DP3 - DECT Scoping Study - Jun 1994

Scoping study on the introduction of "Digital European cordless telephone" (DECT) technology into New Zealand.

Background

This scoping study was commissioned by the Ministry of Commerce in response to expressed interest within the telecommunications industry for the introduction of DECT technology into New Zealand.

The Ministry's objective is to encourage informed consideration of the technical, regulatory and commercial issues involved. In particular, with the increasing globalization of the telecommunications industry, international developments must be taken into account in reaching decisions on spectrum requirements for new wireless technologies. The ultimate goal in this process is for industry and users to gain the maximum economic benefit from these developments.

Invitation to make submissions

The Ministry joins the author in thanking those individuals and organisations who contributed to the study and now publishes this report for public consideration and comment. The Ministry does not necessarily agree nor disagree with the views expressed; they remain the opinion of the author.

The invitation to make submissions does not constitute a commitment by the Secretary of Commerce to grant any radio apparatus licences or create, tender (or otherwise dispose of) any management rights or licences or otherwise act upon any submission made. Furthermore any decision to create spectrum rights rests with Government and not the Ministry. The Ministry's objective is to report the results of its enquiries and consultations to Government. Should you wish to make a submission please address it as follows:

DP3 Spectrum Management Submissions
Radio Spectrum Policy
Communications Division
Ministry of Commerce
PO Box 2847
WELLINGTON
Fax (04) 499 0797

Responses are required by 15 August 1994. These will be considered by the Ministry in the formulation of options from which Government decisions can be made.

Important note: Subsequent to completion of the scoping study the FCC have released a revised Broadband PCS plan. The total spectrum allocation remains the same, that is 120 MHz, however the frequency limits and block pairings have been adjusted to coincide with existing fixed service bandplans. This change is designed to facilitate moving incumbent licensees from the frequencies concerned. The following diagram should be considered in conjunction with Figure 1 in the attached report.

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Scoping study on the introduction of DECT technology into New Zealand

Prepared for the - Ministry of Commerce by Alan R Jamieson added value applications Auckland June 1994

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About the Author

This report was prepared by Dr Alan R Jamieson, Managing Director of Added Value Applications, a professional services company specialising in strategic planning and advising clients on applications of telecommunications and information systems technologies.

Added Value Applications combines a unique mix of high-level technical expertise in the areas of engineering and telecommunications and information systems with specialist skills in marketing and economics. This enables the company to undertake assignments across a wide range from strategic communications planning, marketing studies, organisation studies involving process reengineering through to assessments of specific applications of telecommunications and information systems.

Although based in New Zealand, the community of interest for Added Value Applications extends internationally.

Alan has extensive knowledge as a professional telecommunications engineer and broad business and managerial expertise gained from over 27 years in the telecommunications industry. During his career Alan has held senior executive positions within the New Zealand Post Office and Telecom Corporation in general management, marketing, operational, as well as business planning and engineering planning roles. Alan left Telecom in 1989 to set up his own business with an emphasis on strategic and business applications of telecommunications

Executive Summary

1. DECT Scoping Study

This report presents a scoping study on the implications of introducing digital European cordless telecommunications (DECT) technology into New Zealand. The report canvasses technical, regulatory and commercial issues related to DECT within the context of personal communications services (PCS) in the band 1880-1900MHz.

2. Personal Communications Services

Interest around the world in PCS services is being excited by the communications capabilities made possible by the development of second generation digital mobile systems using cellular and cordless telephony technologies. These technologies, of which DECT is one, offer users for the first time the prospect of truly untethered communications.

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3. Spectrum Allocations

In the regulatory arena, this interest is reflected in moves to find suitable radio spectrum. While most countries are still deciding on specific frequency allocations, already the first commercial PCS services operating in bands between 1400-2000 MHz are appearing in Europe and Asia. Interest in PCS development has been further fuelled in North America by a recent decision in the USA to allocate 160 MHz for PCS services in the range 1850-2200 MHz.

In making decisions regarding PCS spectrum use in New Zealand, overseas developments must be taken into account if maximum economic advantage is to accrue to users and the industry alike. However, even with all the flurry of interest in PCS internationally, to date no one technology has emerged as a universally accepted standard. The introduction of DECT into New Zealand must be seen in this light.

4. DECT in New Zealand

While there is general interest and support for the introduction of DECT - like cordless technologies, particularly for wireless PABX applications, there is no clear view yet on when and what technology standard to adopt in New Zealand. There is merit in not rushing to adopt a standard too soon. Options can be kept open and benefit can be derived from overseas experience and new technology developments. However, DECT applications can not be denied spectrum access solely on the basis that something better may come along sometime in the future.

Finally, the difficulties of sharing spectrum with existing users in the bands of interest for DECT must be addressed. These incumbents, predominantly point-to-point fixed service users, are spread geographically across the country. They face an uncertain future as contention for spectrum grows between fixed and mobile services in the frequency bands round 2000 MHz.

5. Franchising

Franchising of licenses on an area-by-area basis could be used to introduce public access services such as telepoint and wireless local loop into New Zealand. Each license would be auctioned to the highest bidder with applications such as wireless PABXs and residential cordless telephony remaining as license exempted.

Details of such a franchising concept and the sale process to be used would need to be developed by the Ministry of Commerce. A technology neutral position to the licenses could be adopted. However, to ensure the benefits of interoperability can be realized, it may be necessary to nominate a technology standard.

Recommendation As a facilitation plan for the introduction of DECT technology into New Zealand, it is recommended that:

1. The use of DECT technology be permitted for wireless PABX and residential applications on an unlicensed non-interference basis New Zealand wide in the band 1880-1900 MHz.
2. An embargo be placed on the use of DECT technology for public access services such as telepoint and wireless local loop for a period of up to two years.
3. A franchising plan, including a nominated technology standard, be developed for the auctioning of public access service licenses on an area-by-area basis that takes into account the incumbency rights of existing users.
4. A market study be conducted to establish guidelines for the number of franchises to be awarded in each area.
5. An embargo be placed on all further assignments for fixed point-to-point services in the band 1880-1900 MHz and consideration given to extending this embargo to FPLMTS and DCS 1800 bands.
6. Alternative frequency assignments be made available in other areas of the spectrum for the re-location of fixed services in the 1880-1900 MHz band.

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1. INTRODUCTION

This report, prepared for the Communications Division of the Ministry of Commerce, is a scoping study on the implications of introducing digital European cordless telecommunications (DECT) technology into New Zealand.

The DECT standard was developed in response to demands for digital cordless telephones as replacements for the first generation units that used analogue technology. Although a pan-European standard with a growing acceptance outside of Europe, DECT has yet to achieve acceptance as the international standard for high quality, high capacity digital cordless telephones.

DECT based products first appeared on the market in early 1994, so that operational experience with the technology is limited. However, already DECT systems are appearing overseas in applications ranging from use as residential telephones to use as access systems for personal communications services.

It is in the wider context of personal communications services that the implications of an introduction of DECT into New Zealand must be assessed. DECT is seen by many as a leading contender for a major role as an enabling technology in the provision of the mobile communications services of the future.

In this report an overview of developments in mobile communications is given together with a brief summary of international trends. A description of DECT is provided and the areas of greatest interest in the DECT technology in New Zealand are discussed.

The key issues of a regulatory, technical and competitive nature are identified and recomrnended options are presented as a facilitation plan for the initial introduction of DECT into New Zealand. Recommendations are also given for further action by the Ministry of Commerce both to complete the consultative process on the DECT introduction and to formulate policies for personal communications services in New Zealand.

In preparing this report, the author interviewed representatives from a number of organizations and interested parties as listed in Appendix 1. The author expresses his appreciation for the time, comments and opinions so freely offered by the individuals concerned.

The telecommunications industry is plagued by a passion for acronyms. To aid the reader a list of the abbreviations used in the body of the report is attached as Appendix 2.

Finally, it should be noted that issues relating to privacy are not canvassed in this report.

2. Background

2.1 Personal Communications Services

Mobility has become a feature of modern life. It is little wonder then that mobile communications is now the fastest growing sector in the telecommunications industry world-wide.

With this growth, new second generation digital mobile technologies are emerging that will compete with existing technologies as delivery systems for future personal communications services (PCS). Many see these services of the future as the means to satisfy the voice and data communications needs of an increasingly mobile community of users.

It is important to realize that, although heavily reliant on mobile technologies for access and final delivery, PCS services will also make extensive use of fixed telephone networks. PCS is not merely an application of a mobile communications technology, but rather a broader concept of intelligent communications services that will enable individuals to be reached virtually anywhere. Nevertheless, PCS is often understood to mean mobile or portable radio services in view of its promise of untethered access to communications.

The term personal communications networks (PCN) is also used in some countries to describe personal mobile telephony services using portable handsets. In Europe, PCN frequently is identified with the DCS 1800 technology standard. However, like PCS, PCN should be seen as a technology independent concept. In this paper the broader term PCS will be used in preference to PCN.

International attention in the development of PCS is focused on two areas of mobile communications; namely, cellular networks and cordless telephony systems operating within the 800-3000 MHz frequency range. While most countries have yet to decide on specific frequency allocations interest generally is centred on frequency bands around 2000 MHz.

At the World Administrative Radio Conference in 1992, the International Telecommunication Union (ITU) allocated spectrum in the 1885-2025 MHz and 2110-2200 MHz frequency bands for future public land mobile telecommunication systems (FPLMTS) on a world wide basis. FPLMTS will become the basis of PCS by integrating the features embodied in the second-generation cellular and cordless technologies now appearing.

Figure 1 depicts spectrum allocations in the bands around 2000 MHz as they currently exist in New Zealand together with the ITU mobile designations and European, Japanese and US PCS designations of interest.

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2.2 Universal Mobile Telecommunications

PCS services made possible by the combination of digital mobile systems and intelligent fixed networks are developing in a somewhat uncoordinated manner. A variety of different technologies are being trailed and no single approach has yet gained universal acceptance.

International organizations such as the ITU and the European Telecommunications Standards Institute (ETSI) are developing unified technical standards for FPLMTS and for universal mobile telecommunications systems (UMTS) as third generation mobile systems. While the availability of agreed standards will help to encourage a common worldwide approach, it remains likely that initially different technologies will be required for different user segments of the PCS market. Both FPLMTS and UMTS are embryonic concepts at this stage and their introduction either separately or as a merged service will be after the appearance of the first PCS services using second-generation mobile technologies.

The mobile technologies for the initial PCS services will focus on:

1. Satellites for very wide area coverage requirements
2. Cellular and micro-cellular systems using GSM and digital AMPS networks for wide area and high mobility requirements
3. Micro-cellular and pico-cellular systems using cordless telephony for home and office applications.

However, distinctions between areas of application for each technology will become increasingly blurred as technical standards evolve and user demands increase.

2.3 International Developments in Mobile Communications

2.3.1 Europe

Europe has established the lead position in the development of second generation mobile technologies and services; in particular, GSM and its derivatives DCS 1800 and DCS 1900, CT2 and DECT. From a user base in 1993 of almost 16 million excluding cordless telephones in residential and office use, it is predicted that there could be nearly 40 million users by the year 2000 and up to 80 million users by 2010.

Recent market research in Europe shows that 30-50% of business users and 30-40% of private users are likely to use mobile PCS services by the year 2010. This compares with a current market penetration of approximately 6% for cellular services.

The European Union is predicting that with the development of full scale PCS services market penetrations ultimately could reach 80% of the population.

2.3.2 USA

Development of digital mobile communications in the USA has lagged behind Europe due in part to uncertainty over a clear successor to the analogue AMPS cellular standard. PCS development has been spurred by the recent Federal Communications Commission (FCC) frequency allocation of 160 MHz between 1850-2200 MHz for PCS services. The FCC has adopted a laissez faire approach whereby market forces will decide the winning PCS standard/technology from amongst those being promoted by the competing vendors.

Growth projections for the year 2000 in the USA vary widely with market penetrations ranging from about 12% to over 30%. For comparison, cellular penetration is between 5-6% in the USA currently.

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2.3.3 Japan

In Japan development of mobile services for PCS is focused on:

1. Personal Digital Cellular system using 800 MHz and 1500 MHz bands.
2. Personal Handy Phone (PHP) system which is a lower priced two-way telepoint type of system operating at 1900 MHz.
3. N-Star mobile satellite system intended primarily for reaching rural areas.

The Japanese Ministry of Posts and Telecommunications expects there to be 10 million PHP subscribers by the year 2000. This compares with 1.7 million cellular users in 1993.

2.3.4 Hong Kong

Cellular and CT2 telepoint services have both exhibited strong growth in Hong Kong, regarded by many as the most competitive telecommunications market in Asia. By the end of 1993 there were over 400,000 cellular and telepoint users in Hong Kong and within five years it is predicted there will be over 1.1 million users, about 18% of the population, split evenly between the two services.

A plan to license six PCS operators in the 1700 -1900 MHz band has recently been released. At this stage the regulatory authority is taking a technology neutral stance leaving it to the individual operators to select the technology. However, by the very choice of frequency band, DCS 1800 is seen as the leading option.

2.3.5 Australia

Australia too has enjoyed strong sustained growth in mobile services. Telstra has predicted that there could be 1 million PCS users in Australia by the year 2000.

Austel in its August 1993 report on wireless PCS to the government recommended a set of standards for PCS with GSM as the cellular component as follows:

1. National coverage: Satellite service to a standard yet to be determined
2. Land mobile cellular: GSM (900 MHz)
3. General outdoor macro-cellular: DCS 1800 (sub-bands in range 1710 -1880 MHz)
4. Indoor and office micro-cellular: DECT (1880 - 1900 MHz)

2.3.6 Summary

There is a major development trend internationally to integrate digital cellular and cordless technologies to create platforms for the evolution of third-generation personal communications services. However, to date no one approach has emerged as the internationally accepted single standard.

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2.4 Access Technologies

A distinction can be drawn between cellular networks, such as GSM, and network access systems which typically make use of cordless technologies.

The cellular networks are planned as integrated wide area coverage networks. The standards for the networks specify network operation over radio, transmission and switching parts and define service features as well as access to the networks from and to mobile terminals and fixed telephone networks.

On the other hand, access technology standards such as CT2 and DECT only define the interface between a mobile terminal and a fixed radio station (the base station). The interface between the radio station and whatever service network it is connected to is specified separately to the access standard itself. The access standard does not define call routing, switching or service functions as these are part of the service network.

As standards evolve and applications develop, this distinction may become blurred. For the moment it is important because it is reflected in the lower cost of the less complex access technologies.

The current leading contenders for a choice of access technology are CT2, DECT, DCS 1800 (known as DCS 1900 in North America with the shift of the DCS standard to the 1900 MHz band) and PHP. On these it should be noted that:

1. CT2 was adopted by ETSI as an access standard in 1991. CT2 was developed in the United Kingdom but its greatest successes have been in Hong Kong and Singapore as telepoint services. A large scale public trial is being run by Telstra in Brisbane. CT2 cordless PABX products have also been marketed since 1992.
2. The DECT standard was approved by ETSI in 1992. To date, applications have been limited to trial PCS systems in Finland, Norway and the USA, cordless PABX products, wireless LAN systems and demonstration domestic systems. However, it is a more advanced cordless technology system than CT2 with inherent advantages of higher traffic handling capacity, higher user loading capacity and ISDN compatibility.
3. DCS 1800 is an approved ETSI standard based on the GSM standard. As such DCS 1800 is not a cordless technology but rather a derivative of a cellular network technology optimised for high capacity PCS operation using low powered hand-portables. DCS 1800 has been adopted in the UK by Mercury for its One-2One service and by Hutchison Mictrotel, by E-Plus in Germany and for the public PCS service in Thailand operated by Total Access Communications.
4. The Japanese PHP system is being designed as a cheaper alternative to cellular network systems. It will use low power base stations and handsets and provide walking pedestrians with handover functionality. The frequency band in Japan is 1895-1918.1 MHz which overlaps with the DECT band in Europe and with the PCS allocations in the USA (refer to Figure 1). To date, the PHP system has been restricted to the Japanese market.

2.5 PCS in New ZealandTop

The status of PCS development in New Zealand can be summarised as follows:

1. No formal PCS trials or pilot systems have been implemented to date although Telecom NZ conducted a limited trial in Wellington of CT2 based telepoint services in 1991. Although the trial proved the viability of the technology to Telecom's satisfaction, the service was terminated at the end of the trial period. The usage levels reached during the trial were insufficient to sustain a commercial service, the handsets were seen by customers as not being sufficiently user friendly and it was Telecom's view that the relatively high cost of handsets would be a barrier for potential customers .
2. A frequency allocation has been designated by the Ministry of Commerce for unlicensed use of CT2 equipment on a noninterference basis in the band 864 - 868 MHz. Operation of CT3 equipment (a proprietary Ericsson cordless system) is also permitted for license exempted applications such as wireless PABXs in the band 819-824 MHz. No other spectrum allocations for PCS purposes have been made at this stage.
3. A limited number of CT2 and CT3 systems have been installed off PABXs to provide cordless extensions on manufacturing, retail and warehouse sites.
4. There are no DECT installations to date although vendor interest in this technology is now apparent especially for wireless PABX applications.
5. Cellular mobile networks are continuing to enjoy rapid growth with a current market penetration of close to 5%. However, this growth is still concentrated in the analogue AMPS service. The shift to digital services is yet to happen for a significant number of mobile users.
6. Sales of mobile equipment are dominated by handheld terminals. This could be interpreted as showing that a majority of users are already treating their cellular service as a quasi - PCS service.

3. GENERAL DESCRIPTION OF DECT

3.1 History

Work on access standards for second generation digital cordless telephones began in the United Kingdom and Sweden in the mid 1980s. Developments in the UK culminated in CT2 as a national standard while in Sweden in CT3.

ETSI, which was established in 1988, was given the task of preparing a European wide standard for cordless telephones and in August 1992 approved the DECT standard. Originally approved by ETSI as an interim standard in 1991, CT2 is still in place as an alternative standard to DECT, but CT3 has never been endorsed by ETSI and remains a proprietary standard.

3.2 Applications

DECT was developed for applications where high traffic capacities are required and where low powered terminals are used typically over ranges up to a few hundred metres. DECT systems therefore are well suited to in-building use, particularly in business offices as wireless PABXs. Applications which can be characterised as being short range and requiring low mobility.

DECT systems can also be used interfaced to the public telephone network for telepoint services. While DECT provides for seamless handover of calls as a user crosses over a boundary between cells, DECT systems are generally restricted to low mobility applications. That is, applications involving walking pace mobility as opposed to high speed motor vehicle mobility. Residential applications as cordless telephones are also possible with DECT. An extension to wireless local loop is possible but with the low power limits of the DECT standard, economic considerations may limit this application to areas where there are high densities of subscribers.

To summarise; DECT based systems will be capable of meeting user needs in the following types of applications:

1. Domestic cordless telephones
2. Wireless PABX and small business systems
3. Wireless data LANs
4. Public access telepoint services
5. Wireless local loop networks

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3.3 Technical Characteristics

The DECT standard is an open protocol standard based on the principles of the OSI model. The common air interface defined by DECT corresponds to the lower three OSI layers.

DECT achieves its high traffic handling capacity by separating users in geographical location, frequency and time. The cellular concept provides the geographical separation while the frequency and time separations are achieved through using time division multiple access (TDMA) on multiple carriers within the radio frequency band. The management of the spectrum is defined within the description of the physical layer in the DECT standard.

The go and return links between DECT base stations and mobile terminals are duplexed in time in a process known as time division duplex (TDD), also known as "ping-pong". Hence, DECT is referred to as a multiple carrier TDMA/TDD technology.

The basic technical characteristics of DECT can be summarised as follows:

Frequency band	1880-1900 MHz
No. of carrier frequencies	10
Carrier spacing	1.728 MHz
Carrier multiplex	TDMA
TDMA frame structure	24 time slots/frame/carrier (12 slots base to mobile; 12 slots mobile to base)
Basic duplexing	TDD using 2 slots on same RF carrier
Frame length	10 msec
Peak data rate	1152 kbit/sec
Speech coding	32 kbit/sec ADPCM
Channel allocation	Continuous dynamic channel allocation (DCA)
Peak transmit power	250 mW

Major operational features of DECT systems include:

Typical cell size	50-200 metres
Typical traffic densities	6000-10,000 Erlangs/Km^2
Simultaneous calls	Up to 12 per transceiver
Basic information channel	32 kbit/sec; higher rates achieved via concatenation of time slots
ISDN compatibility	Yes
Handover and Roaming	Seamless undectable handover from channel to channel or from cell to cell
Mobility use	Yes; walking pace
Encryption and authentication	Yes

3.4 Potential Areas of Interest in New ZealandTop

DECT systems as an open protocol access technology have the potential to be interfaced with a wide range of service networks and applications systems. However, in New Zealand it is likely that most interest in DECT will be focused on wireless PABX applications.

These applications have the highest demands in terms of both densities of telephone users and traffic handling capabilities, particularly in the three dimensional environments of multi-storey office buildings. Furthermore, they are the most demanding applications in their need for frequent handovers during telephone conversations. Compared with CT2, DECT offers distinct advantages for larger capacity wireless PABX applications:

DECT has a much higher traffic handling capability (CT2 is limited to about 500 Erlangs/km2).

Since DECT is TDMA based, transceivers have the ability to handle up to 12 calls simultaneously (CT2 transceivers are FDMA based and can handle only one call at a time).

Call handover in DECT is truly seamless with a new connection being made before transmission ceases on the original channel (handover is not seamless or inaudible in CT2).

DECT also provides automatic location registration enabling the system to track portable handsets from cell to cell (not available in CT2) .

Other types of application for DECT will be decided on economic grounds with trade-offs between features and costs. Application specific considerations which will impact on the take-up of DECT in New Zealand include the following:

1. Residential applications typically are single cells and therefore do not require call handover but do require high quality voice channels and protection against eavesdropping and interference.
2. For wireless LANs the deciding factors other than cost will be routing, transmission speed and capacity and security of transmission .
3. PCS systems require an interconnecting network which clearly is not a part of DECT. If the public telephone network is used for this role, the service effectively becomes telepoint. Judging by the Telecom NZ trial of CT2 based telepoint, this service may have only limited appeal to New Zealand users. It is also noted that cellular technologies such as DCS 1800 are also contenders for future PCS services and any choice will be made largely on the basis of cost.
4. PCS services may evolve as combinations of cellular and cordless technologies in order to achieve a balance between network infrastructure, mobility, traffic handling capability and cost of operation. Accordingly, DECT may have a role as an access technology to digital cellular networks through the development of dual mode handheld terminals. It is noted that ETSI is preparing an interface specification between DECT and GSM.
5. Similarly to PCS, wireless local loop applications for DECT will be decided on cost. Clearly there is a cost associated with providing an interconnecting network, but another major cost factor is the large number of DECT cells, due to their small size, that would be needed to provide continuous coverage over a wide area. This would off-set the inherent advantage DECT has in its high traffic handling capability likely to be required in city environments.

4. KEY ISSUESTop

The key issues concerning the introduction of DECT technology into New Zealand that need to be addressed are identified below.

4.1 PCS Policy Directions in New Zealand

While a single technology standard for PCS would be ideal, the reality is that a combination of technologies spanning cordless, cellular and perhaps satellite services will be required, albeit with a high level of operational integration between them.

A strong case can be made that the New Zealand market will not be large enough to support multiple standards for each category of PCS enabling technology. Rather than provide users with benefits of choice and competition, a fractionated market approach by restricting economies of scale may result in a cost barriers for users as well as inhibiting operational integration.

This argument supports the adoption in New Zealand of a limited number of standards aimed at achieving an integrated platform for PCS development. In turn, this implies a prescriptive approach to spectrum management rather than leaving it to the market to decide the technology users.

The issue is whether the Ministry of Commerce should follow the prescriptive or the laissez-faire approach in the choice of PCS technology standards.

4.2 Cordless Technologies

DECT is one of a number of contending cordless technologies in the broader picture of PCS. In the absence of agreed policy directions for PCS development in New Zealand, it is difficult, if not premature, to formulate regulatory policies for the introduction of DECT technology in all its applications.

However, it should be noted that spectrum allocations have been made available for other cordless technologies such as CT2 and CT3. The allocation for CT2 is exclusive with no competing technology in the same band.

The issue is whether or not DECT should be treated in the same manner.

4.3 International Trends

The days of "...a special for you, Kiwi" have ended. Go it alone approaches are guaranteed to disadvantage end users through higher costs and restricted equipment options. Maximum economic advantage for users in New Zealand will be gained by adopting international standards and spectrum allocations (refer to section 2.3 above).

The ITU, of which New Zealand is a member with all the associated treaty obligations, in 1992 set aside spectrum around 2000 MHz for FPLMTS. While FPLMTS is not expected to become a reality until the turn of the century, spectrum allocations made now for mobile services must take into account the evolutionary development of future PCS type services. Accordingly, the internationally recognised frequency band for DECT of 1880-1900 MHz must be considered for adoption in New Zealand given the apparent compatibility of DECT as a migration path technology with FPLMTS.

4.4 Market Demand

There is a question as to whether DECT actually is required in New Zealand at this point in time.

It is hard to make a case for DECT on the basis of its superior traffic handling capabilities, even for use in the central business areas of Auckland and Wellington where subscriber densities may approach those of large cities overseas. It is equally hard to make a case for DECT on the basis of a need for a new mobile service to provide additional radio telephone capacity in New Zealand.

Unused capacity in the 800 and 900 MHz cellular service bands alone would be adequate to satisfy total cellular and PCS type needs until FPLMTS services are available.

Ultimately, the market demand for DECT will be determined more by costs to the user than by advanced features of the technology. The question for vendors is whether DECT systems will be able to offer users communications mobility at the right market price compared with the alternatives of CT2 and cellular networks. The issue for regulators is whether the apparent market interest and the undeniable potential of DECT justify spectrum accommodations in New Zealand at this time.

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4.5 Spectrum Sharing Between DECT and Fixed Services

The frequency band 1880-1900 MHz that DECT systems would require is already in use in New Zealand on a geographically widespread basis for fixed point-to-point radio systems. Altogether there are about 85 links whose emissions lie wholly or partly within the band of interest.

Worst case calculations by the Ministry of Commerce based on the technical characteristics of DECT and the fixed systems show that the fixed services are likely to suffer interference from co-channel base stations of DECT public access services such as telepoint and wireless local loop.

In the reverse direction, calculations also show that DECT receivers would be affected in a similar way if within the line of sight of co-channel fixed link transmitters. However, the DECT system has been designed to have a relatively high tolerance to interference. Through the DCA facility, DECT receivers have the ability to switch frequencies and time slots to find alternative speech channels in order to maintain operation when interference is encountered on a particular channel.

Wireless PABX and residential DECT systems are less likely to be subject to interference problems, since there is more opportunity to take advantage of the shielding properties of buildings. However, it can be concluded that should these applications of DECT become widespread, frequency relocations of some f1xed services will be necessary to eliminate harmful interference problems.

Frequency band sharing between non-compatible services usually is achieved by segmenting the band into sub-bands exclusive to each service, sharing on a geographical basis making use of natural and man-made features for shielding or a combination of both.

As far as DECT is concerned, sub-band operation does not appear to be feasible as the full bandwidth of 20 MHz is used in accommodating the DECT algorithms for the dynamic channel allocation facility. While subband operation may be possible, it does not appear to be a design intent inherent in the DECT standard. Further investigation is required to determine whether the DCA algorithms can be adjusted to permit sub-band operation.

The use of sub-bands (which would necessarily differ from area to area to work around the fixed services in each area) would enable DECT services to grow while minimising impact on fixed services. In the more remote areas, even relatively narrow sub-bands, if this mode of operation is possible, would provide adequate capacity to meet any long term demand for DECT services.

However, geographical separation and shielding remain as the most likely options for any sharing of the 1880 - 1900 MHz band between DECT and other services. The potential for interference and the possibility of harmful effects on existing fixed services in the band raises an issue of the rights of incumbents. No doubt current users will argue vigorously against any incursions by DECT based services.

Unfortunately, in trying to stem what could become an almost endless tide of DECT based products flowing in from overseas, the incumbents' stand may be akin to that of King Canute. The experiences of the late 1970s and early 1980s with the private importation and use of so-called illegal citizens' band radios and analogue cordless telephones should not be overlooked.

Furthermore, as the FPLMTS spectrum designations applied by the ITU demonstrate, the international community has signaled that in the longer term the frequency bands around 2000 MHz will become the domain of mobile communications services. This raises the issue as to when is the appropriate time to initiate a clearance of these bands in New Zealand and what arrangements should be made for a relocation of non-mobile incumbent services to other parts of the spectrum.

It should also be noted that contention between fixed and mobile services for spectrum in frequency bands from 1710 - 1800 MHz will also occur if DCS 1800/1900 services are introduced into New Zealand.

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4.6 Spectrum Management and Competitive Access

It is accepted that a fundamental tenant of spectrum management policy in New Zealand is the creation of a regulatory environment in which competition is promoted. It is implicit in the Radiocommunications Act 1989 that access to the spectrum is to be on a competitive basis whenever there is contention for the use of frequencies. This has lead to the introduction of the spectrum management rights regime as the way of using market forces via an auction process to determine the relative worth of competing uses of the spectrum, subject to any international obligations on frequency use.

To date, auctions for management rights in New Zealand have been conducted on single service bases for cellular mobile services and broadcasting services.

In considering the need for spectrum for DECT technologies it should be noted that:

1. New Zealand as a signatory to the WARC ~92 Final Acts is obliged to adopt international frequency allocations where possible. Any allocations for the 1880 - 1900 MHz band should be consistent with the international uses in this band.
2. It is already apparent that there will be wide international use, if not global use, of the 1880 - 1900 MHz band for DECT systems in the near future. This will have implications for international services such as roaming as well as benefits in the availability of technology and products.
3. There will be contention for this part of the radio spectrum; for DECT systems, from existing fixed services and potentially from other radio access and cellular technologies.
4. To summarise; there is an issue as to what is the appropriate method of spectrum management for resolving the competing claims by different services for the 1880 - 1900 MHz band.

4.7 Spectrum Efficiency

The DECT standard requirement for a bandwidth of 20 MHz understandably reflects European needs to achieve very high system capacities. On the basis of a traffic handling capacity of 6000 Erlangs/km2 as quoted above and assuming individual subscriber generated traffic streams of 200 milli-Erlangs, a DECT system could support up to 20,000 subscribers/km2. A very large system peak capacity when compared to typical New Zealand population densities.

This serves to illustrate that fully developed DECT systems would have far more capacity than necessary to service New Zealand communities.

If DECT systems require the full 20 MHz bandwidth for their operation, irrespective of loading, then the efficiency of spectrum utilization achieved will be much lower than for other cordless and cellular technologies. As a result a premium price should be attached to any DECT use of the spectrum if other users are to be excluded.

European studies on DECT applications generally assume that the DECT systems will be the only users in the 1880 -1900 MHz band. The issue for New Zealand is whether or not DECT systems can share the band with other services given that very high system capacities will not be required.

4.8 DECT Competitive AccessTop

Under the DECT standard, multiple applications can be supported within the same frequency band simultaneously. Public access services such as telepoint, which are designed predominantly with outside coverage in mind, can operate alongside wireless PABX and residential applications which are intended primarily for in-building use. Furthermore, the authentication and registration feature enables service operators to control access of users to their systems and gain protection from unauthorised use. This feature together with the dynamic channel allocation process also enables a

number of service providers to operate similar public access services in the same geographical area.

It is also an integral part of the DECT concept that users should be able to use the same telephone handsets to make and receive calls on their home system, Oll their office system and on any public access system for which they are an authorised user. The key to such interoperability between equipment of different manufacture is conformance to common radio interfaces between handsets and base stations.

Proprietary interfaces are allowed for in the DECT standard for stand alone systems where interworking with others is not a requirement. However, where user roaming is to be a feature between different systems, conformance to the public access profile (PAP) common protocol defined within the DECT standard is recommended.

An issue for New Zealand is whether access and hence competition between different services should be promoted to the point of making the use of PAP mandatory.

4.9 Migration to Digital Mobile Technology

While it is accepted that mobile services are evolving from analogue to digital standards the speed of migration in New Zealand is slow.

Overseas governments and regulatory authorities are stepping in and mandating change-outs to digital technologies. In Australia, for example, the government has decreed that the analogue cellular service will be phased out between 1996 and the turn of the century.

The New Zealand approach has been to rely on market forces to promote the user advantages of enhanced features in digital systems. To date no cost premiums have been placed on the relative spectral efficiencies of analogue and digital systems.

An issue for New Zealand is whether DECT (and other second generation mobile technologies) should be used as a vehicle to encourage the migration to digital services by providing an economic incentive based on achieved spectral efficiency.

4.10 Area Franchising

The concept of franchising spectrum access by geographical area has been used extensively in the United States in the development of the cellular service and more recently in the proposals for allocating spectrum for PCS.

Franchising of licenses on an area-by-area basis could be used to introduce public access services such as telepoint and wireless local loop into New Zealand. Geographical market areas could be designated for each license which would be auctioned to the highest bidder. Applications such as wireless PABXs and residential cordless telephony would remain as license exempted.

The susceptibility of each area to interference with existing services would be assessed by the bidders and taken into account when making their bids. Those areas with a higher potential for interference would clearly be given a lower value, providing scope for successful bidders to offer financial incentives to existing services to relocate to other frequency bands.

This use of the franchising concept would have parallels with previously conducted auctions for FM broadcasting frequencies. Like these auctions, the sale of public access service licenses as franchises would be likely to generate wide community interest, particularly if more than one license is offered in each area. It would open the bidding process to smaller organisations with local interests as well as large companies with national interests. The way would be opened for the creation of community based local telephone companies.

The franchises should be non-exclusive to facilitate competitive provision of service. A detailed study with reference to overseas experience would be required to determine how many franchises each area could sustain. Details of the franchising concept and the sale process to be used would need to be developed by the Ministry of Commerce. A technology neutral position to the licenses could be adopted. However, to ensure the benefits of interoperability can be realized, it may be necessary to nominate a technology standard.

At this point, the leading contenders would be DECT and DCS 1800. Advantage should be taken of the time required to put the franchising arrangements in place by continuing to review the technology standard in the light of overseas developments expected in the near future.

It should be noted that existing cellular network operators are not restricted from offering public access services should they so wish.

The issue is whether the franchising concept should be used in New Zealand to encourage competition in the development of public access services.

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5. REGULATORY OPTIONS FOR DECT

As a principle, spectrum designations should only be made when there is clear evidence of market support. While there is general interest and support for the introduction of cordless technologies into New Zealand, there is no clear agreement as to whether or when a standard(s) should be adopted.

Adopting DECT as the access standard now would act to deny spectrum access to other cordless contenders currently under development in Japan and the USA. While conversely, DECT should not be denied spectrum access now solely on the basis that something better may come along sometime in the future. Also a technology neutral approach would achieve little extra, since, as the only technologies currently available, DECT and CT2 would have to emerge as the de facto standards.

The issues raised in the previous section, in particular the existing fixed usage in the band and the expected developments of further cordless technologies, must be taken into account in developing regulatory options for the frequency band 18801900 MHz. Accordingly, the following course of action is recommended as a facilitation plan for the introduction of DECT technology into New Zealand:

Recommendation

It is recommended that:

1. The use of DECT technology be permitted for wireless PABX and residential applications on an unlicensed non-interference basis New Zealand wide in the band 1880-1900 MHz.
2. An embargo be placed on the use of DECT technology for public access services such as telepoint and wireless local loop for a period of up to two years.
3. A franchising plan, including a nominated technology standard, be developed for the auctioning of public access service licenses on an areaby-area basis that takes into account the incumbency rights of existing users.
4. A market study be conducted to establish guidelines for the number of franchises to be awarded in each area.
5. An embargo be placed on all further assignments for fixed point-to-point services in the band 1880-1900 MHz and consideration given to extending this embargo to FPLMTS and DCS 1800 bands.
6. Alternative frequency assignments be made available in other areas of the spectrum for the re-location of fixed services in the 1880-1900 MHz band.

6. FURTHER ACTION

It is proposed that the Ministry of Commerce:

1. Distribute this report as a discussion paper to a wide selection of industry representatives and potential users to solicit their views on the issues and options relating to the development of DECT services in New Zealand.
2. Prepare and distribute for comment a companion discussion paper on the broader aspects of wireless personal communications services in New Zealand.
3. Finalize policies for the introduction of DECT and other PCS services by the end of 1994.
4. Prepare a full franchising plan suitable for the auctioning of non-exclusive operating licenses for public access services such as telepoint and wireless local loop in frequency bands around 2000 MHz.

In addition, it is recommended that further study be undertaken in parallel on the following topics:

1. The practicality of band sharing between existing fixed services and second generation mobile services in frequency bands around 2000 MHz.
2. The technical feasibility of operating DECT and other mobile access technologies (such as DCS 1800) on a sub-band basis.
3. The identification and development of procedures and protection measures to minimise disruption in the frequency re-location of fixed services from bands around 2000 MHz.
4. The development of measures to encourage the migration of analogue based mobile services to digital technologies.
5. The reassessment of the New Zealand policy on technology standards for PCS access services based on overseas developments in cordless and cellular technologies.
6. The assessment of privacy issues relating to the introduction of PCS services.

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KEY TO FIGURE 1

APC Aeronautical Public Correspondence

BC Broadcasting Service

Ext Extension to DECT band

FX(L) L Band Fixed Service

FX(M) M Band Fixed Service

FX(N) N Band Fixed Service

MET-SAT Meteorological Satellite Service

MSS Mobile Satellite Service

NAV-SAT Navigation Satellite Service

PDC Personal Digital Cellular

PHP Personal Handy Phone

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APPENDIX 1: LIST OF ORGANIZATIONS

Organizations which contributed via interviews to the report were:

Alcatel New Zealand

Broadcast Communications Ltd

BellSouth New Zealand

Clear Communications

Ericsson Communications

Ministry of Commerce

Motorola New Zealand

New Technologies

Nokia Telecommunications NZ

Northern Telecom NZ

Spectrum Management Agency (Australia)

Telecom NZ

Telstra

Transpower NZ/Designpower

TUANZ

APPENDIX 2: LIST OF ABBREVIATIONS

ADPCM Adaptive Digital Pulse Code Modulation

AMPS Advanced Mobile Phone System

CT2 Cordless Telephone, 2nd generation

CT3 Cordless Telephone, 2nd generation (Ericsson proprietary)

DCA Dynamic Channel Allocation

DCS 1800/1900 Digital Cellular System at 1800/1900 MHz

DECT Digital European Cordless Telecommunications

ETSI European Telecommunications Standards Institute

FCC Federal Communications Commission (USA)

FDMA Frequency Division Multiple Access

FM Frequency Modulation

FPLMTS Future Public Land Mobile Telecommunication Systems

GSM Global System for Mobile communications

ISDN Integrated Services Digital Network

ITU International Telecommunication Union

LAN Local Area Network

OSI Open Systems Interconnection

PABX Private Automatic Branch Exchange

PAP Public Access Profile

PCN Personal Communications Networks

PCS Personal Communications Services

PHP Personal Handy Phone

RF Radio Frequency

TDD Time Division Duplex

TDMA Time Division Multiple Access

UMTS Universal Mobile Telecommunication System

WARC World Administrative Radio Conference