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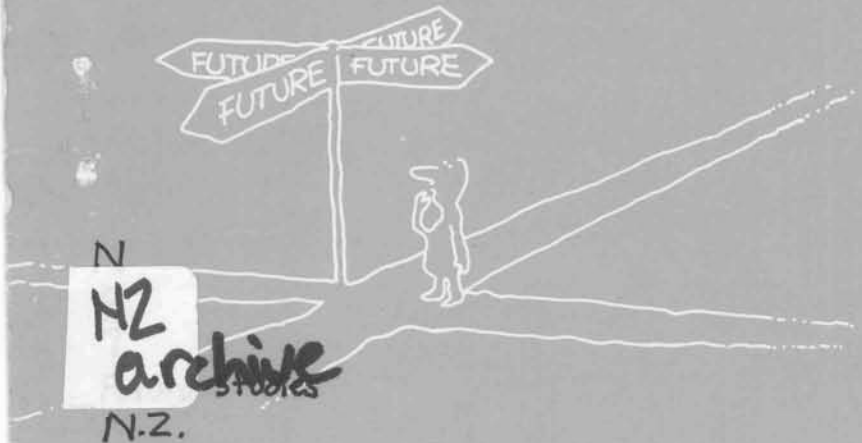
WORKING PAPERS

Communications Policy Research Group



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Contributing papers to

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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.

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COMPUTER COMMUNICATIONS AND INFORMATION SERVICES

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COMPUTER COMMUNICATIONS AND INFORMATION SERVICES

NOTES FOR POLICY RESEARCH GROUP

The object of this paper is to bring together in potted form some notes on the key issues in this area that may have an impact on policy in the 30-year time frame that we are considering.

All technologies have limitations inherent in them and a key issue in mankind's development has always been the invention of another technology when the limits of earlier ones are approached. However it is of interest to note that Dr Robert Hamming, one of the "gurus" of the Bell Telephone Laboratory, calculated several years ago (The History of Computers to the Year 2000) that we had already achieved about half the improvement in computing power that was available by miniaturization. He assumed that the ultimate limits would be set by being unable to make connecting wires between logic gates less than 100 copper atoms in diameter, the velocity of light and heat dissipation and other similar assumptions. There is then a limit to the power of computers as we understand them. One can then consider clusters of computers and so on.

However one is concerned not only with what can be done but with how much it costs.

Cheaper Computing and Data Storage

At page 109 of Computer World Extra, 17 September 1980 we have:

> "the average hardware cost to perform 100,000 calculations has dropped from approximately $1.26 in the early 1950's to 12c in 1964 with the advent of the IBM 360 Series to 1c in 1979 with the large 370 machines and on to a current price of about .05 cents with the IBM 3033."

There are many prognostications about reducing computing cost with a current expected estimate of a reduction of about 30%per year but few seers will look up to ten years ahead let alone the 30 years of our time frame.

Considering the 2000-fold reduction in the last 30 years and the effect of inflation as well as the fact that we are approaching limits it seems reasonable to suppose that the cost of computing in 30 years will drop to somewhere between 100th and 1,000th of what it is currently.

The effect of all this is that computing costs will become smaller but will not vanish.

The change in storage costs will almost certainly be very much more dramatic. James Martin is quoted on Page 120 of the same Computer World Extra as saying that by the second half of the 1980's, video disk technology will give us storage at one ten-thousandth of the price of current disk systems. Since current magnetic disk technology gives us storage at about the same price as making a xerox copy of our information every year this says that for about a $1 a year by 1990 one should be able to store 100,000 pages of information. One would also need a small computer system to record it but the cost of holding information could become very small.

So we should be able to compute cheaply and store information cheaply but we will want to get our information up-dated and the more information that is held on a distributed basis the higher the costs of updating it even if communication costs with satelites and optical fibre become very low. It would seem likely then that static information is likely to be transmitted by physically moving video disks while dynamic information will be held in somewhat centralized databanks.

Since none of the costs will disappear it would seem likely that a tremendous variety of systems will be required to satisfy all the diverse needs of people and different systems will give different economies for different needs.

Against this background let us now review briefly some of the ideas and buzz words that may be of interest. It has to be appreciated that each technique is only a part of the whole and that each separate cost area of communication, computing and storage has to be taken into account in the design of any complete system. A cost saving in one area can be used to reduce the cost in another area as will become clear in a discussion of some of the individual techniques themselves.

The purpose of all techniques is to either improve utility or to cut cost and the techniques made available by reduced cost in one of the component areas of computing, storage or communication makes it economic to use more of that component in order to save the cost of another one.

The same Dr Robert Hamming referred to earlier has observed that a change by a factor of ten frequently leads to a change in kind not a change in degree. He exemplified this remark by observing that when men walked at 4 miles an hour they had one kind of society and when they could travel in automobiles at 40 miles an hour a different kind of society emerged while with aeroplanes at 400 miles an hour a further profound effect could be observed.

What we are talking of in our 30-year frame is clearly a change of 100 or more in each of the areas of computing, communications and storage costs. Any one of these could be expected to have a profound effect on our society but all of them together must be even more dramatic. Now let us look at some of the particular issues that will individually change some component costs effectively by a small factor.

SOME PARTICULAR TECHNIQUES

One possibility for dramatic increase in the capacity of computers which has been talked of for a number of years and has not yet emerged from the development laboratories is the so called 'Josephson Effect' where the resistance in a circuit becomes substantially zero at very low temperatures approaching absolute zero. It appears to be generally felt that this development by the time it gets into application, if it does get into application, will represent only a modest step on top of other developments that are taking place. Because of the supporting technology required it is normally taken that Josephson Effect computers would be of very high capacity and would help to tip the balance between decentralized and centralized computing back towards the centralized systems.

The battle between centralized and decentralized systems can be expected to swing backwards and forwards as the costs of various components change.

For information with a low volatity (low rate of change) but with a high level of accessing, particularly a localized level of accessing, then decentralized systems are an appropriate vehicle for holding such information. But if a large body of information with a rapid rate of change and access required from many different points is considered then generally centralized systems will be the most economical. There is no longer a simple easy answer to the economics of centralized versus decentralized systems. Each case has to be considered on its merits at the appropriate time and in any long term thinking one must provide for both capabilities.

Lower Communication Costs

The cost of communication links is of major importance in considering system design. Various networks have developed from the beginning where one "idiot" terminal (such as a teleprinter) was required to have its own dedicated line all the way to a centralized computer system. The cost of a dedicated line running, say, a a terminal in Auckland from a computer in

Wellington resulted in the development of multiplexing and multidropping techniques whereby numbers of terminals could be serviced on the same line.

With the development of intelligence in terminals (that is with microprocessors as part of the terminals) other techniques such as data compression became possible. Here one would code the signal being transmitted over the communication line so as to require the transmission of fewer characters. The simplest code, which is very effective for a lot of business data, simply provides a count of the number of blank spaces or zeroes when these are repeated. For example at the end of a line of text or the top of a page one may have 40 or 50 blank positions or more and a simple count and a code to indicate that they are blanks might only occupy three or four characters.

Another development involves the use of terminal computers or nodes with "Packet Switching". A chief use of this technique is where one has multiple routes possible between computers and terminals. For example for security in the event of storms or earthquake one might have a communication line from Wellington through New Plymouth to Auckland as well as one on the direct route through the centre of the North Island. In order to average out the loading on both lines and thereby obtain higher average utilization messages can be split into "packets"; typically of 128 characters so that a 2000 character message would be split into 16 packets and some might be transmitted on one line and some on the other. The packets would be reunited at the other end and the whole effect would be invisible to the person at the terminal. The effect with many terminals or computers operating would be to get more information transmitted through the system in a given time and for a given cost.

The use of computer power to reduce communication cost becomes apparent with the techniques used to compress data and to switch packets. In the latter case computing ability is required to split up the packets, to keep track of where they are, to work out appropriate routings, to balance the load, to ensure that no packets are lost and to reconstitute them at their destination.

The same issues arise with respect to video transmission as well as text and data transmission. Scanners for facsimile transmission may make 100 scanning passes per inch of picture and in black or white transmission may simply transmit a bit each 100th of an inch along their scan path if they see something other than white.

It is more common to be talking of 200 "Pixels" per inch meaning that there are up to 200 bits transmitted per inch and these are eventually represented as 200 dots per inch. When transmitting an image of a page if the first 3 inches of the page consist of nothing but white paper it is obviously inefficient to keep transmitting the same information. A common coding technique is to transmit the first pass of the scanner and then to specify the number of repeats and/or to simply transmit the bits that have changed from the previous pass of the scanner. There are many coding techniques and the effects can be quite dramatic. With a sheet of typed text for reasonable quality facsimile transmission at the simplest level one may require 5 million bits of information. Simple coding as outlined above may reduce this to 3/4 million or even 1/2 million bits of information while if one goes to a full optical scanning device which can actually read the characters in the text and transmit as if the text had been keyboarded then possibly only 10,000 bits of information would be required. The better the coding technique the more intelligence or computing capability will be required in the termination device. The same coding technique can of course be used to reduce the storage requirement for holding the information. Again computing capability can cut cost.

Broadening the Bandwidth "Highway"

Another issue in communication is that of bandwidth. This can be seen most clearly and the idea of multiplexing understood from considering the technique that every school pupil knows for sending morse coded signals using a mirror and sunlight. If one uses a prism to split up a beam of white light into the frequency spectrum - red, orange, yellow, green, blue, indigo, violet - then in each colour a different signal could be sent. Thus the electromagnetic bandwidth available can determine the amount of

information that can be transmitted but more complicated devices are required to make use of this possibility. Again as one tries to split up the bandwidth into ever smaller portions one has problems of interference and limitations because of imperfections in all devices and all media. The idea of a "bit" of information is essentially whether one sends a signal saying 'on' or 'off' 'positive' or 'negative' or any other binary signal. Within the part of the bandwidth that one is using to send a signal the higher the frequency that one is using the more 'bits' of information that can be sent in a given time. So bandwidth and frequency are related in quite a complicated fashion.

One can now begin to see some of the problems of standardization. As each technical advance is made the people making it want everybody to change to their way of doing things whether it is a new method of data compression or image coding or use of a different frequency or subdivision of a bandwidth etc. The problem of standards so that different devices can in fact communicate with each other is so horrendous that one frequently finds even within one computer company that they have numerous devices that cannot communicate with one another let alone with those of other manufacturers in the same country or internationally. The interests of uniformity to allow common communication are inimicable to the use of the most advanced technology. Fortunately most manufacturers have announced their acceptance of an international protocol known as X25 for purposes of data transmission. And it appears that this will become a universal standard from which other later standards can be developed. The standard itself is recognised as having a number of inadequacies but it does provide a solid starting point for the future.

Advantages of Digital Transmission

The advantages of digital signals over the normal analogue signals are that they can be code-encrypted for security and via a variety of techniques can be checked for errors in transmission. These advantages are causing digital transmission to displace the existing technologies for transmitting voice, video, facsimile and data. It is interesting to note that a TV

screen without compression requires about a million 'bits' per second of information to be transmitted while digitized voice requires about 50,000 'bits' per second and a lot of data transmission is currently carried out at 1200 'bits' per second or less. The computing power required to manipulate the higher data rates obviously has to be greater and storage requirements to hold it also become greater. Nonetheless if our technology is to become 100 to 1000 times cheaper then we can clearly think of doing the same things for TV as we currently do with voice or data. It is this fact that will bring about the great changes.

Another area which represents a potential bottle neck is the development of the techniques and instructions to tell the computers what to do. These techniques and instructions are referred to as software and over a long period the increase in productivity in software has been only about 3% per year and since it is produced by highly skilled personnel with inflation affecting their salaries the trend of the cost of producing software has been exactly the opposite of the cost of producing computer hardware. In the long term software production must become very much easier and cheaper than it is now but in the medium term software is expected to be a bottle-neck in the application of computers. However in terms of the mass market the cost of software is unlikely to be a great inhibiting factor. Even $1 million of software spread over 100,000 units is only $10 per unit.

SOME APPLICATION AREAS

With the digitization techniques that are now available or in sight the functions of books, television, telephone and computers will all be able to be performed in some way by a common piece of equipment and a common communication system.

Communication with these systems using current technology is most cheaply done using a keyboard and visual display unit. However voice synthesis units are already in use even on $40 toys so that a system can be programmed to speak back to a person. Already systems which will recognise 64 words spoken by an individual are available for about $3,000. Development systems that will handle continuous speech and 2000-word vocabularies are also available for something over $100,000. The Japanese in particular are putting a tremendous amount of effort into speech recognition as a means of communication with computers because their written language requires a keyboard of some 3000 buttons or the simultaneous depression of up to 5 or 6 keys.

Mobile units using digital radio transmission are already in use by a number of police forces and defence organizations. One is obviously not restricted to stationary terminals. There are experimental developments in holography and high resolution video which will add to the impact of these systems and the probable social effects.

The delay in implementing the space shuttle must delay these developments from the date of 1985 which was projected in 1976. But the possibilities are clear and little imagination is required to envisage that within our 30-year time frame there will be no barrier of size and portability for terminals with all the facilities that we have discussed.

Portable television sets are very common and their reduction to a portable wrist watch version has now been accomplished. Once digital techniques are added to these devices we can see that the portability of a book or a newspaper is only a transient advantage over the new media. Further the technology required to give "wrist watch" radio telephones working from satellites was

described in 1976 ("Gazing into Space" - the Orbiter, 18 August 1976). This would have the effect of providing a monstrous "telephone exchange" in the sky. The calculations at that time indicated a cost of $300,000,000 for the satellite and $10 each for the wrist watch radios assuming 2,500,000 people were served in the Continental USA.

Education and Entertainment

One of the dramatic areas of change resulting from the technology is likely to be in the field of education. There is already a considerable market for courses based on video cassette. It is well established that if one can see, hear and read about something then it becomes fixed in the memory more readily and if one can also do exercises with it and go back over the ground at will and at one's own speed the effects are dramatic.

The video cassette courses are recognised as being more effective than working from a book but not as effective as classroom instruction. The use of a course from either local video disk or called up from a central data bank in which one can go back and review any or all portions and branch to other parts of the course might well prove to be more effective than normal classroom instruction.

The same issue might well apply to personalized entertainment. Here again we confront the issue of centralized or decentralized systems and the cost balance between local storage (for example in the home) and centralized storage in a data bank. Again the trade-off would depend on how volatile the information is required to be. If one wishes to learn how to use a computer system which is in a constant state of flux then the person making the changes would like to change his instructions in a central databank and know that everybody using it was then going to have the correct and up-to-date instructions available to them.

Other courses such as the study of Latin Literature which is not going to change could well be supplied on a video disk and retained in a home library. The home library might also well be used for dynamic information such as news so that instead of having to organise one's personal timetable to conform to the programming provided by radio or television programmers the transmissions could be stored and viewed or viewed again and again at leisure.

One would also imagine that suppliers of materials, e.g. paint and wallpaper or kitset furniture, would want to make a choice between supplying recorded media for the home user or putting it into a central databank which the home user could access for instructions on the use of their product.

Scope for Organisational Change

Given terminals widely distributed in the homes and offices completely new forms of industrial and social organisation must be expected to arise. One of the major ingredients of success in large organizations is the disciplined communication channels that are provided within them and the ability to bring diverse resources to bear on a problem.

Electronic mail and teleconferencing facilities are likely first to be used in large organizations. Particularly, they are likely to be used to allow large organizations to implement what is known as a "matrix" organization structure instead of the ordinary hierarchical structure. This would allow far greater delegation and better control within the large organization and would allow it to obtain the benefits of bigness and the benefits of smallness.

Potentially however the same facilities could allow many small organizations to work together by using a common communications medium. The problems of getting many small organizations to work together on a big problem are largely those of communication, common understanding and acceptance of discipline. All of these issues will be impacted by the availability of a more extended communication system. It should then become much easier for one

small company to act as prime contractor and bring together the resources of a number of companies in order to compete with large ones. There is an excellent discussion of pros and cons of which way business organisation might develop in the future in a series of papers in the Economist dated 25 December 1976 page 41, 8 January 1977 page 31, 5 March 1977 page 33 and 12 March 1977 page 33. Clearly it is a subject that could be influenced by the wishes of the populace and the different contexts in which they wish their future to lie.

The development of micro-computers is leading to a tremendous proliferation of automated machines and the subject of "robotics". This is a rapidly growing industry which in turn has alternative futures providing either heavily automated factories mass producing for a world market or equally heavily automated but probably much smaller factories producing efficiently in short runs. Both possibilities are open and will probably occur side by side.

The same types of devices have been used in many areas and the same driving forces and technology in the service industries have brought electronic banking and automatic fund transfer almost to the point of a cashless society. Cash dispensing machines and point of sale devices operated from credit cards are becoming wide spread.

The impact of the cost changes in particular functions is easier to foresee than the overall impact on the fabric of our economy, our social organizations and our politics.

POLICY IMPACT OF THE TECHNOLOGY

It has been pointed out earlier that for policy purposes one is not greatly concerned about what technology is used to achieve a particular effect. What one is concerned with in policy questions is the relative power between individuals, groups and nations and the way that this power distribution can be effected by policy decisions. Within the range of what is possible one presumably then chooses policies which best fit the philosophical context that one embraces.

In the following discussion we will be concerned largely with the question of what can be influenced by policy and what is likely in the various circumstances. Technical advances can be thought of as changing the cost of each of the components of the total system (namely computing, storage and communications) by something over 100 times during the 30-year period. These changes have a dramatic effect since the profit potential for new organizations which are able to get into operation with new technology at the expense of all organizations with old technology is quite startling. Even at much smaller reductions in cost than we have to contemplate the effects could be quite alarming. If for example the $800,000,000 the Post Office has invested in telecommunications equipment could be replaced by equipment worth only 1/10th of that sum then even if the same overhead structure were necessary it would be possible to give a substantially cheaper service to telephone users and still make handsome profits.

The alternative would be for the Post Office to arrive at equivalent pricing by recognizing that its equipment is suddenly worth a great deal less and to recognize the resultant loss. Clearly those with sunk costs who are already in the field will oppose recognition of the changing technology.

However it is extremely difficult to maintain an entrenched position if knowledge of the consequences is wide spread. If such knowledge is not widespread then those who have it are in a privileged position and may be in a position to take advantage of it.

Benefits for Big Business

For example there are very great benefits from the use of electronic mail and the Post Office currently makes a liberal interpretation of its Act to allow service organizations to provide electronic mail services for others but not between others. Thus a service bureau could provide an electronic mail service to company 'A' and to company 'B' but not between 'A' and 'B'. However if Fletcher Challenge were to buy both 'A' and 'B' then they could provide that service between 'A' and 'B'. Another alternative would be for both 'A' and 'B' to use the Post Office's OASIS link into the TYMENET and TELENET Computer Network Services in the USA and to send their electronic mail to one another via that route. No doubt the legality of such a system would have to be tested but it would appear to be perfectly feasible.

All of the major transnationals are now joining their branches worldwide into single communication networks, initially for handling of data but already on an experimental basis - or more than an experimental basis, in some cases - for the handling of facsimile, freeze-frame video and digital voice.

Clearly if the Post Office maintains its restrictions in New Zealand these directly penalize small organizations and favour the large organizations whether transnational or not.

It appears to be inevitable that transnational organizations will evolve a style of management which requires access by their personnel to their computer networks, not only for communication purposes of the sort that we currently envisage but so that they can access company library facilities, company training facilities and company decision making facilities. Such organizations will then be reluctant to make substantial investments in countries which deny them the facilities of their own communication system or which impose tarriffs on them.

There is no longer any serious problem about providing whatever level of privacy and security is required in a computer system provided one is prepared to meet the cost. As has been noted earlier there are valid reasons for coding data to reduce communication costs and one can also go further with encryption to ensure privacy. These facts would then make it very difficult to regulate transborder data flow, especially as voice mail, electronic mail, video telephone conversations, etc can all be dealt with in the same way. If a communication linkage is permitted at all it will be extremely difficult to police the usage of it.

If the multinationals are able to have such services the national companies and the small companies will also require them in order to survive.

Effects of Cost Structure

In any case where services are denied on political grounds this decision attaches an infinite cost to the appropriate service and distorts the development of total systems. For example, high communication costs or inhibitions on communications would favour decentralization. However if the costs associated with decentralization of the computing services was sufficiently high then this would be a factor in closing down regional and branch offices or factories and bringing them all together in one centre.

The current costs of communication by telephone favour centralized locations for business and industry. If telephone charges were uniform throughout the country (as our mail charges are for ordinary letters) then from this aspect telephone charges would be neutral on the issue of centralization or decentralization. If they charged the same figure for each "packet" then they would also be more neutral between large and small organizations. At present the large organization can afford a leased line on some routes and may well get its "packets" of information at a quarter (or a tenth or even less) of the cost for small organizations.

There are some very delicate effects here which need to be decided in terms of the different contexts for development. The Post Office restriction on usage of lines by more than one organization is intended to prevent "creaming off profit" on trunk routes but simply raises costs for small organizations compared with large organizations.

Another issue is the "great New Zealand clobbering machine" of Government monopolies feeling obliged to provide the same service in all parts of the country at substantially the same price regardless of cost, which inevitably means that services which could be provided cheaply in some restricted areas are not supplied at all because the cost of providing them everywhere is unsupportable. In terms of the CFF contexts one could surmise that a community interested in variety could achieve this by providing services with price related to cost while a community interested in uniformity would go for more averaging of cost and price.

In all these issues one is concerned about the social problems of equity and conflict resolution in considering questions of ownership and control. The question of spectrum space is an example. This is currently taken as a free good and is controlled by the Post Office. We have seen earlier that the bandwidth available and the frequencies at which that bandwidth applies are of critical importance to the capacity and cost considerations. With the increased ability to beam signals rather than to broadcast them there are also possible questions of geographic area and space involved. At an extreme level we have the question of whether you can shine a light without a licence and if you can are you allowed to make it carry a signal. Presumably one would want to restrict beamed signals in their intensity so that they would not for example slice aeroplanes in half or blind people if they happen to look into the beam or create radiation hazards. Some control is necessary.

In the different contexts clearly the policies to deal with the spectrum are likely to differ.

Ownership and Control

The question of ownership and control of the means of communication is a very live issue in all countries of the world and the tendency appears to be to move in the American direction of allowing connections to be made to the telephone network provided they meet technical standards. This route has now been followed by the British Post Office and presumably will lead, as it has done since the Carterfone Decision of the early 1970's in the US, to a tremendous proliferation of small and large manufacturers making devices to connect to the telephone system. The same proliferation would be expected if there were a freeing of the frequency spectrum. If a part of the spectrum were to be unregulated all sorts of devices could be developed in an experimental fashion without the overheads and delays associated with licensing though at the cost of the same frustrations as "Citizen's Band" radio.

However the extremely opposite point of view could be taken and not only could the communication system remain a Government monopoly but all computers could be brought into the same type of Government monopoly structure. The rationale for such a move could well be the same as the Post Office's defence of its monopoly of the supply of telephones, that the production volumes in a small country could then become of a reasonable size and local manufacture could be started.

On all of these issues one could be concerned with an act of faith in variety or the supposed benefits of uniformity, standardization and monopoly. By having only a single system, education and training would be simplified. It could be argued that we would have greater employment and that it would be easier to develop our own expertise in a restricted area. These arguments are likely to be pursued by those in control of the established infrastructure. The contrary view is that if a public monopoly is involved it should be restricted to the minimum level and should be open to all on the same terms. Beyond this minimum level variety and competition should be encouraged.

POLICY OPTIONS AND IMPLICATIONS

Resource Allocation

It has long been our custom to expend a considerable portion of our disposable wealth on measures for our defence wherein we assume that we might have to fight with our enemies in order to protect our way of life. It is becoming increasingly clear that we must recognise the need to expend some of our national resources in order to compete with our friends as an economic defence for our way of life. In a peaceful world the battle for resources and power is determined by economic rather than physical struggles. Japan has been pursuing deliberate and mutually reinforcing strategic policies in the computing and communications area for many years. The French with their "Telematique" are now pursuing a vision which will give them world leadership, reduced unemployment and some 32 million multi-function terminals replacing telephones by 1990. The Singaporeans are moving in the same direction while the Americans, the Germans and the British are moving in less controlled, but similar directions.

The new means of communication will require a new meaning to be attached to literacy and education. Inadequacy in the new techniques will be as crippling as the inability to read and write is currently. Our connections with the external world will eventually have to occur in substantially different forms from the current ones. It becomes essential that we avoid the problems which are visible in some under-developed countries where adequate external communications systems have been established but the same facilities are not available internally or to the bulk of the population. Automatically this has reinforced the position of a small elite and diminished the position of the masses.

In the face of these pressures it is clear that the rate of development of the new technologies should not be controlled by the rate of capital accumulation by self-financing that currently limits the growth of the Post Office and the Broadcasting Corporation. New Zealand should be spending some $500,000,000 per year on capital development. It is spending perhaps one tenth of

that amount. To recommend high spending in the face of our balance of payments problems and our unemployment problems may appear irresponsible but in fact all issues are related to one another. New Zealand has many problems that are unique and overseas solutions are not appropriate for them. We do not, for example, have the problems of crowding of our air space that affects the large countries nor do we have our own rocket systems for launching satellites etc. It therefore appears clear that we should draw from overseas only the small amount of skill that we require and should develop our own technology as far as possible. If we manufacture our own devices we will both conserve overseas exchange, reduce our unemployment, meet our own needs and have the security of understanding and being able to support the technology we introduce.

The alternatives are either to eschew the new technologies or largely to import them. There is more to this argument than one of simple economics. There are questions of national security and of understanding. We could simply elect to import the technology on the grounds that in the short run this would be cheaper. That may or may not be so but it is not like importing, for example, timber where we have an indigenous timber industry and an adequate understanding of its uses and frailties. There are many levels to this new technology and a great infrastructure of knowlege is required to support it. Unless we are prepared to be permanently dependent on other countries we must develop our own skills and our own industries in this area. We might well then, out of the stimulus of our own unique environment, also develop a prosperous export trade in some particular areas. Otherwise to be consistent we should cut our expenditure on education which merely serves to provide the brightest of our young people with the background training for them to get jobs overseas.

Ownership, Control and Structure Of Communications Systems

Much of the earlier discussion in my paper is relevant here.

There is a serious question of how far the Government can put any policy into effect. Given that the wrist watch radio, or a somewhat larger higher-capacity brother to it, became available and that some agency such as the US Government (which has already set up a study team to consider the communication needs of the Pacific nations) should establish satellite coverage including New Zealand in its footprint, then it might become extremely difficult to police communications systems. If tourists visiting our shores were used to maintaining worldwide communication then a ban on the use of their devices would inhibit the tourist trade. Foreign fishermen only a few miles offshore might enjoy advantages denied to our citizens. Foreign businessmen might well refuse to establish their businesses here or even to deal with agents if they could not access their normal communication systems. Given that all communication becomes digital in form and that it is encrypted both for reasons of compaction and for privacy it will become very difficult to determine what information is being passed, whether it is speech, data, music, drama, pornography, text or pictures.

The questions of ownership and control depend somewhat on the political judgements and opinions of individuals. One can have ownership and control vested in the State (as with the Post Office control and ownership of the telephone system) or it can follow the American model of entirely private ownership but with Government control of that private ownership of the telephone system. One then has licensing problems, the difficulty of deciding who is to get which licences. Alternatively one could also have complete anarchy with no control. The modern compromise which I favour is for a base level of service to be provided by a Government agency but with added services or value-added services being provided by private organisations.

It is helpful to consider analogies when moving into new territory and the transport system and the reticulation of electricity provide us with examples of past wisdom which can be helpful in the communications area. We need to make a distinction between information policy which deals with the question of who shall provide information, what shall be the rights to it, what controls are required, the privacy issues etc. and the communication policy matters which are concerned with the

carriers of information.

Let us consider the communications carriers first. In the transport field we have some basic public transport provided by local body organizations and by Government and there is a system of licensing to restrict direct competition with these modes of transport. However the bulk of transport is regulated by the road code, warrant of fitness requirements and licence fees. There is also a class of totally unregulated transport - for example, trail bikes - which in particular areas do not even have to conform to the basic law of keeping to the left. We also have vehicles like bicycles which must conform to the general road code but are otherwise totally unregulated. This is all much more relaxed than the current rules and regulations surrounding the information carriers. One would like to see the latter much more closely approximating the position that applies in transport. Thus there should be information carrier services provided by government bodies which are available and accessable to all at reasonable rates. There should be other services which require the payment of licence fees but which do not prohibit anyone from offering or using a service in this area provided they have paid the fee and they conform to a particular set of standards. The essential thing is that licences should be available to all who are prepared to meet these requirements. Again there should be an area which is completely uncontrolled or very nearly so.

Thus one would see the Post Office running its telephone service largely as at present but allowing any devices to be connected to its system and any services run on its telephone system provided only that users pay the charges and that the devices that have been connected to its system meet certain standards. To this end one would envisage having "licensed connectors" similar to licensed electricians and allowing people to run electronic mail services or whatever they wished on the carriers provided by the Post Office. At the other extreme one would envisage that for beamed signals of less than a given power regardless of frequency there should be no requirement other than the payment of a licence fee and the registration of what was being done so that it became a responsibility of later users to avoid interference with earlier users.

It is clear that the Post Office Act gives the Post Office blanket powers which stifle the enterprise and initiative that are required to develop new devices and new techniques in this rapidly changing area. The fact that the Post Office has an extremely creditable record of co-operation, tolerance and assistance does not diminish the fact that such a power is much too all-embracing and is too protective of the monopoly position. The protection given to the Railways in the transport field is incomparably weaker in comparison and rightly so.

Given more relaxed laws along these lines one can envisage the future structure of the communications providers with a whole range from Government departments or corporations providing services to the public through private companies providing services to the public to many private systems of diverse sorts.

If we merely seek to protect the monopoly position of the existing public organizations it is clear that we will retard the development of New Zealand-based communication systems. These then will not be in a position to compete with the foreign and multinational systems which will in any case eventually breach the monopolies of the publicly owned organizations.

Access To Communication System

It can be contended that a part of the "great New Zealand clobbering machine" is the obsession with providing the same services to all New Zealanders or not providing them at all. Thus great expenditure has been incurred in giving national coverage for TV. It seems reasonable to question why the person who chooses to live on the shores of an obscure lake because he enjoys its pleasures should necessarily have the same communication facilities as someone who lives in the city and is necessarily deprived of the lake. There would seem to be a compromise required where again we ensure that a basic level of service is provided to all at reasonable cost but that apart from such basic services the user should be required to pay. One may care to give him a subsidy from the national purse for particular purposes but it should be identifiable and clearly visible. The new communication systems should in fact be able to bring great

benefit to people in remote areas, particularly if satellite systems are used, but even here the cost must be considered and it may well be that the person living in a basement in the canyon formed by blocks of city flats may have more difficulty in organizing his reception than a remote farmer. Given that we have good basic telephone, television and radio coverage we must recognize that not all technologies can be brought to all people (particularly at the same time) and that this should not be seen as a reason for denying it to those to whom it can be provided economically.

Information, Property Rights And Responsibilities

Here we have a need for careful investigation and establishment of laws which are concerned with function rather than with particular mechanical devices. The Act governing the operation of the Wanganui Computer Centre proscribes many actions which could follow from that centre. However it is completely silent on the same actions performed by any other means and one might well use xerox copying of the original records and facsimile transmission to accomplish the same ends in a perfectly legal manner for defeating the purpose of the Act.

We particularly require to address the questions of freedom of information, of privacy and of transborder data flow. In the absence of any laws or guidelines on the latter issue there is a considerable responsibility placed on all users of the Post Office OASIS service. For example one would not like sensitive databases to be created in the USA. It would be irresponsible for the police to use the OASIS system to build up files of sensitive data, which they are not allowed to store on the Wanganui system, in the United States. At present there appears to be no law preventing such an occurrence. Neither is there anything to prevent organizations using an electronic mail system via OASIS to route mail not only internally within their organization but externally to other organizations even though the latter is prevented within New Zealand by the Post Office Act.

Much careful work is required in this area.

Incidentally the computers accessable overseas via the OASIS network will not have paid any sales tax to the New Zealand Government while computers in New Zealand are subject to a 40% sales tax but a Post Office service equivalent to OASIS is not available to computer bureaux in New Zealand even if they were allowed to run the same services.

Choices Of Technologies

This is not on the face of it a policy issue but it can of course have a tremendous impact on the amount of overseas funds required and the employment generated in New Zealand. It may well be best dealt with not by regulation but by deliberate Government policy to choose technologies which are suited to New Zealand for the Government-run services. This would preclude the use of satellites and would instead turn us to the use of optical fibre since we have large deposits of pure silica and also have cable making facilities already in existance. On the face of it the skills required to be imported would be fairly small. Another possibility which suits our rugged terrain is the use of the frequency spectrum with similar technologies to satellites but using our high points and repeaters thus avoiding the need for rocket launchers etc. These considerations would also be advisable in terms of our national security.

Again it may be possible to use ground based systems for the most part and to use restricted satellite services for our remote areas. These issues require careful engineering and costing before sensible decisions can be arrived at.

Given that Government chose appropriate technologies for the country in the Government-based developments they could be expected to find their own place in the private market without the need for specific policy restrictions.

Choices Of Billing Procedures

It has been remarked earlier that current Post Office charging practices militate against decentralization and against small companies. Careful study is obviously required of the implications but if all calls were charged at the same rate according to their duration regardless of source and destination within New Zealand one wonders what the effect would be in terms of individual telephone costs. Certainly it would have a tremendous unifying effect on the nation and could do a great deal to arrest the drift from the South to the North and the concentration in the large centres. Taken with widespread teleconferencing there would be some tremendous effects which all appear to be desirable.

Extent of Institutional Change

The new communication systems will enable the establishment of networks of communication which have never before been possible. One would expect to see a greater break down of the hierarchical organization forms that are currently virtually the only form of organization in large companies and bureauracies in New Zealand. One would hope for more widespread "matrix" organizations with communication up and down the authority chains but in addition very much greater communication across the authority chains with a diminution of departmental boundaries and antagonisms and a much greater sense of delegation and responsibility.

These of course are changes within institutions and as has been implied earlier one also expects great change of institutions with greater power passing to regional government. Because of the improved communication processes these could develop more consultative relationships with central government rather than relying on bureaucratic rules and rigid organizations.

Employment

The effects of the new technology on employment could be dramatic. If our past patterns of purchasing new technology from overseas are pursued we must have a continuing balance of payments problem and will have the old jobs destroyed in New Zealand with the new jobs occurring in the Northern Hemisphere. However if a policy as set down earlier for government procurement is followed then (particularly if we are successful in moving into some of the new technologies while they are still in their formative stage) we may very well succeed in developing highly successful export industries and be once again in the position of "over-full employment".

Education Priorities

The amount of education required is so large and so diverse that one would really like to have the technology of 30 years hence in place in order to accomplish the task. This may well be the key to how we should proceed. We need to reach our decision makers, the public as a whole as well as individuals in the institutions. Much of the infrastructure for producing the required courses and text etc will be little different whether it is presented on television at present, or on current computer terminals, or on the systems of the future. Provided the courses can be properly developed, structured and presented in a machine-readable format they will be available for the future when the new technology is in place. The development of computer instruction and computer aided instruction in our schools with appropriate courses must be seen as a high priority but perhaps the first priority should be the development of educational TV with particular emphasis on courses dealing with the new technology.

We have the opportunities for great new industries in education.

Choice Of Services

I do not believe that this should be subject to any policy restriction. There are possible restrictions on the content of courses etc and there is room for discussion on what is pornographic and what is instructional but in my view we should encourage the greatest diversity of services since by providing variety we also provide security.

Extent Of Consultation With Interested Parties

In principle everybody will believe in full consultation between interested parties but in practice there is usually great disagreement as to who the interested parties are, the extent to which they should be consulted, when that consultation should take place and whether it is a matter of asking or telling. Managements are not inclined to consult with unions until after they have made up their minds on what they want to do nor are unions inclined to consult with managements about things which are within the union purview but even worse is the fact that neither of them are inclined to consult with the public who may also be interested parties.

With the communications industry it is obvious that there is wide public interest because of the likely social effects and it is essential that consultation extends far beyond any of the technical issues and the industries involved.