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FUTURE SPECTRUM USAGE

A FORECAST OF TECHNICAL ISSUES FOR THE PERIODS

2001-2006
2006-2011

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Ministry of Economic Development
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PURPOSE

The purpose of this document is to give an indication of the changes in spectrum utilization that can be expected during the years 2001-2006 and 2006-2011. It is not a "crystal ball" but rather an extrapolation on current usage and changes as they appear now.

PREFACE

The Radio Spectrum Management Group (RSM) of the Ministry of Economic Development (MED) manages the radio spectrum on behalf of the Government through established policies. It is committed to meeting as far as possible, the spectrum needs of our clients, and in particular in making spectrum available in a timely manner to allow the implementation of new and emerging technologies while minimising interference to existing systems.

In 1997 in order to ensure that the Ministry has timely advice on spectrum requirements, RSM facilitated the creation of the Major Spectrum Users Advisory Group (MSUAG). Further, during the restructuring of RSM some two years ago, a new work group called the Spectrum Planning Division (SPD) was created to give technical advice.

SPD is charged with the production of band and channelling plans, and as part of its consultative process has produced a number of Engineering Consideration Documents (ECDs). These have specifically focussed on particular services in identified spectrum segments. A need has been perceived for a wider based document, to look at the full range of technologies that use the radio frequency spectrum.

Additionally, with increasing demands on spectrum comes the realisation that an increasing number of technologies will have to share the same spectrum in future. The task is to facilitate such sharing without imposing unacceptable constraints on any of the services. This means that new equipment design must emphasise immunity to interference and minimising spurious emissions, so that sharing between different services is made as easy as possible.

The purpose of this document is not to predict the future, but to give advice as to the likely future spectrum requirements, to assist both users and spectrum managers alike.

It is hoped that this document will assist in the timely conduct of spectrum management processes and be a useful contribution towards bringing into service the new generation technologies that will improve our every day living.

Hugh Railton

Manager Spectrum Planning

28th August 2001

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PART ONE: THE ENVIRONMENT

1 CHANGE DRIVERS

New Zealand already has a large investment in radiocommunications infrastructure estimated to be in excess of $6 Billion. Because of the high level of existing investment it would appear reasonable to assume that any major change to commercial spectrum applications will only happen if the market demands are sufficient to ensure a good return to the investor.

With the increased interest in demand for digital services, it would appear that the prime driver for new commercial spectrum is to meet the increasing demand for bandwidth to end points. This is being driven by the Internet, digital television and other digital radio platforms like the new cellular radio system: IMT2000.

The so-called "digital divide", whereby people living in rural areas may lack access to digital services, indicates that there is also the need to overcome geographical discrimination in the provision of the new digital platforms. To meet this requirement, different technologies from those that will be used to provide metropolitan services will probably be needed.

Despite the huge advances made in digital technologies over the last two decades, many services still use analogue formats. In fact few of the new technologies have reached the digital implementation phase. While some major transitions to digital formats in the near future are expected, there will not be a total conversion to digital techniques within the forecast periods. The change to digital formats in some services is expected to take a number of decades to happen, and in some services digital platforms may not provide enough benefit to require change.

Not all changes are commercial capacity driven. Some applications for example provide services vital to the safety of life. In radio guidance and scientific systems further spectrum will continue to be needed to achieve improvements in accuracy and reliability.

As New Zealand is a remote island nation, it is highly dependent on international transport. It is also to be noted that New Zealand exercises a responsibility for search and rescue services across large areas of the southern oceans. Excellent and uninterrupted communications in support of aeronautical and maritime transport industries as well as recreational activities is essential to the wellbeing of New Zealand and other island states.

It follows that technological and operational changes made internationally within the aegis of the ITU, ICAO or the IMO with respect to the aviation and maritime industries, will likewise force changes to happen in New Zealand

Where such changes require amendments to international treaties, they often take a number of years for international agreement to be achieved. There is little doubt though, that in some sectors like cellular radio, there will be major changes and upheavals within a relatively short time frame.

It is noted that there is little radiocommunications equipment manufacturing carried out in New Zealand, and most manufacturing that exists, is mainly export orientated. New technologies mostly start in the laboratories of Asia, Europe and North America. These technologies are generally designed to meet perceived demand within their own markets, though in the last few years manufacturers have been moving rapidly to embrace a global approach to realise their investment.

New Zealand industry has a history of monitoring these developments and where appropriate, importing particular technologies to meet the local demand. It should be recognized that even though New Zealand has always been quick to embrace such changes, it is often in a uniquely New Zealand way.

There is no doubt that much of the future lies in the digital medium with a number of services being able to be supplied within the same digital stream. How much this convergence will happen depends on the demand and the ability to meet the market expectations. It will also depend on the expectations of the end users.

1.1 EXTERNAL ENVIRONMENT

New Zealand being an island nation, physically isolated from the nearest neighbour by some 2,000 km, might at first appear to be largely unaffected by what is happening in the rest of the world. History does not support this contention. In the past HF radio was commonly used and international interference, mainly from South East Asia was and continues to be a problem. AM broadcasting is subject to interference from Australia and even from as far away as the USA.

In the last forty years, many of the HF uses have been replaced by more stable VHF, UHF and SHF links, and broadcasting now heavily depends on bands that are largely unaffected by international interference e.g. FM Broadcasting.

In this same time span, global satellite networks have come into being and they are a growing potential interference source that has to be taken into account. With the new generation of non geo-stationary networks, there will be many satellites crossing our skies with the potential to cause interference to our terrestrial services.

It follows that even though New Zealand does not have contiguous land mass borders with other nations, it cannot ignore what is happening around it. Thus the external environment is pivotal to our national development.

1.1.1 THE GLOBAL COMMUNITY

As can be seen from the above New Zealand is firmly part of the "Global Village". Our domestic market is quite small, hence industries tend to be export driven, often supplying the local market from the pool of equipment destined for overseas markets.

New Zealand registered shipping and aircraft ply the "four corners" of the globe, and therefore require technologies and frequencies that are compatible with the rest of the world. Standards that permit global roaming are an expected feature of modern cellular radio just as much as the standards that allow for international exchange of television program material are an assumed part of today's broadcasting environment.

Recent work done by RSM and the members of the ITU-R Sector leading up to the ITU World Radiocommunications Conference (WRC2000), clearly identified that New Zealand industry and users, benefit from the global adoption of common frequency allocations and technical standards. It is noted with interest the move to adopt a global approach to spectrum for public protection and disaster relief communications.

There is little doubt that most future spectrum usage in New Zealand will be dictated by international usage, tempered by the need for the service providers to make a return on their investments. There is also little doubt that the economic and operational benefits derived from the adoption of global standards for equipment and spectrum utilisation will have a major impact on the management of the radio spectrum in New Zealand.

1.1.2 THE REGIONAL COMMUNITY

While New Zealand associates itself with its Australian and Pacific neighbours, many of the telecommunications developments are based on what is happening in Europe or North America rather than the adoption of Regional (Japanese or Korean) standards. New Zealand is not alone in this regard and many of countries in the Asia/Pacific Region have also developed along these lines. As the technologies in North America and Europe are often incompatible and use different frequency bands, regional coordination is essential to ensure interference is minimised. It follows that while New Zealand embraces global developments, regional cooperation is an essential element in realising the best of what the world has to offer.

1.2 INTERNATIONAL TREATIES AND ARRANGEMENTS

Radio waves do not recognise political boundaries. The transmission of radio waves from one country can, and often do, affect the radio services in other countries. As already noted, operational matters such as frequencies for international transport need to be agreed by all countries and therefore radio communications is subject to a number of international treaties and arrangements, that New Zealand is a party to.

1.2.1 SPECTRUM REGULATION: THE ITU AND THE RADIO REGULATIONS

The International Telecommunications Union (ITU) is the oldest international organization and is responsible for the framework under which most telecommunications technologies, including telephony and broadcasting are developed and realised. Of note, New Zealand has been a member since 7/6/1887 being the 23rd country to join.

The ITU consists of the ITU-D, which is responsible for technical development of assistance to developing countries, the ITU-T which is responsible for standards and operational arrangements for the public switched network and associated systems, and the ITU-R which is responsible for matters pertaining to radiocommunications.

The ITU-R provides the international framework for the regulation of radiocommunications along with the expert Study Groups that provide the technical and operational bases for most radio applications. The treaty text for the international regulation of the spectrum is the International Radio Regulations (IRR) which set out the frequency allocations for services and the processes whereby frequency usage in member countries can receive international recognition and protection.

The ITU-R Recommendations that come from the Study Groups do not have treaty status but under New Zealand legislation need to be taken into account when engineering radio licences.

Under the IRR, signatory nations are required to comply with its provisions, and in particular with the frequency allocations found in Article S5. Hence in our studies, the frequency boundaries set by the ITU have had to be respected. It should be noted that there are choices within the allocation table in Article S5 and the selection of which service can use an allocation, is primarily a matter for national determination.

The IRR are reviewed every two to three years through World Radiocommunications Conferences (WRCs) in order to keep up with the continual changes in spectrum demand for new technologies and new service applications.

Experience over the last two decades of ITU Radio Conferences shows that major changes that involve large numbers of bands and services do not occur. Changes tend to be relatively small allocation amendments and /or technology changes within the same service.

Today, most of the useful parts of the radio spectrum are already heavily used. The physics of radio propagation means that new technological developments must compete for the same spectrum, e.g. new generation satellite services, wireless local loop (WLL) and IMT2000 cellular radio services, are all expected to occupy spectrum already heavily populated by existing stations. Even quite small allocation changes can have a major impact, e.g. the new bands identified for IMT2000 may have a major impact on the frequencies used for Television Outside Broadcasting (TVOB). Further, as the spectrum is heavily used, pressure to introduce new services in a given band inevitably has a flow on effect onto adjacent bands. The cost of such changes can be high. Hence, as experience has shown, it is often very difficult to reach international agreement on such changes.

Thus the ITU and the Radio Regulations play a major role in our spectrum management. The ITU-R Recommendations also play a crucial role and give guidance as to how the various applications that use radio can be implemented.

1.2.2 INTERNATIONAL TRANSPORT: ICAO AND THE IMO

While the provisions governing the treaty aspects of radiocommunications for international transport are contained in the IRR, the international civilian aeronautical community and the international shipping community have formed international organisations that manage the operational aspects of their respective sectors.

The International Civil Aviation Organization (ICAO) was created by the Chicago Convention (1944), with the purpose of covering the major practical aspects of civilian air transport.

In a similar manner, the International Maritime Organization (IMO), was created by the IMCO Convention Geneva (1948) and is mainly concerned with safety of life at sea as well as the practical matters of international shipping. The International Convention for Safety of Life at Sea, known as the SOLAS Convention was internationally adopted in 1960.

New Zealand legislation requires that the provisions within Annex 10 of the Convention on International Civil Aviation be taken into account when engineering radio licences. The main thrust of this is to protect vital air navigation systems from interference from other stations. Similarly, New Zealand legislation requires that the SOLAS Convention be taken into account when radio licences are being engineered.

The major changes that will affect spectrum usage by international transport providers are expected to come from changes to the IRR rather than ICAO or IMO actions. These include during the review period, the implementation of digital systems and the introduction of improved radio navigation aids within the existing radiocommunications service categories.

In summary, while the international transport sector is a major spectrum user, changes within the review period are expected to be improvements largely within their existing frequency bands.

1.1.3 OTHER INTERNATIONAL ARRANGEMENTS

Outside of the ITU process there are a number of international arrangements that have a major impact on spectrum usage. Defence agreements for example have a large impact on spectrum usage for their major spectrum applications. It is noted that with New Zealand participation in increasing numbers of joint operations under the aegis of the United Nations, international communications harmonisation and inter-operability are important issues.

In many other forums an international approach to spectrum usage is also sought, for example the World Meteorological Organization (WMO) looking at common requirements for Met Aids and International Union of Radio Science (URSI) carrying out scientific observations.

All this usage is coordinated through the ITU meetings and at any major meeting there are some 20 or more international organisations active in the discussions.

1.2.3 REGIONAL AGREEMENTS: THE APT AND BILATERAL ARRANGEMENTS

Regional agreements tend to be in support of the wider global activities mainly within the ITU. The Asia Pacific Telecommunity (APT) was created in 1979 in Bangkok. The APT has four major activities: technical assistance to the developing countries of the region, a regional information and communications technology (ICT) forum, a telecommunications standards forum and a radio regulatory forum.

The radio regulatory forum, which is known as the APG, has a focus on preparations for ITU-R meetings and conferences. The APG has proved to be a worthwhile forum as it adds regional weight to proposals in a similar manner to the European CEPT and the Americas CITEL. The breadth of membership has meant that proposals are discussed from a wide number of viewpoints and levels of development. This ensures that common proposals that are developed by the APT have wide applicability and impact on the region's future spectrum usage.

Apart from the APT, the New Zealand Administration has a Memorandum of Understanding with Australia that covers the Trans-Tasman mutual recognition of technical standards. Australia and New Zealand also have an understanding that covers the participation in the ITU-R Sector work in both countries.

1.2.4 STANDARDS AND SPECIFICATIONS

Standards New Zealand coordinates standards development and where required these standards are mandated through the Radiocommunications Regulations (1993).

In recent years, strenuous efforts have been made to separate standards from the allocation arrangements in order to achieve technical neutrality in the allocation process, thus minimising the barriers for attaining the most economic use of the spectrum. For this reason there are few actual mandated standards in the New Zealand regime as compared with most countries.

The International Electro-technical Commission (IEC) is the international body that is responsible for the specifications for consumer products that use radio. The IEC has a special committee (CISPR) responsible for the international standards for electro-magnetic compatibility (EMC) which includes radiation from devices other than intentional transmitters. This provides a framework to ensure that the radio frequency spectrum is not unnecessarily polluted.

Spectrum pollution is a growing problem, with the number of unintentional radiating equipments, especially computer hardware, causing a gradual deterioration in the spectrum environment. This is likely to have a negative impact on future spectrum utility.

Apart from the two global bodies there are three regional standards bodies: ETSI serves the European Area, ANSI services the USA and ASTAP serves Asia and the Pacific.

1.3 THE NATIONAL ENVIRONMENT

As well as the international influences on spectrum usage there are also national factors that play a major role in driving change.

1.3.1 DOMESTIC DEMAND

Despite the relative isolation of New Zealand, the population is well aware of international developments and expects that radio applications available elsewhere in the world should be available in New Zealand.

As frequency usage differs between countries, the frequency bands to support new applications supplied off shore are not always available here. For example, take the North American cordless telephone that operates about 49 MHz. In New Zealand that frequency is used for television and therefore is not available for cordless phone use.

In other cases there are interference problems between systems taken from one regional block operating next to systems from elsewhere. The interference between the North American AMPS and the European GSM Cellular systems is an example. Moreover, since New Zealand service operators are able in general to source equipment from manufacturers in Europe, the Americas or Asia, it can mean that systems designed to a number of different regional standards are all attempting to operate in close proximity to each other. This provides another strong argument in support of the adoption of global standards for equipment and spectrum use.

1.3.2 NATIONAL SECURITY ISSUES.

The internal and external security of the nation requires extensive spectrum access. Spectrum access for many of these applications is governed by international arrangements.

About a decade ago there was an initiative to provide common bands for all public safety services. The Public Safety Radio Frequency Management Group (PSRFMG) was established to coordinate the implementation of the Emergency Services (ES) Band concept. Spectrum has been made available in bands from 70 - 900 MHz to provide for various public safety and national security applications in New Zealand.

While most security applications fall within the same services as other users, special recognition needs to be given to these needs which are likely to continue to grow, as more sophisticated security apparatus is required. Of note here is the expectation that public safety agencies will augment their current narrowband communication services with broadband and, in the longer term, wideband services.

While there is a large degree of frequency sharing where it is practical, continued access to some exclusive frequency bands is essential for public safety related services.

1.3.3 IMPACT ON THE ENVIRONMENT

There is no doubt that the physical environment will play a growing role as a change driver. The establishment of transmitting stations is coming under more environmental scrutiny than at any other time. It is expected that environmental concerns will lead to longer construction times with a significant resource approval component thus slowing the overall development times.

PART TWO: SUMMARY OF FINDINGS

2 USE OF THE RADIO SPECTRUM

2.1 INTRODUCTION

The Radio Frequency Spectrum has four major uses:

Radiocommunications

Broadcasting

Radiodetermination (including radionavigation and radiolocation)

Science Services.

Large, almost quantum technology leaps, are expected within radiocommunications and broadcasting services over the forecast period. Also major technological developments and an explosion in numbers and applications, in the use of low power devices is expected. Improvements in technologies are expected in the radiodetermination and science services but these will mainly be based on doing the existing tasks better, although it is expected that new applications using a range of technologies will also be introduced.

The Spectrum Planning Division has produced a document, "Table of radio spectrum usage in New Zealand"[1] This document is structured in frequency ascending order, based on the Table of Frequency Allocations detailed in Article S5 of the International Radio Regulations (IRR).

In contrast, it has been decided to make this study service-based rather than frequency-based as changes are often categorised as new developments in say television or cellular radio etc rather than by changes within a particular frequency band.

It should be noted that nearly all developments are expected to take place within the services as now defined in Article S1 of the IRR. However, as some new technologies cannot be fully described by the existing international definitions, some new definitions may be needed.

In the annexes to this document, each service is examined, identifying broadly what the current usage is and then addressing possible developments in the years 2001-2006 and 2006-2011. In the preparation of this document extensive use has been made of the ITU-R Study Group work and the Ministry/Industry discussion forums. Associated documents and other reference material can be accessed from the ITU and Ministry of Economic Development web sites.

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[1] See PIB 21 at http://www.med.govt.nz/rsm/planning/nztable.html

2.2 RADIOCOMMUNICATIONS

For the purpose of this document, radiocommunications is defined as the provision of telecommunications using radio. It includes the Fixed (FS), Mobile Service (MS), Fixed Satellite Service (FSS) and Mobile Satellite Service (MSS).

For the purpose of our studies these have been broken down as follows:

Fixed Services

Mobile Services

Space Services

Class of Fixed service	**Nature of Change**	**Change for 2001-2006**	**Change for 2006-2011**
Below 30 MHz	Continuous Improvement	Small reduction in number of licences and some new short range devices (SRD) applications	Introduction of HF digital linking likely with frequency congestion problems below 10 MHz.
30 MHz TO 1000 MHz.	Continuous Improvement	Continued expansion of analogue systems with some new digital services being brought into use.	Continual upgrading of existing services to digital formats in particular in support of ICT needs.
Above 1000 MHz	Significant technology changes.	Emphasis will be on higher data rates and higher frequency bands. Introduction of new wireless local network technologies	New FS requirements below 3 GHz in support of TVOB, continued expansion of FWA and the microwave main trunk capacity.
Low Power Applications (SRD)	Large expansion in numbers with a trend towards spread spectrum techniques.	Increase in usage is expected until interference restricts performance.	Some rationalisation of SRD activities may be required in face of demand and lack of spectrum.

Table 1

Class of Mobile service	**Nature of Change**	**Change for 2001-2006**	**Change for 2006-2011**
Aeronautical Mobile	Some technology changes within existing spectrum	Continued HF dependence with some digital system augmentation. Expansion of MSS usage and new wide band MSS usage for IP uses. Little change to VHF services	Some reduction in HF dependence due to MSS take up leading to MSS congestion issues. Proliferation of wide band MSS IP usage. Some rationalisation of VHF usage
Land Mobile other than emergency services	Below 30 MHz little change, Above 30 MHz change to more trunked and digital services	Little change below 30 MHz and with conventional two frequency services. Considerable growth in trunked services.	Some experimental HF digital services with some migration to digital services in the VHF and UHF bands.
Emergency Services	Gradual national and international harmonisation	Domestic harmonisation of analogue services with the start of digital services	Start of the international harmonisation process, along with growth, of digital services.
Maritime Services	Slow uptake of digital and satellite technologies	Little change to HF requirements with some MSS and VHF growth. Reliance on cellphones for close to shore operations will grow.	Some new digital HF systems are expected as well as high MSS growth.
Cellular Radio.	Quantum leaps to advanced digital platforms	Significant technology changes within the existing 800/900 MHz cellular bands.	Start of 3G services at 2 GHz as well as upgrades at 800/900 MHz.
Low power mobile devices.	Technology shift including spread spectrum with a huge increase in numbers.	Large expansion in existing users in support of cordless and Wireless LAN operations. Major interference problems are to be expected.	New global applications will come into use that could cause problems to existing users in the same band.

Table 1 (continued)

Class of Space Service	**Nature of Change**	**Change for 2001-2006**	**Change for 2006-2011**
Geostationary Fixed Satellite	Constant growth and improvement	The growth in new networks will be linked to broadband data applications. There will also be upgrades of existing networks using new digital techniques to improve efficiency.	Growth in the number of high bandwidth, high power of networks is expected in support of ICT activities.
Geostationary Mobile Satellite	Constant expansion of global and regional networks to meet the demand.	It is expected that the MSS bands will be full by the end of this period.	Introduction of new bands and sharing arrangements.
Non Geostationary Fixed Satellite	Implementation of this service	Some experimental networks will be launched this period.	The bringing into service of NGSO FSS constellations, is expected in 2008.
Non Geostationary Mobile Satellite	Improvements and demise of some existing networks and some new entrants.	The continuation of the commercial sorting out of these networks can be expected this period.	NGSO MSS will increase bandwidth and power to challenge NGSO FSS operations.

Table 1 (continued)

2.3 BROADCASTING SERVICES

Broadcasting Services are comprised of Sound Broadcasting (AM & FM radio) and Television (VHF &UHF TV) along with both radio and television being delivered from space craft.

As a result of the convergence of some telecommunications and broadcasting delivery platforms, some broadcasting is supplied by the FS in the point-to-multi point mode and by the FSS in the Direct to Home (DTH) mode[2].

[2] The WRC 2000 accepted that DTH is a special case of BSS operations needing more study and regulatory consideration.

Type of Sound Broadcasting service	**Nature of Change**	**Change for 2001-2006**	**Change for 2006-2011**
MF AM	Some reduction in usage by high power transmitters with little change in numbers of licences	Existing services will continue with some transfer to FM but continued demand for wide area coverage	Possibly some experimental digital transmissions otherwise little or no growth.
HF AM	Very little change.	It is unlikely that there will be any change in this period	There may be some new digital services introduced in this period
VHF FM	Continuous expansion	Very heavy demand will continue with a number of new programs in the band 100-108 MHz	Very heavy demand will continue with expansion of coverage of the new programs in the band 100-108 MHz
DAB Satellite	No development	DAB Sat. systems today are replacing Short Wave services which are virtually unused in New Zealand so there is not likely to be any New Zealand coverage apart from "piggy back" on TV Satellite transmissions	
DAB	Some initial development possible	It is unlikely that there will be any development in this time frame.	If receivers become readily available then some pilot transmissions could be expected in this period.

Table 2

Type of TV Broadcasting service	**Nature of Change**	**Change for 2001-2006**	**Change for 2006-2011**
VHF/UHF terrestrial television.	Possible transition from analogue to digital emissions	During this period the digital TV platform may be determined, with some pilot transmissions.	Possibly some new Digital Terrestrial TV (DTT) services but continued analogue services also likely. UHF re-allocation could happen to facilitate DTT introduction. There is likely to be continued demand for analogue Free To Air (FTA) services as well as DTT.
Satellite TV	Increased program availability	Increasing capacity demand may lead to congestion in the band 12.2-12.75 GHz.	Satellite TV services may become the prime radio based digital delivery platform..
Synergetic services	Increase in number of alternatives.	Television delivery by the FS as an add on to ICT services is unlikely to threaten main stream delivered systems.	With the expansion of cable, BSS and DTH FSS services as well as DTT, alternative delivery systems may have limited scope.

Table 2 (continued)

2.4 RADIODETERMINATION

Radionavigation services use various types of radio beacons and information systems to provide direction and position finding along path guidance. Radiolocation services use various types of radar to locate physical objects.

Type of service	**Nature of Change**	**Change for 2001-2006**	**Change for 2006-2011**
Terrestrial Radionavigation Services	Limited changes to the maritime services with some changes to the aeronautical service. New land based systems expected.	Shipping uses RNSS almost exclusively for position finding. The Aeronautical industry while becoming more dependent on RNSS, will still rely on ground based radionavigation services e.g. NDBs, ILS and VOR.	This period should see some reduction in the dependence on ground based aeronautical services with more reliance on RNSS augmented by GBAS. The start of large scale road information mapping etc is expected.
Terrestrial Radiolocation Services	Continuous improvements in information processing within the existing allocations.	Ground based radars are likely to continue for both periods, with improvements in signal processing and new mobile radar applications for collision avoidance in land and aeronautical applications (both in-flight and on ground).	
Radionavigation Satellite Services	Continuous improvements with new networks coming on line.	In this period large advances will be made with error correcting of GPS services in applications like GBAS[3].	It is expected that the European Galileo network will come into service with spectrum implications at 1.2 and 5 GHz.

Table 3

[3] Ground Based Augmentation System

2.5 SCIENCE SERVICES

Internationally scientific observations are made from space with the Earth Exploration Satellite Service (EESS), and the Space Research Service (SRS). Passive observations are also made by the Radio Astronomy Service (RAS).

Valuable meteorological observations and data are provided through Meteorological Aids Service (Met. Aids) and the Meteorological Satellite Service (Met. Sat).

Almost all applications in New Zealand are in support of meteorological activities.

<table>
<tr><th>Type of service</th><th>Nature of Change</th><th>Change for 2001-2006</th><th>Change for 2006-2011</th></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Met Aids</td><td>Refinements without requiring further spectrum. Overall improvements in spectrum utilisation expected.</td><td colspan="2">Little change is expected throughout both review periods though there may be more sophisticated data collection and better digital transmission radio links.</td></tr>
<tr><td>Met Sat</td><td>Refinements without using further spectrum</td><td>There will be some improvements in imaging and image processing.</td><td>As the Met Sat bandwidth is under threat by the RNSS better techniques and alternative bands may be sought.</td></tr>
</table>

Table 4

PART THREE: ANNEX 1

3 RADIOCOMMUNICATIONS SERVICES

Radiocommunications services are those services that support communications other than broadcasting. Traditionally they include the fixed and mobile terrestrial and the associated space services.

3.1 FIXED SERVICE

The fixed service is defined as providing communications between known fixed points. The service can be point-to-point (P-P), point-to-multi-point (P-MP), unidirectional or bidirectional.

3.1.1 FIXED SERVICES BELOW 30 MHZ.

Nature of Change:	**Little change.**
Demand 2001-2006:	**Below 2 MHz.** Most services have lapsed. Some new SRD applications expected. **2-30 MHz** Existing services will continue to be needed with limited expansion.
Demand 2006-2011:	**Below 2 MHz.** New SRD applications are expected. **2-30 MHz** Most existing services will continue to be needed with expansion to digital emissions to support some ICT activities. Bands below 10 MHz could run out of capacity.

BACKGROUND COMMENT

BELOW 2 MHZ

At these frequencies the propagation is mainly by ground wave, though long distance propagation through the bouncing of signals off the ionosphere occurs at night.

Stations operating below 2 MHz require large antennas and suffer badly from both manmade and natural noise, hence there is little expectation of continued or further development in this frequency order. Short range devices (SRDs) are expected to make considerable use of this spectrum segment over the next twenty years.

BETWEEN 2 AND 30 MHZ

Above 2 MHz the spectrum becomes more useful. Nationwide communications tends to use frequencies in the order of 3-12 MHz while international fixed services operate in the 5-30 MHz range.

Despite the advances in satellite technology, cost factors and use of existing equipment make it attractive to continue to use HF Fixed Services over long distances for voice and low speed data applications. There are currently a number of new digital technologies being studied for HF applications and it is expected that some of these will be introduced over the next five years. Non government national HF communications though is likely to continue to use SSB as the major communications medium.

It is expected that even in the longer term HF Fixed Services will still be required to serve remote outposts, especially where the base equipment also services other uses like aeronautical and maritime mobile services. It is likely that there will be a resurgence in the use of HF Fixed Services, once newer digital technologies are established. It is expected therefore that the existing demand will continue and possibly expand in the 2006-2011 time frame when new digital services will emerge.

3.1.2 FIXED SERVICES BETWEEN 30 MHZ AND 1000 MHZ

SUMMARY

Nature of Change:	**Continuous Improvement**
Change 2001 - 2006:	The usage below 68 MHz is interference limited so will remain about the same. Above 68 MHz there will be continued expansion for narrow and medium bandwidth, stable path communications. Migration to digital formats to increase capacity is likely, as increasing pressure from other services prevents more spectrum from being made available to the fixed service.

Change 2006 - 2011: Most existing services will continue to grow, with upgrading to digital emissions. Where independent thin-route communications services are required, there are significant advantages to using VHF and lower UHF communications frequencies because of the propagation characteristics in these frequency orders.

BACKGROUND COMMENT

The lower VHF (Below 68 MHz) frequencies are subject to varying atmospheric and solar interference conditions (e.g. "sporadic-E skip", "F2" ionospheric reflection, weak scatter modes, auroral effects, and tropospheric ducting)[4] that limit the usefulness of this frequency range.

In the frequency order 300-1000 MHz ducting can cause interference at distances of over 100km. Diffraction and reflection are significant at VHF and increase the reliability of these frequencies for non-line-of-sight paths making it attractive for thin route linking.

Path Loss is significant at the higher UHF frequencies. Reflection of UHF radio-waves from buildings increases the urban and in-building penetration of this frequency order. The modern development of high frequency stability devices combined with the available bandwidth has made UHF transmission attractive for medium range, medium capacity communications.

Signal penetration in forested areas in the lower VHF range is approximately 10 dB better than that at lower UHF. Thus, VHF transmission is favoured over UHF in cases of non-line of sight linking over forested terrain.

[4] *The Radio Amateur's Handbook: The Standard Manual of Amateur Radio Communication,* Head Quarters Staff of the American Radio Relay League, Newington, Connecticut, U.S.A. 1972

Present New Zealand Band Usage:

Between 30 and 1000 MHz, 92.8 MHz is available for fixed service use.

The following table summarises fixed service use between 30 and 1000 MHz:

Frequency Range (MHz)	**Band label**	**No. of Licenses**	**No. of Licensees**	**Path lengths (km)**	**Bandwidths (kHz)**	**Summary of Usage**
30.01 - 37.51	-	<10	1	300+	<16 kHz	National and international communications.
68 - 72, 73 - 74.8	AB	3	1	100+	<16kHz	Service to offshore oil platforms
162.2 - 170.3	EE	372	18	<250	16 - 50	Narrow band non line of sight links.
404 - 406	I 2 3 4	27	-	<75	16 - 110	STL and TTL service
412 - 414	I 2 3 4	44	-	2 - 111	16 - 110	STL and TTL service
410 - 412	I 2 3 4	22	-	5 - 102	50 - 400	Medium bandwidth linking and STLs.
418 - 420	I 2 3 4	21	-	1.2 - 103	16 - 100	Narrowband data links and STLs.
420 - 430	I 2 4	~4000	115	<200	10 - 50	This band is a prime narrow band linking band and is close to maximum capacity.
440 - 449	JL5	7	-	2.9 - 45	50 - 300	Migration band for I Band clearance
450 - 470	J	2700	243	<300	6 - 50	Narrow band linking, including telemetry.
806 - 812 851 - 857	KK	56	7	5 -100	500	Medium bandwidth linking.
915 - 935	K	400	98	<75	16 - 2000 6	STLs

Table 5

Notes to Table 5:

1 In the frequency range 30.01 - 37.5 MHz radio wave behaviour is similar to that within the HF range.

2 Pressure has been put on fixed usage by the mobile services to cater for a digital trunked network for public safety communications.

Notes to Table 5 (Continued)

3 The four lower sub-bands of the I band mentioned are used for linking in support of radio broadcasting. Bandwidths of 50, 60 and 75 kHz support linking for AM radio. Bandwidths of 110 kHz support linking for FM radio broadcasts.

4 The band is close to capacity, thus to effect new assignments, requiring the specific physical properties inherent to the VHF/UHF spectrum, a shift to more spectrally efficient transmission technologies may be necessary.

5 The JL band was created to contain links displaced from the I-band, as a result of the creation of a digital public trunked dispatch land mobile band (412 – 414 MHz paired with 422 – 424 MHz).

6 In the 915 – 935 MHz K-band the 2000 kHz bandwidth links are legacy systems licensed prior to the re-planning of the K-band.

Factors Affecting Future Band Usage

The heavy use of the VHF and UHF Fixed Service Bands means that any changes can only be small and introduced at a slow rate.

The long standing use of technology at these frequencies is reflected in the large number of relevant ITU-R recommendations.

Over the last decade new allocations to other services, mainly new generation mobile and non-GSO satellite services, have reduced the amount of spectrum allocated exclusively to the fixed service. This coupled with the ever increasing demand means that spectrally efficient transmission techniques will need to be introduced over the review period.

Usage in the frequency range 30 – 1000 MHz is approaching capacity. Options for relief exist by using other frequency ranges, but this tends to be unattractive. The alternative is to use more spectrally efficient technologies. Current ITU-R study questions and agenda items confirm that revolutionary enhancements to VHF and lower UHF fixed service usage are unlikely. Evolutionary changes (e.g. digital technologies, dynamic channel allocation and interference avoidance techniques) are being actively pursued.

3.1.3 FIXED SERVICES ABOVE 1 GHZ

SUMMARY

Nature of change 2001 – 2006:	**Continuous improvement, with step function increases in demand for digital linking.**
Nature of change 2006 – 2011:	**A transition to higher efficiency technologies is anticipated, as old equipment is replaced.**

BACKGROUND COMMENT

Microwave fixed services are used predominantly for long haul backbone services. The lower frequencies around 1.5 GHz are being used for rural telephony services, especially as P-MP services.

Most of the bands below 10 GHz. are filled to capacity, and continue to be occupied by mature services using essentially simple and robust technologies much of which will reach the end of its economic life within the review period. In fact, where additional capacity has been required, this has been achieved by upgrading to more efficient digital technology.

Technologies continue to evolve quite rapidly, with more spectrally efficient apparatus becoming available that allows greater data rates by using higher modulation orders such as 16, 32 and 64QAM, or 128TCM. The downside of these higher modulation orders is their increased susceptibility to interference, thus constraining the maximum path length available for given levels of transmission power.

The wide range of physical attributes of the fixed service bands is such that each frequency order has to be considered separately.

Over the last decade, developments in the cellular mobile and satellite services have reduced the amount of spectrum available to the fixed service. At the same time demands for linking of all types have increased to a point where an urgent international review is needed. Even though the fixed service has been ready to employ leading edge technologies to increase capacity, the future demands require more spectrum. This will be difficult to achieve.

Analysis by frequency order.

To assist in the analysis the band have been separated into:

1-5 GHz

5-10 GHz

10-24 GHz

Above 24 GHz.

The following table gives each of the bands and a brief description of its usage.

Frequency range MHz/GHz	**Band Label**	**No of Licenses**	**Path length (km)**	**Bandwidths (MHz)**	**Summary of usage**
1429 – 1530	L	2407	2 – 100	2 – 4	Rural telephone services
2500 – 2690	O		Unknown	28	Outside broadcast video linking
3400 – 3600	PB				Planned for Fixed Wireless Access (FWA)
3600 – 4200	P	63	12 – 81	40	High capacity P-P links, and FSS downlinks
4400 – 5000	5G	460	12 – 95		High capacity backbone linking
5925 – 6420	R	147	8.5 – 76	17 – 72	High capacity fixed links, FSS uplinks
6430 – 7100	T	837	7.5 – 65	17 – 43	High capacity backbone linking
7100 – 7425	V	332	3 – 95	7 – 28	OB video links, low-medium capacity fixed links
7425 – 7730	U	244	3 – 21	7 – 28	Medium/high capacity spurs off backbone links
7730 – 8290	W	331	3 – 89	14 – 29	Medium capacity fixed links
8290 – 8500	Y	36	2 – 100	28	OB video linking, medium capacity fixed links
10.5 – 10.68	H	71	1 – 18	7 -21	Low capacity fixed links, video STLs.
10.7 – 11.7	Z	103	5 – 28	30 – 43	Medium/high capacity fixed links
12.75 – 13.25	X	435	0.8 – 29.4	7 – 28	Short haul low/medium capacity fixed links
14.5 – 15.35	G	84	1.2 – 16.5	3.5 – 28	Short haul low/medium capacity fixed links
17.7 – 19.7	18G	375	0.3 – 19.8	7 – 55	Low/high capacity fixed links
21.2 – 23.6	23G	684	0.1 – 14.1	.5 – 56	Low/medium capacity fixed links, video links
	31G	12	0.3 – 5	25 – 50	Medium capacity fixed links
37 – 40	38G	168	0.1 – 2.6	3.5 – 28	Low/medium capacity fixed links

Table 6

Frequency range MHz/GHz	Band Label	No of Licenses	Path length (km)	Bandwidths (MHz)	Summary of usage
50.4 – 51.15	50G	18	0.4 – 1.4	20 – 40	Short haul low data rate links
57.2 – 58.2	60G	18	0.3 – 1.0	100	Short haul links

Table 6 (continued)

1 – 5 GHz

Propagation within the bands in this frequency range are largely insensitive to rain fade effects and can tolerate somewhat lower path Fresnel clearance criteria than the higher bands. The use of robust low order modulation methods such as QPSK gives good availability.

The L band 1429 – 1530 MHz provides vital rural telephony systems while the O band 2500 – 2690 MHz is used for TVOB. The O Band is also identified for future IMT2000 applications. The PB band 3400-3600 MHz will possibly be used for WLL applications[5].

P band 3600-4200 MHz is constrained by having to coordinate with satellite earth station (SES) receivers. The 5G band 4400-5000 MHz is currently being implemented for very high capacity services.

5 – 10 GHz

Frequencies above 7 GHz need to have some consideration given to rain fade if being used for high capacity services and require at least 0.6 first Fresnel zone clearance for high-reliability operation.

R band 5925 – 6420 MHz is constrained by having to coordinate with existing satellite earth station (SES) transmitters. The T band 6430 – 7100 MHz is heavily used for high capacity digital backbone services. The V band 7100 – 7425 MHz is used in part for TVOB with the balance being used for low and medium capacity linking.

The Y band 8290 – 8500 MHz is relatively lightly used, predominantly by one licensee for both fixed P-P and for TVOB purposes.

10 – 24 GHz

The bands in this frequency range are susceptible to fades and outages due to rain, which determines the maximum usable path length.

H band 10.5 – 10.68 GHz is a small band, with 4 by 21 MHz channel pairs that are suitable for video STLs and stand-alone low capacity digital links over paths in the vicinity of 20-30 km.

The Z band 10.7 – 11.7 GHz is used over path lengths from 5 to 28 km for high capacity traffic using 40 MHz channelling.

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[5] The ECD 2000/4 titled "A draft bandplan for the Band 3400 - 3600 MHz", was completed 19 December 2000 and identified possible use for wireless local loop (WLL) purposes

The band 12.2 -12.5 GHz is used in the point to multi point mode for datacasting.[6]

The X band 12.75 – 13.25 GHz is fairly heavily used for medium capacity linking over path lengths varying from 3 to 30 km.

The G band 14.5 – 15.35 GHz is used for low to medium data rate digital services, but is constrained by rain rate as far as maximum path length is concerned.

The 18 GHz band 17.7 – 19.7 GHz is constrained by the requirement to share with the fixed satellite service (FSS) in the space to earth direction, for systems such as Teledesic and Skybridge.

Above 24 GHz.

The 24.5 – 26.35 GHz band is under consideration for LMDS operation[7].

The 26.4 – 28.35 GHz band is under private management rights so is not considered.

The 31.0-31.3 GHz band is used for short links up to about 5 km.

The 31.8-33.4 GHz band has been identified in ITU-R studies for high density fixed service applications.

The 38 GHz band 37 - 40 GHz is used in the major metropolitan areas for inter-cell-site linking.

The 50 GHz band 50.4 – 51.15 GHz has an effective maximum path length of about 1.5 km, so is of limited utility.

The 60 GHz band 57.2 – 58.2 GHz is similar to the 50 GHz band above.

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[6] The sub-banding of this spectrum by POLDOC Spectrum Band Plans 001, titled "10 GHz to 20 GHz Band Plan", clarified the usage of the spectrum, with BROADCASTING (including DATACASTING) being constrained to the 12.2 – 12.375 GHz range, and the FIXED SATELLITE service being allowed over the full range 12.2 – 12.5 GHz, subject to being able to coordinate with the BS in the lower half.

[7] See ECD 2000-6

3.1.4 LOW POWER APPLICATIONS.

Nature of Change:	**Large expansion in numbers with a trend towards spread spectrum techniques.**
Demand 2001-2006:	There will be continued high demand where the opportunity exists to use spectrum without the acquisition of a licence.
Demand 2006-2011:	The demand will exceed the bandwidth available and possibly new bands will have to be identified as access to other fixed services spectrum becomes more difficult.

BACKGROUND COMMENT

SRDs are devices that provide for a large number of operations that fall outside of the conventional usage of the spectrum. New Zealand has a number of "public parks" where SRDs are authorised under general licences[8]. Globally there are a large number of such devices in use including "Blue Tooth", Wireless LANs and other spread spectrum applications.

In recent years there have been significant networks of such devices established. As the world moves to standardise on technologies such as Blue Tooth, New Zealand will have to make similar provision if the benefits of these developments are to be realised.

The use of short range fixed radio interfaces to provide services currently provided by fixed wiring is expected grow rapidly.

As additional applications unfold, the usage of the "public spectrum parks" may need to be more closely defined, particularly as the distinction between free public access and for-profit access becomes blurred.

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[8] See RFS 29.

3.2 MOBILE SERVICES.

Mobile services are dependent on spectrum access as there is no alternative physical means of effecting communications. There are three major areas of mobile activity: aeronautical mobile, land mobile and maritime mobile. In recent years cellular radio, which is a land mobile service, has grown to a point where it warrants a separate study. It is expected that many of the devices that are wired today will be wireless in the future using Wireless LANs or RLANs. This will bring a whole new set of interference challenges.

3.2.1 AERONAUTICAL MOBILE SERVICES.

Terminology

Convention provides a split in the bands for aeronautical services. The On Route (R) Bands are those frequency bands associated with communications with aircraft flying on recognized air routes. Off Route (OR) Bands are for communications with aircraft operating outside of the established air routes.

There are three internationally defined geographical areas[9]:

Regional and Domestic Air Route areas known as RDARAs;
Major World Air Route Areas known as MWARAs, and

Meteorological broadcasting areas called VOLMETs[10].

Nature of Changes:	**A number of changes in how services are provided are expected to occur within the existing allocations.**
Demand 2001-2006:	
MF/HF Services	Because of the need to service small aircraft, RDARA services will need to be continued. The larger registered passenger transport (RPT) aircraft will use progressively less HF services in favour of MSS. Most of the OR services will continue to be important. There may be some new technology usage by Government Services.

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[9] The frequencies for each of these activities are detailed in Appendix 27 of the IRR, which has been in force now for two decades with little indication of any need to upgrade or change.

[10] New Zealand shares RDARA 9D with the East Coast of Australia and is part of the South Pacific MWARA as well as the PAC-MET VOLMET

VHF Services	The VHF band will continue to be the main stay of air ground local communications, with improvements being made through a reduction in the channel bandwidth.
Satellite Services	The Mobile Satellite Service will continue to grow to become a major provider of air ground communications. High speed data services supporting ICT activities are likely within the review period[11].
Demand 2006-2011:	
MF/HF Services	Some RDARA services will need to be continued throughout this period. By the end of this period, MWARA networks may be discontinued or relegated to backup status. The OR Bands will continue to be heavily used though new technologies giving greater spectrum efficiency are likely.
VHF Services	More efficient communications techniques will be under study in this period.
Satellite Services	It is expected that by the end of this period most long range, R Band communications will be via satellite with many broad band applications both for aircraft control and for passenger services.

BACKGROUND COMMENT

To simplify the analysis the use of aeronautical services has been split into:

HF Services
VHF Services
Satellite Services.

HF R Band Services

While small aircraft will continue to use HF services likely that there will be some movement to MSS during the period of review. New aeronautical services, especially for RPT aircraft may be satellite provided.

HF OR Bands[12].

Aircraft that use these bands tend to be either military, or carrying out business away from of the main air routes e.g. agricultural aircraft, and helicopter services.

Many of the aircraft using these bands are small and could not support a conventional satellite antenna, thus are reliant on HF services. This is unlikely to change over the review period. It is expected that some Government applications will embrace the newer digital technologies as soon as they are cost effective and practical.

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[11] Agenda item 1.11 of WRC 2003 refers.

[12] The provisions for these bands are set out in Appendix 26 of the IRR.

VHF Bands

Most of the local air/ground communications are carried out in the band 117.975 - 137 MHz.

The band is subdivided as follows:

117.975 - 137.0 MHz	Air Ground Communications
121.5 MHz	EPIRB transmissions and Search and Rescue.
132-132.6 MHz	Aeronautical Repeaters Base Transmit
135.4-136 MHz	Aeronautical Repeaters Base Receive
136-137 MHz	Government Services

The modulation method is amplitude modulation with a 25 kHz channel spacing. Any change would require international agreement. There are no current WRC agenda items to address this.

Satellite Services.

The fastest growing field of aeronautical communications is in the mobile satellite service (MSS). The satellite borne communications systems are providing a new generation of air traffic control services (ATC).

Apart from ATC there is a growing demand for passenger telecommunications services while in flight. In-flight phone systems are already in use. Some Administrations are seeking international agreement to use the band 14 - 14.5 MHz for aeronautical mobile satellite services to provide passengers with high data rate services. This is likely to be a continuing trend.

3.2.2 LAND MOBILE SERVICES

The upper practical frequency for mobile services would appear to be about 1 GHz. For the purposes of analysis, the frequency range has been broken down into HF and VHF/UHF services.

HF Land Mobile Services.

Nature of Change:	**Very little change in numbers.**
Demand 2001-2006:	There will be little change in demand.
Demand 2006-2011:	Unless new applications of technology are developed, there is unlikely to be much change. Some experimental low data rate services could be expected.

BACKGROUND COMMENT

Cellular Radio, has to some extent reduced the need for HF services by the land transport providers. Services now tend to be in areas outside of cell phone coverage or government services.

Because of the relatively slow rate of change expected in the other HF services, major technology changes are not expected in the land mobile service. Despite this some experimentation in HF digital land mobile service may occur in the second review period.

VHF/UHF Land Mobile Services.

The conventional two frequency (duplex) land mobile service is usually provided by a repeater, located at an elevated site. The simplex service is provided on a single frequency push to talk basis between mobile units and between mobile units and a base station.

There is also the trunked dispatch service where the two frequency mobile units have automatic channel select. Within the trunked dispatch service there are also the new generation digital services such as TETRA.

The propagation characteristics of the various frequency bands used by the land mobile services, vary considerably, and each has their strengths and weaknesses. It is common for a major network to use a number of bands to exploit these differences.

Low frequencies below 100 MHz have good penetration in the rural environment though they require rather large antennas. Lower frequencies can also suffer from interference from man made noise. Frequency usage at about 150 MHz gives a good compromise with coverage versus antenna size and noise immunity. Such frequencies are in high demand.

The UHF frequencies tend to penetrate buildings better and so are more useful in city environments. There is a growing demand for such services and some bands are congested already in Auckland.

While cellular radio had an initial impact on two-frequency radio license numbers, the two services serve different markets and therefore further growth in both markets is expected.

Simplex Services.

The frequencies for simplex services are often shared between a number of users. Some 7,600 simplex licences have been issued which provide a large portion of local communications. Overall it is a spectrum efficient service for the most part.

The quality improvement that can be realised with digital emissions may mean an early transfer for some services. However the transition may be difficult because of sharing arrangements with other services.

Two Frequency Services

Nature of Change:	**Continued increase in demand with some rationalisation.**
Demand 2001-2006:	
Emergency Services Bands:	There will be some expansion as public services move into the ES bands. It is expected that services using digital emissions will be introduced.
VHF/UHF A, C, D, E & F Bands:	There will be continued evolution of existing services. There may also be some experimentation with digital emissions.
Trunked Services	There is likely to be continued growth.

Demand 2006-2011:

Emergency Services Bands:	The completion of the move of public services to the ES bands is expected. It is also expected that services using digital emissions will be developed nationwide.
VHF/UHF A, C, D, E, F Bands:	It is expected that the transition to digital emissions will start in earnest, for the provision of new functions.
Trunked Services	It is expected that the transition to digital emissions will start in earnest, without further spectrum provision[13].

BACKGROUND COMMENT

Emergency Services Bands

About a decade ago there was a push to provide common bands for all public safety services. The Public Safety Radio Frequency Management Group (PSRFMG) was established to coordinate the implementation of the ES Band concept. Spectrum has been made available in bands from 70-900 MHz to provide for a very high quality public service radio network. The amount of spectrum and the range of frequencies would appear adequate to meet the likely expansion needs for narrowband systems over the next decade.

ESA Band	75.2-76.3 MHz and 78.1-79.2 MHz
ESB Band	138-144MHz
ESC Band	412 - 414 MHz and 422 - 424 MHz
ESD Band	813 - 813 MHz and 857 - 858 MHz

Progress has been slow and there are still public safety organisations that have not migrated. One organization has planned to implement a common service using the TETRA system in the ESC Band (412 - 414 and 422 - 424 MHz).

User demands in New Zealand for broadband and ultimately wideband systems have yet to be established. The public safety community is waiting on the results of current studies on public protection and disaster relief spectrum harmonisation.

Two Frequency Operations (A, C, D, E & F Bands.)

The provision of a well-structured two frequency land mobile service has provided the essential communications for many facets of society. Because of the rugged nature of New Zealand it was recognized that elevated repeater sites were needed and a network of such sites has developed throughout the nation.

Overall there are some 2550 repeaters operating on 12.5 kHz channel spacing along with some 1830 repeaters operating on 25 kHz channel spacing serving some 100,000 mobile units.

Any drive to change to digital technologies is likely to come through pressures for enhanced operations like security and text messaging rather than the need for new networks.

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[13] See POLDOC Spectrum Band Plan 003: 400-450 MHz Band Plan.

Trunked Services

Trunking operations are where a mobile can automatically access a number of channels and sites. These operations are spectrally efficient and can be carried out in any land mobile band.

There are two dedicated bands for this mode of operation. At 400 MHz there is a non-proprietary system operating under UK Standard MPT1325. This involves some 1360 repeaters. At 800 MHz a number of proprietary standards are operating under the Standard RFS 32. There are some 260 repeaters operating at this frequency order.

In the 400 MHz band there is a relatively high level of congestion and a transfer to a digital format is foreseen when commercially feasible.

It is expected that there will be steady growth in trunked networks and that this growth will be partially as a result of migration from non-trunked services operating in the other two frequency land mobile bands.

3.2.3 MARITIME MOBILE

Nature of change:	**Slow uptake of digital and satellite technologies.**
Demand 2001-2006:	There will be a slow migration of HF radio services to MSS. The MSS will need to acquire further spectrum allocations from WRC 2003 to meet this demand. There will be some international experiments with digital HF radio[14].
Demand 2006-2011:	Growth in MSS usage may cause the decline of HF traffic which could lead to the closure of centrally provided HF services towards the end of the review period. It is likely that company HF Radio will continue to be used for many years to come.

BACKGROUND COMMENT

Communications to ships at sea was one of the original drivers for radio development. In the last two decades the service has moved from networks of manned coastal radio stations handling the bulk of the traffic to more automated and modern means including satellite transmissions.

Radio services to shipping are provided through HF radio, VHF with a few UHF applications and satellite communications. More and more use of cell phones is playing a major part of the provision of local communications and is even being used for distress messages from time to time.

The bulk of the small craft in use today use VHF radio under a General User Restricted Licence. There are some 4000 other craft that traditionally use HF to cover distances that far exceed VHF radio range.

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[14] See agenda item 1.14 for WRC 2003.

The relatively high cost of satellite services has limited the growth of MSS communications, hence there is still a large body of ships reliant on HF services to their company headquarters and to the Coastal Radio Station at Matea (Rangitaiki).

With the growing diversity of communications paths, safety of life provisions need to be universally available.

The MSS are in urgent need of further spectrum especially to serve the major shipping areas.

3.2.4 CELLULAR MOBILE SERVICES

Nature of Change:	**Quantum leaps to advanced digital platforms.**
Demand 2001 - 2006:	No new spectrum allocations for mobile cellular use will be needed over the review periods. The transition from first generation (1G) to second generation (2G) cellular service will be completed and the roll out of two and a half generation (2.5G) services will be well advanced. Implementation of third generation (3G) services will be underway by 2006.
Nature of Change:	**Implementation of 3G services.**
Demand 2006 - 2011:	Planning for the fourth generation (4G) technology is expected towards the end of the review period. The development of HAPS technology may be used to augment the cellular network.

BACKGROUND COMMENT

A cellular radio network gives seamless mobile coverage within the service area of the network.

A cellular network has the following attributes:

- coverage area can be closely tailored to where it is required,
- a relatively even power spectral density over the coverage area is achieved,
- average operating powers of the base stations and cell phones are minimal
- greater overall 'traffic' capacities are realised.

The drivers for cellular telephony are market demands for cheap and user-friendly mobile telephone services plus newer messaging and IP-related services.

The success of cellular technology in New Zealand mirrors that of other nations. Market penetration was minimal as long as the cost and size of customer equipment and the cost of network access was too great to allow convenient use. However, today there are approximately 2.2 million cellular telephony subscribers in New Zealand.

Work is now underway in ITU fora, to ensure the standardisation of IMT-2000 networks including the radio interfaces thus facilitating roll-out of the first 3G networks early in the 21^{st} century. New Zealand users are expected to demand access to 3G services as soon as they are commonly internationally available.

Factors affecting the future of mobile cellular service

The essential elements for 3G technology have been identified as:

- Globally agreed allocations along with universally accepted technical, operational and spectrum-related parameters.
- Adequate spectrum allocations.
- New multi-media applications such as high-speed data, IP-packet and by mobile video communication.
- Minimal barriers to global roaming.

Convergence may become a significant driver in cellular development towards the end of the review period.

Overseas developments of the IMT-2000 technology CMDA2000 suggest that 3G services will be implemented in the 2001 - 2003 timeframe in the 800, 900, 1800, 1900 and 2000 MHz range.

The 2.5 GHz band is presently encumbered by Television Outside Broadcasting. A change in use of this band would thus not seem likely in the 2001 - 2011 timeframe.

A number of other key areas are being internationally addressed are;

- Software Defined Radio (SDR),
- Internet Protocol (IP) over wireless systems, and
- Terrestrial Wireless Interactive Multi-media Systems (TWIMS)[15]

These additional features though will not require further frequency allocations.

To realise the full potential of convergence it is perceived that a major review of the ITU service allocations take place, however this would involve long timeframes that exceed the scope of this paper.

The emergence of HAPS is not foreseen in the next five years. However the HAPS technology seems quite well suited to serving large low population density "cells” e.g. in rural areas at lower cost than a satellite-based platform and may well emerge in the years between 2006 - 2011.

[15] TWIMS is a service that encapsulates the convergence of traditional service types and firmly falls into the realm of systems beyond IMT-2000. This is exemplified by the addressing of the TWIMS concept by almost all ITU study groups. It is not envisaged that TWIMS will be in widespread implementation in the 2001 - 2011 timeframe.

3.2.5 LOW POWER DEVICES

Nature of Change:	**A technology shift in some cases to spread spectrum accompanied with a huge expansion in numbers.**
Demand 2001-2006:	A large expansion in uses is expected in support of wireless applications. It is expected that there will interference issues towards the end of the review period.
Demand 2006-2011:	Further new global applications will come into service, which will cause problems if the frequency bands required are not readily available.

BACKGROUND COMMENT

A large number of low power devices are classified as being in the mobile services. These include such devices as RLANs. With the huge investment in blue tooth and other spread spectrum technologies, cordless operations of PCs and domestic appliances like TVs and Hi-Fi systems, will likely become the norm. The data rate required is likely to be greater than can be supported by IR technologies and therefore mobile radio technologies can be expected to proliferate throughout the spectrum.

In particular the global allocation for RLANS proposed for the 5 GHz band will see a huge number of devices in service in the short term[16].

3.3 SPACE RADIOCOMMUNICATIONS SERVICES

Radiocommunications services between space and Earth are provided in the Fixed Satellite Service (FSS) and the Mobile Satellite Service (MSS). Other satellite services like the broadcasting and aeronautical mobile satellite services are discussed in the other annexes.

The FSS and MSS can operate in the geostationary-satellite orbit (GSO), which places a satellite at a position above the equator and stationary in relation to the earth. They can also operate in any of a variety of non-geostationary orbits (N-GSO) in which the satellite rotates in relation to the earth and hence appears to be moving through space.

3.3.1 GEOSTATIONARY FIXED SATELLITE SERVICES.

Nature of change:	**Slow growth in satellite numbers but new ICT applications using existing satellites is expected.**
Demand 2001 – 2006:	The ICT demand for additional services especially in K_u band is unlikely to be met. Use of the higher bands will have to await Non GSO satellite deployments.
Demand 2006 – 2011:	The demand will remain high and be dependent on whether the proposed Non GSO satellite broadband services are available.

[16] See Agenda Item 1.5 of WRC 2003 refers.

BACKGROUND COMMENT

There are currently nine transmitting earth stations in New Zealand operating to foreign owned satellite networks including Intelsat and Optus.

The C (6/4 GHz) band is the band used initially by services such as Intelsat to provide the earlier telecommunications satellite services. It is still in fairly extensive use by some television operators and several telecommunications service providers. The vital nature of the service has been reduced to some extent by the ready availability of a multiplicity of fibre optic cables between continents that provide much higher capacity, and also greater redundancy, than any of the satellite services.

The number of transponder licences have not increased significantly, and any movement in the numbers is generally as a result of shifting between transponders in response to the satellite operators requirements. The size of the dishes required for C band transmission and reception makes the band unattractive for other than larger commercial users, with a minimum size of 1.8 metres being necessary even for VSAT operations.

The K_u band (14/11 GHz) has various parts of the band allocated to different purposes. In the band 12.2 – 12.5 GHz, there is limited usage by four Very Small Aperture Terminal (VSAT) networks. Competition for use of the spectrum between terrestrial broadcasting and FSS makes the spectrum 12.2 – 12.375 unattractive for FSS in the main metropolitan areas.

The K_a band (30/20 GHz) is also available for use by GSO satellites, but has a number of disadvantages compared to the C and K_u bands, especially rain attenuation. The main advantage is the very wide bandwidths available at these frequencies. Launches of various K_a band systems are scheduled from late 2001 through 2006. If these services come into common usage, they will impact FS use of the 18 GHz band, as it appears that the FSS and FS cannot share the spectrum in the same geographical area, because the terrestrial FS transmitters affect the FSS receivers.

3.3.2 NON-GEOSTATIONARY FIXED SATELLITE SERVICES.

Nature of change:	**New generation services are under development and may in time be a major provider of ICT services.**
Demand 2001 – 2006:	During this period satellite systems will be under development with a few experimental launchings.
Demand 2006 – 2011:	The demand will be dependent on whether the proposed broadband satellite networks are implemented.

BACKGROUND COMMENT

The main frequency band available for broadband telecommunications purposes is the K_a band. There are no commercially available services at this time, but several networks such as Teledesic and Skybridge have been notified and intend commencing service from 2002-2004.

3.3.3 GEOSTATIONARY MOBILE SATELLITE SERVICES

Nature of change:	**The existing network capacity is almost exhausted so new networks will be established if spectrum is available.**
Demand 2001 – 2006:	There will be large suppressed demand for both global and regional networks, which can only be met by further spectrum allocations. These services are vital in support of international shipping and aircraft.
Demand 2006 – 2011:	It is likely that there will be competing networks which should drive prices down.

BACKGROUND COMMENT

Most current mobile satellite services are provided from satellites in the GSO operating at 1.5 GHz. and servicing land and maritime mobile services. The majority of use is for maritime mobile purposes, using the Inmarsat series of satellites that provide voice and low speed (up to 64 kb/s) data connections. From the licensing database, there are approximately fifty NZ-registered ships equipped with Inmarsat MM services. It is suspected that there may be some use of the MSS for land mobile services, but this cannot be confirmed from the licensing database.

Other spectrum which has been allocated to the MSS but is not yet in service is the core IMT2000 MSS spectrum 1980 – 2010 MHz and 2170 – 2200 MHz.

3.3.4 NON-GEOSTATIONARY MOBILE SATELLITE SERVICES

Nature of Change.	**Implementation of new technology.**
Demand 2001 – 2006:	Minimal if any demand expected.
Demand 2006 – 2011:	Some demand for IMT2000 roaming anticipated. Possibility of a slight demand for vehicle tracking technology in the VHF/UHF spectrum.

BACKGROUND COMMENT

The Globalstar satellite service is potentially available in NZ, but is not yet licensed. It uses the 1610 – 1625.5 MHz uplink and 2483.5 – 2500 MHz downlink bands. Several other systems such as Iridium and ICO may also be available to meet demand. In general, there is unlikely to be any shortage of MSS spectrum for satellites operating in this mode.

PART FOUR: ANNEX 2: BROADCASTING

4 BROADCASTING SERVICES

Broadcasting is defined by the ITU as a radiocommunication service in which the transmissions are intended for direct reception by the general public. This service may include sound transmissions, television transmissions or other types of transmission such as data-casting. Broadcasting services utilise both terrestrial and satellite modes of operation.

Broadcasting services typically fall into two main categories: that is sound broadcasting and television. There are also new services, which provide a broadcasting service but are not strictly broadcasting transmissions. These are the synergetic services and include fixed, point to multi point transmissions and direct to home (DTH) transmissions within the fixed satellite service.

4.1 SOUND BROADCASTING.

There are three main delivery mechanisms currently in use and a digital platform that is not yet implemented. The classic radio broadcasting that has been is service since the 1920's is Amplitude Modulation (AM) in the band 521-1612 kHz. The other major medium is Frequency Modulation (FM) in the band 88 -108 MHz. Short wave broadcasting has also been in service for the last 70 years and is based on AM transmissions in a number of bands between 5 -30 MHz.

4.1.1 ANALOGUE SERVICES

The growth of radio broadcasting services over the last decade has been spectacular. It is understood that New Zealand has the highest number of radio programs per CBD of any country in the world. Currently there are 173 AM licences in the band 521-1612 kHz and 515 licences in the band 89-100 MHz. There is also one high power short wave transmitter using a family of frequencies to cover the South Pacific and one modest power short wave transmitter used for national coverage by Radio for the Print Disabled.

AM (MF 521-1612 kHz)

Nature of Change:	**Some reduction in usage by high power transmitters with little change in transmitter numbers.**
Demand 2001-2006:	Existing services are likely to continue with some transfer to FM broadcasting but there will be continued demand for wide area coverage systems.
Demand 2006-2011:	In this time frame there could be introduction of digital transmissions for testing and development purposes.

BACKGROUND COMMENT

The AM broadcasting band in New Zealand is very heavily used and the possibility for new frequencies, virtually exhausted. While some expansion for existing networks can be expected using techniques like directional antennas, it is expected that the numbers of transmitters will remain about the same or decrease.

The reception of AM signals can be affected by man made noise like the arcing of overhead wires, but does not suffer the same multi-path effects as FM transmissions. The AM Bands are well suited for broadcasting of the spoken word and monophonic medium fidelity music.

Because MF AM signals can cause night-time interference over many thousands of kilometres the MF AM Broadcasting Band is governed by international agreement[17]. This means that New Zealand cannot unilaterally change the basic characteristics of the MF band.

Even though work is proceeding in the ITU on the technical standards for digital transmissions[18], there does not appear to be international urgency to hold another ITU Conference to agree to new digital formats and assignments for the MF Band. It should be noted that the high numbers of existing receivers would complicate any possible future technology changes, as the proposed technologies are not backward compatible with the existing usage thus would necessitate long time frames for change and simulcasting.

As the existing AM band is full, such changes may need more bandwidth than what is available to provide the transition to digital emissions, and New Zealand might need to follow the Americas, the Philippines and Sri Lanka by providing for Broadcasting in the band 1612-1705 kHz.[19]

FM (VHF 88-108 MHz)

Nature of Change:	**Continuous expansion**
Demand 2001-2006:	Very heavy demand with high competition for new frequencies. During this time frame the Government policy on new networks to meet social objectives is expected. It is likely that these will be met by Crown reservations in the band 100-108 MHz.
Demand 2006-2011:	In this period there are likely to be large numbers of transactions for relocating and modifying existing licences, with continued high demand for access to FM frequencies for the main population centres.

[17] Final Acts of Regional Administrative Radio Conference Geneva 1975

[18] ITU-R Task Group 6/7

[19] Footnotes S5.89 and S5.91 of Article 5 of the Radio Regulations.

BACKGROUND COMMENT

FM transmissions suffer multi-path distortion when the receiver is out of line of sight of the transmitter however they also tend to be much cheaper to establish for the same coverage than the AM counterpart.

The band 89- 100 MHz where the existing services are situated is under a management right and operators generally have long term tenure of frequency access. The band 100-108 MHz has been cleared of two frequency land mobile operations, so it available for deployment. The band 100-101 MHz is currently being used for low power devices and these will have to transfer to the band 107.6-108 MHz.

It is expected that the policy decisions on the deployment and allocation of the band 100-108 MHz will be made within the first review period.

In considering any technology change it should be noted that in New Zealand it is estimated that there are over 5 million radio receivers in every day use representing a significant public investment

As there is little international pressure for a technological change from FM to digital services, continued analogue operations are expected for the next decade. It is unlikely therefore that significant technological changes will happen in the short term.

Some value-added services like SCA may come into being for GPS correction or other low data rate applications.

Short Wave (HF 5-30MHz)

Nature of Change:	**Continuous improvement**
Demand: 2001-2006 and 2006-2011:	It is unlikely that there will be much change, though some experiments in digital transmission are expected.

BACKGROUND COMMENT

In New Zealand, there is a single high power transmitter providing a service to the Pacific and a medium power transmitter providing coverage for the Radio for Print Disabled. These services would appear to have an ongoing demand. Other services have not been forthcoming, though with the completion of the standards for digital short wave services, some interest is expected for the provision of national services[20].

Agenda item 1.2 for the ITU WRC 2003 is to examine the status of play in the Short Wave bands and to determine the technology path forward along with no doubt some transition measures. There would seem to be little point in the world now moving to SSB and a technology "leapfrog" to digital services is almost certain.

With the rapidly developing satellite service in the South Pacific there may be a point where Short Wave services are no longer required. It is expected though that this would be at the end of the review period if at all. Unfettered access for Radio New Zealand International to its Pacific audience will need to be retained in the face of expansion of non government[21] services in surrounding countries. Also the services by the Radio for Print Disabled is likely to continue to require Short Wave access in the bands at 4, 6 and 7 MHz.

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[20] See ITU-R Rec BS 503.

[21] Australia among others has agreed to private (mainly religious) short wave services.

4.1.2 DIGITAL SERVICES

Nature of Change:	**Experimental.**
Demand 2001-2006:	**Below 30 MHz** Mainly academic interest though some experiments are expected. **1.4 GHz DAB.** Some limited coverage transmissions expected.
Demand 2006-2011:	**Below 30 MHz** DRM HF applications to provide services to isolated areas could be expected **1.4 GHz DAB.** Supplementary CBD services using DAB will depend on international developments and receiver availability.

BACKGROUND COMMENT

BANDS BELOW 30 MHz

An international study program is being carried out under the ITU-R TG 6/6 and TG 6/7 to investigate digital options for using these bands. Supplementary data systems have been in service in the MF and HF bands since 1985[22], but recently there have been systems tested using digital transmissions in the MF and HF band in a format called DRM.

DRM technology has matured to the point that it was demonstrated during WRC 2000 with transmitters in Portugal and receivers in Istanbul. A very high quality of reception was reported.

While there is still a lot of development to be done, it would appear as though DRM technology or other similar technologies will be available within the first review period. It is therefore expected that tests will be carried out in New Zealand in the second review period.

BANDS ABOVE 30 MHz

Digital audio broadcasting (DAB) at VHF and 1.4 GHz has now been implemented in some countries. In Europe DAB services have been started in the band 223-230 MHz. In New Zealand this band is not available as it is used for analogue television. In Canada work is advancing on the implementation of DAB services at 1.4 GHz and a channelling plan for New Zealand should such services be introduced is now completed[23]. Internationally the take up of DAB appears to be very slow. It is expected that there will not be a high demand for DAB until economical receivers are readily available.

DAB Satellite Services

DAB Satellite services are operational with the Worldspace Satellite Network but this does not cover New Zealand. There would appear to be limited interest in the satellite

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[22] ITU-R Rec BS 706.

[23] See POLDOC Spectrum Band Plan 005 at http://www.med.govt.nz/rsm/publications/poldocs.html#section10

delivery of DAB services to New Zealand apart from those services that "piggy back" on satellite-provided television services.

4.2 TELEVISION SERVICES

In the last decade television services have gone from three free to air channels available over much of New Zealand to over twenty channels available everywhere under satellite and cable provided, pay television. It is likely that the next decade will be just as turbulent with some major changes in technologies.

Despite the new developments, a significant number of viewers only watch a limited number of channels with non-proprietary installations. It is likely that the requirement for this type of service will continue well into the future. Thus future policies will have to take into account these viewers and the public interest.

While satellite technology has the potential to reach all viewers in the country, it needs a costly installation of a dish and a decoder to work. The extra sets to be found in houses in bedrooms, kitchens and workshop etc would each require extra equipment to access the satellite coverage.

The new terrestrial solutions proposed, will not have the coverage of the existing VHF networks, and also will involve extra equipment for reception. This could mean that while new generation services will come on line, main stream broadcasters may need to continue to transmit some easily received, free to air services possibly using the existing VHF bands.

4.2.1 ANALOGUE TELEVISION

Nature of Change:	**Some technology improvements**
Demand 2001-2006:	It is expected that the existing services will remain over this period with little change. Few new analogue services are expected as the bands are very congested and new services may start in a digital format if receivers are available.
Demand 2006-2011:	It is possible that in this period some of the analogue services will transfer to a digital format.

BACKGROUND COMMENT

This is probably the decade when the long expected transfer from analogue to digital television, will start in earnest. Currently New Zealand has 10 terrestrial based nationwide networks along with a number of regional stations and some private non-commercial stations. A Maori television network will also commence transmission soon.

New Zealand has a very high utilisation of both UHF and VHF TV frequencies making the in-band transition to digital television technically challenging. Overseas experience has shown that market penetration of digital receivers is slow and the situation in New Zealand is not expected to be any different.

Despite the above, it is expected that when the new digital platforms come on-line, the existing analogue services will cease when the penetration of digital receivers is sufficient.

4.2.2 SATELLITE SERVICES.

Nature of Change:	**Increase in number of services provided**
Demand 2001-2006:	It is likely that there will be two major digital television providers on the same space platform during the first review period. Satellite and cable will continue to be the major delivery mechanisms for multi-channel television for this period.
Demand 2006-2011:	The satellite delivery of digital television is likely to continue, and could be augmented by additional ICT services. LMDS and 12 GHz point-multi-point services may also provide competition is this sector.

BACKGROUND COMMENT

With a satellite system, the whole country is covered hence there are no supplementary stations to install and maintain. There is little doubt that satellite systems will meet the immediate demand for nationwide programming, but they are not so well suited to meeting regional demands and programs. There are a number of competitive technologies, such as LMDS that will provide multi-programming and allow local access and coverage, that are also coming on line.

It could be expected that within the second review period, significant terrestrial infrastructure will be in place to replace the satellite demand in a number of areas which might bring the economics of continued satellite access into question.

Despite this it is expected that for both review periods, satellite delivery will be the prime method of multi-program delivery to New Zealand.

4.2.3 DIGITAL TERRESTRIAL SERVICES.

Nature of Change:	**Introduction and development of services.**
Demand 2001-2006:	Digital Terrestrial Television (DTT) services are expected to emerge though the requirement may be diluted by the interest in the satellite digital platforms.
Demand 2006-2011:	Coverage of the major cities and their environments could be expected by the end of this review period.

BACKGROUND COMMENT

DTT comes on the back of a huge technical study that has seen the world adopt two basic protocols. New Zealand industry has adopted the European DVB suite of specifications. Some experimental transmissions have taken place.

DTT is much lower powered than its analogue counterpart, and more robust. It is these features that some countries are utilising to introduce DTT in the unused adjacent channels where analogue transmissions would not work.

With the introduction of DTT services in the UHF TV Bands, it must be recognized that there are pitfalls and unknowns and that there will be geographical areas where coverage will not able to be economically achieved.

It would appear that the successful introduction of DTT may only be achieved with cooperation between the broadcasters and the Crown.

4.3 SYNERGETIC SERVICES

When services move to the digital domain, broadcasting and telecommunications services can be provided within a single digital stream. It would appear that such multi-service platforms are going to be one of the future delivery options. Work carried out in the UK noted that broadcasting as an individual service may disappear in the future.

There are two cases now where significant numbers of viewers around the world receive their TV programming through non-broadcasting channels. These are microwave point to multi point networks like MMDS, LMDS, narrow-casting etc and satellite delivery using direct to home reception in the fixed satellite service. It is expected that both of these techniques may be used in New Zealand in the future. The increasing use of the Internet to distribute streaming video, sound radio programmes and ultimately television programmes is also a factor.

4.3.1 FIXED POINT TO MULTI-POINT SERVICES.

Nature of Change:	**Possible introduction of services.**
Demand 2001-2006:	It is not clear if such services will be developed in this time frame and what bands would be used.
Demand 2006-2011:	The provision of LMDS platforms to the CBDs is expected along with services to smaller cities.

BACKGROUND COMMENT

It is not clear whether these services will proceed or not. There is apparent demand for bandwidth for the Internet and other business needs. This will probably be the driver rather than the provision of broadcasting services by themselves.

Of the frequency bands concerned, an advantage of the 12 GHz band is that cheap receiving apparatus is available, but as most of the world have not sorted themselves out with LMDS, the future is unclear.

4.3.2 DIRECT TO HOME SATELLITE SERVICES.

Nature of Change:	**Increased provision**
Demand 2001-2006:	There is likely to be a significant increase in DTH type operations in the review period.
Demand 2006-2011:	There is likely to be a further increase in DTH type operations.

BACKGROUND COMMENT

Currently there are two broadcasting service providers: one already providing satellite broadcasting and another in the planning stages. Because of the shortage of BSS capacity, the use of DTH services is unavoidable. This is an international trend and the ITU WRC 2003 will address the regulatory issues surrounding this use of the Fixed Satellite Service by these broadcasting applications.

PART FIVE: ANNEX 3: RADIODETERMINATION

5 RADIODETERMINATION AND SCIENCE SERVICES

The radiodetermination services are made up of the radionavigation services and the radiolocation services. The functions of the services are defined in the International Radio Regulations (IRR) as follows:

S1.9 *radiodetermination:* The determination of the position, velocity and/or other characteristics of an object, or the obtaining of information relating to these parameters, by means of the propagation properties of *radio wave*s.

S1.10 *radionavigation: Radiodetermination* used for the purposes of navigation, including obstruction warning.

S1.11 *radiolocation: Radiodetermination* used for purposes other than those of *radionavigation*.

5.1 RADIONAVIGATION

5.1.1 AERONAUTICAL RADIONAVIGATION SERVICES

Nature of change:	**Slow growth of existing services with a number of new developments in the RNSS.**
Demand 2001-2006:	While the utility of RNSS based systems will increase it is highly likely that the existing ground based radio navigation services will remain the prime landing aids. It is noted that new ARNS applications to improve aircraft operations around airports are being developed.
Demand 2006-2011:	With the new RNSS services like Galileo and GBAS augmented GPS, the requirement for some of the older land based landing aids like VOR should reduce.

BACKGROUND COMMENT

Today the aeronautical radionavigation services are comprised of VHF Omnidirectional Radio Range transmitters (VORs), Non-directional Beacons (NDBs), Instrument Landing Systems (ILS) and Distance Measuring Equipment (DME).

An NDB gives the pilot a bearing to a fixed beacon location. It remains the basic non-precision guide for aircraft that have no other navigational instrumentation and as such is used predominantly by general aviation pilots. The country is fairly comprehensively covered by aeronautical NDB emissions.

There are 54 NDBs; 53 lie in the 200 – 410 kHz range and one is at 1630 kHz. There are some 10 unused channels in the band 200 – 405 kHz, which should be adequate to accommodate the future demand.

The VOR also acts as a beacon to provide guidance and is generally used in conjunction with en-route or terminal DMEs. There are 18 VORs in the 112 – 118 MHz range with a further three frequencies licensed for All-NZ use for Government purposes. The situation with VORs is similar to that for the NDBs, with a network of beacons throughout the country servicing the en route and terminal phase needs of aviation. There are sufficient unused channels to allow for anticipated expansion for the foreseeable future.

An ILS is made up of three main components, a Localizer (LLZ) operating on a frequency between 108 –112 MHz, a Glidepath (GP) operating on a frequency between 325 – 405 MHz and one or more Marker or Locator Beacons operating on 75 MHz. There are ILSs at five airports around the country with each runway having its own ILS frequencies.

The DME is comprised of a ground transponder and an airborne transmitter/receiver. DMEs operate in the 960 – 1215 MHz spectrum. As there are 43 DMEs in service, and there is adequate vacant spectrum to accommodate any future requirements.

5.1.2 MARITIME RADIONAVIGATION SERVICES

Nature of change:	**Little change is expected apart from some new GPS applications.**
Demand 2001-2006:	Little change it is expected but the utility of the GPS will increase by the introduction ship tracking systems. Position reports using telephony are expected to continue.
Demand 2006-2011:	With the new RNSS services like Galileo and augmented GPS, the automation of position reporting is likely to be implemented in this period

BACKGROUND COMMENT

Internationally, provision has been made for spectrum allocations for NDBs for maritime use in the 285 – 325 kHz range. All New Zealand maritime NDBs were disestablished in 1989. The need for maritime radionavigation has largely been met by the current satellite based Global Positioning System. The maritime community is implementing AIS which is a system of automatically transmitting the ship's position by VHF.

5.1.3 RADIONAVIGATION SATELLITE SERVICES

Nature of change:	**the establishment of new networks and improvements in use of the existing networks will continue.**
Demand 2001-2006:	GPS will continue to be the mainstay RNSS network for the period. New augmentation systems are expected.
Demand 2006-2011:	New RNSS networks like Galileo can be expected along with further augmentation of GPS.

BACKGROUND COMMENT

The existing two networks of the GPS and GLONASS area adequate for most maritime requirements. An integrated GPS and GLONASS system can provide guidance to aircraft up to non precision approaches. The new Galileo network will provide further improvement.

5.1.4 NEW APPLICATIONS

An increasing emphasis on the use of satellite radionavigation services is expected, as more readily-accessible differential correction data becomes available.

New applications combining cellphone technology and GPS are under development, as are new road mapping services as well as automated long distance driving systems. It is likely that there will be some automated highways within twenty years. The experiments for these systems could well be carried out before 2011.

5.2 RADIOLOCATION SERVICES

Nature of change:	**Little growth of high power services**
Demand 2001-2006:	Very little change to existing stations though the rapid development of collision avoidance radar is expected.
Demand 2006-2011:	Some of the existing high power land based systems may be replaced by other technologies however there maybe rapid development of new low power applications using high frequency order microwave bands.

BACKGROUND COMMENT

5.2.1 GROUND BASED RADAR

Ground radar installations provide aeronautical, maritime, and meteorological services.

There are four aeronautical primary surveillance radars at Auckland, Ohakea, Wellington and Christchurch (1240-1400 MHz) and the six secondary surveillance radars.

The five maritime ground based radars operating in the 9.3 – 9.5 GHz are at various ports around the country.

Meteorological radars operating in the 5.47 – 5.65 GHz and the 9.3 – 9.5 GHz bands are also spread throughout the country. There is also an experimental wind profiling radar operating in the Christchurch area, operating on 42.5 MHz. There is unlikely to be any further significant development in the next 10 years.

5.2.2 MARITIME RADAR

Civilian maritime radars operate in the 8.5 – 9.6 GHz band. There are also some government services using the 1.3 – 1.4 GHz, 2.9 – 3.6 GHz, 5.4 – 5.8 GHz, 8.5 – 9.6 GHz, 13.4 - 14.4 GHz and the 15 – 17 GHz bands.

5.2.3 AERONAUTICAL RADAR

Aeronautical radio altimeters operate in the 4.2 - 4.4 GHz band, and meteorological or weather radar in the 8.5 – 9.6 GHz band. The radio altimeter function is also integrated into ground proximity warning systems.

5.2.4 NEW APPLICATIONS

Short range collision avoidance radar operating in the 76 – 81 GHz radiolocation band is being brought into service in parts of Europe. This application will be introduced into NZ in the immediate future.

5.3 SCIENCE SERVICES

Radio waves play some important roles in the sciences. The observation of the energy emitted by an object in space can help us understand what it is made of. Radio is also used to relay scientific measurements.

5.3.1 TERRESTRIAL SERVICES

Nature of change:	**Light and sporadic.**
Demand 2001 – 2006:	Sporadic increases in use as particular research projects are launched, with a corresponding decline at the conclusion of a project. The use of the science radar bands is light but fairly constant. As the networks are relatively mature, there is unlikely to be any significant increase in the number of stations.
Demand 2006 – 2011:	Continued intermittent use, in support of research

Radio astronomy service

The frequencies are internationally allocated for Radio Astronomy in the bands from 13.36 MHz to 275 GHz. While there is limited usage in New Zealand, as a passive service that is also space borne, use of the international designated bands[24] needs to be avoided.

Weather radar

There are two main uses of terrestrial weather radar. The first is for establishing local weather patterns. The second use is for tracking of meteorological balloons to determine the speed direction of upper level winds. Airborne use of weather radars is to allow en-route determination of significant weather conditions that could affect the safety of flight.

Meteorological aids

Meteorological aids (met aids) other than radars, are the radiosondes and Remote Weather Stations (RWS). Both facilities are operated in the 400.15 – 406 MHz Met Aids band. The sondes provide data on temperature and humidity at various altitudes, in conjunction with wind data. The RWS comprise a group of sensors for a variety of parameters such as rainfall, temperature, wind speed and direction, and water levels.

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[24] See Footnote S5.149 of the International Radio Regulations.

5.3.2 SPACE BORNE SERVICES

Nature of change: **Ongoing protection for externally operated networks.**

Demand 2001 – 2011: Light and variable.

5.3.2.1 Earth exploration satellite services (EESS)

The bands provided for the EESS are internationally allocated in the IRR[25]

From the wide range of frequencies allocated in Region 3, three are specifically allocated in NZ (401 - 403 MHz, 13.25 - 13.75 GHz. and 17.1 - 17.3 GHz.).

Because of the wide range of allocations requiring international protection, these services will continue to have an impact on New Zealand spectrum usage.

5.3.2.2 Space research service

The bands provided for the Space Research Service are also internationally allocated in the IRR[26]. Because of the wide range of allocations requiring international protection, these services will continue to have an impact on New Zealand spectrum usage within the band given in table 7 below.

Frequency range MHz	Status (P = primary, S = secondary)	Notes
1400-1427	P	Passive
1660.5-1668.4	P	Passive
2690-2700	P	Passive
10.68-10.7	P	Passive
13.25-13.4	P	Active
13.4-13.75	P	S5.501A
15.35-15.4	P	Passive
16.6-17.1	S	Deep space, E – S
17.1-17.3	P	Active
23.6-24	P	Passive
31.3-31.8	P	Passive
35.5 - 36	P	Active
36 - 37	P	Passive
52.6 - 54.25	P	Passive

Table 7

[25] See Article S5 of the International Radio Regulations.

[26] See Article S5 of the International Radio Regulations.

5.3.2.3 Meteorological satellite services

The bands provided for the Meteorological Satellite services are given in table 8 below.

Frequency range MHz	**NZ allocation to Met. Sat?**	**Status (P = primary, S = secondary)**	**Notes**
137-138	Yes	P	S – E
400.15-401	Yes	P	S – E
401-403	Yes	P	E – S
1670-1710	Yes	P	S – E
7300-7850		P	S – E, S5.461A&B
8175-8215		P	E – S

Table 8

The only licensed use is of the band 401-403 MHz for the satellite uplinks, as detailed in para. 6.1.4, Meteorological Aids. However, it is known that the downlink services in the 1670 – 1710 MHz band are received at the Kelburn Meteorological Office.

Glossary of Terms

Acronym	Explanation
AII	Asia-Pacific Information Infrastructure
AM	Amplitude modulation
AMPS	Advanced Mobile Phone System
AMSS	Aeronautical Mobile Satellite Service
ANSI	American National Standards Institute
APT	Asia Pacific Telecommunity
ASTAP	APT Standardisation Programme
BS	Broadcasting Service
BSS	Broadcasting Satellite Service
BSS(S)	Broadcasting Satellite Service (Sound)
CEPT	Conference of European Postal and Telecommunications Administrations
CISPR	Comité Internationale Spécial des Perturbations Radioelectrotechnique
CITEL	Inter-American Telecommunication Commission
DTH	Direct to Home
DTV	Digital Television
ECD	Engineering Consideration Document
EESS	Earth Exploration Satellite Service
ETSI	European Telecommunications Standards Institute
FM	Frequency Modulation
FS	Fixed Service
FSS	Fixed Satellite Service
FWA	Fixed Wireless Access
GHz	Giga-Hertz
GMDSS	Global Maritime Distress and Safety Service
GSM	Global System Mobile
HF	High Frequency
ICAO	International Civil Aviation Organisation
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
IMCO	Inter-governmental Maritime Consultative Organisation, later IMO
IMO	International Maritime Organisation
IMT2000	International Mobile Telephone 2000
IRR	International Radio Regulations
ISM	Industrial, Scientific and Medical
ITU	International Telecommunications Union
ITU-D	International Telecommunications Union - Development
ITU-R	International Telecommunications Union - Radiocommunications
ITU-T	International Telecommunications Union - Standardisation
kHz	Kilo-Hertz
MED	Ministry of Economic Development
Met Aids	Meteorological Aids

Acronym	**Explanation**
Met Sat	Meteorological Satellite
MHz	Mega-Hertz
MS	Mobile Service
MSS	Mobile Satellite Service
MSUAG	Major Spectrum Users Advisory Group
PIB	Public Information Brochure
RAS	Radio Astronomy Service
RLS	Radio Location Service
RNS	Radio Navigation Service
RNSS	Radio Navigation Satellite Service
RRD	Restricted Radiation Device (now known as SRD)
RSM	Radio Spectrum Management
SFTS	Standard Frequency and Time Service
SHF	Super High Frequency
SOLAS	Safety of Life at Sea
SPD	Spectrum Planning Division
SRD	Short Range Device
SRS	Space research Service
TV	Television
TVOB	Television Outside Broadcast
UHF	Ultra High Frequency
VHF	Very High Frequency
WLL	Wireless Local Loop
WRC	World Radio Conference