail in the paper and those responding are invited to comment on a number of key questions including:

- confirming that the current ESB and proposed ESC band allocations are the optimal use of the spectrum;
- whether the constraints on use of adjacent spectrum are considered appropriate to manage interference issues; and
- the most suitable method of allocating and managing the proposed band.

# 1. Glossary

---

APCO P25	Association of Public Safety Communications Officials (Project 25) - refers to a suite of standards for digital radio communications developed for use by federal, state/province and local public safety agencies in North America
e.i.r.p.	effective isotropic radiated power
ES	Emergency Services
ESB	Emergency Services Band B (138 – 140.5/141 – 143.5 MHz)
ESC	Emergency Services Band C (proposed - 494 – 502 MHz)
ESD	Emergency Services Band D (812 – 813/857 – 858 MHz)
ETSSG	Emergency Telecommunications Services Steering Group – group set up by Cabinet to oversee emergency telecommunications projects
ITU (-R)	International Telecommunication Union (-Radio Sector)
LMR	Land Mobile Radio
MHz	Megahertz – measurement of radio frequency
PPDR	Public Protection and Disaster Relief – internationally recognised generic term referring to emergency services
PSRFMG	Public Safety Radio Frequency Management Group – a group of ES representatives set up to manage spectrum allocated to ES
RX	Receive
TX	Transmit
UHF	Ultra High Frequency – radio frequencies between 300 and 3000 MHz
VHF	Very High Frequency – radio frequencies between 30 and 300 MHz
WG2	Working Group 2 - set up under the ETSSG to address spectrum allocation issues
WRC 03	World Radio Conference 2003

## 2. Purpose

---

This paper outlines a proposal for the allocation of the ESB (VHF, 138-144 MHz) and proposed ESC (UHF, 494 to 502 MHz) spectrum bands<sup>1</sup> for mobile radio use by public protection and disaster relief (PPDR) services. It discusses the spectrum requirements of such services and the options available to meet them. It further addresses ways of managing the licensing process and the effect on users of adjacent spectrum.

The Ministry of Economic Development now invites comment on this proposal. Details of how to make submissions are provided in section 7 Submissions.

---

<sup>1</sup> Other bands designated for PPDR services are the ESA band , employed largely for analogue voice communications in rural and remote areas, and the ESD band , which is reserved for future PPDR services.

### 3. Background

---

The Government wishes to improve the spectrum efficiency, security and interoperability of radio networks across Government agencies. This is being implemented through the Public Protection and Disaster Relief (PPDR) Radiocommunications Strategy under the direction of the Emergency Telecommunications Services Steering Group (ETSSG).

Responsibility for developing the detailed PPDR Strategy is divided between three ETSSG working groups. These are:

- WG1 Interoperability Standard, which has determined that the APCO P25 standard be adopted under the e-GIF<sup>2</sup> framework for digital PPDR radiocommunications;
- WG2 Spectrum Allocation; and
- WG3 Radiocommunications Strategy

The Spectrum Allocation Group (WG2) was formed in November 2006 with representation from the NZ Police, NZ Fire Service, Customs, State Services Commission, Defence, Ministry of Civil Defence and Emergency Management, Ambulance NZ and Ministry of Economic Development.

From November 2006 to March 2007 the group met a number of times and reached consensus on the preferred spectrum bands and channel plans. These were reported back to the ETSSG and the Ministers of Police, Communications and Civil Defence.

In April 2007 the WG2 recommended that the band 494-502 MHz be allocated for PPDR radiocommunications. The Ministry has considered the implications of this recommendation and now invites submissions from interested parties on the key issues, before making final recommendations to the Minister for Communications and Information Technology

---

<sup>2</sup> NZ e-Government Interoperability Framework (<http://www.e.govt.nz/standards/e-gif/apcop25>)

## 4. PPDR Spectrum Requirements

---

Government PPDR agencies provide front line assistance, both routinely for public protection and law enforcement, and during times of disaster and emergency. They include the Police, Fire, Ambulance and Health Boards, Department of Conservation, Customs, Civil Defence and Emergency Management, Defence, Maritime Authorities and Fisheries.

PPDR agencies have a growing demand for radio spectrum to meet their operational needs for mobile voice and narrowband data radiocommunications. This is due to the increasing complexity of their roles together with greater demands for security and interoperability with other agencies, both nationally and internationally.

### 4.1 Existing Use

In New Zealand band and channel allocations for PPDR use have already been made in the following bands:

Frequency Range	Band	Band Label	No. Duplex Channels
75.2-79.2 MHz	VHF	ESA Band	86
138-140.5/141-143.5 MHz	VHF	ESB Band	200
148-149.9 MHz	VHF	CD Band	20
812-813/857-858 MHz	UHF	ESD Band	80

It should be noted that the full complement of channels in the ESA band is not available due to interference (via inter-modulation products) from high power broadcasting in the 88-108 MHz range, and anomalous propagation effects related to Australian assignments. Use of the ESA band is expected to decline over time.

The full complement of channels in the ESB band is not currently available for routine PPDR activities due to shared use with other Government departments. Work is ongoing to address this band coordination issue.

Due to changes in international regulations, assignments in the CD band should be migrated to other bands by 2004.

## 4.2 Planned Use

A recent survey undertaken by Government PPDR agencies has resulted in a forecast of total channel requirements which are summarised below.

Type of Service	Channels Required
UHF Duplex	297
UHF Simplex	92
VHF Duplex	251
VHF Simplex	80

## 4.3 VHF Issues

Comparison of the number of usable channels in the existing VHF bands (ESA and ESB) with the number required shows that these bands almost meet forecast requirements for VHF duplex channels. Additional band capacity may be realised via improved operational, engineering and co-ordination techniques to ensure compatibility of existing, planned and new licences, suggesting that additional VHF band capacity is not required for allocation for PPDR uses.

**Question 1** – *Do you consider continuing the allocation of the ESB band for PPDR Services in New Zealand to be an appropriate use of the spectrum resource?*

## 4.4 UHF Issues

The ESD band allocation is limited to 80 channels and hence cannot be used to fulfil the forecast 297 UHF channel requirement. Furthermore, because of propagation issues, providing reliable wide-area coverage using the ESD band would require more expensive infrastructure than that required using spectrum in the 400/500 MHz range. The channel shortfall indicates that some new spectrum should be allocated for PPDR purposes, and propagation characteristics support the concept that this spectrum should be in the lower UHF range.

Due to the lack of UHF bands identified for exclusive PPDR use, some PPDR users are licensed in commercial UHF bands. Exclusive bands are preferred internationally for PPDR purposes, in order to avoid unwanted interference from commercial and other non-PPDR transmissions.

## 4.5 International Issues

To support New Zealand's ITU treaty obligations and international interoperability requirements<sup>3</sup>, the Ministry of Economic Development (MED) is required to consider the following frequencies for narrow-band PPDR mobile radio operation:

138 - 144 MHz  
406.1 - 430 MHz,  
440 - 470 MHz,  
806 - 824/851 - 869 MHz

The ESB allocation enables New Zealand to meet the ITU requirements and support interoperability with Asia-Pacific neighbours, especially Australia, in the VHF range.

The bands 406.1 - 430 MHz and 440 - 470 MHz referred to in ITU-R Res 646 are already extensively used by commercial land mobile radio (LMR) networks and fixed services in New Zealand, and could not easily be made available for exclusive PPDR use. This does not preclude providing temporary access for visiting PPDR units during an emergency or disaster relief situation.

The ESD band allocation enables New Zealand to meet the ITU requirements and support interoperability with Asia-Pacific neighbours in the UHF range.

Currently some PPDR users are licensed in the commercial LMR bands. It is planned that these services migrate to the exclusive ES bands over time.

## 4.6 Summary

In summary:

- Planned VHF spectrum requirements can be met from within the existing emergency services bands;
- International interoperability is maintained via access to the ESB and ESD bands and potentially the 406.1-430 MHz and 440-470 MHz bands;
- There is a shortfall in planned UHF channel requirements that cannot be met from within existing bands; and
- The current shortfall in UHF channels may be satisfied by allocating spectrum in the 400/500 MHz range – see section 5.

---

<sup>3</sup> Report ITU-R M.2033 and Resolves 2 of ITU-R Resolution 646 (WRC-03)

# 5. Proposed New ESC Spectrum Band for PPDR Services

## 5.1 Working Group 2 Recommendation

The ETSSG WG2 has recommended that the band 494 - 502 MHz be allocated for PPDR services. The recommendation proposes that licences are issued exclusively for digital land mobile equipment meeting the APCO 25 standard with assignments using a band plan summarised below. Further details are given in Appendix C.

494	497.5	498.5	502 MHz
Proposed ESC band			
Base receive/ Mobile transmit	Sim <sup>4</sup>	Base transmit/ mobile receive	

## 5.2 Current Status of Proposed Band

The proposed ESC band is currently under a Ministerial Directive<sup>5</sup> which prohibits the assignment of new radio licences for services in the band 494-806 MHz, except for fixed term test and experimentation purposes. The band 518-806 MHz is allocated as crown owned management rights, with spectrum licences issued for television broadcasting. The proposed ESC band does not contain any long-term licences or management rights.

The current ITU and New Zealand allocations for this band are summarised in the following table.

	494-502 MHz	502-510 MHz	510-518 MHz
ITU Region 3 allocation	FIXED, MOBILE and BROADCASTING		
New Zealand allocation (PIB 21)	MOBILE	BROADCASTING	

In Australia the band 494 to 518 MHz is allocated to apparatus licences for general Land Mobile services with the exception of (approx) 501-505 and 511-515 MHz which are reserved for technology-neutral spectrum licences.

**Question 2** – *Do you consider allocation of the 494-502 MHz band to the Mobile Service for PPDR applications in New Zealand to be an appropriate use of the spectrum resource?*

<sup>4</sup> Sim refers to Simplex operation where the same channel is used for both receive and transmit signals  
<sup>5</sup> Statement of Government Policy and Directions to Chief Executive of the Ministry of Economic Development – Notice No 3519 issued 21 May 2007

### 5.3 Interface considerations with Neighbouring Bands

The adjacent spectrum below the proposed ESC band is allocated to LMR and is heavily populated by radio licences. Details of the current and proposed band plans from 484 to 502 MHz are shown in the following chart.

484	488	490	494	497.5	498.5	502 MHz
FN Band (LMR)			Proposed ESC band			
Base transmit/ mobile receive	Sim <sup>6</sup>	Base receive/ mobile transmit	Base receive/ mobile transmit	Sim	Base transmit/ mobile receive	

The chart shows a conventional LMR band plan with base transmit (base TX) channels separated from base receive (base RX) channels. Existing license engineering rules for Land Mobile assignments detailed in PIB 38<sup>7</sup> could be applied to new Land Mobile licences above 494 MHz. More details of the proposed channel plan are provided in Appendix B.

The spectrum immediately above the proposed ESC band, 502 - 518 MHz, is subject to Ministerial Directive 3519 and no long-term licences have been assigned in this band. Above 518 MHz the spectrum is under management rights with spectrum licences issued for high-power TV broadcasting. If the band 494 - 502 MHz were allocated to Land Mobile services, this would place some constraints, as potential sources of interference, on the type of services which could operate in the 502 - 518 MHz band.

An analysis of the potential for interference is included in Appendix A. There are two interference mechanisms that could limit band usage in the 502 - 518 MHz range, namely:

Interference from broadcasting transmissions in the 502 - 510 MHz and 510 - 518 MHz bands blocking or “overpowering” land mobile and base station receivers in the 494-502 MHz.

1. Interference from land mobile services in the 494-502 MHz band into broadcast receivers in the 502-510 MHz range.

In relation to point 1 above, Appendix A shows that, as a suggestion to manage interference into the 494 - 502 MHz band, broadcasting transmissions in the adjacent 8 MHz band from 502 - 510 MHz should be limited to less than 100 Watt e.i.r.p. if they have coverage areas overlapping with Emergency Services in the 494 - 502 MHz band.

In the WG2 draft channel band plan the base receivers are located at the lower end of the proposed 494-502 MHz band, providing an additional separation of at least 4.5 MHz from broadcast transmitters operating in the 502-518 MHz band. They are

<sup>6</sup> Sim refers to Simplex operation where the same channel is used for both receive and transmit signals

<sup>7</sup> [PIB 38 - Radio licence engineering rules and information for approved radio engineers and approved certificates](#)

consequently less likely to suffer interference than mobile receivers operating in the upper 4.5 MHz of the 494-502 MHz.

Appendix A further suggests that it may be possible for higher power transmitters, as used for wide area TV broadcasting, to operate above 510 MHz. This would depend on the selectivity of the receivers operating in the 494-502 MHz band and the nature of out-of-band emissions from high power transmitters.

Appendix A also shows that the 100 Watt e.i.r.p. constraint on broadcast transmissions could be relaxed where there was a low probability of land mobile receivers operating in close proximity to high power TV broadcast transmitters. It is also possible to reduce the risk of interference into LMR mobile terminals by locating the associated base site within the proximity of the TV transmitter. In this way the wanted land mobile transmissions are maximised relative to the high-power broadcast transmissions.

Appendix B analyses the potential for land mobile transmissions in the 494-502 MHz range to cause interference to broadcast reception in the 502-518 MHz range, and concludes that the risk of harmful interference is considered to be very low.

As a result of these studies the following radiated in-band and out-of-band powers are proposed for the spectrum immediately above the proposed ESC band:

494	497.5	498.5	502	510	518 MHz
Proposed ESC band			Reduced radiated power in-band $\leq$ 100 Watts TVBC  Out-of-band $\leq$ -50 dBW below 502 MHz	Higher power transmissions permitted  Out-of-band $\leq$ -50 dBW below 502 MHz	
Base receive/ mobile transmit	Sim	Base transmit/ mobile receive	Possible services include low power broadcasting and short range devices such as wireless microphones	Possible services include high power TV broadcasting and Mobile TV	

**Question 3** – *Are the suggested arrangements to manage interference into and from the band 494-502 MHz appropriate?*

## 6. Method of Allocation

---

There is a variety of methods available to MED for allocating the proposed ESC band. One possibility is for the band to be managed under an administrative licensing regime in the same way as the other bands allocated for PPDR use i.e. ESA, ESB & ESD bands. The administrative licensing process requires any new licence application to be approved by the Public Safety Radio Frequency Management Group (PSRFMG). This method of management is consistent with the management of other bands allocated to PPDR.

If the band is managed under the current administrative licensing regime then the Security of Tenure<sup>8</sup> regulations (currently under development) will provide licence holders with five years' notice of any intention by the Crown to revoke any licence. Further, they will require the Crown to provide a transition plan to an alternative licence in the event that a shorter notice period becomes necessary.

Alternative methods of allocation might be considered that would delegate greater management of the band to the users. For example, the band could be designated a Managed Park<sup>9</sup> for emergency services where the spectrum remains under Crown ownership and all eligible parties have full access to the entire band. It would be up to the parties themselves to coordinate the use of the band, to optimise its use and manage interference.

The Ministry's view is that the current system of administrative licence assignment, on advice from PSRFMG, is proven and stable. PPDR agencies have not indicated how they would prefer to manage the band at this stage, but there may be opportunities to review band management in the future.

**Question 4** - *Do you consider that managing the 494-502 MHz band is best achieved using the administrative licensing regime, as at present?*

---

<sup>8</sup> Ref MED website <http://www.rsm.govt.nz/cms/policy-and-planning/current-projects/radiocommunications/radio-licences-security-of-tenure>

<sup>9</sup> Managed parks are intended to allow a number of users to operate services in a common spectrum band on a shared basis, but without any particular party having exclusive ownership. Park rules would probably include requirements to ensure that actual services were only placed in use after a cooperative process designed to protect the quality of service for the various users of the park.

## 7. Submissions

---

If you wish to respond to the questions posed in this paper please provide your comments by **1 February 2008** to:

PPDR spectrum  
Radio Spectrum Policy and Planning  
Energy and Communications Branch  
Ministry of Economic Development  
PO Box 1473  
WELLINGTON

Fax: 04 499 0969 (with '**PPDR spectrum**' in the Subject line)

[radiospectrum@med.govt.nz](mailto:radiospectrum@med.govt.nz) (with '**PPDR spectrum**' in the Subject line)

It would greatly assist our analysis if you would respond in the following format.

<p><b>PPDR SPECTRUM ALLOCATION</b></p> <p>Your name</p> <p>Your organisation</p> <p>Your contact address OR email address</p> <p>Your DDI or mobile number</p> <p>Your response to question 1. Do you agree with the proposal? If not, please specify the nature of your concern.</p> <p>Your response to question 2, etc</p> <p>Any general comments and suggestions</p>
---

Should you wish to discuss this paper please contact the RSM contact centre at: (free phone) 0508 776 463.

The Ministry may post all or parts of any written submission on its website at [www.rsm.govt.nz](http://www.rsm.govt.nz). The Ministry will consider you to have consented to posting by making a submission, unless you clearly specify otherwise in your submission.

The content of any submissions provided to the Ministry may be subject to release under the Official Information Act 1982. Please state if you have any objection to the release of any information contained in a submission, and in particular, which part(s) you consider should be withheld, together with the reason(s) for withholding the information. The Ministry will take into account all such objections when responding to requests under the Official Information Act 1982.

## **Privacy Act**

The Privacy Act 1993 establishes certain principles with respect to the collection, use, and disclosure of information about individuals by various agencies including the Ministry. It governs access by individuals to information about themselves held by agencies. Any personal information you supply to the Ministry in the course of making a submission will be used by the Ministry only in conjunction with the matters covered by this document. Please clearly indicate in your submission if you do not wish your name to be included in any summary of submissions that the Ministry may publish.

# Appendix A

---

## Potential Interference from Adjacent Transmitters

### APCO 25 Standards

APCO Standards define spurious response rejection as the ability of a receiver to prevent single unwanted signals from causing degradation to the reception of a desired signal. These signals may be at any frequency greater than 50 kHz removed from the wanted carrier.

APCO Standard TIA-102.CAAB-B clause 3.1.9 specifies the receiver spurious response for Class B<sup>10</sup> equipment as 70 dB for mobile and base receivers. The reference sensitivity for the same class of equipment is specified in clause 3.1.4 as -113 dBm. The maximum unwanted spurious signal level able to be tolerated by an APCO 25 receiver before its sensitivity is reduced is therefore:

$$(sensitivity) -113 \text{ dBm} + (spurious response rejection) 70 = -43 \text{ dBm}.$$

### APCO Rejection of Adjacent High Powered Transmitters

The draft band plan for the 494 – 502 MHz band allocates these channels close to the upper band edge to mobile receivers. It is assumed that any high power broadcast transmitter antenna in the adjacent band is located greater than 100m from the APCO 25 mobile receiver antenna and greater than 50 kHz from the band edge.

The free space path loss at 500 MHz over 100m is 66 dB. Therefore the maximum power of an adjacent broadcast transmitter before harmful interference could occur in an APCO 25 receiver located 100 m away is:

$$(max \text{ unwanted signal level}) -43 + (path \text{ loss}) 66 = 23 \text{ dBm}.$$

This interference power level of 23 dBm or 0.2 Watts may be used to determine the maximum tolerable radiated power of a transmitter operating in the adjacent band. It is assumed that the APCO 25 receiver bandwidth is 16 kHz and any adjacent TV transmitter has a bandwidth of 6250 kHz. The theoretical maximum power of the TV transmitter before harmful interference could occur is:

$$(interference \text{ power}) 0.2 \text{ W} * 6250/16 = 78 \text{ Watts or } 19 \text{ dBW}.$$

### Spurious Emissions from High Powered Transmitters

Current analogue and digital TV spectrum licences have been issued in bands above 518 MHz. These specify maximum unwanted emissions below 510 MHz of -50 dBW. The worst-case interpretation of this is spurious emissions of -50 dBW or 0.01 mW occurring in the mobile and base ESC receive bands.

---

<sup>10</sup> The performance level of class B is comparable to the performance level for 12.5 kHz analogue radio equipment currently in use for Land Mobile services

If it is assumed that the measurement bandwidth for the spurious emissions is 100 kHz (ITU-R SM.329<sup>11</sup>), then the equivalent power in the APCO 25 receiver bandwidth of 16 kHz is:

$$(power\ floor)\ 0.01\ mW * 16/100 = 0.0016\ mW\ or\ -28\ dBm.$$

The power into the receiver from such a transmission using a minimum separation of 100m as above is:

$$(spurious\ emissions)\ -28\ dBm - (path\ loss)\ 66\ dB = -94\ dBm$$

This is 19 dB above the reference sensitivity of an APCO 25 receiver noted above (-113 dBm) and has the potential of limiting the sensitivity of the mobile service when it is in the vicinity of the broadcast transmitter.

## Interpretation of Results

Analysis of the APCO 25 mobile receiver response to signals > 50 kHz removed from the wanted channel shows that radiated powers >78 W could have the effect of overloading the receivers, limiting their ability to reproduce wanted signals. The mobile receiver ability to reject unwanted signals should increase with frequency separation so it is proposed that a power limitation of 100 Watts e.i.r.p. is applied to the adjacent 8 MHz band 502 to 510 MHz.

There is a risk of out-of-band spurious signals from high power TV transmitters raising the equivalent noise floor in the proximity of their antennas which would limit the sensitivity of a mobile receiver operating in the adjacent band. It is noted that the current spectrum licences for TV transmitters have the same absolute out-of-band emission limit of – 50 dBW irrespective of the permitted radiated power. However since the noise floor from TV transmitters generally reduces as the wanted power reduces and the frequency separation increases, limiting the permitted power of transmitters in the adjacent band 502 to 510 MHz to 100 Watts e.i.r.p. could help to mitigate this risk.

This limitation could be relaxed where there was a low probability of land mobile receivers being required to operate within 100m of the TVBC transmitter. It is also possible to reduce the risk of interference by locating an ES base site in close proximity of the TV transmitter. In this way the wanted signals are stronger, thereby reducing the undesirable effects of the high power TV transmitter on the performance of the mobile receiver.

---

<sup>11</sup> ITU-R SM.329-10 Unwanted emissions in the spurious domain

## Appendix B

---

### Potential Interference into TV Receivers from ESC Transmitters

#### Introduction

This analysis considers the risk of transmitters operating in the proposed ESC band causing interference into TV reception. The TV signal may be from existing UHF analogue transmissions or from prospective new digital transmissions. TV receiver performance standards have been taken from international standards and do not necessarily represent the performance of equipment in use.

#### Land Mobile Transmitter Radiated Power

The proposed ESC band plan allocates the mobile transmitters in the upper half of the band nearest to TV services so this analysis will focus on the risk of TV interference from these transmitters. Base transmitters are further removed from the closest possible TV channel by at least 4.5 MHz.

The maximum transmitter output power for APCO 25 mobiles is 30 W<sup>12</sup>. After accounting for cable losses and a small gain from a typical mobile omni-directional antenna it is assumed that the maximum e.i.r.p. is 30 W or 45 dBm.

#### Analogue TV Receiver Performance

Analogue TV transmitters currently operate in channels above 518 MHz. The closest licence to the mobile transmitters operates in the third channel above the edge of the proposed ESC band. The FCC planning standard FCC 98-24<sup>13</sup>, Appendix E, specifies that analogue TV receivers must tolerate digital signals up to 30 dB above the wanted analogue signal before interference occurs, i.e. a desired to unwanted (D/U) signal ratio of -30 dB.

(Note this D/U ratio is specified for an unwanted signal having a standard DTV format. For this paper it is assumed that a narrow band interfering signal of the same power as the wide band DTV signal will cause the same level of interference - an approximation which is used without substantiation in this analysis.)

The minimum field strength for analogue UHF TV is given in ITU-R Rec BT 804<sup>14</sup>, Table 3, as 62 dB $\mu$ V/m or -65 dBm at the antenna. When the wanted signal is at this level the unwanted signal should be no greater than:

$$(wanted\ signal)\ -65\ dBm\ -(D/U)\ -30\ dB = -35\ dBm.$$

---

<sup>12</sup> ANSI/TIA-102.CAAB-B-2004 Land Mobile Radio Transceiver Recommendations, Project 25 – Digital Radio Technology, C4FM/CQPSK Modulation

<sup>13</sup> FCC Memorandum Opinion And Order On Reconsideration Of The Sixth Report And Order – [http://www.fcc.gov/Bureaus/Engineering\\_Technology/Orders/1998/fcc98024.pdf](http://www.fcc.gov/Bureaus/Engineering_Technology/Orders/1998/fcc98024.pdf)

<sup>14</sup> ITU-R Recommendation BT.804 - Characteristics of TV receivers essential for frequency planning with PAL/SECAM/NTSC television systems

## Risk of Interference into an Analogue TV Receiver

The minimum path loss required to ensure the mobile APCO transmitter does not interfere with an analogue TV receiver is:

$$(mobile\ TX)\ 45\ dBm - (TV\ receive\ signal)\ -35\ dBm = 80\ dB.$$

The free space distance required to achieve this path loss is 0.5 km. Any obstruction between the mobile and TV antennas and the characteristics of the TV antenna radiation patterns are likely to reduce this distance.

## Risk of Interference into a Digital TV Receiver

A similar analysis is possible if digital TV services were to be introduced into the channels immediately above the proposed ESC band. The ITU recommended D/N for a CW or FM carrier 4.5 MHz removed from the wanted signal -33 dB (ITU-R Rec BT.1368<sup>15</sup> -Table 23). If the wanted TV signal is at the same level as the analogue example given above of -65 dBm, then the required path loss is 77 dB, slightly less than the analogue case above.

The minimum field strength specified in ITU-R Rec 1368<sup>13</sup> for DTV is 45 dBμV/m using 64 QAM modulation. This is 17 dB below the analogue figure. However because DTV availability deteriorates much more rapidly than analogue TV once interference starts to occur, NZ planning has been based on DTV signals being 7 dB below analogue signals. For a desired wanted signal of -72 dBm (-65 -7), the path loss required is 84 dB provided by a free space separation of about 0.8 km. Again obstruction loss and antenna radiation pattern characteristics are likely to reduce this distance.

## Analysis of Results

The analysis shows that there is a theoretical risk of interference into TV receivers from APCO 25 transmitters in the proposed ESC band operating nearby. The most vulnerable service is in the fringe areas of a DTV transmitter coverage operating on the channel adjacent to the proposed ESC band where a theoretical separation of 0.8 km is required. Mitigating factors are that obstruction losses and antenna radiation pattern characteristics will generally reduce this distance significantly. Also any possible interference will be intermittent due to the nature of mobile transmitters and fringe areas generally have a low population with infrequent visits from PPDR services. The overall risk of interference occurring is considered to be very low.

Current analogue services operating in the existing UHF TV channels above the proposed ESC band are shown to have a lower risk of experiencing harmful interference than DTV due to their higher signal strength. It is noted that a number of temporary licences have been issued for land mobile services in the proposed ESC band in the past. The MED have no record of TV receivers experiencing harmful interference from to these services.

---

<sup>15</sup> ITU-R Recommendation BT.1368-6 - Planning criteria for digital terrestrial television services in the VHF/UHF bands

# Appendix C

---

## Proposed ESC Band Draft Channel Plan

The following chart details the structure of the draft channel band plan for the ESC band based on 12.5 kHz channel spacing.

