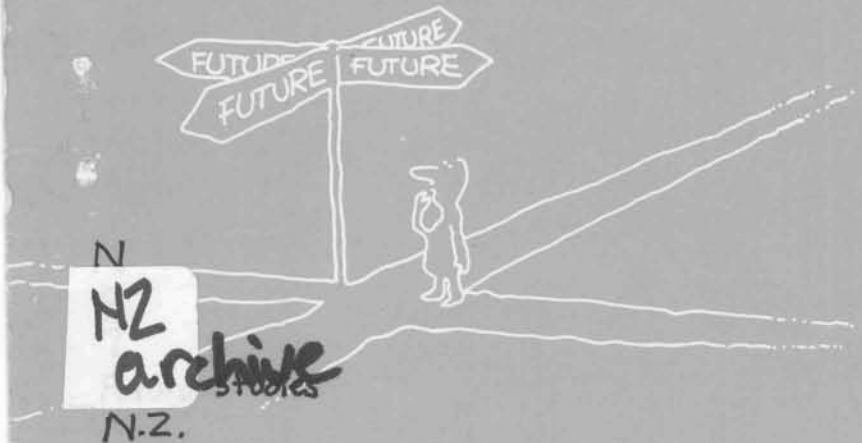
NETWORK NEW ZEALAND
WORKING PAPERS

Embargoed
until 9am Wed 16 Sep 81

Communications Policy Research Group



N
NZ
archive
N.Z.

COMMISSION FOR THE FUTURE

Contributing papers to

NETWORK NEW ZEALAND

COMMUNICATIONS IN THE FUTURE

1. Towards a Communications and Information Policy for New Zealand. A discussion paper by Myra Harpham.

2. Information Occupations: The New Dominant in the New Zealand Work Force. An analysis by Michael Conway.

3. Communication Needs and Rights; Communications in four New Zealand Contexts. A working paper by P.W. Harpham, Marie Keir, Gerald E. Moriarty and George Van Valkenburg.

4. Communications to the Year 2010: Some Social, Political and Economic Issues. Marie Keir.

5. Computer Communications and Information Services. Notes by P.W. Harpham.

6. The Future of Broadcasting and Frequency Spectrum Usage in New Zealand. A working paper by Gerald E. Moriarty.

7. The New Zealand Daily Newspaper: An Endangered Species. A working paper by Michael Conway.

8. Point-to-Point Communication in New Zealand Over the Next 20 Years. A working paper by John P. Moriarty.

9. Space Satellite Distribution. An input paper by George Van Valkenburg.

Published in August 1981 by the
COMMISSION FOR THE FUTURE
Telephone 725-033 Wellington
PO Box 5053
National Provident Fund Building
1 The Terrace, Wellington 1

ISBN 0-477-06219-9
Working Paper No.6

THE FUTURE OF BROADCASTING AND FREQUENCY SPECTRUM USAGE IN NEW ZEALAND

GERALD E. MORIARTY

Classification P.N.

JULY 1981

The views expressed in this paper are those of the author and do not necessarily represent the views of the Commission For the Future.

CONTENTS

THE FUTURE OF BROADCASTING AND FREQUENCY SPECTRUM USAGE IN NEW ZEALAND

1. INTRODUCTION

In recent years there has been an explosive rate of development in computers and telecommunications. The two technologies have merged into what are now widely known as the Information Technologies. Information technologies are generating many new means of communication and information exchange which are expected to have a major impact on society, to the extent that they are considered by many to be the most important agents of social change in the immediate future. Many regard them as the basis of a new social revolution having equal or greater importance to that of the industrial revolution.

The new technologies are the tools of a post-industrial, information-based society in which information is expected to be a key economic resource similar to labour and capital, the traditional factors of production. Efficient high capacity telecommunication systems are expected to provide the means of revolutionising the processing of information just as the transport system did for the processing of raw material in industrial society.

The information technologies themselves are producing major trends towards integration. This is happening at a number of different levels. For example, all forms of communication are rapidly becoming electronic - electronic publishing and information services could eventually replace the printed newspaper and have a significant impact on the publishing, printing and cataloguing of books and reference material; high definition electronic video transmission will produce new forms of cinema.

On a technical level the introduction of digital transmission techniques means that all signals whether voice, music, data or image will be transformed into the same kind of electronic signal for transmission. There will be much greater flexibility in transmission networks and a new freedom to organise services according to other than technical criteria.

The Wired Society

The final product of these trends has already been described in such expressions as: "the electronic highway"; "the wired society"; or a "totally integrated global network", providing all currently available services as well as a host of imagined and, as yet, unforseen ones.

Every individual could have access to multi-purpose communication networks in the future. Users could choose their mode of communication: voice, data, image, or combinations according to their purpose.

Such revolutionary developments can be expected to have a significant impact on broadcasting services as we know them. In analysing the nature of this impact it is apparent that the roles of broadcasting will need to be adapted as radio and television are absorbed into an enhanced range of electronic media, capable of providing many different forms of social interaction and rendering the concept of "mass media" largely inappropriate for the future.

A major policy concern produced by the new diversity of electronic media is the nature of the institutional structures they will generate. Existing vertical organisations of the press, radio, television and the cinema may not be relevant. Horizontal organisations involving information producers and presenters and technical facilitators are likely to evolve.

These horizontal structures could lead to monopoly control of information sources - on the other hand they could give greater opportunities for individuals to participate as information providers in the new services. Communication policy must be concerned to avoid the social dangers of monopoly control of information.

This highlights some contradictions inherent in these technological developments. It appears logical that future systems should ideally be established on the basis of centralised planing, investment and operation (i.e. centralised, integrated technical facilities), yet they should aim to provide for highly individual patterns of use.

Also the trend towards overall integrated systems meets another trend in the opposite direction, a trend towards decentralisation of information and use of services. These trends are obvious at many levels: in the cheapness of micro-electronic equipment and hence its availability to an increasing number of users; in the demands seen overseas for the use of new technology for local broadcasting; and in groups that are already using new electronic communications for individual or group media of expression (for example, community video centres) and thus have moved away from the mass media concept. Observers have already expressed fears in two opposite directions: fears of the integrated global village and cultural homogenisation and fears of social fragmentation created by everyone doing their own thing.

In order that communication and information services in New Zealand develop along a socially acceptable path between these two extremes it is essential that the future be policy-led and that policy be directed

by integrated communication planning and anticipatory policy research involving maximum public debate.

2. COMMUNICATIONS TRENDS

Before considering specific issues, it is useful to review briefly the broad history of communications development and examine where this is currently leading.

The earliest human communication was entirely inter-personal and face to face and the first methods of remote communication - for example, smoke signals and drum beating - were essentially point to point systems (or at best, point to small-mass).

More extended range was possible only by personal messenger services. As civilisation's boundaries expanded, these messenger services often travelled long distances. It is believed a form of postal service existed as early as 2000 BC, but the first postal systems similar to those we know today began in the 17th Century. Postal services expanded rapidly in the industrialised countries because of the increasing flow of information generated by industrial activity.

But it can be seen that during at least the first half-million years of human occupation of the earth (i.e. from the time human conversation is believed to have started), human communication was characterised by two-way point to point systems which by today's standards were very slow.

Telecommunications and the Mass Media

In approximately 1844, Morse introduced what was to be a completely new era in communications when he transmitted the first messages over cable on his 'electric telegraph'. Then in 1876, Alexander Graham Bell introduced the telephone and in 1898, Marconi transmitted the first message over the 'air waves'. He had invented radio telegraphy.

These inventions began a new era of telecommunications which contributed greatly to the efficiency and character of industrialisation and which has continued to evolve rapidly on the tide of the technological revolution.

After a mere 100 years, telephone connections can be made between almost any two countries of the world. The telephone and telegraph produced enormous increases in the speed, efficiency and convenience of communications. These first telecommunications systems were again two-way and point to point services.

About the same time as the innovation of telecommunication, another very significant development occurred. This was the introduction of large scale publishing, using the printing press, for example, 100,000 run newspapers and half a million books. This heralded a Communication Order totally different from that which had previously existed. It was one-way point to mass communication.

The rapidly evolving telecommunication technology developed the first regular radio broadcasting in 1917 and then black and white television, in 1935 and colour in 1954. These new media extended the one-way point to mass pattern associated with newspapers and books. These developments represented the Mass Media Communications Order.

New Communications Order

Since approximately 1970, there has been a growing awareness that yet another communications order is dawning. This is characterised by philosophical concerns for the right of individuals to communicate, the need to correct global and national imbalances in the flow of information, the recognition that communication systems are important resources that need to be shaped into services that satisfy human communication needs and rights.

The new order is driven by advanced technological developments in telecommunications and the enormous potential of the linking of telecommunications and computer technologies.

The new technologies - for example: optical fibre high capacity cable, communications and direct broadcast satellites, digital transmission systems and the new services such as viewdata, teletext and teleconferencing - have the potential to provide greater communication choice and enhancement of two-way, point to point or interactive communications.

Frenchman Jean d'Arcy has identified current telecommunication trends as being towards abundance, planetarisation, and individualisation. He notes that individualisation

> "seems to be the clearest and most important. It is embodied most strongly in tele-data processing, wide-band interactive telcommunication networks ... This technology, which more and more gives each person the capability of direct communication with his fellow man, is restoring to the individual the right to communicate which in the era of mass communication has been monopolised by the authorities." (1)

"The most significant developments in human communications in the next quarter century are much more likely to be in cultural innovations than in technical innovations ... Within communications technology, the disappearance of 'insatiable demands' will be paralleled by shifts in emphasis. The demand will grow most for technologies that facilitate one-one, many-many, us-us communications, least for the technologies that facilitate one-many, many-one communications. As the latter include press, radio, film, television and surveys, the effect would be substantial." (2)

In summary then, it can be seen that the pattern of predominant human communication has been from two-way, point to point to mass-media (point to mass) and now back at least towards a greater emphasis on two-way point to point with greatly increased individual choice. These changes will have widespread effect across the entire communication infrastructure, especially on broadcasting and the press, and are cause in themselves to undertake long-term integrated planning and policy research.

3. EVOLUTION OF BROADCASTING

Broadcasting systems began and have evolved throughout the world at a time when communication services have been dominated by the mass-media. The broadcasting technology of the 1920's and 30's that provided the facilities for the first electronic mass-media is essentially a one-way technology.

With this restriction, broadcasting has been able to provide multi-way communication by allowing community and audience involvement in management and participation in presentation and programme preparation and policy control. But often pluralism has been achieved in high density population areas only by provision of a wide choice of programmes appealing to a diverse range of interests and tastes.

In many countries, however, radio and television have been entirely centralised on a national scale with audiences that are anonymous and undifferentiated, audiences which are passive and frustrated - receiving what is sent to them but unable to react.

Power to speak to audiences via the broadcasting system has often been concentrated in a few hands and messages have been entirely vertical, from the top down. Some critics claim that the electronic mass-media have at best been a tool of information but more often only a means of political and commercial propaganda and social control.

Because of the potential of broadcasting as an agent of social influence and change and even more particularly as an agent of attitude reinforcement, the control of the medium in all countries has largely been politically directed.

4. DEVELOPMENT OF RADIO AND TELEVISION IN NEW ZEALAND

The evolution of radio broadcasting in New Zealand has gone some way towards overcoming the restrictions imposed by its one-way nature. This is commented on by Dr Donald Stewart in his review of communication policy in New Zealand (3).

> "In brief, whilst broadcasting remained confined to radio it retained some degree of flexibility in responding to the needs of the community it served, despite the limitations imposed by the concept of it as a one-way disseminator of information. Radio did develop and respond to conditions peculiar to New Zealand. Real efforts were made to use radio as a means of increasing the receivers' involvement in the community. The Labour Party, upon gaining office in 1935, had moved immediately to introduce the broadcasting of Parliament, and even before this, the broadcasting of sports events was widespread. In 1946 the National Orchestra of the Broadcasting Service was founded.
>
> "The advent of the commercial service resulted in a greatly increased public involvement in the activities of radio. This has been well documented by Downes and Harcourt (4). Once a station had been established it was a relatively simple matter to record and transmit programmes of local interest thus responding to and expressing the concerns of at least some sections of the community. Certainly this development took place within the restricted bounds imposed by the 1923 regulations, but it was an aspect of broadcasting which was to disappear almost completely in the case of television."

Other developments have added to the ability of audiences to participate in the medium. The publicly owned Radio NZ community stations have been extended into areas such as Ashburton, Oamaru and Gore and ten privately owned commercial stations currently operate throughout the country. University stations have been established on all the university campuses and operate at times of special activity during the academic year. These provide channels of entertainment and information to the student communities.

Most New Zealand stations operate some programmes involving audience participation via the telephone. The Auckland based private station, Radio Pacific, operates extended periods of such 'phone-in' or telephone 'talkback' programming. This station and Radio NZ's Te Aotearoa unit in Auckland produce programmes specifically for the minority Maori and Polynesian Island population.

Short-term radio warrants are granted frequently by the Broadcasting Tribunal to give a voice for community groups and special cultural occasions. Radio NZ has recently begun operating Station 2YB in Wellington as a community access station providing the opportunity for individuals, groups and organisations to participate directly in the

presentation and programming of local radio.

In restructuring broadcasting in 1975, the Adam Committee emphasised the difference between radio and television and proposed separate structures to allow for their independent development. It conceived of radio as a medium which permitted a much greater flexibility than television in providing for community participation.

> "Radio is a natural medium for local programming ... radio's costs do not call so insistently for the mass audience which television's expensiveness demands." (5).

Television, which began in New Zealand in 1960, developed almost entirely as a uni-directional medium. The possibility of community involvement except as a passive receiver has largely been ignored. The evolution and institutional restructurings of television which have occurred to date have not been concerned to develop new models for participation or multiple feedback communication.

Lack of Long-Term Planning

The evolution of broadcasting in New Zealand has lacked a coherent, long-term policy. Changes have resulted mostly from political whim. Stewart summarised the effects of this, saying:

> "The present situation, set against a background in which it is acknowledged that New Zealand over-extended itself in providing a second TV channel, which both political parties were keen to see established, results from the lack of regard for continuity and long-term planning. Equally the partisan nature of policy decisions informed by little more than short-term political gain, and 'ad-hocery', have combined to inhibit the development of a coherent communication policy related to broadcasting" (6).

The present 1976 Broadcasting Act empowers broadcasters, both public and private, to develop broadcasting as a 'system of human communication'. Further it establishes public broadcasters as the 'trustees of the national interest' in broadcasting matters. However, very little detailed guidance is given in the Act as to how these things should be achieved and against which they can be evaluated. Nor are there anywhere explicit integrated national communication goals against which performance can be guaged.

The phrase "the public interest" is liberally scattered throughout the Act but as has been demonstrated before the Broadcasting Tribunal this has different interpretations particularly between public and private broadcasters. Even the High Court showed it disagreed with the Tribunal's judgement of what was in the public interest in overturning the Tribunal's decision on an application for a recent new radio station warrant.

5. EFFECT OF NEW COMMUNICATION TECHNOLOGY

There is currently an explosion of new communication technologies taking place which has the potential to affect significantly all existing means of communication. These developments require a re-examination of the present roles of existing means of communication and a review of organisations responsible for their operation.

Developments in communication technology include space satellites which have increased in capacity from 240 to 24,000 telephone circuits in the past fifteen years. Their costs have decreased from $23,000 per voice channel in 1965 to $618 in 1971 and now to approximately $60. Costs are expected to continue to fall and capability to rise further. These satellites provide transmission of voice, video and data internationally and within individual countries. No country is now out of reach for the Intelsat craft through which New Zealand and 101 other countries are interconnected.

Direct to the home satellite broadcasting will be in operation in a number of countries in the next two or three years. Plans are well advanced in France, Germany, Italy, Norway, Sweden, Denmark, Finland, Iceland, Japan, Canada and the USA for these services.

Personal Satellite-Links by 1990

A NASA report projects the availability by 1990 of a communication satellite service providing radio telephone and data communication to "wrist-watch" styled terminals and interconnected to the global telephone network. This would enable anyone anywhere on the earth to communicate with anyone of their choice.

Computer communication network services provide almost boundless potential for individuals to access files of information within seconds that were previously unobtainable or available only at considerable expense and effort. Viewdata is just one example of this type of system.

Such networks will provide new means of interaction for communities and individuals with common interest. Fibre optics cables which transmit information in the form of light through minute glass fibres give extremely high channel capacity - up to 100,000 voice or data circuits, hundreds of television prorammes and thousands of radio stations. These cables could provide the means of distributing enormous choices of services including new forms of participatory entertainment, information and education.

Video cassettes and video discs are already being used to enhance the means of communication between individuals and groups.

6. FUTURE TECHNOLOGICAL DEVELOPMENTS IN BROADCASTING

There are many developments in broadcasting technology; some have been available for a while but not yet applied in New Zealand and others can be expected to be available within the next 10, 20 or 30 years.

The following describe some of these key developments.

FM Radio and Subsidiary Carrier Services

VHF-FM broadcasting is a form of radio broadcasting having the ability to provide a service with enhanced quality, especially in the reproduction of music. It has been in operation in Europe and America for many years.

> "Frequency modulation (FM) operates by varying (that is, modulating) the frequency of a radio carrier in proportion to the amplitude of a programme signal. This contrasts with amplitude modulation (AM) which is currently used for sound broadcasting services in New Zealand, where the amplitude of the radio frequency carrier is varied in proportion to the level of the programme signal. The amount of radio spectrum (bandwidth) occupied by an FM signal can be varied by changing the amplitude of the modulating programme signal, whereas that of an AM signal is dependent only on the bandwidth of the modulating signal. Ten times more bandwidth is occupied by an FM broadcast signal.
>
> "The larger bandwidth FM system requires less radiated power for a given signal-quality and coverage than for an AM system on a similar frequency. FM techniques permit high quality sound broadcasting at VHF frequencies (about 100 MHz) using acceptable transmitter powers (7)".

An additional facility that is available on FM channels is an auxiliary carrier service. On each FM stereo channel, one additional band-limited music channel or several voice or data channels can be radiated. In the United States, these 'Supplementary Communication Authorisations' (SCA) are used to carrying relatively low quality mono sound for background music systems. In Sweden, the 'Subsidiary Audio Channel', (SAC) as they call the additional channel there, is used for a mono radio programme, and in Cyprus this SAC channel is used for broadcasting radio programmes to schools. The Germans use several separate voice channels for transmitting information on traffic and road conditions which are piggybacked on FM radio signals.

One possible use in New Zealand could be the provision of personal paging systems if FM is used to establish a nationwide radio service.

These ancillary channels require a separate decoder at the receiver or a decoder built into the FM tuner.

AM Stereo

Another development in radio broadcasting expected to have an impact in the near future is the introduction of stereo on existing amplitude modulated, MF transmissions. This technology has been developed in the United States and the regulatory authority there, the Federal Communication Commission (FCC) has been evaluating five different systems which will allow stereo programmes to be transmitted on the MF band.

Despite the night-time interference in rural areas which limits the potential of MF for high quality broadcasting the quality of performance in primary service areas in New Zealand is high. Thus the addition of stereo modulation could produce a worthwhile enhancement to radio services in the primary target areas of existing and new MF stations.

Reception of AM stereo will require the use of a new radio receiver. To take advantage of the stereo quality of signals such receivers could be expected to be of better quality than the average mono ones today. It is very likely that a combination AM/FM stereo receiver will be manufactured in the future. This will result in a saving to listeners if such receivers are capable of receiving AM stereo or mono, FM stereo or mono and possible auxilliary carrier services as well.

The demand for higher quality stereo radio transmission can be expected to follow the widespread distribution of increasingly high quality domestic audio facilities. These increase the expectation of listeners by cultivating their appetite for high fidelity sound. Direct to disc and digital recordings are already widely available. These are capable of reproduction quality especially in dynamic range significantly better than AM stereo broadcasting will be able to achieve.

The main motivation behind the development and introduction of AM stereo has come from American AM broadcasters whose audiences and markets have been slashed by the rapid rise in the popularity of American FM stations. The latter now broadcast an identical range of programme formats to the AM stations and have the advantage of hi-fidelity stereo sound. The AM broadcasters in the United States see AM stereo as a means of boosting the popularity of AM services.

Digital Radio Transmission

The long term future is expected to see fully digital transmission from the recording microphone to a digital storage medium (e.g. disc, cassette, bubble memory or equivalent) and then through the transmission chain to the receiver. The technology for such a process is mostly available now but will necessitate extensive replacement of existing equipment to implement. It is most likely that fully digital radio and television transmission will first take place via new direct broadcast satellites.

Broadcast Videotex

This is the general term given to a separate information channel which is 'piggybacked' on the radiated television signal. The service is perhaps more commonly known as teletext. In the home, a standard television receiver which is equipped with an add-on videotex decoder can be used to view the normal television picture or switched to the videotex mode, to display 'pages' of script which are carried over the videotex channel. As with similar cabled systems known as interactive videotex or more commonly viewdata, the viewer has a small keyboard for selection of pages.

There have been a number of different videotex systems developed to date:

CEEFAX, developed by the BBC;
ORACLE, developed by the British Independent Broadcasting Authority;
ANTIOPE, developed in France;
TELIDON, developed in Canada; and
CAPTAIN, developed in Japan.

Some preliminary engineering tests of the British CEEFAX system have been carried out by Television New Zealand.

Currently broadcast videotex systems have a much smaller information capacity than cabled viewdata systems. The CEEFAX service in Britain provides 300 to 400 pages to viewers. Use of the broadcast service is similar to the cable one, but because of the more limited capacity, the data base and page usage must be more efficiently designed. Broadcast videotex can also be used for providing captions for the television programme channel as a service to deaf viewers.

Current developments include the provision of data storage in television receivers to decrease the access time of teletext information. With the continuing reduction in cost of digital storage it is possible that large data storage will be included in future television sets. These local information storage devices could be updated on a trickle feed basis via teletext transmissions and

accessed by users at their will. A future extension of this possibility would be addressable receivers which could have selected information services transmitted to them and stored for later access.

Improved Television Picture and Sound Quality

Present-day television pictures suffer from a number of short-comings, including -

(a) Flicker which is clearly apparent in large bright picture areas.
(b) The line structure is too prominent, particularly near horizontal boundaries in the picture.
(c) The overall subjective sharpness is only marginally satisfactory.
(d) Spurious coloured effects in the fine detail.
(e) Dot-patterning is visible near the vertical boundaries of highly-coloured areas.

The solution to these problems could be approached in two steps -

1. In the short term, better use could be made, in new receivers, of the signals on the present system standard. This approach would be compatible and current receivers would not be rendered obsolescent.
2. In the long term, new high-definition system standards could be evolved which remove the causes of criticism. Signals conforming to these new standards would not be suitable for use by present day television receivers.

In Britain, for example, electronic storage is being used to an increasing extent in the domestic television receiver. As previously discussed, receiver storage is likely to be used to permit very rapid access to a number of teletext pages. Storage of this nature and large-scale integration can be applied to the television picture and would permit the future receiver to accept conventional signals but to display a picture on a new standard which would eliminate large area flicker, substantially reduce the visibility of the line structure and improve the resolution.

Further developments have recently been made in colour television coding and decoding techniques. If these coding methods are adoped by the broadcaster, the pictures displayed by current receivers would not be impaired but if the new decoding methods were utilised on new receivers this would result in the elimination of unwanted spurious patterns and the removal of dot-patterning.

This compatible approach offers the prospect of providing, in new receivers, better immunity to propagation distortion (ghosting) and a reduction in the visibility of noise.

In order to meet all the earlier criticisms, it is necessary to replace the present 625-line system by a new television standard with a higher number of lines. However to appreciate fully the improved detail, a larger screen is required and experiments on large screens in the home suggest a higher aspect ratio (width to height) for the picture is to be preferred.

For the purpose of estimating the transmission requirements of a possible new standard, a recent SMPTE publication has assumed a conventional scanning process with a 1501-line system, 60 fields per second, single interlace and a picture aspect ratio of 8:3. It was also assumed that separate luminance and colour-difference signals would be transmitted. This paper did not discuss the feasibility; its main conclusion was that sufficient spectrum capacity for such a system, assuming broadcast transmission with digital coding, could only be found in a 2 GHz-wide satellite broadcasting band near 40 GHz.

However, before deciding on any radically new standard such as this, important questions require consideration, principally on new picture sources and displays. Equipment for both is likely to be very much more expensive than that of present hardware, especially initially.

The standard of the future may not employ the conventional system in which elements of the picture are scanned in a regular horizontal line sequence. The possibility of digital coding in a random order, or of addressing specific display elements that need to be up-dated, may provide more effective television in the long term.

Of the two approaches, the compatible approach relies on the use of present day technology in the receiver. The approach allows an evolution to high-quality receivers which would increase in number as costs become less.

The radical approach may well be the long term goal but must await several decades before realistic techniques give the major improvement in picture size and definition that is required.

There are a number of proposals for the introduction of multiple sound channels on television. These could be used for single programme stereo sound or for different language channels. These facilities could be provided by adapting the existing television transmission standards but would require replacement of existing receivers or addition of separate multi-channel sound decoders and reproduction facilities.

Television Production Equipment

Development of television production equipment has been in two directions. On the one hand, highly complex professional systems have evolved to maintain the quality and help the efficiency of professional programme production and presentation, such as effects generators and computerised post production editing.

On the other hand, there has been considerable development in semi-professional equipment used initially on closed circuit systems and for educational purposes, e.g. video cassettes and camera equipment. The technical quality of this equipment is continualy increasing and costs are falling as a result of new and cheaper technologies and higher production quantities.

This latter trend in production equipment is expected to increase the potential for access by the public to programme production and presentation activities. It has also introduced a major conflict in technical and performance standards. A number of different and incompatible standards now exist and limit the opportunities for interchange of recorded material.

Three-Dimensional (3-D) Television

Three-dimensional television or pseudo 3-D television has been in use in Japan, Italy and Mexico for several years.

All systems in operation use a different principle and require the viewer to wear special light filtered spectacles to produce the three-dimensional effect. The Japanese system also requires objects to be in motion to achieve 3-D images. Currently, there are no international standards. True stereoscopic television would require some changes to the existing television standards and new television receivers with microprisms and polarising filters in the screen to overcome the need to wear spectacles.

With the inevitable scientific development of a full colour bandwidth light-emitting diode, the future could see the evolution of a high definition, large screen, three-dimensional television standard. The bandwidth necessary for this enhancement would be great and would dictate transmission in the upper reaches of the spectrum or digital transmission over cable.

Cable Services

Radio and television signals can be distributed to homes by cables instead of by radio wave transmissions. Until recently this has been via television cables quite separate from the wires connecting the telephone to the subscriber's house. However with the application of very wide-band cables such as fibre optics and the introduction of new communication services, there has been a combining of all services onto a single cable in a number of recent installations overseas.

Originally cable television systems were only one-way, designed to disseminate programmes outward. More recent systems now provide a return circuit from the viewer to the studio to facilitate interaction and participation.

In the United States where cable systems have developed rapidly they were first introduced to give coverage of rural areas because the frequency channels had been utilised to give multiple programmes in the major urban areas. Cables then became popular in the cities as a means of distributing additional programmes. Many of these services distribute what is known as 'Pay TV' where the viewer pays for the cable connection to the home as well as for individual programmes or packages of programmes watched. Typical TV cables reticulate 36 channels but some currently being introduced have a capability of twice this number.

The Warner Brothers Communication QUBE cable services in the United States (described in a later section), the HI-OVIS evaluation project in Higashi-Ikoma in Japan and the Canadian Elie-St Eustache fibre optics trial are examples of the potential capability of modern cable systems. They go well beyond the distribution of television programmes and extend the one-way concept of broadcasting to a two-way interactive medium. They include many new information and home monitoring services as well as normal telephone and new videophone facilities.

The HI-OVIS project uses a wide bandwidth cable to distribute national and regional television channels together with news, information and relays of events closely geared to the Higashi-Ikoma community. Production of local programmes relies greatly on the participation of the local people. The system can provide local news in motion and activities of many kinds using the community's mobile camera vehicles.

HI-OVIS is seen as a means of providing comprehensive communication facilities in which anyone can participate and which offer the community an extensive range of information speedily and accurately. It is regarded by the Japanese promoters as a means of solving the problems of post-war urbanisation and isolation of the nuclear family which are seen to have weakened the traditional solidarity of regional Japanese societies.

The range of local information is extensive and includes details on local government, consultation programmes related to legal problems, taxes, complaints about housing and other matters, relays of city office sessions, prompt reports on the local government election results, views on crime and fire prevention, traffic densities, hobbies, shopping guides, education programmes (pre-primary, language and technical education, hygiene and welfare), as well as a diverse range of programmes produced by the local people themselves. Residents can request replay of video cassettes over the cable from a library at the communication centre. These include locally produced programmes, re-runs of broadcast material and movie films.

The range of communication services being supplied on the Canadian trial system is equally comprehensive. A list held by residents connected to the Elie-St Eustache cable identifies options as seen in Table 1 below.

TABLE 1 - POSSIBLE USES OF ELIE-ST EUSTACHE FIBRE OPTICS TRIAL

Digital Telephone Service
Voice Mail
Telephone Message Recording and Retrieval
Fire, Intrusion and Medical Alarms
Temperature Alarm for Deep-Freeze Malfunction
Hold Up in Progress Alarms
Remote Meter Reading for Power, Gas, Water
Mono Music, Stereo Music and Voice Distribution
Teleshopping
Two-Way Interactive Video School
Electronic Mail
Facsimile Transmission
Electronic Newspapers
Yellow Pages
Library Services
Stocks and Securities Information
Polling and Auction Systems
Restaurant Listings
Guide to New and Used Cars
General Government Information
Income Tax Advice
Electronic Funds Transfer
Cable Television Distribution
Educational Television
Pay TV
Televideo Phone
Real Estate Listings
Market Prices - World and Local
Detailed Information Tailored to Specific Operations
General Agricultural Extension Information
Weather Information

Subscriber Television

Subscriber television is a form of 'Pay TV' and generally refers to television signals that are transmitted over the air in 'scrambled' or encoded form so that they can be received only by viewers who have subscribed to the service and been given the necessary decoder. STV services are a means of charging users for reception of television signals on a direct subscription or user pays basis.

7. FUTURE ROLE OF BROADCASTING

In the face of these revolutionary developments in the possibilities of human communication, the future role and responsibility of broadcasting must be analysed. The aim of broadcasting should not be its own internal development but the creation of communication between people.

It may be that some of the roles that broadcasting has currently adopted in New Zealand could better be performed by other new forms of communication, and investment by both public and private sectors in these may better satisfy the overall public good than extensions of broadcasting services along traditional lines.

An examination of the future role of broadcasting suggests a need for development of the medium in a different manner from that of the past.

Howard Gough has identified the primary and secondary roles presently adopted by broadcasting in New Zealand as follows:

"Primary roles:

Journalism: covering the fields of information and education.

Show business: incorporating entertainment and recreation.

Marketing: dual objectives of consumer information and resource generation

Within these broadcasters differentiate levels of cultural taste and sophistication.

Secondary roles:

Derive from collective and individual use of the media are the so-called:

Companion role: time-filling, surrogate company.

Gate keeper role: reinforcing positive social behaviour and morality, the community's conscience.

Watchdog role: reporting and exposing malpractice - the fourth estate role.

Entrepreneurial role: mobilising community activity.

Promotional role: cultural platform, employing and publicising talent and causes.

Parish pump role: 'society talking to itself', putting people in touch, social welfare.

Agenda setting role: selecting discussion topics (secondary communication), offering shared community experience.

Educational role: standard setting in language, attitudes, values, extending experience.

Emergency role: supplementary public warning system - in disaster and crises" (8).

Journalism Role

Distribution of information, exchange of opinion and comment, co-ordination of community activities and education of mass audiences have been the main functions of broadcasting's journalism role.

Access to an abundance of information sources unthought of in the past will be made possible by future computer/telecommunication information systems. These will transmit text and grahics via cable as in viewdata type services, or over dedicated radio transmission channels or within the bandwidth of existing television and possibly FM radio signals (for example television teletext and FM auxiliary carrier systems).

These will allow individuals to choose and access information at their will, unconstrained by mass-audiences or by time or location (assuming national coverage of the services). It can be envisaged that these services will achieve more extensive and flexible distribution of information to individuals than is possible via broadcasting as we know it today.

The selection of information will be personalised: for example, continually updated general news bulletins may be transmitted in text form and be read by consumers at any time. Additionally a diverse range of specialist news and detail could be selected on subjects such as business, finance, shopping, price guides, farming, sport.

The electronic mass-media have an enormous potential for education, especially via the audio-visual character of television. Programmes such as Alistair Cooke's 'America' and Bronowski's 'The Ascent of Man' are regarded by many as excellent examples of the combined entertainment and educational potential of the medium. Radio and television will continue to be powerful agents of influence and change with huge scope for nation building, social development, co-ordination

and re-inforcement of social values.

Additionally, both radio and television have been used for formal educational purposes in a number of countries. School broadcasts have been transmitted by radio in New Zealand for many years. In the UK the Open University uses national broadcast television channels at certain times of the day and night to transmit "lectures" and supplementary visual material to thousands of remote students. It has grown rapidly to become the largest university in Europe in terms of the number of students taking degrees. The operation of the Open University is limited by the available television channels. In the future a number of television channels fully occupied by educational programmes may be needed.

Information transmission systems, particularly interactive ones, will offer different learning facilities. These may take the form of electronically distributed text and graphics similar to that provided in a printed book. Interactive systems allow testing of the user's understanding and can control the rate of progress accordingly.

The widespread availability of domestic video cassette and disc equipment will enhance the educational potential of broadcasting. Programmes will be able to be recorded in the home and at schools for later and repeated replay. This gives increased flexibility. Distribution of educational cassettes and discs via the mail or selectable access to electronic libraries using wideband networks from the home, school, office, or community centre could be possible in the future. The 'freeze frame' function on video disc machines provides an excellent educational aid whereby normally moving video displays can be held still for more detailed or extended study.

The existing broadcast technology has the potential to be extended to offer some of these services. For example, FM radio and television transmissions have the capacity to carry within their broadcast signals additional data services which could be used for information and education as described. These are again one-way channels of dissemination, and are limited in their data-carrying capacity. They can be regarded as a means of increasing pluralism and diversity of choice, extending the opportunity for individuals to participate as information providers in response to identified community information needs.

Show Business

Most people think of broadcasting primarily as a source and promoter of entertainment, acknowledging its show business role. Audiences partake as passive partners in this form of entertainment which, to most, is a relaxation and often an antidote to the increasing pressures of society.

The social and psychological dangers of this absorbing passive entertainment medium have been reported increasingly by researchers and critics (9).

New television technology, particularly over cable, can provide a direct feedback channel enabling viewers to participate actively in the communication act. Warner Brothers Communication cable television QUBE in the USA operates a low-bandwidth return channel from every viewer's television receiver to the presentation studio. It gives the audience the ability to vote on the acceptability of programmes (if sufficient of the audience dislike a programme it is stopped and a new programme screened). Many may see this as dictatorship of the proletariat.

Viewers can participate in quizes and react to questions of news and current affairs. Other services on QUBE include security monitoring of homes connected to the system, notification of ambulance services in the event of an elderly user becoming ill or injured, and purchasing of goods remotely from the home. QUBE has demonstrated some of the potential of active forms of entertainment possible by extending broadcasting to a two-way medium. Further potential in this respect has been described in the HI-OVIS and Elie-St Eustache projects.

Interactive data networks in the future will offer other forms of participatory entertainment. They will be a means of communication between groups and individuals with common recreational interest who will be able to share and exchange ideas via electronic conference facilities. Individuals and groups will be able to engage in interactive games although physically separated. Already electronic games are available to plug into the television rceiver. These are limited in that they do not, at this stage, offer participation by players in different locations.

The entertainment role of broadcasting will alter with the introduction of these new means of human interaction - audience figures will be affected if nothing else.

It will also be affected by the increasing availability of video cassettes and discs which increase flexibility in viewing behaviour. Community and individual libraries of cassettes and discs can be expected to grow rapidly. Communal libraries could evolve as extensions of existing library services - they may be a part of the development of community communication centres or an alternative service offered by broadcasters or cinema operators.

Marketing

The persuasive ability of broadcasting has been exploited widely as an advertising medium in New Zealand as in many other countries. It is, perhaps, this function of broadcasting that offers one of the most compelling reasons to maintain the medium in its present one-way, captivating, mass medium form. A huge advertising industry has grown and it is involved in the preparation of messages which subtly (and not so subtly at times) coerce audiences that have been lulled into mental inertness by the mesmerising power of the medium.

The concept of marketing is not confined to the paid advertising and consumption of consumer goods and services. The media are used also to persuade users to accept particular ideas and attitudes. Thus a marketing approach is often adopted by non-commercial, non-profit organisations using the broadcast media.

New communication services could be used as advertising channels. Individualised information services may not generate widespred mass audiences in the way broadcasting does at present but could offer means of capturing well segmented target groups, e.g. businessmen, sporting enthusiasts, etc.

Any increase in communication channels within a closed community or coverage area will fragment the target audience of existing services and will affect their commercial and financial viability. The introduction of television in the 1960's had a major effect on the revenue of newspapers and radio. There is a limit to the total pool of advertising to be gained in any market and this may not be able to support the vast range of new communication services if they are expected to operate on commercial revenue. This raises the major policy issue of how existing and new communication resources should be funded in the future.

Service to Society and Minorities

It can be seen that the primary roles of broadcasting could be greatly affected by the introduction of new means of communication. Analysis of the identified secondary roles shows similar potential: for example, even at the present time all forms of the media are increasingly having difficulty in grasping their cultural role in an atmosphere of survival and competition. In the present market place environment of the mass media it is more and more difficult to justify the costly programming that is likely to satisfy minorities.

In its gatekeeping role, broadcasting as with the other media has a responsibility in influencing attitudes to social behaviour and morality. Despite the care taken by journalists, editors, programme-makers and programme controllers to act impartially, they

reflect particular social and cultural values and perspectives when writing, selecting, interpreting or placing any programme material. There is a need for consistent standards to be applied across all existing and new services. It would make no sense if the standards applying to the electronic press in the future were different from those regulating television or radio which might be being transmitted to homes on the same cable or over the air on adjacent channels. Despite commonly defined standards, there will always be disagreement in interpretation. It is therefore important to guard against monopoly control of programme production and dissemination, and of information sources.

The Future Summarised

The future of radio rests on its mobility and the fact that it is the only existing and foreseen communication medium which requires the use of only one of our senses. Radio can and will continue to be used on the move - in cars, at the beach, in the mountains. Radio wave transmission of radio will remain essential to ensure the preservation of this mobility which cable connections cannot provide.

The future of broadcast television is likely to lie in two different directions. It will be a medium for:

* community-based, participatory interaction
* high-performance spectacular entertainment.

8. OWNERSHIP AND CONTROL OF BROADCASTING

Because of its potential for social control and influence, its persuasiveness, its marketing ability and hence commercial revenue, the ownership and control of broadcasting services will always be fiercely contested.

Politicans will continually try to exert as much control as is publicly tolerable, either directly or indirectly. The control of broadcasting, as with many communication issues in New Zealand to date, has been a subject of political party debate and decisions have often been made on the basis of short-term political expediency.

There have been four major broadcasting Acts in New Zealand as well as a number of amendments. All the changes have been concerned with the control and organisational structure of broadcasting.

Broadcasting is a medium of influence and change. Its roles are not neutral - values and judgements have to be applied to almost every decision in the broadcasting process. Even entertainment is not neutral. Entertainment in the form of plays and local theatre has been an instrument influencing social values for centuries. Religious stations such as Radio Rhema use music to promote their Christian values.

Broadcasting channels set community standards, they purvey values for good or ill. This is apart from the power they hold for weighting particular programmes and information by time placement, by repetition, by censoring or by withholding from broadcasting altogether.

All this has implications for ownership and control. It underlines the greater need for the public to take part in and to monitor media generally and especially broadcast programme decision making and the content of future new information services. It also implies that the integrity of broadcasters and information providers and presenters must be beyond reproach and that they must not succumb to pressures from political, bureaucratic, commercial or public sources.

Ownership and control are inherently related to the philosophy of funding broadcasting services. There are two extremes within which broadcasting can develop. On the one hand it can be an exclusive entertainment medium to serve advertisers, and generate its operating costs from commercial revenue, and on the other, an exclusive propaganda medium to serve government.

Middle Course

New Zealand has steered a middle course between these two extremes and developed a hybrid system involving public and private radio and (so far only publicly operated television). Because available channels have been used to develop services on a national coverage basis, there has not been a large number of channels available in any one location even in the highly populated areas. Regulation has been necessary to ensure fair distribution of the restricted channel resources and to some extent to control content. This could change in the future as technology makes many new channels available via cable and satellite transmission.

One of the most strongly contested policy issues of the future can be expected to centre on the case for regulation of ownership and control in a future climate of channel abundance and, if there is regulation, on how this should be administered.

Many argue that in such an environment regulation should be abolished and a laissez-faire approach to channel usage applied. This, they believe, will allow all users to satisfy their needs as they wish.

On the other hand, because of the powerful social influences of the electronic media others believe that the increase in channels and services will necessitate a greater level of control.

Intense competition could develop between New Zealand's electronic media in the future. This may result in exploitation of audiences rather than of the medium and distortion of the potential of the communication resource in fulfilling its diverse social roles. In order to prevent such a stifling of broadcasting by undue commercial pressure it is likely that some form of regulation of future ownership and control will be necessary even with channel abundance.

Effect of Overseas Programmes

Regulation may also be necessary to control the activities of overseas communication organisations in New Zealand. With an abundance of local channels to be filled and readily available cheap overseas links, particularly via satellite or even direct-to-the-home satellite broadcasts from other countries, it is inevitable that we will experience a large increase in imported overseas programmes. These are likely to include overseas networks and complete broadcast packages as are currently available for cable transmission in North America.

This will not be a problem unique to New Zealand. It is a growing international phenomenon. The social impact of such trans-border information flows on any country's cultural identity and national sovereignty is likely to be very significant. The difficulties of regulation in this area appear to be immense and are currently the focus of much international research. It is possible that the only fruitful approach in the future will be to ensure that a good balance involving a wide variety of different national programmes is made available.

A local programme production industry must be fostered. This provides scope for extended public participation in the broadcast media through locally commissioned and purchased work. Increased outlets can be expected to give greater scope for diversity and may release new talent. In a small country with limited markets and an increasingly competitive international environment, a local programme production industry must be stimulated by firm long-term policies.

In summary:

> "The ideal is (as Unesco documents suggest): pluralism of control, reducing the pressures of commercialisation, freer access to the means of communiction, freedom from government or political harassment, guaranteed 'freedom of the press' or, in broader terms, freedom of information, multi-cultural development through media, extension of small-scale local community media, development of policies for future applications of communication technologies, further innovation in use of media for educational, cultural, social roles ....
>
> "In an information society which claims to be democratic, the mass media of information shouldn't flourish or fall by the wayside according to the buoyancy of the market place or the ideologies or prejudices of those in power - whether political, financial or commercial power, and that might incude multi-national commercial power. The flow of information should be more constant, more stable and more evenly distributed than either of these conditions would allow" (10).

9. CONVERGENCE OF MEDIA

The technological trends in communication/information services which will have a significant effect on the future role of broadcasting can be seen as a convergence of function, authority and control of all media.

These forces are also producing an integration of all forms of mediated expression into a single technical system which will be electronic.

Newspaper publication via data networks and television displays, viewdata and teletext type services, cinema by electronic video transmission, multi-channel television and interactive information systems on cable are all striking examples of this evolution towards convergence.

Horizontal Media Structures

This convergence or integration calls for re-examination of media and technical institutions. The present vertical type structures which divide organisations into different media or systems (e.g. press, radio, cinema, television, data processing, etc.) may not be appropriate for the future and could well be replaced by horizontal structures divided by function: the gathering, production, transmission and presentation of information, for example.

The current moves by the New Zealand newspaper industry to initiate viewdata information services and establish a third television channel are examples of the existing media organisations moving towards these new horizontal structures.

This introduces a high potential for ownership and control of information sources becoming undesirably restricted. Care must be taken to devise policies to diversify control of information sources as much as possible.

One could regard many of the new services as different or evolving forms from what has traditionally been known as 'broadcasting'. (This can become a semantic argument). However, it seems more likely that 'broadcasting' will become an inadequate term for the future, and electronic media will be more appropriate.

The electronic media of the future could be defined narrowly as including only those services using essentially one-way technical means for dissemination. However, one could more suitably include all

electronic systems for the dissemination and exchange of information, both one-way and two-way. This then includes systems using radio wave transmissions and cable distribution. It includes the telephone as an instrument of two-way interchange.

The implication of such an all-encompassing definition could be significant especially to the technical organisations currently responsible for existing services. It could result in an amalgamation of existing broadcast and telephone carrier institutions and include all new electronic information services.

An alternative way of viewing services in the future is to continue much as in the past and identify all electronic media which use the telephone switching systems as telephone related electronic media and all others as broadcast related services.

It can be seen that new technologies and services make the concept of 'mass media' similarly inappropriate. At one extreme, the 'mass media' are beginning to abut on, or even to merge with communications modes that traditionally were classified as telecommunication or computerised information services, for example videotex. At the other extreme the 'mass media' are evolving into more individualised patterns which are more correctly described as group or mini-media, for example alternative/independent press or cinema, community video organisations, etc.

The concept of 'mass media' is linked to concepts of mass production and mass markets. It is related particularly to industrialisation. The information society of the future has the potential to free audiences from being passive group participants or objects of the mass media process and allow them to become active individual participants.

Transmission Organisation

With the integration of media and acceptance of the all-encompassing concept of electronic media there appear to be good reasons to consider establishment of a single national transmission organisation or local/regional transmission bodies responsible for the reticulation of, and perhaps provision of, all technical means of electronic communication.

A national transmission authority would rent technical channels to all information producers and presenters. It could be privately or publicly operated. Private operation would amount to making available hundreds of millions of dollars of existing publicly funded investment for private use and financial return. Under such an approach the technical channels of communication would be developed and provided to information producers and presenters entirely on a market basis. This is unlikely to be publicly acceptable and without rigid regulation is

unlikely to achieve equality of service and satisfaction of minority users.

A government agency or more desirably, a public corporation, would be an appropriate body to operate a National Transmission Authority. There are, however, obvious dangers in monopolising the means of communication and information distribution just as there are advantages.

Some disadvantages include:

- High potential for the enormous power of such an essential organisation to be abused.
- High potential for manipulation of all means of public communication politically and commercially.
- High potential for operational regulations and practices imposing censorship of information distribution.
- Disruptive staff and union activity could affect all means of communication having severe impact on all social and commercial activity.
- Duplication of technical systems, unless deliberately built in, is reduced. This could be important in times of national emergency.
- Inherent inefficiency in large organisations.
- Staff identity with smaller defined media function is lost - staff are not able to identify as easily with a large organisation and its objectives.

Some advantages of combining the provision of the technical means of communication include:

- Rationalisation of equipment and systems - particularly microwave trunks and local cable services.
- Possible staffing rationalisation.
- Establishment of a suitable technical body for integrated planning and development of national communication services.
- Establishment of a single body able to adjust priority of resource allocation across all forms of communication.

Under this system of a unified transmission authority public and private information producers and presenters should be given maximum freedom to distribute and exchange their product. Obviously basic technical performance requirements would need to be set and monitored by the transmission organisation.

Information Providers and Presenters

Within a horizontal media structure, information providers would gather and produce information, education, and entertainment material for supply to presenters who would exercise editorial control, determine audience needs and finally package it for distribution over leased channels either cable or radio wave transmission. Information producers may also operate as presenters.

Whether information presenters are required to obtain a licence to use channels or simply must comply with specified technical requirements is likely to depend on whether regulations exist to control channel content and whether the available channel resource is limited.

Regulations aimed at guarding against undue preference in allocating a limited resource are likely to lead to the existence of a semi-judicial organisation which hears applications in public as does the existing Broadcasting Tribunal. Although this can be expected to result in fairness it inevitably lengthens and makes more expensive the decision-making bureaucratic process.

10. FREQUENCY SPECTRUM

THE FREQUENCY SPECTRUM AND GEOSTATIONARY SPACE ORBIT ARE THE MAJOR NATURAL RESOURCES OF COMMUNICATION. THEIR MANAGEMENT AND PLANNING ARE THEREFORE CRITICALLY IMPORTANT.

The Nature of the Spectrum

Communication between two remote points can be achieved by the transmission of signals either by cables (e.g. the telephone network) or through the air - by radio waves (e.g. radio and television services as we now receive them in New Zealand). Radiated transmissions use electromagnetic radiation which is energy resulting from acceleration of an electron or other charged particle. Radio waves may be characterised by wavelength - the distance between one peak or trough and the next or by frequency - the number of peaks that pass a point in a given time. For any electromagnetic wave, the arithmetical product of wavelength and frequency is always equal to the speed of light.

Frequency is measured in terms of cycles per second, and the unit of measurement is the 'hertz', or one cycle per second. A kilohertz (KHz) represents a frequency of 1,000 cycles per second; a megahertz (MHz) is 1,000 KHz, a gigahertz (GHz) is 1,000 MHz, and a terahertz (THz) is 1,000 GHz.

For convenience the designations in Figure 1 are used to describe the radio spectrum. Electromagnetic waves at the bottom of the spectrum are audible - those below 10 KHz are not suitable for radio communications. The radio spectrum ranges to 3 THz (or three million million cycles per second). At these frequencies and above, electromagnetic waves become visible - they are light waves.

The whole of the spectrum is not technically or economically available. The propagation characteristics of the spectrum change with frequency so that some parts of the spectrum are better suited to certain purposes than others. At the lower end (VLF and LF) the radio waves tend to follow the curvature of the earth, and are useful for reliable long-range communication through relay stations.

In the MF and HF ranges, advantage is taken of the fact that these waves are reflected from the ionosphere (the lower levels of the atmosphere) and they are used for long-distance (but less reliable) radiocommunication (for example marine communication and some point to point communication links particularly in remote areas) and for international broadcasting.

ELECTROMAGNETIC SPECTRUM

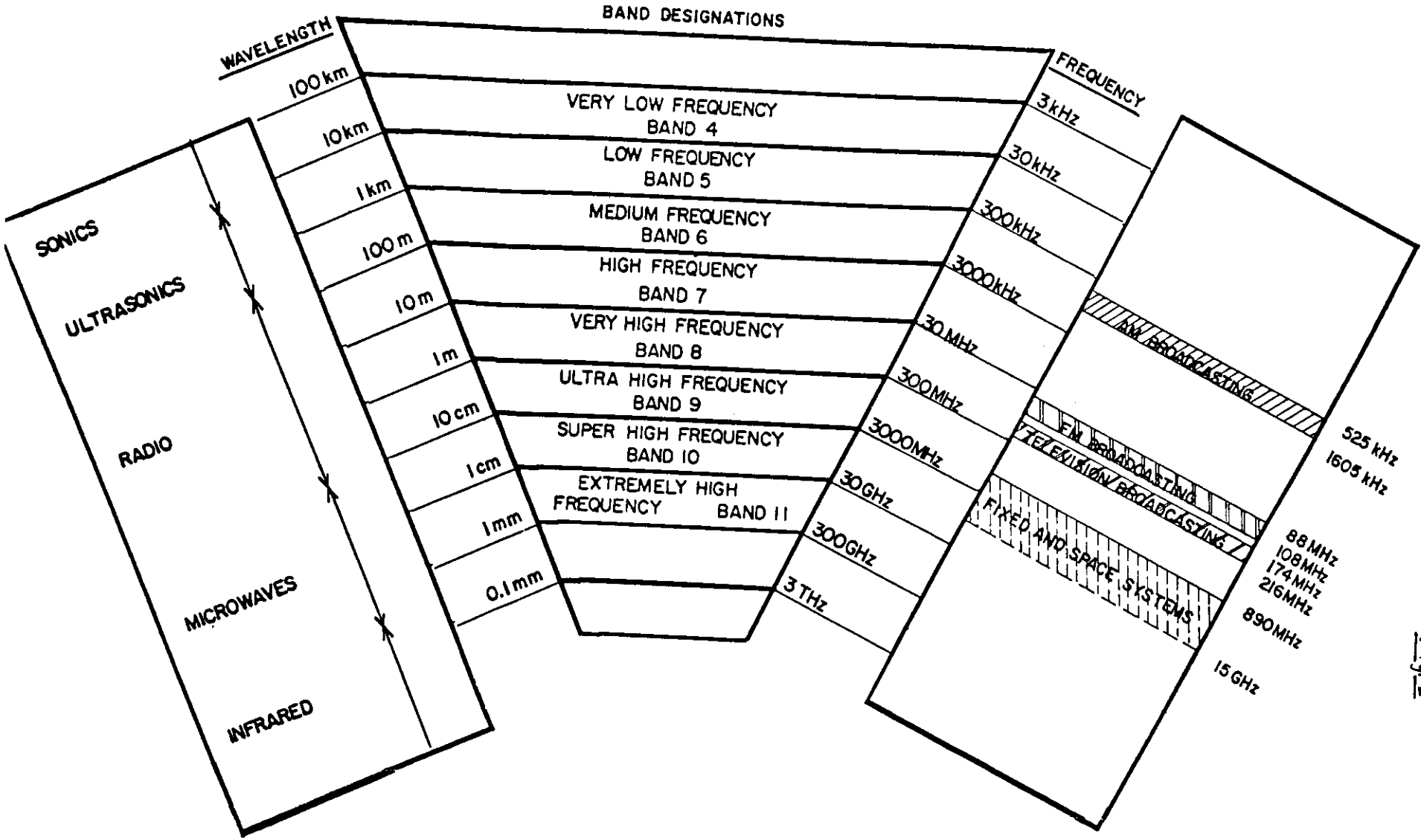


Fig. 1

Frequencies in the VHF range and above have two characteristics that limit their use; they are progressively blocked by surface objects and attenuated by the atmosphere, and are therefore useful only for satellite communications and terrestrial transmission over line-of-sight paths.

The prime area of the spectrum has been up to 1 GHz since this is well suited to simple systems, such as sound and television broadcasting and mobile communications (land, aeronautical and marine) as well as for long-distance point to point radio navigation.

Above 1 GHz there is a need to use more complex antennae and transmission is restricted to line-of-sight and suffers progressive attenuation with distance as the frequency increases. This reduces possible applications, creating a relative abundance of spectrum for services to which the range is suited and permitting the transmission of complex broadband high-volume data and voice signals.

Satellite Frequencies and Orbits

It is in the area of the spectrum above 1 GHz that most transmissions via satellite take place. For this reason it can be expected that most development in frequency usage will take place in this sector in the future.

Most communication satellites nowadays circle the earth in what is known as the 'geostationary' or 'geosynchronous' orbit. In this orbit, 35,860 kilometres (22,282 miles) above the equator, a satellite travels around the earth in exactly the earth's rotation time and hence the satellite appears to be stationary over one point on earth.

Most point to point communication satellites to date have used frequencies in the 4 to 6 GHz band. The power level that can be used at these frequencies is limited because of the potential to interfere with terrestrial services also using these bands (for example telephone and television microwave links). This was not a severe limitation with early satellites as the available power sources on the satellites from solar collectors and storage batteries was also low.

More recent satellites (e.g. Canada's Hermes and Anik craft) use higher frequencies, for example 12 to 14 GHz as will future satellites. These frequencies allow use of higher powers and closely controlled coverage areas or 'footprints' and make possible direct to the home broadcasting. The use of higher frequencies is also important in that it allows satellites to be parked more closely in the geostationary orbit without interfering with each other. This will increase the number of satellites which can be used in the orbit. At frequencies of 4 to 6 GHz satellites must be kept almost 2,000 miles

apart.

Massive military expenditure is currently being spent on laser development. This may lead to satellite up-links being carried on laser beams in the future which would mean satellites could be placed very close together without interference.

> "Lasers operate at more than 10,000 times the frequency of today's up-links and hence have a much higher potential bandwidth. Lasers may not be used on the down-links because of possible dangers to persons on earth. Highly directional millimetre wave spot beams (10 to 100 GHz) could carry the signals down. With such technology the main foreseeable limit on satellites is man's own capacity to use the available bandwidth" (11).

Allocation of Resources

The radio spectrum, together with the geostationary orbit, are the major natural resources of communication. These are national as well as international resources. Because of this and the characteristics and limitations on the use of the spectrum and satellite orbit, management and control of them are critically important.

Efficient and orderly use and development of the spectrum is subject to international and regional agreement. At the international level, chaos in global communications is avoided by the allocation of frequency bands for particular uses and the co-ordination of specific assignments within these allocations. This overall frequency planning takes place under the control of the International Telecommunication Union (ITU), formed in 1865 and now an international agency of the United Nations.

The ITU divides the world into three administrative regions. Region 1 covers Europe, the USSR and Africa; Region 2 - North and South America and Greenland; and Region 3 - Asia and the Pacific. Within Region 3 New Zealand negotiates bilateral agreements with other countries, for example Australia and the Pacific Island nations for frequency usage within the internationally allocated bands. The ITU's co-ordination of spectrum and satellite orbit involves international conferences such as the World Administrative Radio Conferences (WARC) the last of which was held in 1979.

New Zealand has been a member of the ITU since 1878 and the NZPO acts as the 'administration' for New Zealand. This involves licensing of frequency users, registration of frequency use with the International Frequency Registration Board, policing of interference and co-ordination of requirements for use of frequency bands.

Authority from the NZPO to use a particular frequency does not convey any property rights. The licensee is entitled to the use of the frequency for only a limited term and accepts certain concomitant obligations. These are set out in the conditions for a licence as determined by the Post Office under the Act.

Pollution

A subject of increasing concern in spectrum management is the prevention of 'pollution' and interference. Pollution or man-made noise is generated by electrical plant and machinery, by high voltage electrical transmission lines particularly with 'leaky' insulators, electrical switch gear, etc. These sources produce broadband interference which affects the use of all radio frequencies particularly below about 500 MHz. The accumulated interference from multiple sources of noise becomes very much higher in urban areas and requires the use of higher power radio transmissions to produce the necessary signal strength at radio receivers and hence maintain acceptable quality of service.

Interference between radio transmitters as distinct from generalised pollution can mostly be controlled by proper frequency assignment and policing of unlawful users. This is the function of the NZPO. However, as the use of the spectrum increases, some increase in noise must be expected.

Protection of Users

Planning, however skilful, is unlikely to be perfect, and unavoidable expenditures may be incurred by spectrum users when reallocation is necessitated by unforeseen events.

In Canada where spectrum crowding is much more serious than in New Zealand because of the high population and heavy usage in North America (particularly in areas close to the Canadian/United States border) there has been the suggestion than an insurance fund be established to cover the costs incurred as a result of reallocation or enforced reassignment before the expiry of an agreed planning period. A relatively small annual premium paid by thousands of licence holders would provide a substantial fund within a few years, and it was proposed that the scale of premiums could be related to the nature of the risk for each licence holder (12).

It is probable that such a scheme is not warranted in New Zealand at the moment but consideration might be given to it for application by certain high usage services in contested areas of the spectrum in the future.

11. SPECTRUM USAGE IN NEW ZEALAND

New Zealand is fortunate that because of its geographic isolation it suffers much less interference from other countries than many areas of the world. This combined with the small population means it has a relatively uncluttered radio air space compared with many countries particularly those in Europe or America. However use of frequencies in New Zealand has not always been planned with sufficient concern to conserve the spectrum resource.

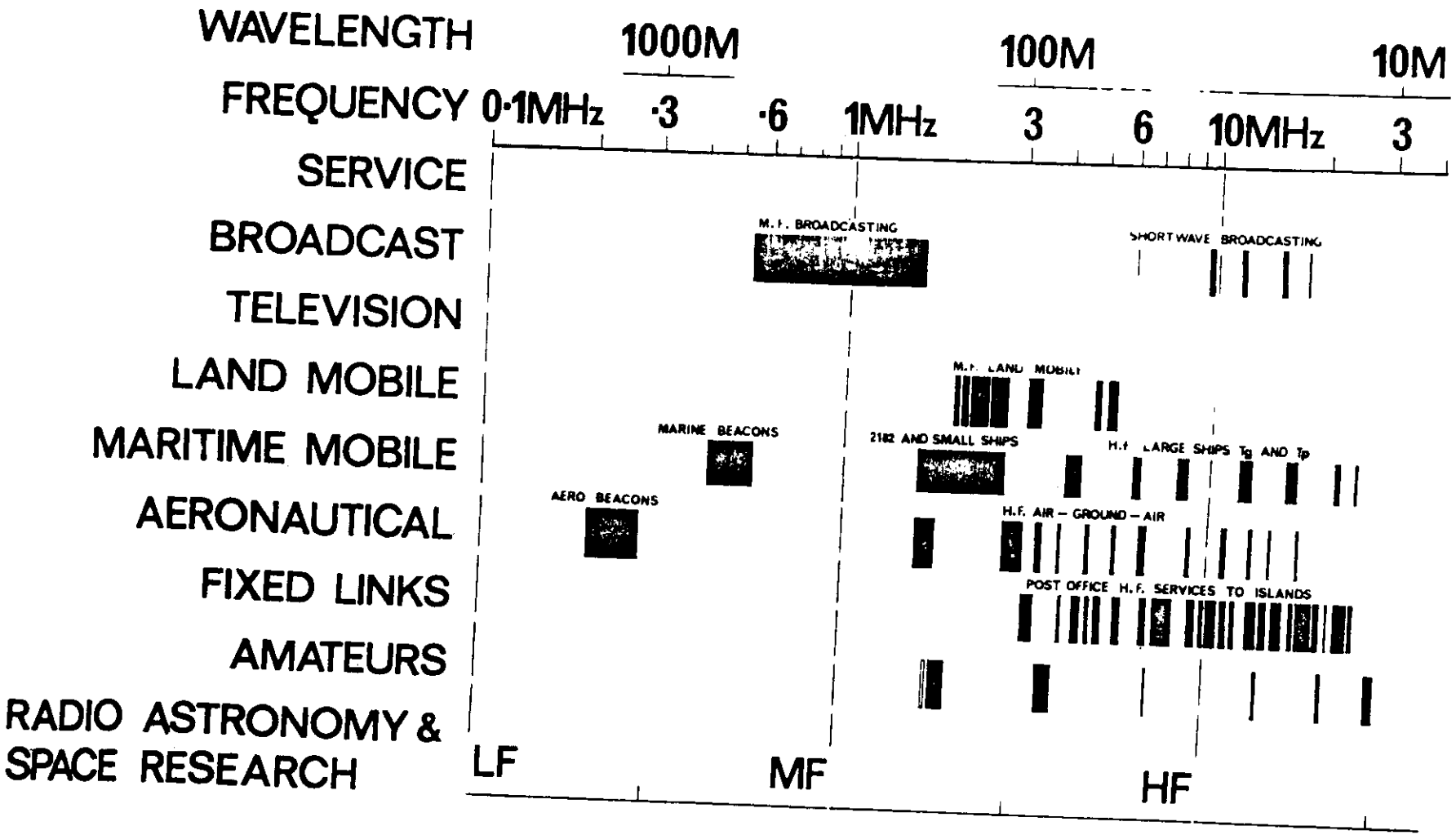
As frequency usage has increased, so have noise levels and some prime frequency bands have become full and are subject to continuing pressure. This is particularly so in the VHF television broadcast band, in some mobile radio bands and to some extent in the MF radio broadcast band.

It is true that there are large areas of spectrum available, particularly above 1 GHz. However, as already indicated, these frequencies are not necessarily as useful as lower ones and require more expensive equipment. The technology necessary to use the highest frequencies in the spectrum, where enormous capacity exists, are not yet available. For example, the power levels necessary to provide direct to the home satellite broadcast services in the 40 to 80 GHz area are in the order of hundreds of kilowatts. These power levels cannot yet be supplied by satellites, but it is expected this will be possible in the future.

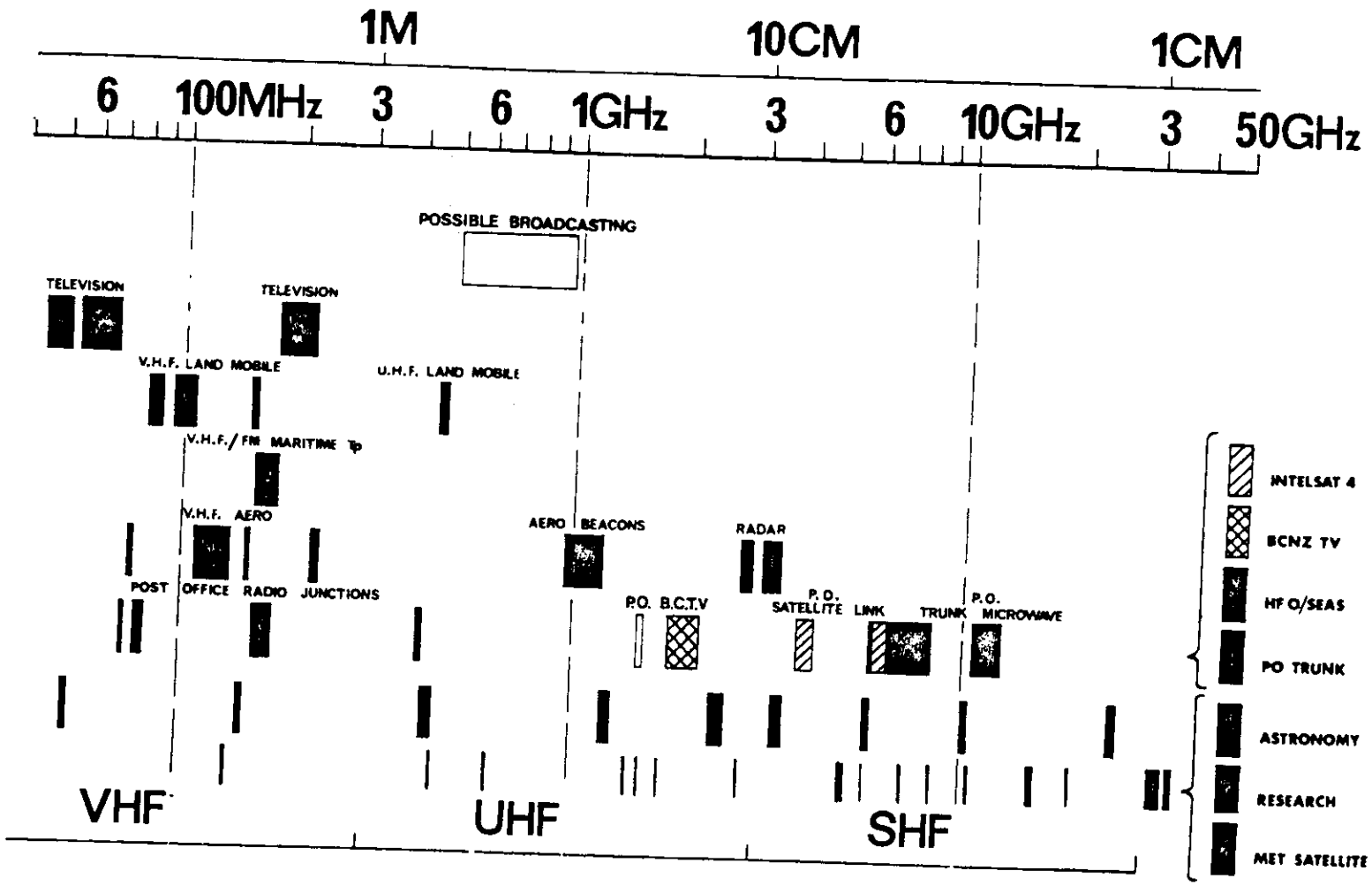
A fully comprehensive survey of all future spectrum requirements is well beyond the scope of this paper. However, present usage of the radio frequency spectrum in New Zealand is shown in Figure 2.

Fig. 2

RADIO FREQUENCY USAG



E IN NEW ZEALAND



ISSUE 1 JULY '77

Spectrum Planning and Control

Spectrum planning and control involves much more than the allocation of frequency bands and the assignment of particular frequencies. It requires long-term planning and the establishment of related technical and performance standards as a basis for regulation in the interests of all users.

This is a continuous process which needs to be supported by the monitoring and evaluation of performance to provide the feedback essential for the revision of criteria, standards and plans. Spectrum management ideally requires participation from all users so that the resource can be allocated equitably to all New Zealanders. This is a democratic ideal and prohibitively difficult to implement.

Some theorists argue that the most effective use of the spectrum in economic terms can be assured by treating it as a marketable commodity, frequencies being assigned to the highest bidder. Under such arrangements it is suggested that providers of 'essential services' could be charged an economic rent for spectrum space on the grounds that, in conditions of excess demand, this would necessitate a close examination of the relative cost-benefit aspects of other means of distribution.

Because of the vital nature of the resource and the need to ensure consistent and stable supply many would argue that the market force mechanism is not best suited to determining the allocation of such a critical and limited natural resource. Consideration of the concept does, however, highlight the need for well planned, fair and responsible control of the spectrum.

Efficient management of the spectrum is vital to the development of telecommunication systems that will provide access to services for the largest number of New Zealanders at the lowest feasible cost. Every effort must be made to weigh the relative cost-benefit of conflicting uses of the spectrum or parts of it.

Telecommunication services using the spectrum can be encouraged for national and regional economic expansion and development, for education of people in remote rural areas, for provision of essential manufacturing information, sales and contract co-ordination, for entertainment (which is a symbolic use satisfying much deeper human needs), for assisting in the resolution of increasingly complex urban problems and for emergency and defence problems.

In some cases of spectrum planning it might be necessary to restrict the use of the spectrum even in circumstances of temporary abundance of frequencies, to anticipate future congestion or use by future services in accordance with international usage. This will overcome

the need for expensive rechannelling as is now being undertaken to clear the FM radio band. Such planning requires an objective, fair and integrated approach, preferably by a single authority.

This is not the case in New Zealand. Spectrum planning and control involves a number of different organisations, most with vested commercial interests. Although the Post Office is the radio licence regulatory body and ITU administration neither the Post Office Act nor the Radio Regulations empower the NZPO to control or plan frequency allocations. Rather, they empower the NZPO to protect existing and planned services from "harmful interference".

> "In its role as regulatory authority, the Post Office exercises control over frequncy allocation but does not exercise any control in a planning or developmental sense" (13).

Assignment of Broadcasting Frequencies

It is in the broadcasting area that the planning and allocation of frequencies is the most confused. Historically the detailed planning of broadcast band usage has been left to the public broadcasting service, plans for use of specific frequency assignments being submitted to the NZPO radio regulatory section which then exercised its responsibility as ITU administration in checking for "harmful interference".

The Broadcasting Act 1976 set up the Broadcasting Tribunal to hear applications for new broadcast warrants. The Tribunal does not have the resources or expertise to plan frequency assignments.

Prior to the Tribunal's existence the NZPO and the now defunct NZ Broadcasting Authority sought expert engineering guidance from the frequency planners in the public broadcasting service. However currently because these people are now part of the BCNZ, an organisation with competing commercial interests in spectrum usage, the Tribunal has some difficulty using their expertise for independent advice.

The NZPO is itself a trading organisation. It provides telecommunication services for commercial return and plans the detailed frequency assignment for these services. In areas of spectrum other than the broadcast bands, it therefore also has vested commercial interest. Despite the integrity of its staff in exercising impartiality in allocation of frequencies this situation is also clearly open to criticism.

It is thus apparent that the authority for forward planning and control of the natural resources of communication is currently fragmented and not in the hands of any single independent agency. In the broadcasting area planning authority seems to involve: the NZPO, the Broadcasting Tribunal, existing users (i.e. public and private broadcasters), public broadcasting frequency planners, applicants for new warrants and in the case of an appeal, the Courts.

There is no statutory definition as to who has authority to plan and control the use of a scarce natural resource that has growing social and economic importance. This is clearly an important policy issue for the future.

Alternatives for Future Spectrum Management

An essential aspect of any future mechanism for spectrum management is that it should allow a high level of public involvement. The NZPO as part of its ITU responsibility in co-ordinating the requirements of New Zealanders for spectrum use set up a number of working parties with widespread representation prior to the WARC 79 conference. This was a good example of selective public participation and the experience indicated many of the problems of involving the non-technical public in a highly specialist area. However to quote from John Gilbert, past Director of Spectrum Policy in the Canadian Department of Communications:

> "Without public input, the danger exists that the 'experts' and lobbyists influence decisions by default..."

Commenting further on the results of the Canadian system of public participation in spectrum planning, Mr Gilbert said:

> "...First, decisions emerging as a result of the consultation process seem to have two characteristics. On the one hand ... they allow major developments to take place. They do so, however, taking into account the existing patterns of use of the spectrum and the short and medium-term plans of all those affected...
>
> "On the other hand, a set of long-term objectives has emerged, accepted (albeit sometimes grudgingly) by all concerned, which forms a roadmap or framework within which future decisions can be made...
>
> "Second, there is now a greater awareness by those potentially affected of the decisions being made in the allocation of the radio frequency spectrum. Gradually people in government and the public are becoming aware of the value of the resource, of its

capability to provide the means for better or a greater variety of telecommunication services to the public, to create opportunities for manufacturers and to provide employment and economic benefits to Canada" (14).

There are a number of possible institutional arrangements for future management of the frequency spectrum and satellite orbit which require detailed analysis. Some of the more appropriate are briefly analysed below:

Overall Control by NZPO

Statutory authority could be given to the Post Office to extend its function as the regulatory body and ITU administration to cover forward planning and development of all spectrum assignments. Under this option the broadcasting expertise in frequency planning could perhaps be moved to the NZPO, creating a single body with full legal frequency planning and control authority.

This does not overcome the moral and ethical conflicts which could be seen to act to the disadvantage of non-NZPO revenue-earning organisations in obtaining a fair share of the radio-frequency spectrum if conflict of interest or competition with a NZPO trading section occurred.

There is currently some advantage in having the detailed planning of broadcast frequencies undertaken by a separate body such as the BCNZ and submitting their proposals for interference checking to the NZPO. The two separate groups of 'experts' provide a limited form of checks and balance.

Control by Frequency Tribunal

In this option, planning and control of all frequency spectrum usage would be undertken by a newly created public Frequency Tribunal or Spectrum Commission. This organisation would be directly responsible to the Government, be directed by Government-appointed Commissioners and have an engineering secretariat including frequency planning, interference control inspectorate and radio regulatory function.

The new Commission or Tribunal may also take over the existing role of the Broadcasting Tribunal, in allocating new broadcasting warrants. It could also hear submissions and issue licences for future information producers and presenters if licensing is necessary.

This body would not have vested commercial interests in frequency usage and would remove the existing problem of conflicting interest held by NZPO and BCNZ.

Control by Communication Advisory Council

The present Communication Advisory Council is a body set up to advise the Government on development of telecommunications. It is not a statutory body but could be re-constituted as such with responsibility for long-term frequency planning and control. It would require an expanded directorate to include frequency planning, interference control and radio regulatory functions.

12. NATIONAL COMMUNICATION POLICY AND PLANNING

In conclusion it is abundantly clear that the future of communication and information will involve change, and a good deal of it. Communication and information will become increasingly important to the social, economic and political environment of the country and hence affect to an even greater degree, our individual lives, business and recreation.

If the dawning social revolution and future information society are to enhance our way of life in New Zealand, national communication planning and policy will be of critical importance. It is essential that the necessary mechanisms are developed to undertake effective, immediate and long term planning and anticipatory policy research.

Such planning and policy research must concentrate on the many difficult social issues related to the introduction and use of the many new information technologies and services. Any authority charged with this task must have adequate recources to undertake effective integrated planning and policy formulation.

In order to cope with the expected social turbulence of the future, communication planning should conentrate on ideals and set realistic national communication goals which can be translated into institutional goals, objectives and strategies by the different communication organisations, including all electronic media.

Future policy making must involve considerable public discussion which will necessitate continuing public education on the potential and likely impact of new technologies.

It is most unlikely that an enlightened communication future will evolve of its own accord: it must be driven by informed anticipatory policy.

ACKNOWLEDGEMENT

The author acknowledges the many writers and contacts who have influenced the concepts presented in this paper, particularly the participants of the Communication Policy and Planning Project at the East-West Communication Institute in Hawaii.

The author participated in research with this project for eight months in 1980 and part of the report was written during that period.

REFERENCES

1. D/Arcy, Jean: "Broadcasting in the Global Age" in Symposium on the Cultural Role of Broadcasting. Summary Report, October 3-15, 1978, Hoso-Bunka Foundation and cited by Dan J Wedemeyer in "Developing Communication Services for Human Development" Media Asia, 1980.

2. Emmery, Fred and Merrelyn et al.: "A Choice of Futures: To Enlighten or Inform" a Report to the Australian NIP, 1975.

3. Stewart, Donald:"Communication Policy in New Zealand" in forthcoming book edited by Patricia Edgar and Syed Rahim, Communication Policy in Six Developed Countries.

4. Downes, P and Harcourt, P: "Voices in the Air: Radio Broadcasting in New Zealand", Wellington, 1976.

5. Adam, K: "Report of the Committee on Broadcasting", 1973.

6. Stewart, Donald: ibid.

7. FM Planning Report, Government Printer, 1980.

8. Gough, Howard: "Facts and Theory in Organisation", BCNZ Training Paper.

9. For example: Jerry Mander "Four Arguments for the Elimination of Television", William Morrow & Co., NY, 1978.

10. Gough, Howard: "The Broadcast Mass Media (Radio and Television) - Random Thoughts". Paper prepared for Commission For the Future.

11. Martin, James: "Communication Satellite Systems", Prentice Hall, 1978.

12. See "Instant World: A Report on Telecommunications in Canada", Information Canada, 1971.

13. "Telecommunications in New Zealand", Report of the Communication Commission, 1977.

14. Gilbert, John "Does Public Consultation Work?" In Search: The Canadian Communications Quarterly, Fall, 1978.