Ministry of Economic Development
Manatū Ōhanga
Radio Spectrum Management

Review of Radio Spectrum Policy in New Zealand

2005

NOTE

A large part of the analysis and commentary contained in this document is drawn from current national and international sources. It is included for the sake of balance and for discussion purposes only. None of the material in this document should be taken to reflect the views of the Ministry of Economic Development or to represent official Government policy, unless it is explicitly stated otherwise.

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Glossary

Allocation	Designation of spectrum bands for specific uses
Allotment	Designation of specific frequencies for assignment within a spectrum allocation
APCO	(US) Association of Public-Safety Communications Officials
Assignment	Licensing the use of an allotted frequency
BCL	Broadcast Communications Ltd
DTV	Digital television
ES (A, B, etc)	Emergency Services spectrum bands
FCC	(US) Federal Communications Commission
FWA	Fixed Wireless Access
G (1G, 2G, 3G, 4G)	First, second, third and fourth generation cellular telephony
GPS	Global Positioning System
GUL	General User Licence
ISP	Internet Service Provider
ITU	International Telecommunication Union
MCD	Ministry of Civil Defence and Emergency Management
MCH	Ministry for Culture and Heritage
MDS	Multipoint Distribution System
MED	Ministry of Economic Development
MRR	Management Rights Regime
NTIA	(US) National Telecommunications and Information Administration
NZDF	New Zealand Defence Force
PSRFMG	Public Safety Radio Frequency Management Group
PSRN	Public Safety Radio Network
RLR	Radio Licence Regime
RNB	Resources and Networks Branch, MED
RSPP	Radio Spectrum Policy and Planning, MED
SRD	Short range device
TETRA	TErrestrial Trunk RAdio
TLAs	Territorial Local Authorities
TPK	Te Puni Kokiri
WLAN	Wireless local area network

Radio frequencies

VLF	Very Low Frequency	10-30 kHz	VHF	Very High Frequency	30-300 MHz
LF	Low Frequency	30-300 kHz	UHF	Ultra High Frequency	300 MHz-3 GHz
MF	Medium Frequency	300 kHz-3 MHz	SHF	Super High Frequency	3-30 GHz
HF	High Frequency	3-30 MHz	EHF	Extremely High Freq[y]	above 30 GHz

Executive Summary

In early 2004, the Associate Minister of Communications requested the Ministry of Economic Development (MED) to provide a review of radio spectrum policy. This report is the MED's response to that request.

The Review is designed to inform the Minister on:

- the radio spectrum management environment in New Zealand and its effectiveness;
- the factors that influence that environment; and
- existing and emerging policy issues warranting consideration in 2004/2005 and beyond.

This document is intended, therefore, as an overview of current radio spectrum policies and management, and as a mechanism for identifying and prioritising policy issues for future action. These issues are identified throughout the text and summarised in the final chapter.

The radio spectrum policy environment is delineated primarily by the Radiocommunications Act 1989 ('the Act') that, in addition to providing the framework for radio spectrum management, recognises New Zealand's obligations to the world-wide radiocommunications community as a signatory to the International Telecommunications Union (ITU) convention. Other Acts, Regulations and Cabinet decisions further influence the ways in which radio spectrum is managed and allocated. The responsible Minister is the Minister of Communications, acting through the Ministry of Economic Development (MED).

In passing the Act and its subsequent amendments, New Zealand was the first country to redefine radio spectrum in terms of property rights, and to assign it in a tradable form. After fifteen years it is now appropriate to review the effectiveness of the Act in the context of the current radio spectrum environment, and to determine whether new issues have arisen that require its revision.

New Zealand's radiocommunications sector encompasses:

- commercial service providers, notably in radio, television, information technology and cellular telephony;
- government-supported public broadcasting services at national, regional and community levels;
- providers and installers of radio sensors, locking and control devices, short-range communication systems, and similar low-power short-range technology;
- defence forces, police, emergency services and other public safety and security providers;
- aeronautical, maritime, and land- and satellite-based communication, location, navigation and anti-collision facilities; and
- radio-astronomy, meteorology and other science services.

Radio spectrum is managed under three complementary regimes that reflect the diversity of objectives contained in legislation and Government policy.

Executive Summary

Radio spectrum policies and their administration fall within broader Government initiatives to improve the economic, social and cultural environment. These include:

- the Growth and Innovation Framework (GIF), whose purpose is the delivery of sustainable growth that improves the lives of all New Zealanders; and
- the inclusive society, within which inequalities are reduced and opportunities provided for all.

Objectives more directly related to spectrum are:

- promoting competition;
- maximising the value of spectrum to society;
- satisfying growing demand; and
- meeting Government's economic, social and cultural policy outcomes.

Spectrum in commercial demand is, in general, assigned competitively under the Management Rights Regime (MRR). Spectrum allocated for other commercial purposes and for use in the 'public interest' by, for example, public safety and security services, is normally assigned administratively under the Radio Licence Regime (RLR). Such low power, ubiquitous devices as garage door-openers and CB radio, also known as 'public park' applications, are assigned spectrum under General User Licences.

Each has particular constraints and requirements in terms of ITU obligations, enabling legislation, government policies, optimum spectrum allocation and licensing mechanisms.

To assist in promoting economic objectives, selected spectrum used for commercial purposes has been moved from its historical administrative assignment under the RLR to the MRR. New Zealand has been a world leader in this area. Management rights spectrum can be sold to service providers ('right-holders') and subsequently traded between them. An underlying assumption, that market mechanisms will ensure spectrum is allocated to its highest value use, has not necessarily been realised in practice. Various approaches that might be employed to optimise the spectrum market, including auction design, ownership limitations and implementation requirements, are considered in this report.

Social and cultural policy objectives that utilise spectrum are, in general, met through administrative assignment, including the reservation of frequencies for possible future 'public interest' use. In the broadcasting sector, and to a lesser extent in telecommunications, there are allocation and funding issues, as the demand often exceeds the supply for community, regional, national, ethnic, and special interest spectrum. Spectrum for public safety and security purposes appears to be adequate in supply but could be better coordinated in use. A comprehensive independent audit may be one way to identify inefficient utilisation.

New technologies impact on spectrum use and management. There is a general shift away from hard-wired voice and data services to various types of wireless delivery, some of which operate most effectively in 'public park' spectrum. Convergence in technology is notable in cellular telephony (text, pictures, internet, and handheld data) and in television broadcasting (interactive digital TV carrying internet and programming-on-demand). There are opportunities and tensions for New Zealand in these developments. New technologies operating in public parks are designed to use spectrum efficiently, are self-managing as regards interference and attract little in the way of compliance costs, to the benefit of users. On the other hand, they are difficult to identify and regulate.

Resolution of such issues will contribute considerably to the creation of a communications technology infrastructure that enhances New Zealand's economic performance and social achievements. The economic, efficient and rational use of the radio spectrum offers significant opportunities to reduce costs, raise productivity and enhance the quality of life.

Major themes that have emerged from the Review are:

- the effectiveness of current legislation in achieving Government's objective in the deployment of spectrum;
- the relative effectiveness of the MRR, the RLR and GULs, and the desirable balance between them;
- the mechanisms by which the benefits of competitive assignment can be maximised and its drawbacks moderated;
- the degree to which Government intervention is necessary and effective in ensuring that social and cultural objectives are met;
- the implications of new technologies for spectrum management; and
- the need to further enhance international co-operation.

The issues identified in this report are to be incorporated into the MED work programme. The timing of any future work on the issues will be agreed with the responsible Minister in the annual Output Agreement, taking into account related work streams in the Ministry and other departments.

The report is presented in seven Chapters and an Appendix.

Chapter	Title	Content
1	The New Zealand spectrum policy environment	An overview of the economic, social and cultural policy objectives that underpin New Zealand's management of the radio spectrum
2	The New Zealand spectrum management environment	An overview of New Zealand's spectrum management structures and processes
3	The New Zealand radiocommunications industry	An overview of the radiocommunications-based industries sector in New Zealand.
4	Economic outcomes	Describes and reviews spectrum policies and processes that contribute to the achievement of New Zealand's economic outcomes
5	Social and cultural outcomes	Describes and reviews spectrum policies and processes that support New Zealand's social and cultural objectives
6	The impact of technology	Describes and discusses the impact of changing technologies on New Zealand's management and use of the spectrum

Chapter	Title	Content
7	Themes, Issues and Priorities	Lists and prioritises the policy issues identified in the report
Appendix	Spectrum Management in other Jurisdictions	Brief summaries of significant spectrum management developments in Australia, Canada, the European Union (including Finland and the United Kingdom) and the United States

The report was compiled by the Radio Spectrum Policy and Planning group, in the Resources and Networks Branch of the Ministry of Economic Development. Valuable content and commentary was received from other branches within the Ministry, and from the Ministry for Culture and Heritage, Te Puni Kokiri and the Treasury. The document has been peer-reviewed by Professor Martin Cave of the United Kingdom and Professor Henry Ergas of Australia, whose comments and suggestions are gratefully acknowledged and incorporated.

1 – The New Zealand Spectrum Policy Environment

This chapter provides an overview of the economic, social and cultural policy objectives that underpin New Zealand's management of the radio spectrum.

1 Radio waves are defined by the International Telecommunication Union (ITU) as *electromagnetic waves of frequencies arbitrarily lower than 3000 GHz propagated in space without artificial guides*. In practice, the range of frequencies accessible with current technology is 30 kHz to 100 GHz. This is regarded as the *radio spectrum* ('spectrum') for all practical purposes.

The radio spectrum

Below 30 kHz	30 to <300 kHz	300 kHz to <3 MHz	3 to <30 MHz	30 to <300 MHz	300 MHz to <3 GHz	3 to <30 GHz	above 30 GHz	
VLF	LF	MF	HF	VHF	UHF	SHF	EHF	INFRARED
	Long wave	Medium wave	Short wave			Microwave		

2 Radiocommunications are modulated radio waves generated at a common frequency across a transmitter-receiver link. 'Interference' results when signals from 'intentional radiators' (ie, radio transmitters) overlap, obscuring or distorting the modulated signal. Interference may also be generated by 'unintentional radiators': for example, electrical machinery, power lines and other electrical devices, by electric storms ('atmospherics'), and such natural space objects as stars and planets.

3 Spectrum allocations and standards, agreed within the Radio Sector of the ITU and observed by New Zealand, play a large part in ensuring compatibility of radio systems and minimising harmful interference. The economic value of spectrum access is determined by a combination of factors including the suitability of a particular frequency band for specific technologies, equipment availability and the phenomenon of interference. Because of high existing usage and competing demand, obtaining access to some of the more versatile parts of the radio spectrum can be difficult.

THE LEGISLATIVE FRAMEWORK

4 New Zealand was, in passing the one-page Wireless Telegraphy Act of 1903, the first country to introduce legislation specifically governing radiocommunications. Prior to 1989, all uses of radio frequency spectrum were authorised by the Government (acting through the Ministry of Commerce and, previously, the New Zealand Post Office) under an *administrative licensing* process: that is, any person or entity requiring exclusive use of a particular radio frequency applied for a radio licence, specific to a particular class of radiocommunications equipment. If the frequency were available and its use would cause no interference problems, the licence was assigned on payment of an administration fee. This is commonly referred to as the *radio licence regime* (RLR).

5 Radio licences in the RLR are issued under regulations that take into consideration public interest, international agreements and government policy statements. Licences define the frequencies to be used and the location and technical configuration of the transmitting equipment to which they relate. They are generally renewable each year for a fee set at a level to cover the Ministry's administrative costs, but are not tradable.

The Radiocommunications Act 1989

6 The Radiocommunications Act and its Regulations introduced a management regime that treats spectrum rights as tradable property. The Act was one of a number of legislative measures enacted in connection with deregulation of the telecommunications and broadcasting industries. As the traditional RLR model was judged inappropriate to meet the needs of a deregulated market, the Act put in place a framework of spectrum rights for assignment to those users who valued them most, thus obtaining their maximum (economic) value to society. This outcome was predicated on a competitive market environment, with spectrum required for non-commercial purposes secured by Government intervention.

7 The Act put in place a two-tier market-based mechanism for managing spectrum access:

- management rights, which give the rightholder unencumbered use of a nationwide block of spectrum with the right to assign spectrum licences within that block; and
- spectrum licences within a management right, which may carry conditions of use, but otherwise are tradable property.

8 In detail, the Act:

- established a Registrar and Registry of radio frequencies (Parts 1, 4);
- enabled the registration of radio spectrum management rights (Parts 2, 3);
- permitted the transfer of management rights from one manager to another (Part 5);
- permitted managers to mortgage management rights (Part 9); and
- gave managers the power to assign spectrum licences (Part 6).

The Regulations deal largely with licence administration.

Radiocommunications Amendment Act 2000

9 The Radiocommunications Amendment Act 2000 (section 41) gave government the power to sell or auction management rights. It follows that spectrum management rights may be sold, assigned, leased, transferred and traded, initially by the Crown and subsequently by rightholders in secondary markets.

10 New Zealand was one of the first countries to enact a legislative framework that assigns spectrum as tradable property rights, and it is still seen to be one of the most efficient and cost-effective spectrum management regimes. Until recently, most nations assigned frequencies directly to the user under a RLR or by ranking competing applications against qualifying criteria (a ‘beauty contest’). A number of countries have since implemented a property rights regime to some degree and some are actively implementing market-based mechanisms to improve spectrum assignment (see the *Appendix* for examples).

11 The Act has been in force for fifteen years at the date of writing. In later sections of this Report (see, for example, Chapter 4, *Economic Outcomes*) the effectiveness of the Act in establishing market mechanisms and promoting Government policy objectives is examined in detail.

The Commerce Act 1986

12 The new radiocommunications environment was established in the context of a light-handed regulatory environment. The Commerce Act 1986, New Zealand's generic competition legislation, was relied upon to promote a competitive market. The Act protected against mergers and business acquisitions that resulted in 'dominance' and/or misuse of a dominant position in the market. These provisions were intended to apply to all commercial markets, including radiocommunications: it was not considered necessary at the time to pass sector-specific legislation.

13 The core provisions of the Commerce Act were strengthened in May 2001. A new purpose statement was inserted to clarify that the intention of the Act is to *promote competition in markets for the long-term benefit of New Zealand consumers*. The prohibition against misuse of a dominant position (section 36) was amended to prohibit persons with a substantial degree of market power from taking advantage of that power for anti-competitive purposes. The prohibition against anti-competitive business acquisitions (section 47) was amended to prohibit acquisitions that *substantially lessen competition*. These provisions replaced the previous market dominance test (see page 27 *et seq*).

The Telecommunications Act 2001

14 Telecommunications are carried by copper and fibre networks, and by wireless (ie, radio) links. Examples are landline telephone services, cellular telephony, the Internet, and telemetry. With the continued roll-out of new communications technologies and systems, the use of spectrum for telecommunications is expanding rapidly.

15 The Telecommunications Act 2001 recognised a concurrent perception that sector-specific regulation was needed to promote competition in the New Zealand telecommunications services markets, and to deliver benefits to consumers in the form of new and improved services and lower prices. The Commerce Act was eventually considered inadequate to deal with this complex and dynamic sector. In particular, there was strong dissatisfaction with lengthy disputes resolution processes in the courts, and with the sluggish development of competition in the sector.

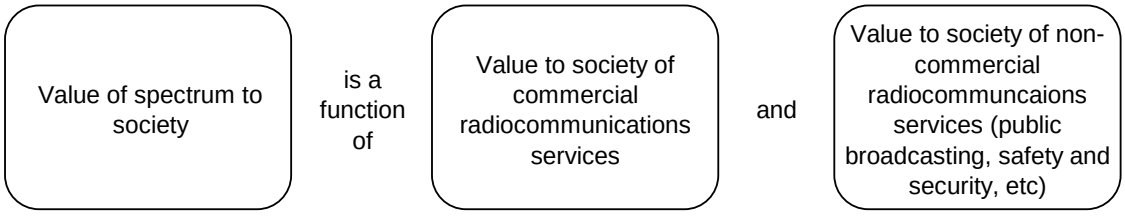
16 The focus of the Telecommunications Act is the *promotion of competition for the long term benefit of end-users of telecommunications services in New Zealand*. The Act also spells out telecommunications service providers' obligations, including a requirement to supply non-commercial services to achieve government's social objectives (eg, the 111 emergency service). The Act established the position of a Telecommunications Commissioner within the Commerce Commission, New Zealand's competition enforcement agency. The Commissioner's role is to:

- recommend appropriate regulation of specific telecommunications services to the Minister of Communications;
- resolve disputes between regulated services over access determinations; and
- administer cost-recovery processes for telecommunications services obligations.

Policy objectives

17 The spectrum is a scarce, finite resource that supports a range of wireless communications services critical to the NZ economy and to a variety of government functions. If managed effectively and efficiently, spectrum can contribute to innovation, job creation, economic growth and public welfare.

18 The prime objective of spectrum management is to maximise the value of spectrum to New Zealand society. Value can be derived from the spectrum in a number of ways. As a tradable good, it has an economic value, but it can also facilitate the achievement of social and cultural objectives that are independent of spectrum's commercial worth. In making decisions about the allocation and assignment of spectrum, it is important to strike a balance between the economic and social objectives of the relevant radiocommunications services.



19 For providers of such commercial services as television broadcasting and cellular telephony, the value of the spectrum resource is the profit that can be obtained from supplying services that use spectrum as an input, which in turn depends on the demand for those services, their costs of supply, and the nature of the competition in actual or potential markets. In a perfect market – that is, a market with a comfortably large number of well-informed and willing buyers and sellers – the spectrum would be valued at its market price. It is generally appropriate to assign spectrum by commercial processes for such services, as their providers are considered to be in the best position to assess its current value.[1]

20 Non-commercial services could be defined as radiocommunications that the commercial market would not be likely to provide to any useful level, and which consequently tend to be funded by government, territorial authorities and voluntary organisations. They include defence communications, police mobile, community and student radio, and public, Maori and Pacific Island broadcasting. Were spectrum assigned to these services commercially – that is, in competition with providers of commercial radiocommunications – the probability is that affordable spectrum would not be readily available to them. Hence, it is generally seen as appropriate that spectrum is assigned to such services by administrative rather than commercial means, incurring only a cost-recovery fee.

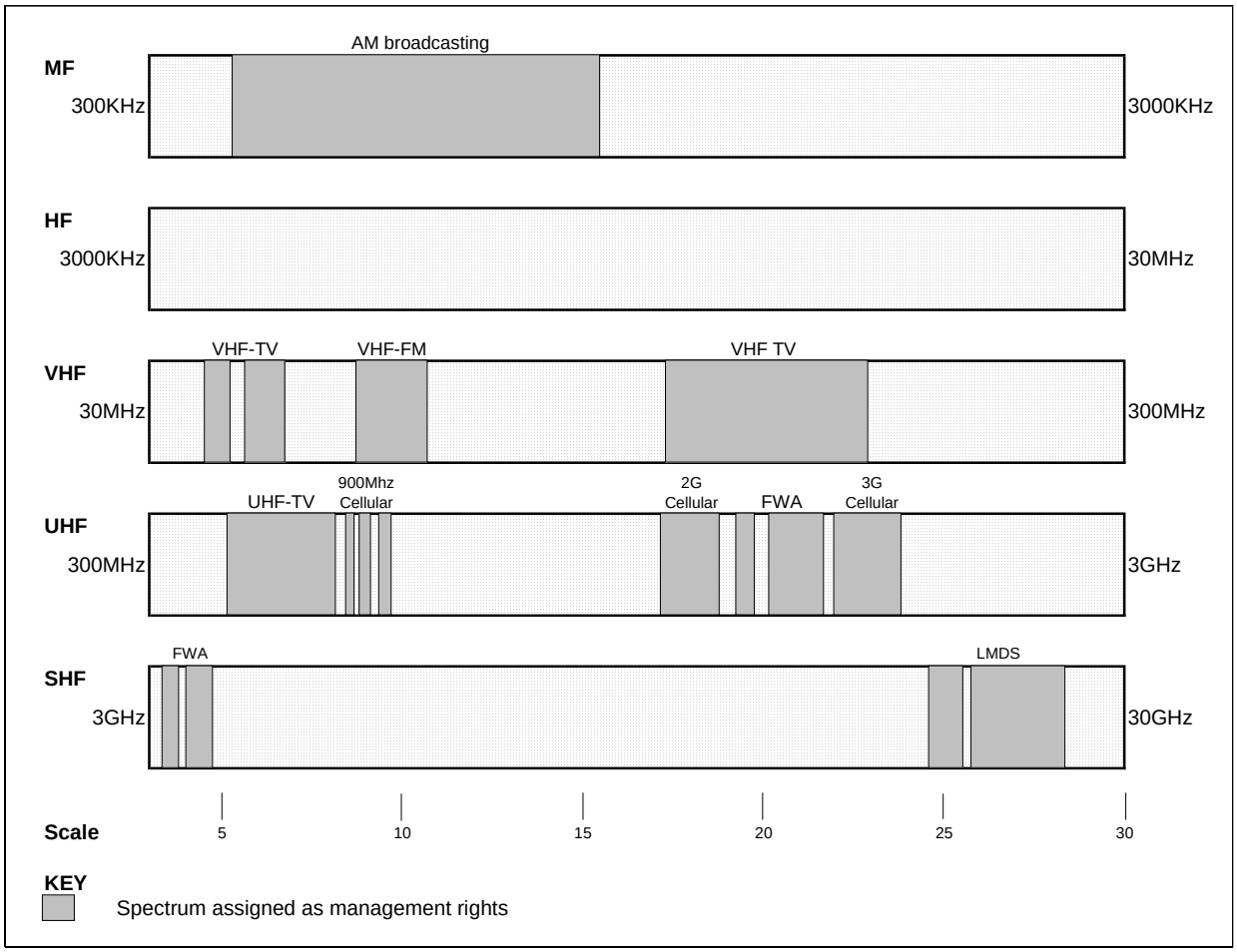
21 An issue with administrative assignment is that, although it is clear that the spectrum assigned is important to society, its value cannot be easily assessed vis-à-vis spectrum assigned commercially in a market. This can only be done easily in a dollar market. One option, where demand exceeds supply, is to assign spectrum competitively to commercial and non-commercial services alike, the latter's dollar outgoings being made good from other sources (government, etc). This would have the merit of making transparent the opportunity cost of providing

[1] See page 25 for a discussion of the value of spectrum and page 28 et seq for market issues.

spectrum for public policy purposes, but it would not necessarily reflect the intrinsic value of the policy's objectives.[2]

22 Governments set the policies that determine whether spectrum is assigned administratively or sold commercially. In a number of overseas jurisdictions, spectrum is treated entirely as a community asset and distributed according to perceived need at the lowest possible cost. In others, it is partly or wholly categorised as a natural resource from which the greatest possible financial return should be generated. Mixed economies, combining free market and state regulated distribution mechanisms, tend to embody both principles but are not always clear, in principle or practice, as to the boundary between them. New Zealand, for example, has gone further than most countries in treating spectrum as a commodity, but continues to manage most frequency bands administratively.

SPECTRUM ALLOCATED UNDER MANAGEMENT RIGHTS



23 The Act itself contains no specific spectrum policy objectives *per se*, nor does it provide explicit guidance and direction to the government in the exercise of its regulatory powers. Policy objectives are nonetheless implicit in the powers, duties and functions outlined in the Act, in government policy announcements at its enactment and the making of its various Regulations,

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2 See *Modifying the regime*, page 17, for further discussion of this issue.

and in subsequent government policy statements, discussion documents and Ministerial directives.

24 Public sector policy is informed by the Key Government Goals of:

- strengthening our national identity and upholding the principles of the Treaty of Waitangi;
- growing an inclusive, innovative economy for the benefit of all;
- maintaining trust in government and providing strong social services;
- improving New Zealanders' skills;
- reducing inequalities in health, education, employment and housing; and
- protecting and enhancing the environment.

25 The second of these, *growing an inclusive, innovative economy for the benefit of all*, is amplified as:

- developing an economy that adapts to change, provides opportunities and increases employment, and while reducing inequalities, increases incomes for all New Zealanders; and
- focussing on the Growth and Innovation Framework to improve productivity and sustainable economic growth.

The MED is tasked by Government to lead this initiative.

26 The Growth and Innovation Framework (GIF) is the government's main statement of economic development policy and provides a context for specific polices relating to spectrum use. The government recognises that sustainable growth in personal income is a key to improving the living standards in New Zealand. In its GIF strategic policy, the government sets objective of increasing New Zealand's rate of growth so that our per capita income returns to the top half of the OECD scale and remains there.

27 The GIF identifies information and communication technologies (ICT) as one of the priority areas underpinning economic growth. In response to this, the MED is developing a strategy that provides an integrated framework for existing and future ICT initiatives ('the Digital Strategy'). The Digital Strategy is designed to provide the tools necessary to capture the horizontal enabling benefits of ICT for the economy and provide companies with the ability to enhance their own development.

28 Spectrum policy has the potential to contribute to GIF and the Digital Strategy in the following key areas through:

- assisting economic growth by creating and maintaining a spectrum management environment in which existing and new radiocommunications technologies can develop easily and cost-effectively;
- underpinning new radiocommunications-based industries that in turn offer employment opportunities;
- enhancing communications and lowering associated costs for government, individual firms, industries, educational institutions and research establishments; and
- enhancing linkages with regional centres through wireless communications networks.

29 The strategic priorities of the MED are to:

- facilitate the alignment of economic development activities across the public sector;

- improve international connections, especially with Australia;
- stimulate enhanced entrepreneurial and innovative capability of New Zealand firms;
- improve the regulatory environment for business; and
- improve the quality and reliability of infrastructure services.

Spectrum policies and processes contribute in some measure to all of these objectives, but have particular application to the last three.

30 In addition to its role in assigning commercial spectrum, the MED has responsibility for reserving and managing spectrum allocated to uses that are in the public interest and that would not normally be provided by commercial services (eg, public broadcasting, defence, police, and emergency services). It also acts to minimise interference to and between radiocommunications by regulating, largely through its licensing function, the characteristics (power, location, etc) of transmitters and other devices (eg, electrical machinery) that emit radio waves, intentionally or unintentionally.

THE INTERNATIONAL PERSPECTIVE

31 The use of spectrum is co-ordinated internationally through the Radio Regulations annexed to the Convention of the ITU, which designate frequency ranges for the operation of standard types of radio service. New Zealand is a signatory to the Convention. The Radio Regulations range from elaborate and detailed plans for satellite radiocommunications to more generalised specifications for amateur radio bands. They encompass 60 Articles and 42 Appendices, with numerous Resolutions and Recommendations, providing the basis for national and international use of the spectrum, and the framework of frequencies around which radio system designers and manufacturers develop transmitters, receivers and other radio-based products.

32 The Government has consequent obligations in international law relating to spectrum utilisation in New Zealand. By making specific reference to some of these obligations in Schedule 1 of the Act, Parliament has embedded them in national law. Regardless of whether or not all of New Zealand's international obligations have been so incorporated, it was intended that the Act be consistent, and promote compliance, with ITU obligations.

33 Every three or four years a World Radiocommunications Conference is held to revise and update the ITU Radio Regulations, thereby determining the assignment of spectrum for future use by new or expanding types of delivery service. This provides an opportunity for countries to influence the allocation of the spectrum internationally. Conversely, decisions taken in this forum affect the allocation of spectrum in New Zealand. MED leads an industry forum that develops New Zealand positions for the Conferences.

34 There are incentives to establish spectrum-related regulatory arrangements with New Zealand’s key trading partners, through the development of agreements outside the ITU framework. Agreements have been completed with Australia under the Trans-Tasman Mutual Recognition Agreement (TTMRA) and with the European Union, but the challenge is to expand the concept to other countries. Such harmonisation arrangements are expected to support economic growth by simplifying and minimising the cost of compliance for importers and exporters.

35 To foster the tradability of radiocommunications equipment, mutual recognition agreements on radiocommunications standards with other countries are desirable. Whether or not there should

be closer alignment of spectrum bands within the broad general framework mandated by the ITU is debatable. New Zealand is sufficiently isolated that problems of interference are unlikely vis-à-vis the rest of the Asia-Pacific region. In addition, radiocommunications equipment is becoming increasingly 'agile' in terms of the frequency bands it can access.

Issue 1.1

To what extent should mutual recognition agreements with other countries be pursued, and in what areas?

TELECOMMUNICATIONS

36 While the allocation of spectrum generally falls under the provisions of the Act, specific reference to the telecommunications sector is contained in the Telecommunications Act 2001, which gives the Commerce Commission powers to regulate the supply of telecommunications services where competition is an issue. The Telecommunications Act also established a Telecommunications Services Obligation (TSO) regime, to facilitate the supply of telecommunications services to those end-users for whom such services may not otherwise be supplied on a commercial basis or at an affordable price.

37 [A] *purpose of* [the Telecommunications Act] *is to promote competition in telecommunications markets for the long-term benefit of end-users of telecommunications services within New Zealand by regulating, and providing for the regulation of, the supply of certain telecommunications services between service providers*.[3]

38 The Telecommunications Act falls within the portfolio of the Minister of Communications and is administered by the Ministry of Economic Development.

BROADCASTING

39 Broadcasting is *transmission of programmes, whether or not encrypted, by radio waves or other means of telecommunication for reception by the public by means of broadcasting receiving apparatus*[4]… ie, transmission of sound and television. New Zealand has one of the world's highest ratios of radio and TV channels to population.

40 In 1988, the government embarked upon a series of legislative, regulatory, and institutional changes intended to improve economic efficiency in the broadcasting sector. The government-owned Broadcasting Corporation of New Zealand (BCNZ) was restructured as two separate state-owned enterprises, Television New Zealand (TVNZ) and Radio New Zealand (RNZ), which were required to return a profit. Responsibility for broadcasting policy advice was transferred to the Department of Trade and Industry. Deregulatory measures to promote competition across the sector and reduce restrictions on foreign ownership were also adopted. A regime to maintain broadcasting standards was established and a set of local content objectives adopted and supported by a contestable grants scheme.

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3 Telecommunications Act 2001, s18

4 Broadcasting Act 1989

41 Key legislative elements of the restructuring were as follows.

- The Broadcasting Amendment Act (No. 2) 1988:
  - disestablished the BCNZ; and
  - established TVNZ (Television One and Channel 2), and RNZ (National Radio, the Concert programme, and 32 commercial stations), which became state-owned enterprises under the terms of the State-Owned Enterprises (No. 4) Amendment Act.
- The Broadcasting Act 1989:
  - disestablished the Broadcasting Tribunal;
  - established the New Zealand Broadcasting Commission (now called NZ On Air), funded through the Public Broadcasting Fee; [5]
  - established the Broadcasting Standards Authority (BSA);
  - reduced restrictions on foreign ownership;
  - reduced restrictions on advertising hours;
  - provided for election broadcasting;
  - granted licences to several specific broadcasters; and
  - provided transitional arrangements for existing spectrum users and broadcasters.

42 The Broadcasting Act falls within the portfolio of the Minister of Broadcasting and is administered by the Ministry for Culture and Heritage (MCH). Government's reasons for involvement in the broadcasting sector are, at a general level, the same as those that motivate and justify its involvement in other sectors. The power and pervasiveness of broadcasting as a form of communication and shared experience means that broadcast media play an especially significant role in the functioning of civil society, and can either promote or undermine its core values.

43 In July 2000[6], the government formulated a set of new objectives to guide the development of broadcasting policies to ensure that desired kinds of broadcast content are available to the New Zealand public. The objectives have guided such subsequent decisions as a reorientation of the direction of TVNZ, and the allocation of non-commercial spectrum. These objectives are:

- ensuring that all New Zealanders have reasonable and regular access to broadcasting representing the uniqueness and diversity of New Zealand life, recognising that the histories and stories of whanau, hapu and iwi are integral to any description of that life;
- meeting the information and entertainment needs of as many interests as reasonably possible, including those that are unlikely to be met by commercial broadcasting;
- contributing to public awareness of and participation in the political and social debates of the day;
- providing for minority interests and increased choice;
- contributing to the Government's goals in relation to the Treaty of Waitangi; and

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5 The Public Broadcasting Fee has since been abolished. NZ On Air is funded now through general taxation.

6 Refer *Broadcasting in New Zealand: a 2003 stocktake,* Ministry of Culture and Heritage 2003

- encouraging innovation and creativity in broadcasting while aiming to continually increase audience satisfaction with the quality of the content.

These objectives have been furthered by the Television New Zealand Act 2003, the Maori Television Service Act 2003 and amendments to the Broadcasting Act 1989.

44 MCH provides advice on the assignment of spectrum to non-commercial and public broadcasters. Similarly the Ministry of Maori Development, *Te Puni Kokiri* (TPK) facilitates spectrum assignment to Maori broadcasters. MED, MCH and TPK work closely together on policy issues, as changes in spectrum policy impact on broadcasting policy, and vice versa.

45 The document, *Building a Strong and Sustainable Public Broadcasting Environment for New Zealand - A Programme of Action*, released by MCH in late 2004 proposes six priorities:

- adequacy and certainty of funding, by changes to current mechanisms, including a switch to direct funding of Radio New Zealand;
- strengthen public broadcasting, by, inter alia, increased funding for TVNZ and assigning spectrum without charge;
- facilitate the successful development of digital broadcasting (see page 54);
- enhance regional and community broadcasting (see page 43);
- enhance independence and responsibility in broadcasting; and
- enhance quality incentives for broadcasters and producers.

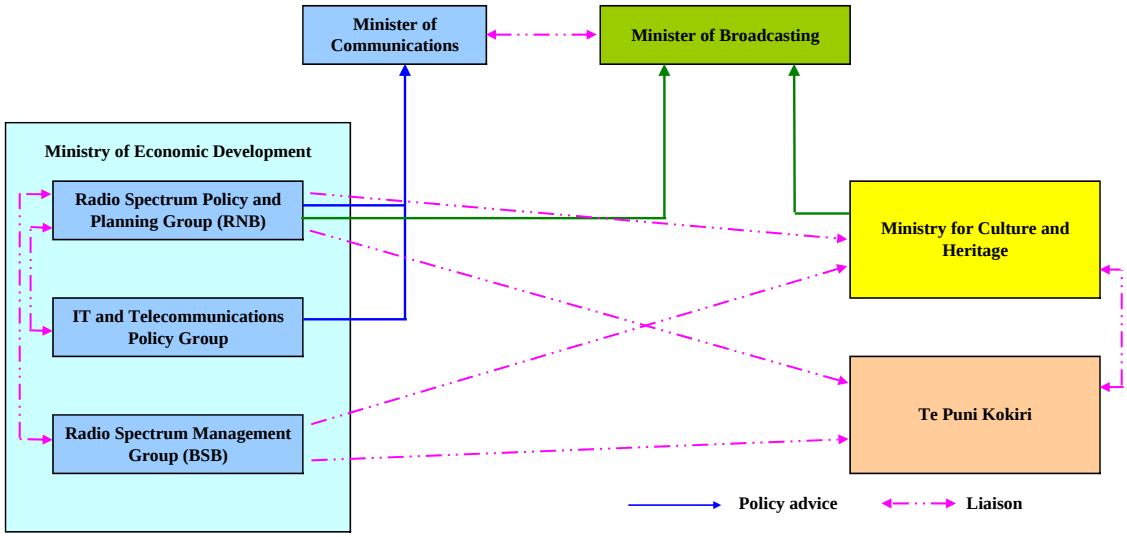
CONCLUSION

46 Radio spectrum is the passive carrier of a wide variety of radiocommunications services, which in turn are subject to a diverse range of legislative controls and policy intentions. Some services are predicated to function optimally in an open market environment, others in a governed environment, and a further group in an environment that has elements of both. A need to balance the policies and purposes of Government, and of service providers, is characteristic of such a mixed spectrum management regime. These issues are examined in more detail in Chapter 4.

2 – The New Zealand Spectrum Management Environment

This chapter provides an overview of New Zealand's spectrum management structures and processes.

47 Parliamentary responsibility for spectrum policy under the Radiocommunications Act is with the Minister of Communications. Spectrum policy is closely connected with broadcasting policy: hence, there is a need for the Ministers of Communications and Broadcasting to work closely together. The various relationships between Ministers and Departments are shown below.



48 The Act is administered by the Chief Executive of the MED. Spectrum policies are developed and implemented by the Resources and Networks Branch (RNB) of the MED, under the delegated authority of the Chief Executive.

49 *The Radio Spectrum Policy and Planning [RSPP] group of RNB is responsible for providing policy advice to the government on the allocation and management of the radio spectrum and related commercial broadcasting matters. It is also responsible for ensuring that spectrum allotments are planned in accordance with sound engineering principles. The objective is to ensure that spectrum is used in a way that maximises its value to New Zealand society – by supporting sustainable economic development and such social goals as public safety and cultural expression.*[7]

7 *Our Strategy for Growth, 2004-2007* MED, 2004

50 RSPP's functions include:

- policy:
  - advice on spectrum planning, allocation and related matters;
  - policy and engineering planning documents;
  - spectrum auction rules;
  - auction management;
  - international liaison;
- planning:
  - *allocation* of bands to specific uses (eg, FM broadcasting);
  - *allotment* of frequencies within allotted bands (eg, TV broadcast channels);
  - technology forecasts;
  - spectrum use forecasts; and
  - international relationships.

RSPP's 2004-2005 policy budget was $2.2 million. Planning is funded from revenue.

51 The Radio Spectrum Management group (RSM) in the Business Services Branch of MED is responsible for the day-to-day management of licensing activities, including:

- registration of radio frequencies and access to them;
- *assigning* spectrum and radio licences;
- engineering licences;
- interference resolution; and
- compliance and enforcement.

52 Licensing and engineering fees are charged on a scale that covers the administrative costs of managing the spectrum, including those of RSM and the planning costs of RSPP. RSM's 2002-2003 budget was $11.3 million. Following organisational restructuring in that year it was reduced to $9.5 million and, in the 2004-2005, to $8.7 million, of which $7.2 million is recovered in fees and charges.

53 General information about the allocation and licensing of the radio spectrum is available on-line through *Spectrum on Line*, a database maintained by MED. Technical information for radio engineers and band managers can be accessed with the *PRISMS Lite* search tool.

54 In order to contribute to MED's strategic priority of improving the regulatory environment, new software known as Spectrum Management and Registration Technology (SMART) is being developed. When the system is deployed, members of the public will be able to, online:

- search the Register of Radio Frequencies in real time;
- apply and pay for a radio or spectrum licence;
- pay engineering and annual fees;
- engineer a licence externally – externally engineered licences will require a policy check only;

- register instruments;
- lodge and track interference complaints; and
- modify contact details.

55 The MED's licensing regime is designed to:

- minimise interference;
- ensure compatibility of adjacent technologies; and
- encourage technical efficiency.

Three licensing systems operate under the Act: the Management Rights Regime (MRR), the RLR and, as a subset of both, General User Licences (GULs).

THE MANAGEMENT RIGHTS REGIME

56 The MRR was established to facilitate a spectrum market. The intention was to decentralise spectrum assignment, allowing *those who have the best information, the individual users, to make the decisions that determine spectrum allocation. For example, whether a* frequency *would be of greater value for FM broadcasting rather than land mobile communication can be difficult for an outside observer to assess: individual users, however, will have a good idea of how much the* frequency *is worth to them and will disclose that value through the price they are willing to pay for the right to use it. In a similar fashion, allowing spectrum users to decide among themselves the patterns of interference that will be permitted is attractive because users are likely to have a much better notion of the cost of interference on one hand and the cost of abatement on the other.*[8]

57 The MRR is a tradable property rights regime, modelled on the Torrens system[9] for land transactions, with a Registrar and Register of Radio Frequencies. It encompasses two tiers of spectrum rights:

- *management* rights, which give rightholders (the *managers*) exclusive rights to a nationwide band of spectrum for a period of up to 20 years; and
- a tradable *spectrum licence,* which is assigned by the owner of the applicable management right, and permits the licensee to transmit radio waves within the range of frequencies specified on the licence.

58 Management rights:

- offer security of tenure;
- are recorded as depreciable assets, with legal boundaries that are recorded on a public register;
- may be assigned competitively; and
- if so, attract charges based on the assignment method (usually auction) and may be tradable.

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8 *Management of the radio frequency spectrum in New Zealand,* National Economic Research Associates (London), November 1988

9 Developed in Australia, a system of the registration of interests in land in which documents are closely regulated, monitored, and examined by the recording authority to ensure that they are correct and that title is transferred without flaw. Property may not be transferred if uncorrected title defects exist.

59 Management rights can be created only by the Crown. Some have been retained under Crown ownership, while most have been sold to private interests. Management rights permit the rightholder to grant spectrum licenses for specific frequencies, within the frequency band specified in the right. Of the spectrum used primarily for telecommunications or broadcasting, approximately 30% has been converted to the MRR.

60 MED policy is to allocate spectrum in its most flexible and technology-neutral form, according to the type of radiocommunications service proposed and the criteria against which access is assigned. Management rights provide this flexibility, as they give rightholders a high degree of choice in levels and timing of investment, and in the type and configuration of the service provided. Radio licences issued under the RLR are more prescriptive. Hence, wherever appropriate, the MED makes spectrum available through the MRR. When supply exceeds demand or the band is heavily encumbered, however, there is little benefit in making the conversion.

61 To date, only national management rights have been offered under the Act, thus confining the range of interested purchasers to larger, well-funded organisations with a national scope. A recent report by Market Dynamics[10] argues that, to create a competitive market and facilitate the entry of smaller organisations, management rights should be offered on a regional basis, despite the complexity this would add to administering the MRR.

62 Government has chosen to retain some management rights, typically for broadcasting uses, from which it issues spectrum licences to individual users. This has created a hybrid management regime, with elements of both the MRR and the RLR (see also page 38, *Broadcasting Issues*).

Issue 2.1

How has the development of the MRR and the market for spectrum given effect to the objectives underlying the Radiocommunications Act 1989?

THE RADIO LICENCE REGIME

63 There are many spectrum uses where the facility to trade spectrum rights is not desirable, and value to society is perceived to be maximised through direct allocation by the Government. These include radio-based services:

- of a non-communications nature (eg, radio beacons, radar);
- provided in the public interest (eg, defence, security, safety of life);
- subject to international accords (eg, maritime, aviation);
- meeting the Government's social and cultural policy objectives (eg, public broadcasting, Maori broadcasting[11]);
- facilitating scientific studies (eg, meteorology, space communications);
- other non-commercial activities (eg, Citizens Band; Amateur Radio).

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10 *Allocation and Acquisition of Radio Spectrum*, Market Dynamics/Moore Wright Associates for MED, April 2003 (pp 54-56).

11 The Maori Television Service has been allocated a UHF management right, and a number of iwi broadcasters hold spectrum licences.

64 Access to frequencies not taken under the MRR is managed by the Chief Executive (CE) of the MED under Part XIII of the Act. Current features of spectrum assignment under this regime are:

- no guarantee of tenure[12];
- no value as assets;
- no tradability; and
- no competitive assignment.

65 The RLR operates on traditional frequency assignment lines, through the issue of radio (device or station) licences. The majority of the spectrum is managed under this regime, with approximately 36,000 licences extant (3,500 were issued in the year to December 2003). Most spectrum for non-cellular mobile and fixed services is assigned through the RLR. Radio licences are issued for a specified period, subject to the payment of annual fees. They are normally assigned on a first-come first-served basis and are not tradable.

Fees

66 Initial and administrative fees are charged for each individual radio or spectrum licence registered under the Act. Fees are based on cost recovery (that is, the amount charged is set at a level intended to recover the direct and indirect operating costs of the MED), with some differentials that relate to frequency, bandwidth and power.

67 Licence fee revenue accrues to the government, which keeps a year-to-year memorandum account so that revenue and costs can be balanced in the long term. Issues of over-recovery and cross-subsidisation under the current fee regime are being addressed by a series of amendments to the Radiocommunications Regulations.

General User Licences (GULs) and exemptions

68 An important category of licence is managed under both regimes. These are the General User Spectrum Licence (GUSL, managed under the MRR) and the General User Radio Licence (GURL, managed under the RLR). These licences permit the use of specified spectrum with no requirement for individual licensing or fee payments.

69 Uses of the GUL bands typically include such radio-based applications as wireless local area networks (WLAN), cordless telephones, garage door openers, remote locking devices, maritime VHF radio, CB radio and, in New Zealand, low power FM broadcasting. The technologies employed, their conditions of operation, and their minimal operating radius normally limit the likelihood of interference with other services. Internationally, GUL bands are termed *public parks* or *class licence bands.* Where there is unrestricted access to such bands they are termed *unlicensed bands* or *spectrum commons.*

70 It is possible for some classes of radio licence to be exempted from licensing requirements, but the MED prefers to use GULs where individual licences are impracticable or inappropriate. Hence, exemptions are seldom considered, other than temporarily, when a GUL is pending.

71 A growing use of GULs as an alternative to privately owned management rights is for broadband communications services, particularly those employing such ‘smart’ technologies as

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12 In practice, tenure is renewed indefinitely until the licence is relinquished, or cancelled for cause.

IEEE 802.11, and WiMax. Smart technologies have the potential to control the impact of interference on other services, and therefore may not require interference management or exclusivity of rights. Some commentators believe that spectrum management will eventually be revolutionised by these smart devices, as they eliminate the need to allocate specific spectrum bands to particular uses or users. However, it should be noted that, once a band has been allocated to a GUL, it can become populated rapidly by users whose nature and number is unknown to the regulator. It therefore becomes difficult to return the band to an individual licensing regime.

72 New Zealand is well advanced in using 'public parks' for spectrum management, and has instituted general user licences for WLANs as well as for high-capacity long-distance links in the 5.8 GHz band (following the US lead) and for low power FM broadcasting in the guard bands (see page 43, *Low and medium power radio services*).

73 There are incentives for users to locate their services in the GUL bands, as there are no entry or licence charges. Given that they are using a scarce public asset, there may be some theoretical rationale for the regulator exacting an appropriate usage payment. This is likely to be outweighed, however, by the difficulty of identifying users and setting a justifiable price.

APPLYING THE REGIME

74 Economic benefits of radio spectrum management are generally maximised where:

- sufficient exclusivity of use is provided to enhance the value of particular parts of the spectrum;
- security of tenure encourages spectrum-related investment;
- there is a reliable means of resolving interference problems with minimal transaction costs, both within and outside New Zealand's legal jurisdiction;
- spectrum can be acquired or disposed of freely at a fair market value; and
- concentration of control of the spectrum does not unnecessarily inhibit competition.

75 In general, spectrum is allocated to the MRR or to a GUL to promote the efficient operation of the downstream markets that use that spectrum. Key considerations when converting to the MRR are whether demand for the particular spectrum exceeds, or is likely to exceed, supply and whether the market will be in a better position to make technology and implementation choices, initially and over time. GULs are chosen where the risk of interference is low, and individual licensing would impose relatively high compliance costs without perceptible benefit.

76 Spectrum is retained under the RLR where the public interest is served by a retention of Crown command-and-control (eg, for the use of public safety and security services or to meet Treaty of Waitangi objectives) or where commercial use of bands is settled and supply is adequate to meet demand. In the latter case, consideration could be given to pricing the bands in a way that more closely reflects their market value.

Issue 2.2

For spectrum in the RLR, are any changes to licensing conditions advisable (eg, tradability, resource rentals, differential charging) to promote the highest value use for spectrum?

Modifying the spectrum environment

77 The private and public sectors have identical interests in procuring spectrum: that is, both wish to obtain it at the lowest price and/or opportunity cost in order to achieve productive efficiency. Spectrum is one of a range of goods and services utilised by government, the majority of which (for example, energy or labour) are purchased on the open market. The question should be asked, therefore, whether government should allow all spectrum to be tradable and assigned on a commercial basis.

78 The perceived advantages are that a relatively restrictive dual assignment system would be replaced by a wider and (presumably) more efficient market, and that government spectrum transactions would be transparent and equate with their opportunity costs. A possible counter-argument is that the government's primary role is to promote the public benefit, and that in a commercial spectrum market a significant number of desirable social and cultural outcomes might be defeated (see, for example, *Low and Medium Power FM Services*, page 43). It is also likely that government's transaction costs would be increased.

79 Open market purchase of spectrum by government would require the regulatory authority to be at arm's length, as a statutory authority. Spectrum with multiple potential uses and users could be traded by this entity, which might also act as an agent for secondary transactions.

Issue 2.3

Should the transfer of spectrum from the RLR to the MRR be accelerated? Is there merit in transferring all non-essential spectrum to the MRR?

80 A further option for change is to retain the current MRR/RLR regime but to progressively allocate more spectrum to 'public park' uses (see pages 15 and 58), which would tend to ease the demand for individually licensed frequencies and lower the transactional costs of licensing. Intelligent technologies (see page 53 *et seq*) may in the foreseeable future make this a practicable option even for such essential functions as emergency services and defence.

INTERFERENCE MANAGEMENT

81 Interference is managed primarily through 'engineering': that is, by planning such technical parameters of licences as frequency, bandwidth, power, aerial pattern, distance and other pertinent factors, so that interference is contained within acceptable limits. A simple form of interference minimisation is to create a 'guard band' between adjacent transmission frequencies. These are commonly used to protect radionavigation and safety service radiocommunications.

82 While considered necessary to protect safety and security services, guard bands are *per se* an inefficient use of spectrum. The ideal of spectrum planning and engineering is a licence that assigns the minimum possible bandwidth and power for the service concerned, while containing interference beneath an acceptable threshold level. ITU Radio Regulations and Recommendations define some of the pertinent parameters.

83 Engineering certification for radio licences has traditionally been carried out by RSM, but the current plan is to offer licensees a choice of engineering services, with RSM providing engineering advice only when there are no viable alternatives. Certification for radio and spectrum licences under the MRR can now be undertaken by Approved Radio Engineers. Band

managers are responsible under the Act for the engineering of spectrum licences within their bands.

84 RSM investigates, in order of priority, complaints about interference to safety services, broadcast services and radiocommunication systems, and also carries out audits. RSM does not investigate interference to private management rights, but will assist on a case-by-case basis when non-compliance with electromagnetic compliance legislation, interference by RLR licensees, or safety to life or property is suspected. Typical examples of interference sources are jammed microphones, unintentional distress signals, faulty transmitters, cracked insulators on power lines, shaver sockets, and faulty home appliances.

SPECTRUM MANAGEMENT OVERSEAS

85 Most nations of the world, with such rare exceptions as Guatemala (page 28), tend to have retained administrative licensing of spectrum in a governed market. There is a growing trend, however, towards the free market assignment of 'commercial' spectrum. In the United Kingdom, for example, Ofcom has recommended liberalisation of the management regime (page 68). A number of other examples can be found in the *Appendix* (page 64 *et seq*).

3 – The New Zealand Radiocommunications Industry

This chapter provides an overview of the radiocommunications-based industries sector in New Zealand.

TELECOMMUNICATIONS

86 Telecommunications services include the following.

- Fixed services, including 'backbone' point-to-point distribution networks that carry aggregated telephone, Internet services and broadcast services to and from distribution points.
- Cellular mobile, including first, second and third generation (1G-3G) cellular technologies.
- Fixed wireless access (FWA) point-to-multipoint services.
- Land mobile services: eg, radiotelephones in the emergency services and logistics industries.
- Fixed satellite, including international telephone traffic, internet via satellite and international distribution of news services.
- Mobile satellite.
- Maritime and aeronautical satellite, including traffic between vessels and shore stations.

87 Since the corporatisation of the Post Office in 1987 and the introduction of competition policies, telecommunications services have largely been provided commercially, through:

- customer services purchased from such telecommunications service providers as Telecom, TelstraClear or Broadcast Communications Ltd (BCL); or
- private networks tailored to organisational needs: eg, those operated by Transpower and the Airways Corporation.

In addition, a number of government agencies operate land mobile networks, including the Police, Defence Force, Customs and Conservation.

Fixed services

88 Fixed services are an essential element of 'backbone' distribution of telecommunications, providing wireless connections between main centres at a modest cost. Typically, a provider will look to a combination of radio and cable (copper or fibre-optic) in the provision of services (eg, Internet), deployed according to their relative cost in any particular location. Assignment of the traditional fixed service bands used for backbone services is through the RLR, with the exception of two UHF bands sold under the MRR. Some operators are initiating backbone links in 'public park' spectrum under GULs. Other fixed services provide point-to-point links, typically used for the delivery of rural telephone services (Telecom) and by territorial local authorities (TLAs) for telemetry (eg, monitoring river levels).

Cellular telephony and FWA

89 These sectors provide customer access to telecommunications services. Established companies have been joined by such newcomers as Woosh Wireless and, more recently, Compass Communications and Counties Power, who provide telecommunications services over Fixed Wireless Access networks. Internet service providers are offering broadband services to their customers, while electrical line companies are looking to exploit and expand on their network experience and customer knowledge in establishing local telecommunications networks to supplement their electricity offerings.

90 Cellular telephony encompasses first, second and third generation (1G-3G) services, all operating in spectrum that has been assigned in the form of management rights to, *inter alia*, Telecom, TelstraClear, Econet and Vodafone. A block of cellular 3G spectrum is reserved for assignment to Te Haurahi Tika Trust, to promote Maori participation in the knowledge economy.

Mobile services

91 Mobile radio services operate in the VHF and UHF land mobile bands and are assigned through the RLR. Users include transport companies, police, local authorities and taxi operators. Teamtalk is the largest holder of licences in this spectrum.

92 Analogue land mobile is an older technology progressively being superseded by digital delivery. The land mobile spectrum is heavily congested and there is little room for growth or for new entrants, particularly in such areas as Auckland City. Recent extensions to the lower UHF mobile bands, also used by public safety and security services, will alleviate the situation.

Other services

93 Outside broadcast bands are used for television linking from such special events as horse racing, the America's Cup and other significant cultural or sports occasions. A new band has been made available for outside broadcast services but operators seem reluctant to move into it, probably because of the cost of new equipment that would be needed to operate in the band.

94 Paging services are licensed nationally under the RLR, and may also be implemented 'on-site': for example, in rest homes, hospitals, and factories. While paging is generally regarded as a sunset technology, there are specific applications (eg, mobilising volunteer firefighters) that require its ongoing use.

BROADCASTING

95 Broadcasting services are accessible to virtually all New Zealanders. Providers of these services include commercial entities, Crown owned companies, incorporated societies, iwi, private trusts and individuals.

Radio

96 New Zealand has more than nine hundred licensed radio broadcast transmitters, of which about five hundred are operated by commercial providers and four hundred by public service and non-commercial services. They include MF-AM and VHF-FM sound broadcasting, and Radio New

Zealand's international SW service. Some sound broadcasting is carried on the Sky TV satellite network. In addition, a significant number of local broadcasters operate under GULs.

97 The allocation of spectrum bands to broadcasting is determined largely by the ITU Radio Regulations and by the configuration of equipment sourced from overseas markets. Advice on the use of commercial spectrum (ie, spectrum used by commercial broadcasters) is provided by MED, while advice on the assignment of public interest and other non-commercial broadcasting spectrum is provided by MCH and TPK. MED retains responsibility for technical planning and licence administration.

98 There is a greater concentration of commercial services in major population centres, where the density of population enables viability to be established more easily, whereas services in rural areas are fewer. Government supported services, on the other hand, tend to be available at much the same level in all areas.

Television

99 At present most television services are based on analogue terrestrial transmission using spectrum in the VHF and UHF bands, broadcasting from hill-top sites to give coverage of main population areas, that are supplemented by a multiplicity of low-powered transmitters in areas shaded from the main sites. A few local TV broadcasters transmit over the terrestrial network.

100 Satellite television broadcasting is available in digital format, through Sky TV's pay-to-view network, to which approximately 40% of New Zealand households subscribe. Sky TV uses a *conditional access* system to encrypt most programmes, including TV3, TV4, Prime and Trackside. TVNZ has its own satellite capacity, which it uses to broadcast *unencrypted* regional versions of TV One and TV2. TVNZ does not currently promote a separate free-to-air satellite service, but a number of independent retailers sell free-to-air satellite receiving equipment to the public.

101 Telecom NZ has recently announced plans to distribute television services in digital format over its broadband network, which can commence without alteration to current government policy. TelstraClear currently distributes Sky programmes via its cable system.

102 All broadcasters are required to comply with codes approved by the Broadcasting Standards Authority or the Advertising Standards Authority, as applicable. There are defined procedures for complaints about content to be investigated and, if confirmed, remedied.

PUBLIC SAFETY AND SECURITY

New Zealand Defence Force

103 The New Zealand Defence Force (NZDF) is an extensive user of spectrum. The band from 230 to 405 MHz is recognised nationally and internationally[13] (eg, Australia, Canada, the USA and the United Kingdom) as reserved for defence/security purposes. These bands are largely self-regulated by NZDF in New Zealand, where their main use is for tactical communications. Some

[13] The agreed international range is 225 to 400 MHz. In New Zealand the 225-230 band is used for TV broadcasting.

frequencies are assigned to non-military uses, including aircraft navigation systems and civilian short-range devices (eg, garage door openers). Non-defence access to the 230-400 MHz spectrum is, in practice, subject to NZDF agreement.

104 NZDF uses other frequencies, both routinely (eg, via commercial service providers) and for specific military functions (eg, radar), in bands shared with non-military users. Some sea-borne and airborne navigation devices use internationally-agreed aeronautical and maritime bands, and employ common technical specifications. On occasion NZDF uses commercial cellular or land mobile spectrum, by prior agreement, for such purposes as large-scale military exercises.

105 All NZDF radio and spectrum licences are issued by MED under protocols that provide scope for NZDF to meet its operational needs without revealing sensitive information.

Public Safety and Security Services

106 Non-military public safety and security (PSS) services include such organisations as police, civil defence, fire, ambulance, coastguard, surf lifesaving, search and rescue, and mountain rescue. While some of these services are professional and uniformed, others are partly or wholly staffed by volunteers.

107 All PSS services require a substantial wireless infrastructure, carrying both voice and data, with some commonality between services (eg, between police, fire and ambulance services at road accidents). Civilian public safety groups that operate only in emergency situations (eg, local search and rescue) may use communication networks operated by organisations whose routine responsibilities lie elsewhere (eg, the Department of Conservation). The Fire Service is a significant user of pagers, especially for contacting volunteer firefighters.

108 Advice to MED on frequency allocation is provided by the Public Safety Radio Frequency Management Group (PSRFMG), whose membership is drawn from all of the major PSS organisations. PSS services pay standard administrative costs for radio licences. Because the majority operate in patrol and/or emergency response mode, the greatest use of spectrum is for mobile services, occasionally in areas so remote that portable transmission facilities are essential.

Civil Defence and Emergency Management

109 Spectrum assignments for national and local emergency management are planned by the Wellington office of the Ministry of Civil Defence and Emergency Management (MCDEM) and implemented through the RLR regime. Most of the assignments are in the HF and VHF bands. The range and penetration of these frequencies make them attractive for emergency communications, and MCDEM has at present no intention of migrating to UHF or higher frequencies.

110 MCDEM is represented on PSRFMG. The main business of the spectrum manager at MCDEM is to find and assign frequencies to Territorial Local Authorities (TLAs) for emergency radiocommunications, and to manage the national HF radiocommunications network. An early 1990s' intention to migrate all TLAs from the old HF civil defence bands to the VHF ESA band has been defeated by lack of funding for the requisite VHF equipment and by saturation of the ESA band. Approximately one-third of TLAs have yet to migrate to VHF, where there are now no spare frequencies.

111 MCDEM's national HF network is scheduled to be upgraded to a combined satellite-phone, VHF and HF system, but awaits the implementation of a national Crisis Management Information System. This will be based on a broadband data network with a microwave backbone leased from a commercial operator (eg, Telecom or BCL).

Aeronautical and maritime services

112 This group of services operates largely at frequencies determined by international agreements and conventions, and is accessed mainly by shipping and aircraft, and by vehicles and recreational users (eg, trampers, hunters) operating in remote areas. Its primary purpose is to ensure safety, either direct (location, and protection of crew, passengers and cargo) or indirect (protection of third parties and property from, for example, collision impact). Services take the form of:

- navigation aids (eg, radio beacons, Global Positioning System satellites);
- air/sea traffic control (eg, air-to-ground/ship-to-shore communications, Instrument Landing Systems [ILS], VHF Omnidirectional Radio range [VOR]);
- collision avoidance systems (eg, radar, transponders, air-to-air/ship-to-ship radio);
- emergency assistance systems (eg, INMARSAT, COSPAS-SARSAT, EPIRBs, Search and Rescue); and
- commercial and personal communications (eg, radio, cellular and satellite telephony).

113 Most of the spectrum used in this category is clearly defined, under ITU and other international conventions, as being for aeronautical, maritime or emergency use. Access is managed by, variously, the Civil Aviation Authority, the Maritime Safety Authority and the MED. All licences are assigned under the RLR, with many aeronautical and marine services operating under GULs.

114 A large number of licences have been issued for these bands, the majority of which are for mobile radio operating on common frequencies (eg, in fishing vessels, recreational craft and small aircraft). There is increasing use overseas of satellite communications, particularly for aeronautical and maritime broadband data applications.

115 A number of other networks may periodically be employed for air, sea and land emergency communications, notably the Department of Conservation's radio network (1248 licences), the national Police network, and the cellular telephony networks.

116 As with defence and other public safety and security services, spectrum is used intermittently, as and when the need arises, but needs to be kept clear of other traffic and/or interference to meet such needs. Efficient use is not, relative to public safety, the priority.

OTHER RADIOCOMMUNICATIONS SERVICES

Earth-based radio astronomy

117 Radio astronomy is the study of celestial objects through passive[14] observation of radio waves emitted or reflected by these objects. The domestic band plans for radio astronomy mirror

[14] ie, it does not transmit RF, it merely receives it.

largely the ITU assignments. A number of bands are dedicated exclusively to radio astronomy use. Other bands are shared with fixed terrestrial and mobile services that have the ability to interfere with the radio astronomy use.[15]

118 Because there is no need for radio astronomy users to acquire a licence, it is difficult to determine the level of occupancy in these bands, and thus whether the amount of spectrum set aside under ITU provisions is utilised efficiently. The degree of protection afforded to astronomy sites in particular bands has the potential to constrain the deployment of alternative services.

119 Although this spectrum band does not generate any revenue to the Crown for its use, there are potential costs associated with investigating any interference queries. To date this has been largely mitigated by the ITU regulation which requires the user to take all reasonable steps to prevent it. Such costs have, to date, been negligible.

Meteorological services

120 A number of bands are dedicated to such meteorological services as weather balloons, radar and satellites.

Amateur services

121 The amateur bands operate as a public park, managed under the RLR. A licence entitles the operator to transmit within a particular band, but frequencies are not exclusively assigned. There is a requirement to obtain the relevant operator qualification prior to a licence being issued. Users of amateur bands are forbidden to operate for pecuniary gain.

122 Bands are allocated in accordance with the ITU Radio Regulations. Their provision acknowledges the potential of the hobby to advance the communication and technical skills of radio, and to enhance international goodwill. The amount of spectrum dedicated to the amateur services in NZ is large compared with the number of licensed users.

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15 'The ITU has allocated some 2% of the spectrum below 50 GHz to radio astronomy for passive observation of cosmic emissions.' *Review of Spectrum Management*, Professor Martin Cave, HM Treasury, March 2002, p.195.

4 – Economic Outcomes

This chapter describes and reviews spectrum policies and processes that contribute to the achievement of New Zealand's economic outcomes.

ECONOMIC OBJECTIVES

123 It was noted in the conclusion to Chapter 1 that the management of radio spectrum is governed directly or indirectly by a variety of Government policies and purposes, which are embodied in legislation and Cabinet decisions. It is convenient to divide these into *economic* and *social and cultural* objectives, although the distinction is not always clear-cut. This chapter examines the effectiveness of radio spectrum management in supporting economic objectives. Social and cultural objectives are discussed in Chapter 5.

124 Under current Government policies, economic objectives encompass:

- promoting competition;
- maximising the value of spectrum to society; and
- satisfying growing demand.

PRICING

125 Initial assignment of spectrum, under the RLR or the MRR, can be administrative or by the sale of spectrum rights. It is usual for spectrum managed under the RLR to be assigned at a price that covers the costs of administration but does not necessarily reflect the real value (whatever that may be) of the spectrum. If the regulator wishes to assign spectrum at a price that reflects its value to society, the main options are *administrative pricing* or *commercial allocation*.

126 Administrative pricing sets charges for spectrum that approximate the market value of the resource, thus providing users with incentives to release unused or underused spectrum, to consider alternative services or uncongested frequency bands, and to implement more efficient technologies. Recent experience suggests that calculating such charges can be difficult and that they are unlikely to be wholly accurate. Further, raising the price of spectrum through this mechanism would run counter to Government's policy of reducing business compliance costs.

127 In academic literature, a number of methods for estimating the monetary value of spectrum rights have been postulated, all subject to uncertainties and inaccuracies. It is widely accepted that *opportunity cost* provides the least uncertain estimate, but that rather begs the question, as the next best alternative use of spectrum must be identified and such information is seldom available. Calculating the *marginal value* to an incumbent user is equally problematic, because the data available (revenue, profit) lends itself more to the calculation of average than marginal values.

128 Were such calculations reliable, uncertainty remains as to whether the incumbent is currently allocating spectrum to its highest-value use (and whether this actually represents its maximum

value to society, not merely to its user: a proposition much argued but incapable of proof). Opinions vary, therefore, as to the most practical method of valuing spectrum.[16]

129 *Economic value analysis* examines the total value generated in the economy of the country as a result of activities associated with radio spectrum (eg, profits of cellular operators, salaries, equipment purchases) in order to determine which applications add the most value. More spectrum can then be allocated to those applications that generate high levels of value. The main problem with this technique is the inherent difficulty in performing the work to any degree of accuracy. A further problem is that there is a high resource cost in gathering the required data (if that data is indeed available), that measuring such proxies as salaries may not yield an economic value, and that the market may change more rapidly than analysis can follow.

130 Secondary trading of administrative licences could be used to develop a real market in spectrum, as opposed to the pseudo-market of administrative pricing. Theory posits that, as long as an efficient secondary market exists, it matters very little how the spectrum is assigned initially. Trading would allow prices to fluctuate according to supply and demand and the true market value would be realized at all times. The main disadvantage, in some critics' views, is that windfall gains would be enjoyed by those who happen to be holding spectrum at the time trading is introduced. Further, the government, although avoiding engaging in profit-taking, would not capture the market value of that spectrum in its revenue. The market itself might be difficult to regulate.

131 With commercial assignment, the regulator offers spectrum on the open market, relying on competition to determine the value of the spectrum to purchasers. This mechanism works most effectively when there are large numbers of willing and informed buyers and sellers, but is less effective where buyers are few and high entry costs prevail as, for example in the New Zealand telecommunications market.

132 Auctions can be effective determinants of value where there are large blocks of unused spectrum and many competing buyers. Advantages include transparency, a relatively low cost of operation, and significant revenue returns to government. Auctions also produce a market price that could be applied to spectrum assigned by other means: for example, administrative pricing. While well-resourced bidders tend to overshadow small or low value users, with diminished downstream competition resulting, auctions are a cost-effective rationing mechanism where no social and cultural objectives are at risk.

COMMERCIAL ASSIGNMENT

133 Commercial assignment of long-term spectrum rights can generate efficient outcomes, as the competition to obtain spectrum should mean that radio frequencies are used by the entities valuing them most. However, the relatively small number of operators in the New Zealand market creates a likelihood that management right-holdings will be concentrated, with the conditions by which markets operate competitively being compromised. Government maintains some ability to intervene in the market where necessary, with the options of encouraging competitive behaviour, discouraging anti-competitive behaviour, or both.

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16 Abridged from *The Role of Economic Techniques in Spectrum Management*, IEEE Communications Magazine (March 1998) pp 102-107.

134 The Radiocommunications Act deems management rights and spectrum licences to be assets of a business for the purposes of s47 of the Commerce Act 1986, which prohibits the acquisition of assets (in this case management rights and spectrum licences) if the acquisition would be likely to have the effect of *substantially lessening competition*. Section 36 prohibits the taking advantage of substantial market power for exclusionary purposes. With respect to merger and acquisition control, the onus is on the acquiring company to comply with the Act. In order to provide certainty to companies whether a proposed merger does comply, the Act provides a potential purchaser with the ability to apply to the Commerce Commission for a clearance or authorisation.

135 A *clearance* is granted if the Commerce Commission concludes that a proposed merger will not substantially lessen competition in a market. An *authorisation* is granted if the Commerce Commission concludes that, although competition will be substantially lessened, the benefit to the public will outweigh the detriments of the proposed merger. If granted, a clearance or authorisation protects those acquiring the business from further scrutiny by the Commission and/or complaints from private individuals.

136 When the Radiocommunications Act was reviewed in 1995 the government determined that the provisions of the Commerce Act should, in general, continue to be used for competition issues and that no industry-specific legislative safeguards were required. This accorded with the prevailing view of industry and the MED. Since then, industry-specific regulation of downstream telecommunications markets has been implemented through the Telecommunications Act 2001.

137 The Commerce Act was amended in 2001. A key amendment was to change the s47 threshold from a test of dominance to a test as to whether an acquisition *has the effect of substantially lessening competition in a market.*[17] No complaint made in respect of radio spectrum has yet been assessed by the Commerce Commission as breaching this provision. Consequently, major rightholders have been able to continue the expansion of their holdings. This in turn has precluded spectrum acquisitions by local and regional interests, as they lack the financial resources to compete at auction with the national networks.

138 There is provision in the Act for the Commerce Commission, at the request of a Minister, to set qualitative and quantitative thresholds relating to anti-competitive market behaviour: for example, percentage of total radio assets held or price charged for access to a network. This provision has never been invoked in respect of radio spectrum.

139 The MED has the power to impose such limitations on spectrum acquisition as spectrum caps (see page 30) and eligibility requirements, and has done so in recent auctions, though only on a case-by-case basis.

Issue 4.1

The Act relies on the provisions of the Commerce Act to resolve competition issues. Given the perceived need to apply spectrum caps and eligibility requirements in past and future auctions, and the absence of determinations against dominant acquisitions, is there a case for re-examining the effectiveness of these provisions?

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17 Commerce Amendment Act 2001, Section 11(2). The new test is similar to that applied under parallel Australian legislation.

Secondary markets

140 A secondary market is perceived to work efficiently when there is a large number of informed and willing buyers and sellers. Secondary market trading in spectrum, however, is constrained in New Zealand by a number of factors. These include:

- New Zealand's small consumer market;
- the high entry costs of new radiocommunications and telecommunications services;
- the limited number of buyers and sellers; and
- the ready availability of inexpensive alternative spectrum under the RLR, which limits incumbents' incentive to trade.

141 The low volume of spectrum trading does not necessarily imply hoarding for anti-competitive purposes. New Zealand companies state that they purchase spectrum with the intention of using it, rather than for on-selling, and that they bid in auctions largely to ensure that they are able to compete in any future downstream markets that may develop (eg, 3G mobile spectrum). It does, however, place pressure on the stock of spectrum that remains available for auction. There is a view that, if there were a properly functioning secondary market for spectrum, companies would be able to use resources more efficiently by investing in spectrum closer to the time it is needed. Instead, they are forced to anticipate future use and stockpile unused spectrum.

142 A way of addressing the issue is to allow more players into the market, by limiting the percentage of spectrum that may be held by any single entity and/or creating a more favourable start-up environment. There are arguments against such measures, the most cogent being that small players are unlikely to benefit from economies of scale, thereby negating any advantages to the consumer that might accrue from competitive pricing. Nonetheless, monopolistic or duopolistic influence in the consumer market commonly promotes over-pricing and excess profit-taking, and can discourage innovation.

143 The way in which spectrum is packaged is also significant. Australia has recognised this in creating Standard Trading Units (STUs) for spectrum. These can be traded *en bloc* or subdivided, in contrast with NZ's regime of licences tailored to specific users on a case-by-case basis, which may not as easily be transferred to other users or uses. A recent decision here, to assign spectrum by means of area licences based on administrative boundaries for 3.5 GHz fixed wireless access use, may facilitate the adoption of more flexible uses and engineering solutions.

Issue 4.2

Is there merit in re-packaging the MRR to provide for regional or local management rights? What would be the implications for legislation, engineering and administration?

144 Guatemala has recently instituted a system of usufruct[18] titles (TUFs) to spectrum, by which individuals may apply for the right to use *any* unused spectrum and, if there are no interference issues or public objections, receive title within 15 days. Competing applications are settled by auction.

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[18] The right of using and enjoying the benefits of something belonging to another. The Market Dynamics report noted that NZ's spectrum rights are 'usage' rights much more than they are management rights.

145 Since 1996, the Guatemalan regulatory authority has received more than 13,000 TUF applications and has issued more than 5000 usufruct titles. Of these, a quarter has been transferred in what appears to be a healthy secondary market, augmented by an unknown number of unrecorded leases. Guatemala has experienced a remarkable growth in telecommunications since the introduction of the new regime, exceeding all relevant statistical benchmarks for middle-income Latin America by a considerable margin.[19]

146 Australia, the United Kingdom and the USA (see the *Appendix*) are moving towards the establishment of trading desks, to facilitate sales and transfers of spectrum. Whatever measures are adopted, simplicity, transparency and low transaction costs will be advantageous.

Issue 4.3

Are there proactive means by which the government could promote and enhance secondary spectrum markets?

Spectrum auctions

147 The MED moved to *simultaneous, multiple round* (SMR) ascending auctions from 1996, initially by faxed bids. An Internet bidding system was implemented in 1998. Such auctions make all lots available for bidding at the same time. The auction takes place over a number of rounds of a specific duration (say thirty minutes), until no further bidding takes place on the lots being offered.

148 In theory, auctions should result in a similar clearing price to a second-price tender as the auction clearing price is one increment above the value placed on a lot by the second price bidder. The fact that the identity of bidders and the value of bids are disclosed during the auction encourages clearing prices which more fairly reflect the real market value of rights. SMR auctions allow bidders who wish to purchase specific combinations of lots to take part. Other advantages are that bidders obtain full market information and are able to determine their level of success on any combination of lots at any time during the auction.

149 An alternative to the SMR auction is a *combinatorial* auction, in which bidders make offers for specific combinations of lots on an all-or-nothing basis. This reduces the risk inherent in SMR auctions that a bidder may acquire an unmatched or incomplete block of licences. It does, however, introduce a number of technical problems related to auction design. In SMR auctions, each lot is bid for separately and is clearly distinguishable from other lots. In combinatorial auctions, no two bidders will necessarily be bidding for the same combination of lots, and comparing bids in each round requires the application of an algorithm to determine the optimum (highest value) bid. Combinatorial auction theory is still evolving and the methodology has yet to be proven on a significant scale[20].

150 The FCC is considering variations of the *clock* auction as a potential method for future spectrum sales. Clock auctions are multi-round bidding events at which similar lots are offered by the auctioneer at a single price and, within a predetermined time period, bidders nominate the *quantity* required. If there is excess demand (ie, more lots are required than are available) the

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19 From *Spectrum Management for a Converging World*, ITU 2004

20 The world's first combinatorial and clock spectrum auctions have recently been held in Nigeria (reported by the Australian Communications Authority).

price is progressively raised until demand matches supply. Conversely, if there is excess supply, the price is progressively lowered. Clock auctions have the merit, in most cases[21], of precluding the 'winner's curse', by which the winning bidder pays well above the market clearing price, as the bid price is always the clearing price.

151 A *Vickrey* auction commences with bidding on a single lot, SMR-style. The successful bidder has the opportunity to acquire multiple lots at the winning price. Bidding recommences on the remaining lots, and continues in this fashion until all lots are sold. This method overcomes the problem of acquiring mismatched lots, as under the SMR method, and to some extent mitigates the effect of the winner's curse.

152 In an auction, the highest bidder has to convince its governing body and/or the money market to provide sufficient financial backing for the bid. Price-based assignments have the advantage of being more efficient and transparent, and less prone to challenge. Concerns that participants with significant market power may hoard rights or exclude competitors can be met by the application of general competition law, or (more controversially) by such specific safeguards as spectrum caps and implementation requirements. Auctions are being used increasingly overseas for the assignment of commercial spectrum (see the *Appendix* for Australian, North American and UK references).

153 Alternatives to auctions include *first-come-first-served* assignment and *beauty contests*. Where demand exceeds supply, first-come-first-served licensing is less likely to ensure that spectrum achieves the highest value use. Beauty contests are superficially attractive, as they ensure that a wider range of considerations than price determines the highest value use of the spectrum. All beauty contests rely, however, on a subjective judgement by the decision-maker, whether the MED, Ministers or an independent tribunal, and can be unreliable as a method of assignment. They may, however, be useful for qualifying bidders at auction, in terms of their eligibility under current spectrum policy.

Issue 4.4

What are the relative merits of different types of auction, and are some types more suitable than others for the various spectrum markets?

Spectrum caps and eligibility requirements

154 A spectrum cap is a restriction on the amount of spectrum that any one entity (including associates of that entity) may hold. A cap can be applied at original assignment: for example, through auction rules which prevent any person from purchasing more than, say, a third of the management rights on offer in the auction, or incrementally acquiring more than a third of the total management rights allocated to the industry. It could also be applied following an auction by an agreement with the winning bidder that prevents any trading of management rights that has a similar result.

155 Determining the optimal size of a cap involves balancing two key efficiency considerations. If the cap is set too 'loose', relative to the amount of spectrum available, the successful bidders will be in a dominant position with little incentive to limit consumer charges. If the cap is too

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21 An exception is where the winner requires a large proportion of the spectrum on offer, and is forced to bid high to shut out other bidders.

restrictive, restricting the size and scope of spectrum acquisitions by any single entity, reduced economies of scale will result in higher implementation costs and higher consumer prices.

156 A further difficulty in determining the configuration and duration of a spectrum cap lies in deciding what limits to association between bidders should be imposed. It would be possible, for example, for several bidders to acquire management rights at auction without breaching spectrum cap conditions, but for a single entity to consolidate all of the holdings in secondary trading. In such circumstances, extension of the cap to cover secondary trading could be justifiable.

157 From 1989 until 2000, the MED did not apply any spectrum caps. The main policy rationale was that the Commerce Act applies to acquisitions of spectrum rights under the Act, so no specific restrictions were required.

158 In 2000, the Crown imposed a spectrum cap on the acquisition of spectrum rights for 3G mobile services. Its purpose was to facilitate the development of competition in the provision of such services in New Zealand. It addressed concerns that one or two of the 3G spectrum bidders might purchase enough of the spectrum to significantly reduce competition in downstream telecommunications markets. The Commerce Act provisions were not considered adequate to mitigate this concern, given the potential for an enduring 3G duopoly to exist under the 'dominance' threshold. There was also some uncertainty at the time as to the eventual characteristics of the 3G market.

159 In extending the 3G spectrum cap, the Crown recognised that some constraints would be placed on commercial partnership models that spectrum holders might consider: for example, in some circumstances the long-term interests of consumers of 3G mobile telephony services might be better achieved by a joint venture servicing low-density areas. In the event that such a proposal were of interest to two or more parties and complied with Commerce Act requirements in being in the public interest, the Crown will consider modifying the 3G cap.

160 A spectrum cap was applied to some lots in Auction 5 in 2002 to ensure there would be at least three successful bidders. The cap was lifted automatically after one year, to allow secondary market trading to occur. It was considered that, as the Commerce Act had been amended to provide a 'substantial lessening of competition' test and markets were more clearly defined, general competition law was again assumed to provide the most effective means of ensuring effective competition.

161 No spectrum cap was applied in Auction 6, of licences for sound and television broadcasting. The radio and television markets were considered to be mature, so the Commerce Commission was expected to have little difficulty in applying the 'substantial lessening of competition' test. Further, to be effective, any cap would have had to be applied as an eligibility requirement which excluded two of the major broadcasters. There did not, at the time, seem to be sufficient policy justification for this. The auction was followed by some complaints about acquisitions to the Commerce Commission, which concluded, however, that no action was warranted.

162 Eligibility requirements are a potentially useful mechanism for ensuring that government policy objectives are met while maintaining a commercial spectrum market. Typical examples include requirements that:

- telecommunications providers maintain a 111 service;
- 3.5 GHz spectrum is used to provide rural broadband services; or

- urban FM radio spectrum is used for educational broadcasting.

When acquiring such spectrum, bidders are able to take into account the cost of providing the specified services

163 An outstanding policy issue is whether the justification for the application of spectrum caps or eligibility requirements is founded in competition policy (ie, enhancing competition) or public policy (encouraging diversity). For example, in Auction 6 the Commerce Commission found that increases in licence holdings by the two largest rightholders in the mature radio broadcasting market did not breach the 'substantial lessening of competition' test. There is some concern, however, that lack of diversity of ownership in this market may not serve the best interests of consumers.

Issue 4.5

There is a tension in the design of auctions (including the application of spectrum caps and eligibility requirements) between the objectives of assigning spectrum to the bidder according it the highest value and promoting the competitiveness of downstream markets. How might this tension be managed? Should constraints continue in place after the spectrum has been assigned?

Implementation requirements

164 The MED has not applied an implementation requirement when assigning spectrum under the MRR, although radio licences assigned under the RLR can be revoked for non-use under Regulation 15. With respect to the issue of the hoarding of spectrum for anti-competitive purposes, the MED has usually concluded that there is little evidence of any problem, and that implementation requirements are difficult to impose and enforce. It may be appropriate to impose an implementation requirement where spectrum is allocated for social and cultural purposes, but this issue has not been examined in detail.

165 The Ministry proposes to apply both eligibility and implementation requirements to the assignment of two blocks of FWA spectrum in the 3.5 GHz band, retained by the Crown from Auction 5. The requirements accord with Cabinet's intention that licences in these blocks be made available for specific geographic areas, typically for high speed internet connections in rural/provincial districts[22].

166 If there is evidence of spectrum hoarding, or of barriers to re-assignment of spectrum to higher value uses, there is a question as to how the Government should and could prevent such hoarding, whether through an implementation requirement or some other mechanism. An inherent difficulty has been in defining 'implementation', and in the latitude that should be given before new services are considered not to be implemented.

167 Practical 'implement' or 'lose' provisions would be extremely difficult to apply, and the compliance costs of policing such a requirement are likely to be high.

- 'Implementation' is difficult to define. Many frequencies can be used for more than one purpose. For example, a broadcasting frequency may be used for a low-power service, or to provide a sub-carrier communications service, as well as for a high-power broadcasting

[22] See http://www.med.govt.nz/rsm/spp/fixed-wireless-access/draft-proposals/index.html.

service. Utilisation for even a modest purpose could frustrate the intentions of the implementation requirement.

- People denied the use of a frequency under an implementation requirement may have passed the cut-off date purely because market conditions had changed, or equipment had not arrived on time. There would need to be a great deal of administrative flexibility, which in practice would make the requirement difficult to enforce.
- Rightholders have paid for their spectrum. If they were to forfeit their spectrum for non-implementation, the question of compensation for the lost spectrum would arise unless the conditions of forfeiture were clearly stated in the licence agreement. Otherwise, there would be significant prospects of court action to avert the loss. This would not be solved by a provision for a cash refund: this might simply encourage rightholders to return their frequencies to the Crown for a refund in the event that market prices for spectrum fell.
- It would be difficult to define the date at which an implementation requirement would apply. It would have to be determined whether the requirement applied from the date of sale, after a fixed period from the date of sale, or some other date. Further, it would need to be stipulated whether the requirement continued to apply if the licence were traded before the implementation requirement came into force.
- There would be an incentive for right-holders to defer investment until there was certainty that the rights would be retained. Hence, services may be developed to the bare minimum required for compliance with the implementation requirements.

Issue 4.6

Use-it-or-lose-it requirements are common in overseas jurisdictions on both anti-hoarding principles and the proposition that unused spectrum is not realising its highest value to society. Notwithstanding the administrative difficulties, would it be in New Zealand's interest to impose such conditions more generally on management rights and spectrum licences? Under what circumstances should they be applied?

ALLOCATION OF SPECTRUM

168 The use of spectrum is steadily increasing, particularly for cellular, WLAN, broadband access and radio identification services. Project PROBE[23] is driving significant network building activity for the delivery of broadband services to rural communities. Compared to countries with higher population densities, however, New Zealand's spectrum still has a modest level of congestion.

169 The demand for spectrum is driven by demand for the goods and services to which it is an economic input. These are extremely varied, ranging from entertainment, leisure and consumer products to education, health and public security. Recent years have seen a spectacular increase in cellular telephony and short range devices. Demand is difficult to predict in an era of rapid technological development. There is no doubt, however, that the demand for spectrum will increase, and that its management will become increasingly complex.

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[23] Project PROBE (Provincial Broadband Extension) has been developed jointly by the Ministry of Education and the Ministry of Economic Development to roll out high speed internet access, or broadband, to all schools and provincial communities.

170 The ready availability of spectrum has prevented any excess demand issues arising, but greater consideration may have to be given to competition as the growth of consumer markets and new technologies place pressure on the remaining spectrum available. In addition to the Commerce Act provisions, it may be necessary to consider implementation requirements and spectrum cap provisions to ensure that there is equitable access to the spectrum within the RLR.

171 Any judgement as to the efficacy of the allocation system and the efficiency of spectrum use needs to be underpinned by accurate data: any such relevant information as currently exists is patchy and, to a degree, anecdotal. It may be timely, therefore, for the regulator to commission a comprehensive independent audit of spectrum allocation and use, similar to that recently proposed by Ofcom in the United Kingdom.

Effectiveness of the Radio Licence Regime

172 The RLR does not provide a competitive market environment, but there is little incentive to transfer spectrum to the MRR where the supply of spectrum exceeds demand. Nearly every application under the RLR is satisfied with a licence for the applicant's preferred operating band, or with a reasonable alternative. Even where demand does not exceed supply, there appear to be few incentives for licensees to hoard spectrum in most bands, as new assignments can be applied for with relative confidence.

173 Low cost and ease of access, however, may also encourage licensees to be profligate in its use in order to save costs elsewhere: for example, by operating 25 kHz channel equipment rather than replacing it with more spectrum-efficient 12.5 kHz channel equipment. While this is a good business decision, it can also contribute to band congestion.

174 In bands that are becoming congested (ie, demand exceeds supply), technical innovation may absorb demand in the short term. In the longer term, however, fully saturated bands managed under the RLR may not be achieving their highest market value. At this point or before, consideration could be given to transferring spectrum to the MRR, or applying such incentives for efficient use as resource rentals or opportunity cost pricing. Too early a transfer of spectrum, however, should be avoided: in the absence of excess demand, the purchaser may pay low prices at auction and consequent enjoy later windfall benefits.

Effectiveness of the Management Rights Regime

175 *The fundamental mechanism, by which the spectrum management regime could contribute to economic growth, is through ensuring that users face continuing incentives towards more productive use of this resource. …these incentives should be financial and be based on the opportunity cost of spectrum use. In this way, spectrum would be costed as any other input into the productive process. Price signals about the cost of spectrum would be distributed throughout the economy. This information should enable dispersed economic units to make their own judgements about the use of spectrum and the alternatives open to them to meet their organisational goals.*[24]

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24 Cave report, *op cit.*

176 *The advantages of a market system are tempered … by the notion that a spectrum market could involve numerous bilateral transactions. If the cost of individual transactions is high and there are numerous spectrum 'neighbours' with whom negotiations are necessary, then efforts to achieve economically efficient interference patterns will be inhibited. The difficulties involved in designing market mechanisms which enable the efficiency gains to be realised while minimising transaction costs have, in part, inhibited the move towards market systems of spectrum management elsewhere in the world.*[25]

177 Since 1989 the approach of successive governments has been to create an efficient market mechanism for radio spectrum so that decisions involving the use of new technology are devolved to its users. To this end the Crown has created and sold defined management rights in many of the frequency bands used by commercial operators, particularly in those sectors experiencing the greatest technological change.

178 In theory, the economic value to the holder of rights assigned under the MRR, whether as an input to production or as an asset to be traded or mortgaged, is reflected in the auction fee paid or, when rights expire, by the market-value price paid for renewal. These relatively high costs motivate rightholders to use the spectrum efficiently in the generation of income. RLR licences, on the other hand, are subject only to administrative fees, whose impact may provide insufficient cost incentive for efficient use.

179 Before management rights can be assigned by auction, decisions must be made on the configuration of lots, including the size of each management right, its boundary conditions and whether the lot consists of an individual right or a pair of rights. In general, the Ministry balances competing objectives of:

- technical neutrality, which suggests that no judgements should be made as to the likely end use of the management rights;
- technical efficiency, which suggests that the lots should be defined in a way that facilitates their likely end use; and
- competition issues, which suggest that the number of lots should facilitate competition in the downstream market.

When considering these issues, the Ministry seeks the best available market and technical information, through industry consultation, expert technical analysis and consideration of overseas trends.

180 Despite this, the end use of management rights is not always predicted accurately, as is demonstrated by the examples that follow. This is not surprising, given the rapid rate of technological change in the communications sector, and is anticipated when allowing market flexibility to determine the highest value use of the management rights.

- A management right configured for a 1G cellular telephony technology known as TACS A was purchased by BellSouth in 1990, and subsequently used for GSM, a 2G technology.
- Management rights sold in 1989 in the 2.3 GHz band were configured for multipoint distribution services (MDS), a form of television broadcasting. These rights have had very little use over their lifetime, as the relevant technology has not been implemented on a

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25 NERA report, op cit.

significant scale either locally or internationally. The most likely future use now appears to be for FWA, although the boundaries of these rights may not be optimal for such use.

- Adjacent spectrum configured for fixed links (ie, point-to-point) in the 2 GHz band was purchased by Woosh Wireless and BCL, who separately decided to use incompatible technologies for FWA (ie, point-to-multipoint) delivery. This created potential interference issues between the two services, which eventually were resolved by an agreement to coordinate further deployment.
- Spectrum at 3.5GHz configured for FWA was sold in lots consisting of pairs of management rights of 7 MHz each, with a spectrum cap which prevented bidders at the auction from acquiring more than three pairs each. This has been criticised by one potential new entrant as having had a harmful effect on competition in the downstream market for the provision of broadband, as a large bandwidth would be needed if a single provider were to compete successfully with wire-based technologies.

181 If, despite the Ministry's best efforts, lot design does hamper competition, the Act allows the market to remedy the problem through secondary trading, amalgamation and division of management rights, and arbitration provisions. In addition, the case-by-case review undertaken when management rights are renewed provides the opportunity for the Ministry and industry to consider whether the configuration of the rights promotes highest value use, or whether adjustments are warranted.

Issue 4.7

When 'packaging' management rights, what weighting should be given respectively to technical neutrality vs. technical efficiency, and competition issues?

Issue 4.8

To what extent should MED be involved in resolving coordination issues between management rightholders?

Expiry of rights

182 Spectrum rights created under the MRR have a maximum term of 20 years under the Act. The first rights created, for UHF television, expire in 2010. Rights for AM and FM audio broadcasting expire in 2011 and VHF television rights (TV1, TV2, TV3 and C4) in 2015. Expiry dates for mobile telephone services vary, with the first rights expiring in 2011.

183 The original Act provides that rights revert to the Crown on expiry, but is silent as to how they should be allocated or reallocated. Amendments to the Act in 2000 allow the Crown to create a 'succeeding' management right ahead of expiry, to ensure a seamless transition from one term to another.

184 In mid 2003, following consultation with industry, Cabinet agreed the following policy for the reassignment of commercial spectrum rights:

- that commercial spectrum rights be reassigned five years before expiry for a further 20 years, subject to review on a case-by-case basis to ensure consistency with New Zealand's international radio obligations and with the general objective of maximising the value of the spectrum to society as a whole;

- that the Crown should receive a fair financial return for the use of spectrum in the future period; and
- that spectrum rights be reassigned to existing rightholders based on price-setting formulae that reflect the market value of the rights, and that, if existing rightholders do not wish to pay this price, the respective rights be reassigned by auction.

185 Econometric consultants were employed to develop and peer-review a price setting formula, which has been approved by Cabinet as a general framework for implementing its policy. The price-setting formula calculates the renewal price for a spectrum right (V2) by taking the acquisition price (V1) and applying a compound growth factor ('z'). The growth factor represents an estimate of how much the net cashflows from the use of rights in the renewal period compare to the net cashflows from the current period. At the time of writing, a process was being developed for the implementation of government's overall policy on expiry of rights, and for the application of the price-setting formula to specific rights, particularly those rights due to expire before April 2011.

186 It has been argued[26] that spectrum rights should be issued in perpetuity, because incentives to trade in secondary markets and to invest in spectrum-dependent activities could diminish as the payback period of a fixed-term licence shortens. Since the report was written, a right of renewal has been established in Government policy, which reduces the weight of the argument. A prudent band manager might consider lobbying for perpetual management rights but would be unlikely to assign spectrum licences in perpetuity.

TELECOMMUNICATIONS ISSUES

187 In the telecommunications sector, current policy is to promote maximum market flexibility, allowing service providers to choose the timing and type of service established. Where demand exceeds supply, the timely assignment of management rights by auction is seen to be the most effective means to achieve this objective.

188 It is government policy to transfer commercial telecommunications spectrum from the RLR to the MRR progressively. The government has usually chosen not to retain the relevant management rights, which are assigned to the private sector by auction. Where the government has retained management rights, spectrum licences are assigned by auction.

189 Government has a number of mechanisms through which it can directly influence the market's investment decisions, including by regulation (eg, specification of co-location and national roaming in the Telecommunications Act 2001), by purchasing services which promote infrastructure investment (eg, Project PROBE), by making spectrum available for a particular use (eg, assignment of Crown-retained spectrum at 3.5GHz for use to provide FWA to specific geographic areas) and reserving spectrum for a particular purpose (eg, reserving spectrum to increase Maori participation in the knowledge economy).

190 Where the Crown controls the assignment of licences, options for the relief of congested spectrum in the telecommunications bands include:

- implementation requirements on licences not currently implemented;
- the encouragement of narrowband technologies (eg, in land mobile communications);

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26 The Market Dynamics report (pp 35-36) – see footnote, page 14.

- encouraging migration to less congested bands; and
- re-planning all or part of the congested spectrum.

Where there is a private band-manager, assignment of the right at or near its market value may be sufficient encouragement for the rightholder to implement such measures.

191 The secondary market in management rights spectrum for telecommunications services is limited. There has been some rationalisation of the MDS spectrum, with most management rights now owned by Telecom, and of the LMDS spectrum, now predominantly owned by TelstraClear. The MDS and LMDS spectrum is largely 'idle'. The 3G spectrum is also largely unused, although Telecom has rolled out its new 3G network and two other companies have expressed an intention to establish 3G services in other bands.

192 Although spectrum is a critical business asset, its costs are negligible compared with the cost of establishing infrastructure and the potential return from the sale of services. The price and availability of spectrum is not, therefore, a major item in the balance sheets of cellular service providers.

Fixed services

193 There is a complication in converting fixed services to the MRR as many of the bands are shared with satellite services and require coordination to minimise interference to New Zealand domestic satellite services and those of other countries. The New Zealand Government, as an ITU member, is responsible for the relevant co-ordination process. Meeting this responsibility could be impeded if the spectrum were assigned as a management right under private control.

Fixed wireless services

194 There is congestion in that part of the VHF and lower UHF spectrum[27] used for fixed wireless services. As a general principle, it would be beneficial to encourage FW services to migrate from analogue systems in these bands to digital systems in higher bands, where there is greater bandwidth and less congestion. Current re-planning of the lower 400 MHz band is designed to make spectrum available for digital solutions.

Land mobile

195 Consideration could be given to creating for assignment management rights and spectrum licences in the land mobile bands. However the heavy use of the bands and the extensive transitional rights provided to land mobile licensees under the Act might limit the benefits of such a transition. Use of narrower channelling in these bands and their transition to digital use could provide substantial relief, but there is a trade-off between the substantial cost of this type of change and the benefits of making it.

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[27] …also occupied by public safety and security land mobile services.

BROADCASTING ISSUES

196 Government's overall objectives for the broadcasting sector are met by a mixture of commercial and non-commercial services. Commercial broadcasters are expected to purchase the necessary licences and to fund the requisite investment through normal commercial processes. There is, however, a growing emphasis in Government broadcasting policy on community, regional and iwi broadcasting, which may not be met by market mechanisms and may need to be encouraged through some form of Government intervention. Such intervention may be direct (eg, the reservation and allocation of spectrum for specific purposes) or indirect (eg, the imposition of eligibility requirements for bidders at spectrum auctions).

197 Crown management, by imposing conditions on spectrum licences, may on the one hand stifle innovation and compromise the potential for the spectrum to be applied to its highest (financial) value use, and on the other hand promote social and cultural objectives. The Crown seeks to limit unwanted effects by operating flexible management policies.

198 To assist in the promotion of public broadcasting objectives and in order to exercise greater control over the end-use of the spectrum, the Crown has retained management rights in some terrestrial broadcasting bands. Spectrum licences assigned by the Crown, acting as band manager, are property rights similar to management rights, in that they have value, security of tenure and tradability. Spectrum licences give greater security to the rightholder than a RLR assignment.

199 The two major commercial broadcasting companies, TRN and CanWest, each hold approximately one third of the available radio broadcasting spectrum licences, with most of the remainder held by government supported broadcasters. A number of aspiring broadcasters have been unable to acquire licences at auction because of the strong bidding from the two large operators. These acquisitions were challenged by complaints to the Commerce Commission in 2004, following Auction 6: none was upheld. Under the provisions of the Commerce Act, therefore, the main commercial broadcasters will probably be able to acquire further licences at will, at least until an acquisition is seen to significantly lessen competition. For the immediate future, it is unlikely that the current ownership concentrations in the market will change significantly, therefore.

200 There is little secondary trading of individual licences, but there have been a number in conjunction with the sale of a broadcasting business or as a result of a rationalisation of licences between parties. Some leasing of licences has occurred. The government auction has been the primary mechanism by which most commercial broadcasters have acquired licences.

201 In past allocations there have been views expressed, often by intending broadcasters, that some degree of priority should be given to locally owned services, locally programmed services, services not affiliated with major networks, and/or particular types of programming. No obvious and transparent mechanism currently exists for assessing whether any such priority should be granted, and to what degree this priority should override the value-based auction assignment process, although one could probably be developed. There is a risk of creating a windfall financial gain by issuing such a licence, which may be seen as inequitable by competing

broadcasters. The costs of monitoring compliance with the licence conditions could also be substantial.

202 There are, nonetheless, government policy objectives related to meeting the needs of diverse and/or minority audiences, which are quite separate from competition issues. Dominance of the market by one or two broadcasters not only potentiates inefficient use of the spectrum: it also, by encouraging programming for the mass market, stifles variety of content. Government has a choice of indirect and direct interventions to correct this.

203 As the seller, the Government can place acquisition limits on a particular set of auction lots: ie, a spectrum cap or conditions of entry. This could be used to exclude the larger commercial interests and encourage participation by minority and/or community groups wishing to broadcast commercially, although there is no guarantee that it would do so. To date, however, no exclusions have been directed at any specific licence holder, as only anti-competitive behaviour has been considered and none has been declared by the Commerce Commission.

204 A more direct alternative is to declare a particular spectrum lot for a specific use (eg, commercial broadcasting in a language other than English or Maori). Any interested party could bid, but the use would be quite specific and defined by contract. Careful market research and regular review would be necessary to support such prescriptive conditions, and compliance costs would need to be considered. The most obvious way to ensure allocation of spectrum to social and cultural purposes is to reserve it, as is done for public broadcasting, or to impose such conditions of use as an implementation requirement.

Narrow spacing channelling

205 New Zealand follows international criteria in the planning of its FM broadcast bands, which in accordance with ITU guidelines are normally separated by 800 kHz. Narrower channelling (ie, separating channels by, say, 400 kHz or 600 kHz) would increase the carrying capacity of the VHF-FM bands, and some overseas jurisdictions have carried out experiments in this area.

206 In early 2003, Canwest approached the Ministry with a proposal to move an unused licence based on Waiheke Island to the greater Auckland area from Auckland Skytower. This frequency is between two other Canwest stations operating from Skytower and on the same frequency as a Canwest station providing service to the Hamilton area. Canwest proposed a frequency separation of 400 kHz. A temporary licence was assigned on a pilot basis and no interference effects have since been reported.

207 MED has carried out testing of 400 kHz channelled services in Auckland. These tests concentrated on interference issues and the ability of domestic receivers to operate when stations are separated with 400 kHz channelling. Results indicated that while some experienced tuning difficulty, most domestic radio receivers can operate satisfactorily in the 400 kHz channelled environment. Some FM broadcasting services in the Waikato district could be disrupted if all Auckland FM services were channelled at 400 kHz separation.

208 Where technical issues can be resolved to allow narrow channelling, it will need to be implemented on a case-by-case basis. For any large-scale planning a review of current management policies for the FM broadcast band will also be necessary, which will include reconsideration of the re-planning options and possible effects on current licensees and rightholders.

5 – Social and Cultural Outcomes

This chapter describes and reviews spectrum policies and processes that support New Zealand's social and cultural objectives.

SOCIAL AND CULTURAL OBJECTIVES

209 The framework of social and cultural objectives that influence radio spectrum management is contained in a range of Government policies and, in generalised terms, in various Acts relating, *inter alia*, to individual radiocommunications providers: for example, the Maori Television Service Act (MTS) 2003.

210 In this area, the value of spectrum is determined vis-à-vis policy criteria rather than through the operation of the spectrum market. The assumption is that, through the meeting of policy objectives, spectrum achieves its highest value to society, an assumption that is reliant on a robust and effective policy process accurately identifying and describing objectives of maximum social and cultural value.

BROADCASTING

211 Government's broadcasting policy objectives are:

- ensuring all New Zealanders have reasonable and regular access to broadcasting representing the uniqueness and diversity of New Zealand life, recognising that the history and stories of whanau, hapu and iwi are integral to any description of that life;
- meeting the information and entertainment needs of as many interests as reasonably possible, including those that cannot be met by commercial broadcasting;
- contributing to public awareness of and participation in the political and social debates of the day;
- providing for minority interests and increased choice; and
- encouraging innovation and creativity in broadcasting while aiming to continually increase audience satisfaction with the quality of the content.

It is recognised that these objectives cannot be met solely through a free spectrum market, as such a market is unlikely to assign spectrum to the purposes stated. The justifiable nature and extent of Government intervention is a key policy question.

212 The primary purpose of the MTS Act is to enable the Crown to meet its obligations under the Treaty of Waitangi to preserve, protect, and promote te reo Maori.

213 Many of the social and cultural outcomes sought through broadcasting fall under the first of the Key Government Goals, *strengthen national identity and uphold the principles of the Treaty of Waitangi.* To this end both public broadcasting policy and spectrum allocation policy seek to provide for New Zealanders' entertainment, educational and information needs, to cater for cultural diversity and diversity of interest, and to promote Maori language and culture. Spectrum has a central role in the establishment and maintenance of public safety and security.

214 A variety of support mechanisms is provided by Government for non-commercial broadcasting services. These range through full funding and provision of transmission licences (Radio New Zealand), part funding and provision of licences (National Pacific Radio Trust, Maori Radio, Maori Television Service, access radio), provision of licences only (student radio), and part government funding with commercial acquisition of licences (Television New Zealand [TVNZ]). Recent proposals in MCH's *Building a Strong and Sustainable Public Broadcasting Environment for New Zealand - A Programme of Action* ('the *Programme of Action'*) would modify these arrangements to provide direct funding of Radio New Zealand and to provide additional funding for TVNZ.

215 For supported services, the Government may encourage broad categories of broadcast content through such mechanisms as the Radio New Zealand and TVNZ Charters, funding contracts, or licence conditions. Government provides significant financing of broadcasting through indirect funding agencies (New Zealand on Air, Te Mangai Paho).

Reservation of spectrum

216 In general terms, there are greater numbers of prospective broadcasters than there are available licences. This does not mean that all broadcast services would, in competition with others, be viable operations, but simply that the market entry point is the acquisition of a spectrum licence. Given this demand, it is necessary that licences for government-supported services be identified and reserved prior to any commercial assignment. Government has recognised that the nature of the commercial broadcasting market does not favour non-commercially oriented radio and television services.

217 For this reason, government has assigned licences on a non-commercial basis without charge (except for licence fees relating to transmission power) for a variety of radio and television broadcast purposes. As an example, the distribution of reserved, 'public' (government supported), and commercial radio broadcasting licences is shown in the table on the following page.

218 Reserved frequencies provide for future services, and may be assigned to particular broadcasters. For unassigned frequencies, a beauty contest is used to determine the actual broadcaster. The rationale of the reservation system hinges on the future use of the licence to promote government's content objectives. To date there has been little reassessment of reserved licences, although the potential for review does exist.

219 Reserved spectrum not being utilised can be re-assigned for other use. As a general policy, a reservation could be time limited so that if it is not used within, say, three years, it is automatically released to auction. This would prevent reservations lying unused in the long term, but it could also be argued that future non-commercial use not yet identified may be jeopardised. Reservation of spectrum for telecommunications is of less significance than reservation for broadcasting. Some examples are given on page 37.

Issue 5.1

Is a regime of tradable (MRR) spectrum, with a reservation for such non-commercial uses as essential services or iwi broadcasting, likely to meet future social and cultural policy purposes?

2004 ASSIGNMENT OF RADIO LICENCES

TYPE OF SERVICE	LICENCES ISSUED OR RESERVED	NO OF LICENCES	UNUSED LICENCES	NO OF LICENCES
Commercial	*AM*	*88*	*Few are unused*	
	Lower FM (approx)	*421*		
	TOTAL	***509***		
	Percentage of all licences	***56%***		***0%***
Non-commercial (including reserved frequencies and priority networks)	*AM*	*100*	*AM*	*23*
	Lower FM	*165*	*Lower FM*	*44*
	Upper FM (approx)	*140*	*Upper FM (approx)*	*125*
	TOTAL	***405***	***TOTAL***	***192***
	Percentage of all licences	***44%***		***21%***

Breakdown of Non-commercial Licences:

TYPE OF SERVICE	LICENCES ISSUED OR RESERVED	NO OF LICENCES	UNUSED LICENCES	NO OF LICENCES
National Radio	*AM*	*24*	*Upper FM*	*±25*
	Lower FM	*1*		
	Upper FM	*±50*		
Concert FM	*Lower FM*	*34*		
Youth	*Upper FM*	*±40*	*Upper FM*	*±40*
Maori Language and Culture	*AM*	*33*	*AM*	*23*
	Lower FM	*77*	*Lower FM*	*23*
	Upper FM	*±40*	*Upper FM*	*±40*
Pacific Island Radio	*AM*	*1*	*Upper FM*	*±10*
	FM	*±.20*		
Access and Community Radio	*AM*	*31*	*AM*	*2*
	FM	*14*		
Community Extensions	*Lower FM*	*41*	*Lower FM*	*21*
Parliament[28]	*AM*	*7*		
Short Term (6 months) Licences	*AM*	*7*		

220 Some overseas jurisdictions clearly separate the agencies responsible for licensing commercial and non-commercial radiocommunications. Others differentiate public from commercial broadcasting by fully funding the former. In New Zealand, all licensing and assignment of commercial spectrum is carried out by MED, but assignment of reserved public broadcasting spectrum is determined by advice from MCH and TPK. There is some disparity between the objectives of these agencies. MED's policy is to assign spectrum to its highest value use,

[28] Shared with Radio Rhema

without necessarily specifying use. MCH and TPK allocate reserved spectrum to meet defined social and cultural objectives.

Issue 5.2

Responsibility for advice on the allocation and management of spectrum for broadcasting is shared by MED, MCH and TPK. Is there scope for improving the linkages in this structure?

Second and third tier FM broadcasting

221 Government policies, and broadcasting policy in particular (as is made explicit in the *Programme of Action*), promote cultural diversity, not only in terms of ethnicity and culture of origin but also for people sharing common interests, age groups and beliefs, at local, regional and national level. Attempts to acquire spectrum at auction by special interest groups, and by local and regional commercial interests, have been defeated in the past by the bidding power of the two dominant radio networks[29].

222 The consequence is limited variety in programming and audiences addressed. This concern might be resolved by a second and third tier of independent FM stations, broadcasting respectively on medium and low power licences, and catering for the specialised interests of specific cultural, social and interest groups. This would necessitate the imposition of ownership conditions on licences and, perhaps, some limitations on content.

223 Some of this specialised demand is being met incrementally. New Zealand allows broadcasting within the FM band on a full commercial basis, under policies which allow any person to apply for a spectrum licence at any location or power. In addition, if technically compatible with existing licences, a full FM licence may be granted on a temporary pending auction basis at the maximum power at which it can be certified under the Radiocommunications Act.[30]

Low power FM

224 The outer guard bands of the overall FM broadcasting band cannot be licensed at the high powers typically used by broadcasting services, as this would cause interference to adjacent aeronautical and land mobile services. They are currently accessible to broadcasters, therefore, under Low Power FM (LPFM) GULs. GULs permit any person to broadcast in the specified frequency range as without securing an individual licence or incurring spectrum charges. Whilst the primary purpose of LPFM licensing is to protect services in adjacent frequency bands, it also facilitates a low budget entry into local broadcasting.

225 Low budget entry does not necessarily lead to growth or permanence. Most of those who enter the market at this level remain there, if they survive at all. The odds are against any low power broadcaster, however willing, acquiring a commercial spectrum licence in competitive bidding against the major networks. The result is that there is congestion of the LPFM frequencies in

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29 As, for example, in Auction 6, when exceptionally high prices were paid for spectrum in key market areas.

30 Such temporary licence assignments occasionally give rise to unreasonable expectations of continuity.

some major centres. User groups have been formed in a number of areas to coordinate the use of LPFM spectrum.

226 It is uncertain how many additional FM licences would be available for assignment if a LPFM licensing regime offering less protection from interference and a lower guarantee of tenure were introduced. Also uncertain are the implications such licences would have for the overall management of the FM broadcasting band.

Medium power FM

227 Medium power FM broadcasting can operate within the existing FM band, but is somewhat different to LPFM use of the guard bands.

- In-band medium power FM must be engineered so as not to cause interference to high-power services, so individual licences are required.
- Because in-band medium power FM licences are engineered, the maximum output power of each transmitter can be several magnitudes higher than LPFM in the guard band (eg, up to 100W compared with 0.5W).

228 Of 47 temporary pending auction FM licences included in auction 6, 36% were for 100W of broadcast power or below, while 11% were 10W or below. Generally speaking, smaller commercial and semi-commercial broadcasters are the main applicants for lower power licences but, at least in the most recent auction, these temporary rightholders are subsequently outbid by the larger commercial entities.

229 Some countries, including Australia (10W maximum), USA (100W) and the United Kingdom (25W) have recently introduced medium power FM licensing regimes, which issue individual licences with limited protection from interference, or none. The management regime and maximum power output for medium and low power FM licences vary from country to country, but all impose eligibility requirements which at the least exclude full commercial broadcasters seeking a broad audience.

Issue 5.3

How would a new tier or tiers of FM broadcasting spectrum licences meet community and regional needs? What implications, if any, would such licences have for overall management of the FM broadcasting band?

Issue 5.4

Should lower power FM licences established through temporary pending auction policies be assigned through an open auction, or should conditions apply on who is eligible to hold such licences?

TELECOMMUNICATIONS

230 Most spectrum used for telecommunications is assigned to commercial services, but the Government has identified some areas where some form of intervention is necessary in the public interest. These include Project PROBE and the Maori Spectrum Trust. Project PROBE, managed by the Ministry of Education, is designed to provide broadband access for schools, rural populations and community groups, who would otherwise be unlikely to obtain affordable access through commercial provision. To assist with the programme's implementation, the

Government is to release reserved spectrum in the 3.5 GHz band for Fixed Wireless Access use, with priority given to Project PROBE telecommunications suppliers.

231 The Maori Spectrum (Te Huarahi Tika) Trust, an independent charitable trust broadly representative of Maori, was provided with establishment funds and an option to purchase 3G telecommunications spectrum to support its purpose of increasing Maori participation in the information and telecommunication sector in New Zealand. The Trust's intention was to develop a third cellular telephony network, in which it was assisted by the passing of the Telecommunications Act in 2001. To this end it formed a commercial relationship with Econet (NZ) Ltd. To date, the Trust's option to purchase spectrum has not been exercised.

232 Some public park spectrum is used for telecommunications: for example, fixed wireless access links used by local territorial authorities for broadband communications.

PUBLIC SAFETY AND SECURITY

NZ Defence Force

233 In military applications, adequate bandwidth is critical. A naval vessel or heavy military vehicle may have several wide-band radars, weapons-guidance arrays and voice/data channels operating in close proximity, each needing interference-free spectrum. Tactical communications rely for security on frequency-hopping devices which require substantial bandwidth to operate at peak efficiency. At any given moment, there is much apparently 'idle' spectrum within the defence allocation, but the nature of modern military electronic systems creates a potential for it to be employed without notice at any time.

234 The bandwidth currently allocated is reported by NZDF Headquarters to be adequate for today's purposes, although there are some restrictions on mobile communications. There is, however, an increasing reliance among defence forces world-wide on digital broadband radiocommunications: eg, in short-range weapons-guidance systems and mobile communications at combat level. The down-sizing of our military forces has offset this rising demand somewhat, as have improved data compression techniques, but it is highly unlikely that this will reduce the demand for spectrum in the long term. Overseas experience suggests that downsized forces tend to use more spectrum, to support compensatory increases in automated surveillance and targeting equipment. There is also the likelihood that demand may increase as increasingly sophisticated electronic equipment is developed and deployed.

235 NZDF reserves bandwidth to support large-scale exercises and for deployment in the event of hostilities. This can be supplemented, under emergency conditions, with commercially-managed spectrum in adjacent bands. Consequently, the defence band could be considered as *optimally* utilised, with the acknowledgement that criteria for military efficiency do not coincide with those for commercial spectrum allocation. In some overseas jurisdictions, notably the United Kingdom (see page 67), the military is being encouraged, through reviews and administrative pricing, to return unused spectrum to public use.

236 There may be merit in assigning the NZDF full management rights for the 230-400 MHz spectrum, with consequent management responsibility for assigning licences within the band. Advantages of implementing this proposal are seen to be:

- guaranteed NZDF tenure;
- augmented levels of security;

- for NZDF, an enhanced capacity to rationalise and improve use of its spectrum, including sharing with non-military users;
- a resolution of current difficulties for MED in the licensing of military devices that operate across a multiplicity of frequencies in a variety of modes, and do not fit the criteria for commercial apparatus; and
- a saving in administration costs to MED.

237 Perceived disadvantages are:

- the administrative costs of transferring the management rights from Crown to NZDF ownership; and
- an increase in administrative costs to NZDF.

238 Any such proposal needs to be seen in the wider context of developing policies for spectrum management by public safety and security services that will, under the SMART[31] system, give them effective control of their assigned spectrum. There may be little advantage, therefore, for NZDF or any other PSS service to acquire management rights.

Non-military public safety and security services

239 The fragmentation of PSS radiocommunications systems referred to in chapter 3 hinders efficient co-ordination of the various services in the event of a major incident or emergency. The issue is not of efficient spectrum use but of effective linkages between PSS services, whose integration at major incidents and during large-scale civil emergencies would be greatly facilitated by the use of compatible equipment on common frequencies. This may be an issue for Government to address proactively, through more effective high-level facilitation and/or assignment of additional resources. It is not, however, MED's direct responsibility.

240 The Emergency Services spectrum bands are co-ordinated and managed by the Public Safety Radio Frequency Management Group (PSRFMG). Members of the Group include NZDF, NZ Police, NZ Customs Service, Civil Defence, Department of Conservation, and NZ Fire Service. PSRFMG was established to promote a migration of PSS radio communications to four Emergency Services (ES) lower UHF bands.

241 Not all services have migrated or will migrate to these frequencies. The NZ Coastguard, for example, communicates on the maritime bands, and many routine communications are most cost-effectively and conveniently carried by commercial cellular and land mobile services. Other emergency services operate on HF bands in remote areas, as VHF and UHF do not achieve sufficient penetration of foliage and rugged terrain.

242 PSS use today is largely analogue and unencrypted. This is likely to change within the next few years as increased concerns over public security impel the PSS services to adopt encrypted broadband mobile applications. The Police, for example, have requested further spectrum at UHF to accommodate a replacement digital land mobile network.

243 The Public Safety Radio Network (PSRN) concept being championed by the Police offers three major benefits for PSS services and, indirectly, for spectrum users in general. These are more efficient use of spectrum, more efficient use of capital equipment and high-capacity data

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31 See page 12

transfer. If the project is to proceed, issues of agency co-ordination and funding will require resolution.

244 The primary objective of the project is to establish broadband PSS communications capacity in the UHF band, on a platform of common transmission sites and relays (some VHF or even HF may be retained for penetration of remote areas). This would facilitate relinquishment of some current ES bands, which could be transferred to commercial use. Extensive re-equipping will be necessary to achieve this. The capital cost would, it is argued, be offset by efficiency gains and lower long-term network maintenance costs. There is an underlying spectrum assignment issue, in that these bands are heavily congested, with a large number of small-scale operators who would be difficult to move to a more rational band plan.

245 PSRN will make possible high-speed mobile data links, similar to those being developed for the USA's APCO[32] 25 initiative. At the outset, it is expected that these links will be used for secure voice and low-speed text transmissions only: the police are currently testing related digital communications equipment in the lower UHF band. In the long term, PSRN is planned to add broadband capability, for the transmission of high-speed data and real-time video.

246 The absence of an overall strategy, common commitment and contributory funding among the PSS services has so far delayed the implementation of PSRN. Consequently, the Police, who need secure communications urgently[33], intend to develop, in collaboration with the NZ Fire Service, an internally-funded APCO-based PSS microwave network linking 380 permanent sites. Should other PSS services wish to participate, it is planned that adequate bandwidth will be available to them at a reasonable entry cost. However, it is likely to be many years before New Zealand can deploy a fully integrated PSS command and communications system on the scale proposed in, for example, America's Project MESA[34].

247 Some overseas PSS services are working towards better integration of communications through the adoption of common technical standards, notably the European Union (TETRA[35]) and the USA (APCO). Interoperability can be a major concern in disaster zones (eg, Turkish earthquake, US forest fires) and in international search and rescue operations.

248 TETRA is an encrypted telecommunication system. It can be particularly useful for joint emergency operations, enabling police, ambulance drivers, firefighters, doctors and military personnel to communicate directly and securely with each other. Some doubt has been expressed in the UK as to the adequacy of the bandwidth allotted to TETRA, which operates on 25 kHz channels. TETRA was considered by the NZ Police and spectrum was assigned to it, but the technology proved to be insufficiently mature for useful development.

249 APCO has developed a similar system for the USA, whose thousands of national, state and local public safety services operate a wide variety of often incompatible communications networks. The APCO 25 project establishes common standards for two-way digital communications, with such features as mobile communications-and-command centres, automatic mobile/vehicle

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32 Association of Public-safety Communications Officials.

33 At present, Police mobile communications can easily be, and frequently are, monitored with inexpensive scanner-receivers.

34 http://www.projectmesa.org/you/home.htm ('MESA' for the city of Mesa, Arizona).

35 Terrestrial Trunk Radio.

location and high-speed data transfer. In the long term this concept may well merit further evaluation.

RECREATIONAL

250 A small proportion of radio spectrum is available, generally under ITU guidelines, for personal and recreational uses. Examples are amateur radio, personal radio services (eg, CB and PRS radio), wireless controlled models, personal GPS devices, short-range locking and alarm devices, mountain radio and locator beacons. Many of these have a safety function in addition to their practical use. Short-range device issues are examined in the following chapter (page 56)

Issue 5.5

How may spectrum best be allocated for public safety and security services?

6 – The Impact of Technology

This chapter describes and discusses the impact of changing technologies on New Zealand's management and use of the spectrum

TECHNOLOGY AND THE SPECTRUM

251 New Zealand spectrum policy is, in principle, technologically neutral[36], and as far as possible leaves decisions on use of the spectrum to the market, which is generally considered to be in a better position than government to make decisions on technical innovation. Where the nationwide management right over a spectrum band has been sold to a commercial entity (eg, cellular spectrum), that entity decides what technology to use when it deploys the spectrum, provided it does not cause interference in adjacent bands. Some restrictions in technology are inherent if the Crown retains management control of the spectrum band, but the Crown seeks to apply technological neutrality as far as is practicable.

252 As well as creating new services, new digital technologies generally enable more efficient use of the spectrum. The spectrum management regime needs to provide suitably flexible arrangements for users to migrate from legacy technologies. Recent examples are the Government decisions[37] surrounding spectrum for digital television broadcasting, and a new band plan for the lower UHF band to support high-efficiency digital linking services. Emerging opportunities that will need to be considered include spectrum for digital radio broadcasting, 802.16 broadband services, 4G mobile services, and new services based on ultra wideband (UWB) technology. Greater deployment of GULs may be an appropriate means of encouraging and supporting new technologies.

253 Many new technologies are partly or wholly self-managing, in that operators are able to access a frequency band without individual licensing (in New Zealand, under a GUL) and are responsible for ensuring that their transmissions do not cause harmful interference for other users. For software-defined radio (see page 53), which automatically seeks out an interference-free frequency, the latter is not even a consideration. Hence, the task of band managers has the potential to be considerably reduced, with increasing opportunities for administrations to establish light-handed spectrum management regimes with minimal compliance costs.

254 New Zealand's physical isolation from neighbouring countries ensures that much of the spectrum can be used without having to coordinate with neighbours over potential interference. This, along with consumer acceptance of new technologies, places New Zealand in an ideal position to be used as a test bed for the development of new wireless technology products. The challenge is to promote this opportunity to foreign entrepreneurs and to develop partnerships

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36 In practice, spectrum allocation is largely dictated by the technical specifications of radiocommunications equipment manufactured overseas in conformity with ITU guidelines.

37 EDC Min (03) 19/5

that support a longer-term exchange of funds, knowledge and capability around new technologies.

COMMUNICATIONS

255 The technology for delivering telecommunications services is constantly evolving on a long-term cycle. Cellular mobile technologies, for example, tend to follow a ten-year sequence from inception to obsolescence. The spectrum for 3G services was identified and made available at an international level in 1992, after some years of planning. Planning has already commenced within the ITU for the introduction of 4G, or next generation cellular service, even before the world-wide implementation of 3G services.

256 The introduction of such new technologies as 3G presents significant challenges as the spectrum nominated by the ITU may be identified in New Zealand for use by other services or technologies. For example, the ITU is considering additional allocations in the SHF band, which conflict with New Zealand's current use of the relevant frequencies for outside broadcast operation. In this situation, Government must consider the highest value use for the spectrum and whether to transfer the outside broadcast frequencies to another band.

257 Improved modulation systems allow the spectrum to carry greater amounts of traffic. To profit from such technical developments, a service provider will typically replace a complete system at one time, which is a significant investment. These updates are planned and implemented in conjunction with the MED. Licensing policies permit upgrades provided that other licensees are not adversely affected, and encourage licensees to use technically efficient systems.

258 Current technical developments are characterised by a convergence of telecommunications and IT systems, with ISPs in particular offering more bandwidth and higher transfer rates to customers. Typically, the technology to provide the necessary bandwidth is purchased in international markets, which in turn dictates which bands are suitable for their deployment. This tends to place pressure on those bands.

259 Considerable work is underway in the equipment industry and in the ITU on innovative radio systems, including ultra wideband and software defined radio. The developers of these technologies often have an IT rather than a radio background and this is leading to the development of systems that challenge existing spectrum management policies and processes. Following overseas trends, it is likely that much of this technology will operate in 'public park' spectrum. Existing licence-holders are concerned about possible interference from such systems.

Fixed Wireless Access

260 FWA is a method of delivering broadband data to individuals and (usually) small business concerns. An FWA network typically consists of a fixed radiocommunications base serving multiple clients ('point-to-multipoint'). FWA services can augment or bypass existing copper cable networks for telephony and Internet applications. FWA is available in a number of frequency bands which have been assigned in the form of management rights, including spectrum in the 2 GHz and 3.5 GHz bands (known as '1098 bands' and 'MDDS bands'), where two management rights are retained under Crown management.

261 Woosh Wireless's network uses 2 GHz spectrum, BCL has access to both 2 GHz and 3.5 GHz spectrum for its 'Extend' network, and Counties Power's 'Wired Country' wireless network uses 3.5 GHz spectrum. Other telecoms operators hold spectrum (eg, Telecom [MDS] and

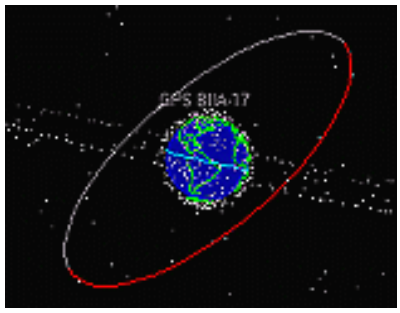
TelstraClear [2 GHz and 3.5 GHz]) but have yet to roll out fixed wireless access networks on a commercial basis.

262 Developed from short-range indoor WLAN technology, fixed wireless access services can also be provided in the GUL bands. Current examples are Wellington's CafeNet, ThePacific.Net (a PROBE supplier) and a number of commercial, community and domestic networks around New Zealand.

263 LMDS spectrum in the upper SHF band has been assigned as management rights, largely to telecommunications providers. These rights remain largely unused as suitable technology to make effective use of this spectrum is not yet available at a reasonable cost.

Satellites

264 Satellites transmit from outside New Zealand's territorial jurisdiction, providing fixed and mobile telecommunications links, and broadcasting services. For satellite communications, a licence is required under the Radiocommunications Act to transmit (up-link) to the satellite, but only if the uplink is from within New Zealand's jurisdiction. The ITU requires satellite operators to coordinate their intended operations with the administrations that may suffer interference from, or who may otherwise be affected by, their proposed operation. No licence is necessary under the Act for transmission from a satellite (down-link) to New Zealand, but a satellite operator may seek a 'receiver protection licence' to protect satellite down-links against interference from terrestrial transmitters operating in the same frequency band.



265 As a member of the ITU, New Zealand has the ability to file applications for, and to use, satellite allotments. The Act does not provide explicitly for satellite filings or for the exploitation of satellite allotments, which are currently dealt with as a matter of government policy.

266 A large number of existing satellites can be accessed from New Zealand, depending on the reception or transmission equipment used. In general, satellites which have a focussed (and therefore higher power) New Zealand 'beam' are most suitable for such consumer services as satellite broadcasting or broadband Internet access. Other satellites require larger aerial dishes for clear reception, and are more suited to telecommunications linking or transmissions between ground stations.

267 Television satellite services to New Zealand are currently provided by Sky TV and TVNZ via the Singtel-Optus satellite network. Other satellites in foreign ownership support a variety of telecommunications, navigational, military and meteorological services. New Zealand's consent is required before anyone can establish a satellite that utilises or restricts the NZ satellite positions allotted by, and registered with, the ITU.

268 In July 2002, the MED filed applications with the ITU for satellites known as 'NZLSAT1-4' at 158°East, covering four frequency bands outside New Zealand's current satellite allotments, which may be used for a range of broadcasting and telecommunications services. In combination, the NZLSAT filings and the Fixed Satellite Services (FSS) and BSS allotments in the planned bands to some extent 'reserve' the 158°East orbital position for New Zealand, as

any person who *subsequently* proposes an incompatible satellite must seek to co-ordinate with these filings and allotments.

269 There may be interest from commercial entities in using any combination, or all, of the BSS or FSS plans, NZLSAT filings, or other frequency bands at 158°East. Following recent Cabinet decisions, the MED has published guidelines regarding applications to access all or any of these.

Radio sub-carrier services

270 These are audio or data services added to a normal FM transmission which require a specialist receiver, or RDS (Radio Data System) type transmissions which are designed for use by consumers through readily available receivers. Both types of services require appropriate licence parameters. Use of sub-carrier type services generally necessitates a slight reduction in effective coverage of the main programme, or a wider spectrum allotment. A number of licences have been created to allow RDS services.

Software-defined radio

271 In its basic form, software-defined radio (SDR – also known as 'cognitive' or 'smart' radio) allows the user to send and receive information on any available frequency without adjusting or replacing the associated hardware, as all the relevant coding and decoding of signals is performed by computer software. It is expected that SDRs will eventually have the capacity continually to locate and utilise any unoccupied spectrum within their operating range.

272 SDRs will be particularly effective for utilising unassigned and idle spectrum, 'white space' (operational spectrum not in immediate use[38]), guard bands and public parks. The technology is still in the laboratory, but roll-out is expected to be rapid and have far-reaching effects on spectrum policy and planning.

273 None of New Zealand's current licensing types is particularly well-suited to managing the use of SDRs, as all three regimes are based on regulating access to specified frequencies. Some form of GUL covering, say, the whole of the UHF band, or a designated spectrum commons[39], may have to be considered

Ultra wideband

274 A growing technology, ultra wideband devices operate below the power floor on bandwidth many times greater than conventional radiocommunications devices. The bandwidth required implies use across a number of 'normal' bands, which above the power floor may be populated by a variety of more conventional technologies. Likely to operate under the GUL regime, UWB devices typically include: high speed data communications; imaging apparatus used in law enforcement, rescue operations and medicine; automotive anti-collision radar; and such indoor/handheld communication equipment as wireless laptops or audio and video links. They generally cause minimal interference to radiocommunications in the same band but they can, in

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38 95% of spectrum licensed to the US Government is unused at any given moment (*Economist*, 14 August 2004, p58)

39 See, for example, page 69, final paragraph.

sufficient aggregations, raise the *noise floor* and may need to be lightly regulated in bands where sensitive devices are deployed (eg, GPS, radio-astronomy).

BROADCASTING

275 Broadcasting is a somewhat different to most uses of the spectrum in that the largest overall investment is made by the consumer through purchase of the necessary receiving equipment. There are several new transmission technologies available for broadcasting services. The new technologies can add supplementary features to existing services, using existing receivers or requiring a new type of receiver. The critical factor in implementing a new transmission technology is the recommendation by Standards New Zealand of a given technical standard to ensure that receivers read the transmitted signal accurately.

Digital television (DTV) broadcasting

276 DTV standards have already been adopted by consensus amongst interested parties in New Zealand. The preferred DVB (Digital Video Broadcasting) family of standards is suitable for cable, satellite and terrestrial broadcasting. Television New Zealand already uses the DVB-S standard for its satellite service, as does Sky's conditional access system.

277 Broadcasters will need to decide whether to transmit DTV broadcasts by terrestrial or satellite platforms, or both. Implementation of either is likely to incur a considerable cost for simulcasting, additional spectrum, and equipment conversion, with no corresponding profit. Representations made to Government by broadcasters have included requests for free spectrum for simulcasting, and the naming of a specific analogue cut-off date.

278 Current Cabinet policy is to facilitate industry planning and decision-making, but to leave the pace and timing of DTV implementation to the market, with an expectation that public broadcasting services will take a leading role. The government has, nonetheless, planned spectrum for both digital audio and digital television broadcasting[40], and has requested TVNZ and MTS to prepare plans for implementing DTV.

279 Government's identification of spectrum for DTV may limit further development of analogue broadcasting. Policies have been developed for protecting, creating and assigning licences suitable for terrestrial digital services, but it is not certain that these alone will motivate either broadcasters or viewers to adopt digital services. Should progress to digital services not take place, then the restrictions created by the reservation of spectrum for such services will need to be reviewed.

280 A number of overseas administrations are developing policies for the implementation of digital television (DTV) broadcasting, with mixed results. Key issues are:

- the greatest proportion of the cost of conversion falls on the consumer, who at the very least has to purchase a decoder (commonly known as a 'set top box') and may ultimately have to buy a digital receiver;

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[40] There is also potential for UWB services below the noise floor in these frequencies.

- without strong incentives in the form of improved reception quality and/or interactive services, consumers have no reason to make the transition;
- during the transition from analogue to digital reception, parallel broadcasting ('simulcasting') of content is usually necessary, requiring extra spectrum and incurring additional broadcasting costs, but providing no extra profit incentive; and
- in order to clarify the timeline for initiating digital services, simulcasting, and replacing equipment, broadcasters and consumers see a need for the certainty of an 'analogue cut-off date'.

281 Australia has recently attempted to establish DTV broadcasting, conditional upon transmission of a proportion of digital content in high definition (HD) format. Penetration of consumer markets has, to date, been relatively low[41] and the cost to broadcasters of producing in HD format is reported to be relatively high. There has been some criticism of this approach, and particularly that broadcasters are not afforded greater flexibility to choose between increasing standard digital content or converting existing content to HD format.

282 The UK has probably had the most successful penetration of DTV, reaching 13 million households (53%) by 31 March 2004, largely because of heavy government investment via the BBC's digital services. A little over half of this total is accounted for by satellite TV. Digital terrestrial television (DTT) supplies a further quarter, with the remaining 20% being received by cable. Despite this rapid growth, there continue to be difficulties in confirming a cut-off date, as 43% of households are still reliant on analogue services.

283 The USA's DTV services are provided almost exclusively by satellite and cable. DTT accounts for only 2% of the market, despite encouragement by the FCC. As of May 2003, more than 1,000 stations were on the air with DTV signals, and every major TV market was served by at least one DTV station. The cut-off date set by Congress for the completion of the transition to DTV is December 31, 2006, but that date is to be extended until a majority of homes (85%) have made the transition. At that point, broadcasting on the analogue channels will end and that spectrum will be put to other uses. Until the transition to DTV is completed, television stations are required to broadcast on both their digital and analogue channels.

Digital radio broadcasting

284 A variety of transmission standards has been developed for digital radio, but until recently none had been implemented in major markets. There are three potential standards:

- EU's Eureka 147, which allows several audio transmissions to multiplex on a single frequency;
- IBOC (for In-Band On-Channel), which 'piggybacks' a digital transmission on an analogue frequency (particularly useful for transitional simulcasting); and
- DRM, which being trialled by Radio New Zealand.

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41 However, penetration is likely to be affected by other policies: for example, the restriction on free-to-air broadcasting over multiple channels, except for strictly controlled types of content (e.g. educational programming).

285 Broadcasting to either standard requires a receiver configuration unique to that standard. Without any specific government action, digital audio is likely to be implemented in New Zealand only when affordable consumer-grade receivers are available.

SHORT RANGE DEVICES

286 Short Range Devices (SRDs)[42] using low power radio transmitters have a wide variety of applications. They are at the forefront of consumer demand and technical development, and create an ever changing environment for the spectrum regulator. Individual SRDs, as the name implies, have a small operating range, but their use is proliferating exponentially. They are a significant user of the spectrum. They include:

- industrial scientific and medical devices (ISMs) where the radio energy is used for a purpose other than communication: eg, industrial kilns for drying wood, medical diathermy and domestic microwave ovens;
- communication of data over short distances, as in wireless local area networks (WLAN or WiFi);
- telemetry and telecontrol: eg, Radio Frequency Identification (RFID) tags used for animal ID and to track individual goods and pallets of cargo;
- radio-controlled models and toys;
- baby-minders;
- security devices: eg, keyless car locking and garage door openers; and
- proximity detectors: eg, security detectors and (soon to be seen) car radar systems for collision avoidance.

287 Spectrum allocated to SRDs in this country is about 5% of the usable total. Each of the SRD bands is assigned under a GUL. This gives any number of operators access to the band without a requirement for an individual radio licence. The GUL carries the basic technical specifications of the equipment and the conditions of use. Under GUL licences, operators of SRD devices have no protection from interference caused by other users of the spectrum. Similar levels of regulation are used by authorities in other countries.

288 There is rapid growth in the diversity and magnitude of markets for SRDs, with light handed regulation of the SRD bands providing easy access for all users. Because SRDs have to work in a busy, unmanaged spectrum environment there is a growing trend to build more intelligence into the equipment. Such features as the ability to identify a clear channel before transmitting and radiating sufficient power to meet only the needs of the transmission are becoming mandatory in some WLAN bands shared with other users.

289 In some bands, New Zealand has less spectrum allocated to SRD use than many overseas jurisdictions. In the 900 MHz band, for example, the spectrum allocated to SRDs is 25% of that allocated in the USA and half that allocated in Australia. Given New Zealand's relatively small population and usage this is not a problem of capacity *per se*. Imported equipment engineered for US or Australian use cannot always be operated in the bandwidth available here. Equipment purchased overseas, therefore, may cause interference with studio-to-transmitter links and

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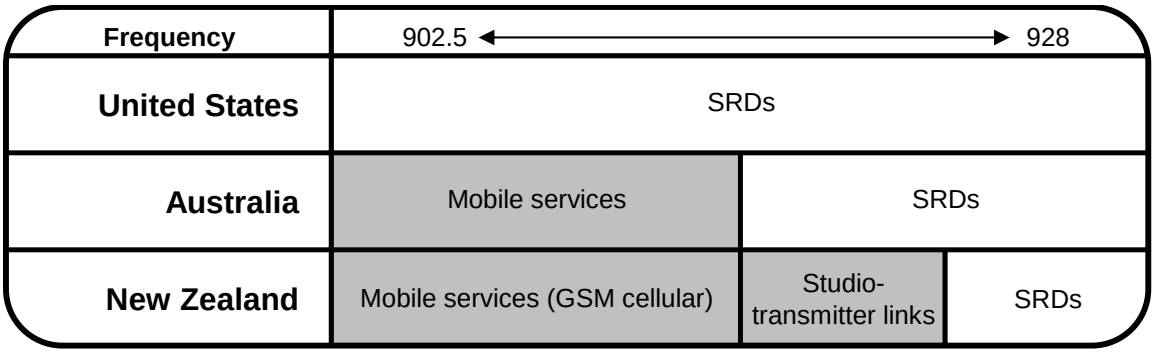
42 An Engineering Discussion Paper on SRDs is at http://www.med.govt.nz/rsm/whatsnew/index.html.

mobile services in New Zealand. There are similar issues in the 860 MHz and 5.5 GHz bands. It may be possible to address this issue with more selective border controls or extensions to multilateral standards agreements.



290 The SRD market is readily accessible to all distributors and users. Provided the specified equipment standards are met, the product may be distributed as a consumer item. Typical are WLANs, Bluetooth products, garage door openers and cordless doorbells. This type of market tends to attract large volume manufacturers producing low cost goods for mass distribution.

291 Major network operators have little interest in using SRDs for their core networks, as GUL bands do not provide the quality of service required. SRDs do offer, however, an easy start-up environment for new entrants and enable small enterprises to compete with large service providers. This is seen in the recent growth of regional internet networks.

292 There is no charge for use of the SRD bands and they remain 'public property' with access available for all parties. Because of the lack of protection from interference and potential congestion they do not compete directly with the licensed bands but rather provide a broader range of options for the spectrum user.

293 Within the NZ environment there appears to be a reasonable understanding of the rights and limitations of operating under a GUL. Some operators, however, seem to assume that good quality of service will always be available using such bands. Others try to use the lowest cost solution even if it does not meet the conditions of use specified in the GUL. It is difficult to manage these issues where there is no record of users and no income from fees to support education or compliance management.

294 Although modern radiocommunications equipment has the capacity to distinguish meaningful signals from noise, the signal must first be above the noise floor. The more SRDs operate within a band the higher the noise floor and, consequently, the narrower the range of discernible transmission for *all* devices operating in the band. Options are to restrict entry in favour of essential users or to spread the load over additional SRD frequencies.

295 The ITU offers no significant guidance on the management of SRDs. Until recently the only germane reference in the ITU Regulations was in a definition of ISM (Industrial, scientific and medical SRD) bands. There is worldwide demand for the allocation of more spectrum to SRDs and each regulator has responded in its own way. There is a strong desire for internationally recognised standards, to stimulate competition and reduce the use of non-standard equipment. However each authority, including New Zealand, has to work around legacy systems and strike a balance between the rival standards and frequency ranges offered by products sourced from Europe and the USA.

296 In many countries alternative regulatory regimes are being considered to meet increasing requirements for SRD operating space. These include:

- where there are low volumes of SRDs operating, light licensing to *record* SRD systems with the potential to cause interference with licensed services;
- regional allocation of under-utilised spectrum for SRD use (eg, the US Federal Communications Commission [FCC] is considering the use of unused TV channels for rural broadband networks); and
- sharing spectrum between technically compatible services (eg, ultra wideband services operating in broadcasting bands).

MESH NETWORKS AND SPECTRUM COMMONS

297 The new technologies afford opportunities for networks and services to be constructed in innovative ways. Two examples follow.

Mesh networks

298 In a mesh network, each radio device (a 'node') acts as a router as well as a terminal; ie, it not only transmits and receives data for its operator but also relays data for other operators. As long as each node is within range of another there is net-wide coverage. Unlike networks relying on a single line-of-sight base station, mesh networks can relay around transmission barriers, including high ground and the earth's curvature, and can extend to theoretically unlimited distances. A functional mobile mesh network includes base stations that provide gateways to other services and to the Internet, and mobile nodes that relay data to each other and to base stations. The capacity of the net increases in proportion to the number of users.

299 Mesh networks are able to employ very low transmission power, as the range between devices is usually short. Consequently, they operate below the *power floor* of more conventional radio technologies and can utilise a wide range of spectrum bands without creating interference. The system is yet to impact on the radiocommunications market, but trials in the USA are giving positive results.

300 There is nothing to prevent commercial operators from setting up a mesh network in New Zealand. It may, however, be in the public interest for government to intervene, in that a common 'open access' network used by all commercial operators would be of greater capacity and be more spectrum efficient than any number of smaller separate networks.

Spectrum commons

301 *Rather than property, spectrum should be left in a 'commons' — […] a public space. Like a freeway, or a public park, use of a spectrum commons would neither be regulated nor* [be made property]. *Its use would, instead, be free for anyone, subject only to a few simple rules about devices.*[Code Breaking: Spectrum for All, *Lawrence Lessig*] [43]

302 There is increasing lobbying overseas, notably in the USA, for spectrum to be wholly unregulated, open to all users as 'spectrum commons'. This is more of a practicable proposition than it might have been a decade ago. The advent of smart radio, capable of continually finding

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43 http://www.cioinsight.com/article2/0,3959,932656,00.asp

and linking through interference-free frequencies[44], may make conventional spectrum assignments irrelevant. One commentator has observed that, once the technical capacity exists to distinguish a particular radio transmission from the background chatter of other signals, it makes no more sense to licence spectrum than it does to licence sound waves.

303 Proponents of spectrum commons have to address successfully such issues as:

- the widespread availability of smart technologies, most of which are still in the laboratory;
- the implementation of relevant access and relationship protocols
- harmful interference – there appears to be an assumption that the technology will manage this without human intervention;
- loss of spectrum rights, which are business assets with a significant book value and associated capital investment; or
- public safety and security reservations including, in particular, those for emergency services and navigational aids.

304 New Zealand has already made some progress in the introduction of 'public park' spectrum under its GUL regime, and appears ready to accommodate new technologies as they are introduced. Further allocation of such spectrum to these technologies has to be contingent on the regulator's satisfaction with interference issues.

Issue 6.1

What would be the costs and benefits of establishing a partial or complete spectrum commons in New Zealand?

CONCLUSION

305 New technologies are shifting the emphasis in radio spectrum management away from frequency allotment within clearly defined engineering parameters to open access systems operating concurrently in broadly defined spectrum bands. While presenting the band manger with opportunities for more intensive use of the available spectrum, new technologies operating in a public park environment are difficult to regulate, particularly with respect to raising the noise level and creating interference problems for other users of the spectrum. Regulatory authorities may therefore have to consider modifying their legislative basis and administrative procedures, and increasing levels of monitoring.

Issue 6.2

What changes, if any, are required to the New Zealand legislative and regulatory environment to accommodate new technologies?

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44 …still in the laboratory at the time of writing…

7 – Themes, Issues and Priorities

THEMES

306 The purpose of this report is to identify and provide background to policy issues that might need to be considered further by MED in the short-to-medium term. For this reason, none of those issues has been argued to a conclusion. Each one identified needs to be prioritised, incorporated into the Ministry's work programme, and be progressed through research, analysis and consultation to a set of recommendations to Government.

307 Major themes that have emerged from the report are:

- the effectiveness of current legislation in achieving Government's objective in the deployment of spectrum;
- the current effectiveness of the MRR and the RLR, and the balance between the respective merits of competitive and administrative assignment;
- the mechanisms by which the benefits of competitive assignment can be maximised and its drawbacks moderated;
- the degree to which Government intervention is necessary and effective in ensuring that social and cultural objectives are met;
- the implications of new technologies for spectrum management
- opportunities related to spectrum commons; and
- the need to further enhance international co-operation.

308 The specific issues relating to these themes have been grouped appropriately and prioritised in the summary table below. Subject to agreement with Ministers, they will be reflected in the Ministry's work programme, with the items of highest urgency and impact being given priority.

ISSUES AND PRIORITIES

KEY

Impact
H = High impact issue carrying a significant risk to spectrum management and users.
M = Medium impact issue carrying moderate risk to spectrum management and some users.
L = Low impact issue carrying little risk to spectrum management and users.

Urgency
S = High urgency issue likely to have significant consequences if not resolved within a relatively short time frame.
M = Medium urgency issue likely to have significant consequences if not resolved in the medium term.
L = Low urgency policy issue with no significant consequences if not resolved in the short to medium term.

International issues

No	Issue	Impact	Urgency
1.1	To what extent should mutual recognition agreements with other countries be pursued, and in what areas?	M	L

Allocation and assignment issues

No	Issue	Impact	Urgency
2.1	How has the development of the MRR and the market for spectrum given effect to the objectives underlying the Radiocommunications Act 1989?	M	M
2.2	For spectrum in the RLR, are any changes to licensing conditions advisable (eg, tradability, resource rentals, differential charging) to promote the highest value use of spectrum?	H	M
2.3	Should the transfer of spectrum from the RLR to the MRR be accelerated? Is there merit in transferring all non-essential spectrum to the MRR?	H	H
4.2	Is there merit in re-packaging the MRR to provide for regional or local management rights? What would be the implications for legislation, engineering and administration?	M	M
4.6	Use-it-or-lose-it requirements are common in overseas jurisdictions on both anti-hoarding principles and the proposition that unused spectrum is not realising its highest value to society. Notwithstanding the administrative difficulties, would it be in New Zealand's interest to impose such conditions more generally on management rights and spectrum licences? Under what circumstances should they be applied?	H	L
4.7	When 'packaging' management rights, what weighting should be given to technical neutrality vs. technical efficiency, and competition issues respectively?	M	M
4.8	To what extent should MED be involved in resolving coordination issues between management rightholders?	M	H
6.5	What spectrum issues need to be resolved to support the introduction of digital broadcasting?	M	M

Non-commercial allocation and assignment issues

No	Issue	Impact	Urgency
5.1	Is a regime of tradable (MRR) spectrum with a small reservation for such non-commercial uses as essential services or iwi broadcasting, likely to meet future social and cultural policy purposes?	H	L
5.2	Responsibility for advice on the allocation and management of spectrum for broadcasting is shared between MED, MCH and TPK. Is there scope for improving the linkages in this structure?	M	M
5.3	How would a new tier or tiers of FM broadcasting spectrum licences meet community and regional needs? What implications, if any, would such licences have for overall management of the FM broadcasting band?	M	M
5.4	Should lower power FM licences established through temporary pending auction policies be assigned through an open auction, or should conditions apply on who is eligible to hold such licences?	M	M
5.5	How may spectrum best be allocated for public safety and security services?	M	L

Competition issues

No	Issue	Impact	Urgency
4.1	The Act relies on the provisions of the Commerce Act to resolve competition issues. Given the perceived need to apply spectrum caps and eligibility requirements in past and future auctions, and the absence of determinations against dominant acquisitions, is there a case for re-examining the effectiveness of these provisions?	H	M
4.3	Are there proactive means by which the government could promote and enhance secondary spectrum markets?	H	M
4.4	What alternative auction methodologies could be employed in future sales of spectrum where there are significant quantities of similar and substitutable lots?	M	H
4.5	There is a tension in the design of auctions (including the application of spectrum caps and eligibility requirements) between the objectives of assigning spectrum to the bidder according it the highest value and promoting the competitiveness of downstream markets. How might this tension be managed? Should constraints continue in place after the spectrum has been assigned?	M	H

Technology issues

No	Issue	Impact	Urgency
6.1	What would be the costs and benefits of establishing a partial or complete spectrum commons in New Zealand?	H	M
6.2	What changes, if any, are required to the New Zealand legislative and regulatory environment to accommodate new technologies?	H	M

Appendix: Spectrum Management in other Jurisdictions

AUSTRALIA

309 Spectrum management policies and processes fall under the Radiocommunications Act 1992 and the Australian Communications Authority Act 1997. Sections of five Taxation Acts, and various Regulations, Standards and determinations deal with particular aspects. Primary responsibility for managing the spectrum lies with the Australian Communications Authority (ACA). Radio and television broadcasting frequency bands are managed by the Australian Broadcasting Authority (ABA)[45]. The Department of Communications, Information Technology and the Arts is responsible for the relevant policies and legislation. The stated objectives of spectrum management are:

- managing international interference issues;
- equipment compatibility;
- technical efficiency; and
- facilitating the assignment of non-commercial spectrum.

To these ends the ACA produces spectrum and frequency plans.

310 Licences are issued by the ACA in three categories:

- *apparatus*, assigned administratively for 1 to 5 years, with an expectation of renewal;
- *spectrum*, assigned for up to 15 years and not renewable, other than in the 'public interest'; and
- *class*, covering 'public park' frequencies, and not issued to individuals.

A separate licence, issued by the ABA, is required for transmitting broadcast content.

311 Commercial spectrum licences, normally assigned by auction, may be traded, subject to any limits established by the responsible Minister, through direct negotiation or a spectrum trading exchange, or by leasing from a band manager. Non-commercial licences are assigned administratively and subject to conditions appropriate to their use (eg, defence, public safety and security, public broadcasting, etc).

312 The Australian Department of Defence (DoD) is exempt from the provisions of that country's Radiocommunications Act, and manages the defence bands directly. Licences are obtained by DoD largely to protect tactical bands from interference, as the Department's exemption gives no protection. DoD pays A$1.2 million a year for licences, on the same basis as commercial users.

313 The Radiocommunications Act 1992 allows the responsible Minister to require limits on aggregated spectrum holdings, in terms of bandwidth, geographic area or population cover.

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[45] The ACA and ABA will merge to become the Australian Communications and Media Authority by 1 July 2005

Such conditions have been imposed on spectrum auctions from time to time, to prevent anti-competitive hoarding and blocking.

314 Australia has introduced secondary trading, on a basis of subdivisible Standard Trading Units (STUs) defined by geographic and bandwidth boundaries. Licence holders are able to sell, lease, repackage and change the use of STUs assigned to them. This has had the effect of bringing secondary trading prices down to initial auction levels.

CANADA

315 Spectrum management falls under the Radiocommunications Act 1985 and its Regulations, and under the Telecommunications Act 1993. An agency of Industry Canada, Spectrum Management, has the relevant administrative responsibilities. Its primary objectives are:

- to ensure that all spectrum use is compatible;
- to provide consumers with frequency assignments that meet their needs;
- to minimize occurrences of interference; and
- to ensure that cases of harmful interference are investigated promptly.

316 Broadcasting policy and licensing, both commercial and non-commercial, is the responsibility of the Department of Heritage. All licences carry content requirements. Broadcasting and telecommunications regulation is under the Canadian Radio and Telecommunications Commission.

317 Spectrum licences were introduced in 1996 by an amendment to the Radiocommunications Act. Assignment is by geographic area and frequency rather than by apparatus licence, which considerably reduces administrative costs. Licensees are responsible for proper planning and coordination of their radiocommunications networks. There are nine classes of spectrum licence, issued on an annual basis with a ‘reasonable certainty’ of tenure.

318 Licences may be converted to alternative uses and transferred to third parties with Ministerial approval. Prices, other than at auction, are determined through a relatively complex administrative process based on full cost-recovery. Services provided in the public interest are exempt from licensing requirements.

319 Where there is competition for licences, auctions are employed, and three have been conducted to date. Most licences continue to be issued administratively, however.

320 A small number of low power FM licences have been assigned by Industry Canada on a case-by-case basis.

EUROPEAN UNION

321 Most EU member states operate a first-come-first-served spectrum assignment regime, with variations to resolve competing applications, or to provide medium-to-long-term security of tenure for telecom providers and broadband networks. In the majority of jurisdictions, licences are for prescribed apparatus operating at a given frequency, and are renewable as of right on payment of a periodic fee whose rationale is administrative rather than commercial.

322 A recent report submitted to the European Commission recommended that EU countries should be required to implement spectrum trading and liberalisation to spur more efficient use of spectrum. The report recommended that member states create tradable rights, basing the definition on such minimum characteristics as geographic coverage and frequency.

323 The report added that, given the likelihood of wide divergence among member states in implementing spectrum trading, countries should be given considerable latitude in deciding how their systems will work provided that national regimes are coordinated across the EU, by such bodies as the Spectrum Policy Group and the Spectrum Committee.

Finland

324 The primary agency for managing spectrum is the Finnish Communications Regulator, FICORA, whose objectives are:

- to promote efficient, appropriate and interference-free use of radio frequencies;
- to safeguard the fair availability of radio frequencies;
- to create conditions that maximise the unrestricted mobility of radio equipment; and
- to promote efficiency on the public telecommunications market.

325 FICORA determines the frequencies that will be used for different classes of service, in alignment with ITU and EU decisions. There are three major classes of licence.

- *Radio transmitter*, issued for periods of up to ten years at varying fees (€16 to €178.90 – there is an annual fee of €896.30 for spectrum use).
- *Telecommunications*, issued for periods up to 20 years at varying fees (€700 to €815,500 plus annual spectrum fee).
- *Television receiver*, issued annually at a fee of €186.60. Yleisradio (YLE), the national broadcasting service with approximately 50% of the radio and television audience, is supported by the TV receiver licence fee.

326 Licences are renewable annually, with an understanding of continuity. Spectrum planning and auctioning of rights is not current FICORA policy[46], despite contrary EU recommendations. There are no secondary markets, therefore.

327 The following pieces of radio equipment are, for instance, exempted from licensing.

- GSM and UMTS mobile stations.
- PR 27 and LA (CB) telephones.
- Cordless telephones.
- Satellite telephones.
- WLAN/RLAN equipment operating in 2.4 GHz and/or 5 GHz bands.
- Telecommand equipment operating on collective frequencies.
- Equipment for detecting movement and equipment for alert.

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46 …in common with a majority of EU members

328 Digital television services started in Finland officially on the 27th of August, 2001. Analogue networks will be closed down on the 31st of August, 2007.

United Kingdom

329 Spectrum management falls under the Communications Act 2003, which created the Office of Communications (Ofcom). The Act updated and amended a plethora of prior Acts. Regulations are made under this Act and, to implement EU directives, under the European Communities Act 1972.

330 A Cabinet-level Committee provides oversight of spectrum allocation. Military and national security spectrum is managed by the Ministry of Defence. Ofcom manages all public spectrum, subject to direction by the Secretary of State, with the overall objective: to further the interests of the citizen-consumer where appropriate by encouraging competition. Ofcom maintains the national Frequency Authorisation Plan, in which are incorporated all UK decisions on spectrum. The Working Group for Spectrum Engineering (WGSE) resolves optimum efficiency and compatibility issues.

331 Management of spectrum designated for defence purposes is the responsibility of the Ministry of Defence (MoD). Spectrum is allocated to MoD by the Cabinet Office-level UK Spectrum Strategy Committee. Within MoD, the Defence Spectrum Management unit implements military spectrum strategy.

332 The UK's 2002 *Review of Spectrum Management* recommended that the MoD make a comprehensive audit of all military frequency assignments, and disclose to industry all those frequencies which might be released or shared. Protocols already exist for the return of unused spectrum to civilian use, and for shared use where this is feasible. The recent introduction of partial spectrum pricing is thought to have influenced MoD to make more efficient use of spectrum.

333 The *Review* also recommended that MoD bear the full opportunity cost of spectrum used in mobile, aeronautical and maritime applications, to stimulate its efficient use and encourage the release of unused bands.

334 The UK has 67 classes of licence. Seven classes of apparatus are exempt from licencing (eg, alarms, telemetry). The fees structure is complex. Commercial apparatus fees are based on a percentage of annual turnover. Other services, including defence and public safety organizations, pay a variety of fixed fees. Regulations permit the extension and conversion of existing licences on payment of the appropriate fee. Licences are issued for a fixed term that varies with the class of licence. 'Rolling' licences with an annual term carrying a presumption of renewal have been proposed.

335 Spectrum is allocated according to the Frequency Allocation Plan, with decisions on competing assignments being made by Ofcom. Incentive pricing is applied to congested bands, based on a formula developed by NERA-Smith in 1996. Given that Ofcom's primary objective is the promotion of competition, market mechanisms are ultimately favoured as a means of resolving competing applications.

336 The Cave report, 2002, recommended more realistic pricing and, where applicable, auctions. Auctions are now being used selectively for new national and regional services: eg, Broadband

Fixed Wireless Access and 3G cellular telephony. The MoD spectrum is also subject to incentive pricing, and the Ministry is obliged to publish details of spectrum available for shared or public use.

337 *[…] Ofcom has [since] published the Spectrum Framework Review - its strategy for securing the optimal use of the civilian radio spectrum. [The Review's] proposals will enable radio spectrum licence holders to make more efficient use of their spectrum* [assignment] *and encourage innovation and investment in wireless communications services across the UK.*

338 *Spectrum has traditionally been centrally allocated and managed by the regulator. However, demand for spectrum has increased dramatically in recent years and centralised administration has resulted in an inefficient system which has limited the innovation and development of higher-value services.*

339 *The Spectrum Framework Review sets out four key recommendations to address this problem:*

- *Allow the market to decide the best use for new spectrum allocations.*
- *Allow licence holders to trade spectrum in an open market and change the use they make of spectrum rights to develop new technologies and offer different services to customers (also known as liberalisation).*
- *Clearly define the rights of spectrum users, giving them the confidence to plan for the future.*
- *Increase the amount of licence-exempt spectrum which allows businesses to develop and bring to market new technologies and services without the need for a licence.*

340 *Ofcom will, over time, apply this market-led approach to over 70% of the radio spectrum (currently 0%). However, it must continue to maintain control over spectrum licences where:*

- *Signals cross international boundaries;*
- *International mobility is critical, or*
- *The UK has agreed to harmonise spectrum use in line with important multi-national accords.*

341 *Ofcom will continue to monitor and act against interference between spectrum users. It will introduce trading and liberalisation in a phased way, intervening where necessary to make sure that these initiatives do not result in excessive harmful interference for other users.*[47]

UNITED STATES OF AMERICA

342 Spectrum management falls under the Communications Act 1934, which established the Federal Communications Commission (FCC) and gave it the power to make regulations. Commercial spectrum is managed by the FCC, which has 2000 employees, and federal spectrum by the National Telecommunications and Information Administration (NTIA), which was established in 1978 and has 250 employees in spectrum management.

343 FCC objectives are economic efficiency and revenue maximisation. NTIA's primary objective are to make effective, efficient, and prudent use of the spectrum in the best interest of the Nation, with care to conserve it for uses where other means of communication are not available

47 http://www.ofcom.org.uk/media_office/latest_news/nr20041123

or feasible. A Spectrum Policy Task Force is currently recommending changes to legislation governing spectrum auctions and the use of auction proceeds to consolidate federal bands.

344 The US military, assigned frequency bands through the NTIA, has reported no shortage of spectrum, but in 2003 predicted an increase in total military use by 90% by 2005. This reflects not only the employment of ever more complex technology, but particularly heightened levels of security following 9/11.

345 Commercial spectrum is assigned by the FCC, generally through auction, and federal spectrum is assigned administratively by NTIA. There are several classes of FCC licence, varying in term from eight to fifteen years with an implementation requirement.

- FM Broadcast Station License[48]
- TV Broadcast Station License
- Digital Television Broadcast Station License
- License for AM, FM, TV, Translator, or LPTV Station
- Low Power FM Broadcast Station License
- Multipoint Distribution Service Authorization
- Satellite Space and Earth Station Authorizations

346 All spectrum is auctioned, except that allocated to international satellites, public safety and public broadcasting, federal services, and unlicensed ('public park') bands. The FCC is actively exploring alternatives to SMR auctions, including combinatorial and clock methodologies. Fees are levied for spectrum assignment applications and for operating radiocommunications apparatus, on a sliding scale according to such factors as technical complexity, power output and population coverage.

347 Licences are tradable and convertible, on application, to other uses. There is a small secondary market, which may grow if the FCC implements an intention to establish a spectrum trading desk. Five-year experimental licences can be issued to encourage innovation.

348 The FCC's Spectrum Enforcement Division resolves complaints regarding spectrum use, such public safety and technical issues as interference, transmission tower registration, marking and lighting, equipment requirements, unauthorized construction or operation and compliance with operational provisions of licenses.

349 The imminent roll-out of 'smart' radiocommunications has prompted the FCC to initiate spectrum management reforms that move away from the traditional system of assigning frequencies under licence or as management rights. An FCC Notice of Proposed Rule Making is pending. A Notice of Rulemaking has been issued regarding new unlicensed activity in the VHF and UHF bands, for intelligent low power transmitters[49] that 'hear before they talk' and fill the 'white spaces' in this spectrum.

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48 US spelling

49 Refer *Software defined radio*, page 53