REPORT
ON
Possible Interconnection of Mobile Radio Services With the Public Telephone Network

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TABLE OF CONTENTS

PAGE

SECTION V

PRIVATE MOBILE RADIO SERVICES

SECTION VI

CONCLUSIONS AND RECOMMENDATIONS

APPENDICES

APPENDICES (cont'd)

Executive Summary

The rapid growth in the use of land mobile radio during the past decade has greatly increased public awareness of this formerly obscure sector of telecommunications. From less than 15,000 mobiles in Canada in 1961, the mobile population reached approximately 129,000 in 1971 and is expected to be aproximately double the 1971 figure by 1980. In addition public radio paging service is now provided to about 25,000 individuals and the number of users could easily exceed the two-way radio figure in a very few years.

There are four significant categories of commercial mobile radio service, each of which must be viewed by itself in relationship to interconnection. They are:

1. Radio Paging - a competitive one-way service provided by both independent operators and wireline carriers non-interconnected manual operation and interconnected automatic operation respectively. There are powerful incentives in the form of operating economics and spectrum utilization for seeking interconnection of the independent public paging systems.

2. Multi-user private dispatch - through a community repeater. This accounts for about 90% of Canadian Restricted Common Carrier Mobile Radio Service (RCCMRS) activity. It does not appear to be a candidate for interconnection.

3. Multi-user message relay radio service - operated in conjunction with a landline answering service. About 10% of Canadian RCCMRS activity is of this type - operating under rather primitive manually interfaced conditions. Interconnection is desirable from the standpoint of spectrum utilization, subscriber convenience and operator economics.

4. Private commercial radio - a mixed bag with diversified usage and varying needs. Many users (probably most) will have no desire for interconnection. A few may. Interconnection should be treated on a case by case basis within a general policy framework.

   This group includes agencies providing emergency services which are currently permitted interconnection of customer provided base stations by some carriers. However, in Bell Canada territory, at least, almost all of the interconnected services in this category use carrier provided equipment.

A fifth category, the public mobile radio telephone service (MTS) is a network-connected carrier offering which makes provision for customer provided mobile equipment. It is touched only briefly in this paper.

Distinction should be made, in discussing mobile radio services, between local, i.e. intra-city operations and long haul or inter-city operations. It seems reasonable to expect, as is current practice among U.S.A. telephone common carriers, that telcos could prevent intra-city mobile radio systems from toll bypassing by suitable terms incorporated in any interconnect contract.

There are about 120 public commercial radio paging transmitters in Canada, with frequent new entries into the field. About 20 of these are operated by the common carriers - the remainder are provided by independent operators.

DOC user surveys indicated that the paging subscriber operates within the typical 20 mile (or so) reliable coverage radius about 97% of the time, and has no apparent interest in long haul paging. Paging services as they have developed to date, System Wide Area Paging (SWAP) excepted, have for the most part been established to serve a local area only.

About 12% of the independent public commercial paging operators, have made representations to the DOC for interconnection since early 1972. These representations have varied in form from routine applications for licence, through comprehensive briefs, up to written and heated appeals for the Minister to intervene. There has been one known threat of litigation, and one operator at least is reputed to have a dial interconnect terminal installed, presumably poised to interconnect at some future time. Another operator has apparently devised a method of providing his customers with direct access to the paging terminal without resorting to a physical interconnection. This sector is exhibiting considerable unrest and the situation warrants the early attention of the DOC.

Manual operation of public paging terminals increases the operating costs and reduces the potential for efficient utilization of radio channel capacity. A manually operated system might need five channels to serve a mere 3% of the subscribers that could be accommodated on a interconnected terminal using one channel with up-to-date digital techniques. These factors are generally reflected in higher charges to the subscribers. As the demand for paging increases they will reflect in increased demand for spectrum. It is worth noting that one interconnected paging terminal using modern digital techniques can handle about four times as many subscribers as currently exist in all of Canada!

In the case of one-way radio paging and two-way Message Relay Services, the issue is not primarily one of customer provision of terminals. Rather it is that network access in any form is completely denied to independent service companies. It is recommended that, as a first step in liberalization, the DOC should encourage the federally regulated common carriers to permit interconnection of non-carrier owned terminals at reasonable costs, for public commercial radio paging.

SECTION I

INTRODUCTION

The first phase of an inquiry, in which the Department of Communications has been engaged, concluded with the publication in November 1972 of the "Working Paper on Possible Interconnection of Non-Carrier Owned Terminal Equipment and Terminal Systems to the Public Switched Networks". This paper, which is part of the second phase of the inquiry, deals with the possible interconnection of Land Mobile Radio facilities to the public switched network.

The Carterphone case in the U.S.A. in 1968 revolved around a mobile radio interconnection issue. The per capita usage of mobile radio in Canada, although only about half of the current per capita usage in the U.S.A., is nevertheless now slightly greater than it was in the U.S.A. when the Carterphone case erupted. Similar pressures for mobile interconnection are developing here.

Land Mobile radio services can be subdivided into five general categories. Although the basic hardware, excepting paging receivers, is the same in all categories, the social and economic considerations related to interconnection with the public network differ significantly from one service category to another. This paper examines the

following four categories:

1. Radio Paging Services
2. Multi-User Shared Private Dispatch Services
3. Multi-User Shared Message Relay Services
4. Private Mobile Services

These four categories are defined more fully in Appendices C,D, E and F. Base stations in the first three categories are licensed formally in the Restricted Public Commercial Service and the fourth is licensed in the Private Commercial Service. The portable receivers in the Radio Paging Services are exempted from licensing.

The fifth category, Public Mobile Telephone Service (MTS), commonly known as General Land Mobile Radio Service (GLMRS) is provided by the telephone common carriers exclusively and allows full access to the public telephone network. For several years the carriers have permitted the use of compatible customer owned and maintained mobile radios in the service. Since a form of interconnection of customer provided equipment already exists this category of service has received only brief mention in this paper.

Background information on land mobile radio in general and on the first four service categories listed above, is provided in Appendices "A" through "F" . General considerations including toll bypassing and regulatory implications of interconnection are included in Appendices "G" through "J".

... 3

TECHNICAL STANDARDS FOR INTERCONNECTION

Preservation of network integrity is a national objective which must be met in any interconnection arrangement. The preparation of network interface specifications and hardware type approval standards are already underway for passive (network non-addressing) devices. Preliminary draft network interface standards for paging terminals have been drawn up by an outside consulting* firm and, subject to carrier acceptance, could serve as a basis for appropriate hardware type approval specifications.

CONTRACTUAL CONSIDERATIONS

It is not only essential to interconnected public paging and mobile radio operations that the carrier's interests be protected, but also that the interconnecting company have some assurance that it can indeed be provided with the required facilities. For example, blocks of C.O. numbers in the case of network outpulsing or alernatively the provision by the telephone company of data (DTMF) pads on paging subscribers' telephone instruments must be available on time to accommodate existing and future requirements.

It follows that the telephone companies must be able to quote contractual rates for Central Office codes, trunks and access lines, tone pads and so forth.

* CRC Consultants R.K. Walker & R.J. Crowder, Brampton, Ontario

... 4

Sample contracts similar to that employed between one major U.S. Bell system company and the independent "radio carrier" are included in Appendices "I" and "J".

... 5

SECTION II

RADIO PAGING SERVICES

Value of Interconnection

Background information on Radio Paging Services is contained in Appendix C. One of the strongest arguments for interconnection of radio paging services has been advanced in the form of allegations that the protected common carrier is using its monopoly privileges to suppress competition in a non-monopoly segment of its operations. The independent paging service is frequently competing with the telco's paging service and is kept at a distinct economic disadvantage by having to provide manual interface between the telephone network and the paging terminal.

The common carriers have, with few, if any, exceptions elected to provide dial accessed automatic paging services. Their customers' paging messages are dialed directly to the paging terminal and there is no need to have an operator in attendance.

The independent paging operator, who under existing rules and practices is not permitted interconnection, must operate manually and is faced with the greater operating costs. Based on amortizing the investment in the interconnect terminal over a 5 year period, the equivalent annual cost at present day interest rates of a 1,000 capacity terminal would be about $4000. By way of comparison, annual cost of keeping a minimum of one operator

... 6

in attendance around the clock 7 days a week is about $40,000. This becomes significant, especially for those operations serving only a few customers. Interconnection would virtually eliminate this operator expense, except in cases where the operator's presence is required to perform some other function or functions not directly related to paging.

It seems reasonable to expect that the telephone companies can pass their savings on to the subscriber and this is supported by the fact that the telcos paging offerings are generally $5.00 to $9.00 per month lower than those of the independents. Although there is no guarantee that interconnected independents would reduce rates, there is evidence that this has happened in the U.S.A., where some unregulated independents are charging as little as $15.00 per month for interconnected paging services.

Apart from monetary considerations, paging subscribers appear to have no real preferences and seem equally satisfied whether subscribing to manually operated or fully automatic services. However, there can be little doubt that, if lower rates were assured, the automatic services which could be provided through interconnection would be the more attractive alternative.

Traffic Load

Since the public telephone system is the only means by which the subscriber initiates a paging request, whether the service is interconnected or not, denial of interconnection does not relieve the network of traffic. Furthermore, the carriers themselves are

promoting interconnected services. This indicates that they are not fearful of overloading facilities nor of running out of central office codes.

Toll Bypassing

If prevention of toll bypassing (see Appendix G) is agreed to be in the public interest, some effective form of prohibition will be required where the potential for toll bypassing exists. Paging terminals however, do not have facilities for addressing the network, nor for providing two-way conversation. The threat to the carriers in lost toll revenue is not apparent with paging, where very little of the traffic is long distance.

It seems reasonable to expect that tariffs filed by the carriers or individual interconnection contracts with public paging enterprises could contain a proviso whereby interconnection privileges were subject to appropriate "no toll bypassing clauses"

Alternatively, the radio licence might be issued, subject to such a clause. Should interconnected paging operations be brought under the purview of a regulatory agency, the latter might impose similar restrictions.

As a fact of life, the few paging calls that would originate from a distant point could be made by Direct Distance Dialling (DDD), if interconnection were permitted, probably much more economically than would be the case with radio links or dedicated private wire lines. At least on major independent paging company in the U.S.A. has expressed such a preference.

... 8

Summary of Radio Paging

Public commercial radio paging services are provided on a competitive basis and are not intended to be a monopoly service like telephone. Both the common carriers and independent companies provide such services, with the latter in the majority. The independents have shown considerable initiative in providing service in the smaller communities. The telephone companies have tended to serve larger areas initially and move into the smaller ones after the market has been developed by the independent. Telephone companies in the prairie provinces have not provided paging services.

The paging subscriber gains access to the paging transmitter by the public telephone network. Only the paging services provided by the common carriers are permitted interconnection to the public network. Independent companies must, because of the carrier's refusal to interconnect, maintain a human operator in attendance to take calls and manually activate the paging transmitter.

The carriers' practice of denying interconnection to independent radio paging facilities suggests that they may be using powers that have been acquired for their monopoly services to restrain competition in a sector which is not and was not intended to be a monopoly service. The issue is more fundamental than that of private ownership vis-a-vis carrier ownership. It involves the provision of a service, i.e. automatic dial access to the paging encoder, which currently is not available to independent paging service operators.

The independent paging company incurs much higher operating expenses in wages and salaries, than would be the case with interconnected terminals. This one fact argues strongly for inter-

... 9

connection. It is believed that communities as small as 2,500 population might produce 50 paging subscribers. With interconnection, 50 subscribers could form the base for an economically viable operation. Without interconnection, these small communities may be denied paging service indefinitely.

"Tone only" paging terminals fully compatible with North American telephone networks with capacities of from 10,000 to 100,000 subscribers are available and in use throughout the U.S.A. and by Canadian Common Carriers. There is already a small Canadian manufacturing base but its market is mainly in the U.S.A. The terminals are essentially passive (network non-addressing) and network integrity can certainly be preserved by the use and enforcement of adequate standards.

Thus interconnection has the potential for economically increasing radio spectrum utilization by as much as 100 times on a single channel. Interconnected "tone only" paging can reduce telephone network hold time to about 20% of that required in a manually operated service. The use of technologically up to-date equipment, on an interconnected basis, would make it possible to serve Canadas largest cities on a single channel for the forseeable future. Sharing of terminal and transmitter facilities by two or more paging entrepreneurs would be quite practicable and would ease spectrum congestion in the large metropolitan areas.

The recent emergence of a device which provides no functional benefit, but which legally gets around the carriers' tariffs, has opened the door for independents to get the equivalent of interconnected paging service. The carriers probably have nothing to gain at this time by continuing to deny interconnection. However, if such interconnection occurs with no overall guidelines, the potential economies in spectrum and land line usage may never be realized.

... 10

SECTION III

MULTI-USER SHARED DIRECT DISPATCH PRIVATE MOBILE RADIO

Need to Communicate With The Telephone Network

Based on subscriber opinion surveys, the typical direct dispatch subscriber does not want his vehicle operators to have direct access to the telephone network. Since his radio system is used almost exclusively to direct the business activities of the mobile fleet, he considers that it is of the utmost importance that he maintain personal control. This control would be seriously jeopardized if the public, including the customers of the business were able to talk directly by telephone to vehicle operators.

A very few subscribers indicate that controlled access to the telephone network from the vehicle would be of some value to one or two executives with radio equipped cars, but not at the expense of exposing the entire fleet to the telephoning public.

The potential for using private dispatch mobile systems for emergency alternate communications in a time of disaster such as flood or storm could in fact be jeopardized by unnecessary routing through the switched network. Not only do networks and switching centres sometimes fail in earthquake, storms or floods, but traffic tends to overload with the risk that the switching centres may not be capable of handling it.

... 11

In their reply to FCC Docket 18262, Motorola Inc. made the following comments, "many types of private dispatch land mobile systems may be used to meet the need for communications when wireline systems and switching centers fail, but only if private dispatch systems are not dependent on the wireline system or a switching center".

There is no compelling reason for wholesale interconnection of the remote dispatch class of service. This is further substantiated by the fact that in the U.S.A. private dispatch "community repeater" operations have continued to thrive alongside of interconnected two-way public services, catering to those needs which are peculiar to their subscribers.

Although interconnected two-way radio systems could have their place in fulfilling a different user need, as discussed below and in Section IV, it would be an error to assume that the exisiting private dispatch type of service can be replaced by an interconnected service.

Alternatives to Radio Common Carrier Base Station Interconnection

There is, however, within the community of Private Dispatch RCCMRS subscribers, a small number of people whose business activities would benefit from some form of access to the public switched network. If the special needs of this minority group are

to be met, some economical means of doing so, without destroying the working efficiency of existing multi-user systems, must be found. There are two alternatives which might accomplish that objective.

One of these alternatives has been in use in the Province of Alberta for a number of years. The Millman's Communications Services Limited, which provides private dispatch automatic repeater services, under Restricted Public Commercial licences at a number of locations throughout the province, operates on frequency assignments sufficiently close to the General Land Mobile (MTS) part of the spectrum to permit channel switching, within a single mobile radio, from the RCCMRS channel to the telephone channels. The service, which is used largely by firms engaged in oil exploration activities, permits the customer to subscribe to public mobile Telephone Service from Alberta Department of Telephones if he desires.

The nature of usage in the Alberta case is understood to be such that virtually all MTS calls originate from the vehicle, and continuous monitoring of landline to mobile calls is not usually done. Such a service would have some of the characteristics of the "unlisted number" landline service. However, this service is used primarily in remote or undeveloped areas where the provision of conventional landline is inadequate for normal business purposes, and the radio substitutes for landline.

In the more densely populated regions of Ontario and Quebec as well as the major urban centres throughout Canada, VHF

... 13

frequencies which would permit operation as described have long since been allocated to other services many of which are municipal fire, police etc. Consequently, an allocation of suitable compatible VHF frequencies on a nationwide basis could only be made at this time by a major disruption involving several thousands of mobile equipments. In less sparsely populated areas, such allocations might still be feasible. It is understood that the wireline carriers are favourably inclined to this dual service arrangement.

A second alternative would be through the interconnection of the subscriber's private dispatch base station. This would be done in a manner identical to that discussed in Section VI under Private Commercial Services. Provided that adequate safeguards are built in to prevent other subscribers on the system from making unauthorized use of the interconnect subscriber's facilities, it would have identical implications to that of an interconnected private system operating on a private dedicated channel. This would be technically easier to accomplish because there would be no need to reallocate frequencies. However, an interconnected subscriber talking at length over the telephone network could substantially impede the normal use of the system by other subscribers. Because of the absence of significant expressed need for this form of network access by remote dispatch subscribers, it does not appear to be worthwhile considering it

... 14

at this time. Should future demand become sufficient that reasonable loading of a channel dedicated exclusively to this type of interconnected subscriber, could be achieved, it might be feasible to permit it.

Summary of Multi-User Direct Dispatch

The multi-user private dispatch facility provided by RCCMRS licensees fills a very distinct need in the early growth stages of a small scale business. It provides a means whereby the private user can get mobile radios into operation with little or no time delay, with an extensive zone of reliable coverage which otherwise he might not wish to or could not afford. During his growth period, it affords him a means of dispatching and controlling company vehicle operators with a degree of efficiency very close to that which might be achieved on a dedicated private channel.

The need for instant access to the channel, consistent with efficient channel utilization precludes any form of dialling or working through an operator, that would be imposed if dispatching were to be routed through the public switched telephone network. The degree of subscriber dissatisfaction that can be anticipated in such circumstances would be a serious negative factor in such a service.

... 15

Furthermore, unnecessary routing through the switched network could, in times of emergency or disaster where wire line systems and switching centres fail, result in the radio system being taken out of service where it might otherwise provide an alternate means of emergency communications.

Interconnection of multi-user private dispatch systems main RCCMRS base station to the switched network appears to be operationally undesirable. In those few cases where network access is occasionally desired, it can be accomplished by one of the alternatives discussed in the preceding sub-section.

... 16

SECTION IV

MULTI-USER RADIO SERVICE WITH MESSAGE RELAY

Need to Communicate With The Telephone Network

This service, is currently provided as a Restricted Common Carrier Mobile Radio Service, and is described in Appendix E.

Subscriber surveys indicate that there is definite disatisfaction with the verbal relaying of conversations between landline and mobile radio. Often the subject matter is technical in nature and the operator does not understand the content or terminology that is being relayed, rendering the communications unreliable and time consuming.

The RCCA has emphasized the same points in their submission to the DOC. From the standpoint of spectrum utilization, there is little doubt that the elimination of the operator interface would result in a significant improvement, although it cannot be expected that channel capacity would ever be equal to that achieved by the remote dispatch type of service.

An overwhelming argument for interconnection of this service arises from the fact that message relay service subscribers, by

... 17

the very nature of their business operations, have to communicate with landline subscribers. Their traffic is already on the network, being handled in an inefficient and time consuming manner. At least for them one of the first effects of interconnection would be to reduce both landline and radio hold time for the same volume of traffic.

The MTS services traditionally provided by the carriers, with no facility for message holding and relaying can not fill the peculiar needs of this sector any more than a one-line business service alone can substitute for an answering service, since the subscriber is chronically absent from the vehicle and does not want to have his calls go unanswered. At the same time, some telephone carriers are not permitted to provide these kinds of service. For example, Bell Canada's General Regulations, Rule 3 and Rule 42 precludes Bell from assuming responsibility for the transmission of intelligence (see Appendix K). B.C. Telephone Company, on the other hand is permitted to relay messages. It is not apparent that the regulatory agency would deny such authorization if a telephone company were to ask for it.

Origin of Traffic

Discussions with operators of interconnected message relay systems in the U.S. indicate that in that environment, most of the traffic is between vehicle and landline and that 75% of it originates in the vehicle.

... 18

Scope of Service

The subscriber to message relay class of service, under existing rules which do not permit interconnection, rents on a time shared basis, a radio channel for purely private purposes to communicate between his own mobile station(s) and a land line telephone answering service operator. The provision of radio facilities, by the (RCCMRS) base station licensee, for private purposes is directly analogous to the provision by the telephone companies of a time shared private telephone line, physically disassociated from the public switched network.

Should the RCCMRS base station, which provides message relay facilities, become interconnected to the public telephone network, the whole telephone world would be opened to the subscribers. As such the base station licensee becomes what might be described as a semi-symbiontic common carrier, whose existence depends on the wireline carrier with whom his system is connected. The implications of such an arrangement extend into a multitude of social, technical and economic aspects of telecommunications some of which are discussed below.

The provision of communications services to the public implies a responsibility on the radio carrier to serve all subscribers within his territory of operations, who apply for service, 24 hours a day on a year round basis. He is expected to provide, through his own facilities and/or those of associated

common carriers, a reliable technically compatible hook-up between his subscribers and any other subscriber-to-landline telephone or interconnected mobile services. To be consistent with modern telephone concepts of service his subscriber must be able to access any other subscriber through a single instrument. In other words, the provision of services must not be fragmented to the point that any subscriber would have to subscribe to more than one mobile radio service within his local calling area in order to communicate with the entire community of telephone or interconnected mobile telephone users.

It is implicit in such a service that facilities for efficient and accurate customer billing of toll calls, and if applicable, local message charges are provided.

Traffic Load Capability

In the traditional landline telephone sphere, the making of traffic load surveys has become an important function of the common carriers. These are carried out to keep a watchful eye on the capability of the communications facilities to accept traffic during peak periods. Failure to accommodate the load can cause repeated call-ins, tie up the central office circuits and generally back-up traffic to the detriment of the system. A typical landline objective is that an "all trunks busy" signal will not result more than once in one hundred calls. Such

.... 20

a capability has generally been achieved by provision of facilities which in fact lie idle, a significant part of the time. Modern practice is aimed at achieving the desired level of service most of the time while recognizing that an office may experience overload in an unusual situation.

Party line service, such as is still common in rural areas, results in a somewhat lower level of availability, but typically the associated plant remains idle up to 50-60% of the time. Because of the vagaries of propagation etc. associated with mobile radio, availability of air time is typically no better than 50%. Because only one conversation can take place on a channel at a given time, the provision of additional trunks etc. can not contribute to increased availability on an interconnected service. Availability may be optimized however through a combination of sophistication of physical plant and other incentives such as message rate structures and/or message time limits which would serve as a mild form of rationing of the service. Although the introduction of message rate charges in Bell Canada Public Mobile Telephone Services has apparently resulted in greater channel availability, U.S. experience on interconnected RCC systems seems to indicate that time charges alone have not been an effective deterrent to lengthy conversations, particularly among the more affluent subscribers. Fixed time limits on any one conversation seem to have been more effective in achieving equitable division of channel time between subscribers.

... 21

Easier access to the landline and greater facility in carrying on conversations could lead to an increase in the message content or the number of messages passed. U.S. experience indicates however that subscribers can be conditioned to accept restrictions on message length. Given such restrictions, existing subscribers could still be accommodated on a given interconnected channel and they would experience significantly greater utility, from the service, than they had had prior to interconnection.

Network Loading

Since messeage relay class of service already depends on landline with manual interface, the immediate result of interconnection would probably be a reduction in hold time per call to about half the present span. However, easier access to and from the landline could result in increased calls and could attract new subscribers who do not now use mobile radio.

The potential for overloading central office facilities, due to the random presence of too many subscribers during peak periods, has been cited as one reason for approaching mobile radio interconnection with caution. Careful consideration however, leads to the conclusion that a radio channel corresponds to one heavily loaded business line (trunk). The number of trunks required at any one time cannot exceed the number of available radio channels, hence the service is inherently not trunk limited, but rather channel limited.

... 22

At the present time there are theoretically, about 3,200 mobile radio channels available. Practical considerations prevent any more than about 2000 of these from being used in the largest cities. At the present state of affairs all restricted public commercial two-way radio operations combined account for only about 4% of the mobile population, hence would be entitled at the maximum, to about 80 channels. However, based on the conclusions and recommendations of the foregoing section III about 90% of these are not candidates for interconnection. The remaining 10% who would benefit from interconnection might therefore be expected to use only about 8 channels.

It is relatively impossible to predict how many non-users of mobile radio might eventually become subscribers to interconnected mobile service. In one American city of 220,000 population where interconnected mobile service has been strongly promoted, there are about 275 subscribers. They are being adequately served on 11 channels. Approximately 1,200 to 1,500 messages pass through the system per day with no message exceeding three minutes duration. Should a corresponding per capita usage develop in Canada, Montreal might be expected to have about 3,000 such interconnected mobile subscribers by 1980. If there were 120 channels available to provide a similar level of service, then the central office could be called upon to handle 120 radio calls simultaneously during peak periods. This would be a relatively minor load in a city of Montreal's size. The number of channels required in any other urban area could be expected to bear a similar per capita relationship. There does

... 23

not therefore appear to be any real threat of network overload. Discussion's between DOC representatives and one U.S. Bell Company which is host to several interconnected mobile operations has confirmed that they do not experience overload problems from interconnected mobile services.

Channel Capacity

Operating experience in fully interconnected U.S. mobile operations indicates that a majority of calls (75% originating in the vehicle) are completed directly without operator involvement. As a result, the time required for a given message content is cut in half or less of that required where an operator manually interfaces the radio with the landline. From that standpoint, the message handling capacity of a channel is just about doubled.

Value of Interconnection

The first beneficiary of interconnection would be the subscriber, who, except when absent from the vehicle, can talk directly to a caller without operator involvement. He can also call a landline party directly. The result is increased privacy and confidentiality as well as greater efficiency of communications. The additional psychological factors associated with direct person-to-person conversation, although not easily evaluated from a quantitative point of view, would be a significant benefit. The effect would be a smoother and generally more satisfactory communications process with increased information capacity.

The other beneficiary would be the independent mobile radio service operator. The provision of optional operator interception is one of the strong points that distinguishes the independent from the common carrier MTS, consequently the operator can not be eliminated. Observation of an interconnected service however, leads to the conclusion that the operator load is sufficiently light, even on a system of several hundred subscribers, that other duties can be shared. Reduced involvment of operators will free them for other duties such as landline answering, mobile paging etc., and may result in reduced staff requirements and lower operating costs.

Undoubtedly, the ability to offer interconnected service with optional operator handling would stimulate sales and open the door to new marketing opportunities for the independent operator.

Alternatives to Interconnection

As discussed in Section III, some RCCMRS systems have been allocated channels such that the subscriber can readily switch to the common carrier provided General Land Mobile channels and thus access the public telephone network. For standard production mobile equipment, such channels must be within approximately 600 Kilohertz of the desired General Land Mobile channels on VHF and about 1800 Kilohertz on UHF.

...25

These are specialized applications, peculiar to an area where landline telephone facilities do not exist and where the bulk of the subscriber's traffic is private dispatch with only occasional need to access the telephone landline.

Such an arrangement might serve as a second rate alternative to full interconnection of message relay services, but would preclude operator interception of unanswered landline calls to the mobile subscriber. In the heavier populated areas of Canada, where approximately half of the mobile radios operate, frequencies within 600 Kilohertz of the General Land Mobile Service frequencies have already been allocated to other services. Although such allocations may still be feasible on UHF, they could only be achieved on VHF through a major reallocation program.

Possible Variations in Interconnected Service Offerings

One of the more sophisticated forms of interconnected mobile service would be based on the IMTS (Improved Mobile Telephone Service) concept which is used extensively in the U.SA. by the common carriers. Such a service would provide landline access by simply lifting the mobile handset, accompanied by automatic searching for a free channel, with aural (and optionally visual) busy channel indications and traditional dial tone when an available channel is seized.

The mobile unit then has dial access to the network and the transmitter automatically sends a subscriber identification code

... 26

which permits automatic ticketing of local message (if applicable) and toll charges.

The full IMTS system permits direct dialling to the mobile from the landline without manual operator intervention. If the called party (mobile) is out of the vehicle or does not answer, within a given period of time a call lamp indicates that there has been a call. Other optional features such as horn blowing or external lamp lighting are available.

The IMTS system can be readily adapted to the interconnected message relay service. Depending on the operator's preferences, other facilities can be added. For instance, if the mobile subscriber does not answer a call within a given time period, it can be made to automatically revert to the landline answering service operator who records the call, takes the message and later relays it to the subscriber (who has been alerted by the call lamp) when the latter "calls in" to the operator.

Another variation automatically summons the answering service operator if the mobile subscriber lifts the handset, but does not begin to dial within a prescribed period. Other options include timing devices which audibly warn the subscriber when a basic flat rate message time is about to be exceeded, and in the extreme form even break the connection when a maximum allowable message time has expired! In some cases, by arrangement with the interconnecting landline telephone company, all long distance calls from the mobile

are automatically routed through the telephone company operator to enable direct billing by the telephone company.

Some subscribers are content with one-way dialling, either from mobile to landline or landline to mobile. For these, a somewhat less sophisticated system will suffice, in which the answering service operator intercepts calls in the appropriate direction and then summons the called party making the interconnection by manual switching. The subscribers then converse directly without operator monitoring.

Various combinations of the above and other features are possible. In its simplest form, the system could operate as a relatively unsophisticated mobile radio working through an answering service operator who intercepts all inbound and outbound calls, dials or summons the called party and then manually interconnects and disconnects the radio channel and the landline. As the number of automatic features are reduced, the less the facility resembles the familiar home telephone and privacy, ease of use, spectrum utilization and overall subscriber satisfaction suffer. There is little excuse, considering the advanced state of available technology, for interconnecting primitive facilities to the network. As a condition of interconnection mandatory service standards should be established to ensure that the equivalent of IMTS, as a minimum, is provided.

Competition With the Common Carriers

In the event of interconnection, the radio common carriers would then in effect be offering a Land Mobile Service operationally similar to the General Land Mobile Service now provided by the telephone companies but without roaming capability. In some cases this might result in the provision of mobile telephone services in locations where the telephone companies have not seen fit to provide service to-date. In other cases, it is to be expected that the radio carrier would be offering service in larger urban centres where the traffic handling capabilities of the telephone company's mobile telephone service has historically been limited. If the message relay services were interconnected there would still be two essential differences, namely:

a. The message relay service would provide an operator to answer the landline, take messages and pass them to the subscriber.

b. The message relay service would generally be a community service offered within the reliable coverage area of a local transmitter (about 25-30 miles radius) whereas the general land mobile service offers roaming privileges thoughout all areas served in Canada and the U.S.A.

It is reasonable to expect that subscribers, who do not require roaming service, may be enticed for one reason or another to leave

... 29

the telephone company and go to the independent local service. On the other hand, if the telephone companies are generally concerned, the competition provided might be incentive for them to upgrade existing services and market them more vigorously to retain or even expand their mobile business.

Summary for Multi-User Message Relay Service

The interconnection to the switched network of two-way mobile radio message relay services, operated in conjunction with landline telephone answering would provide distinct operational benefits in the form of efficiency and convenience to existing subscribers and would probably attract new subscribers who otherwise would not use two-way radio. Telephone companies generally do not offer and, in some cases are precluded by their general regulations from providing operator message relay services.

Such an interconnected service would be limited by the availablility of radio channels and would not constitute an overload hazard on the switched network.

Network integrity can be preserved by observing procedures and technical standards of performance and network compatibility. In the interest of preserving toll services for the common carriers, authorization should be confined to the primary reliable coverage area of the base station and connection with any other systems by means of radio link or private network should be prohibited.

... 30

Continued denial by the carriers of interconnection privileges for this group does not appear to be justified on an economic or competitive basis since the carriers themselves do not provide a comparable service.

Whether or not the operation of such interconnected services should be completely under the purview of a government regulatory agency is a matter for further consideration and may be influenced by the power which the DOC already has or does not have to control or limit the scope of such operations.

... 31

SECTION V

PRIVATE MOBILE RADIO SERVICES

Need For Interconnection

Background information on the Private Mobile Services is contained in Appendix F. It is impossible to generalize on the value of interconnection to private systems. The majority of them are employed exclusively for dispatching vehicles where the only person having a need to communicate with the vehicles is the dispatcher in the owner's office.

Most such users do not want their drivers to have access to or be reached by the public through the public telephone network. Waste of time, unnecessary tie-up of the radio system and intolerable loss of control over fleet operations could result. Furthermore as with multi-user remote dispatch services, the requirement for instant access to the system generally precludes going over the switched network as a normal mode of operation.

On the other hand, there are some categorie's of users to whom interconnection would be of considerable value. These are discussed in the following subsection.

User Categories Which Would Derive Benefit From Interconnection

Resource development and exploration companies have complained that their requests for interconnection of privately owned base stations to facilitate mobile access to the landline have been consistently denied in Bell Canada territory, although other carriers have been reasonably co-operative. This has resulted in some instances in duplication, by radio, of the carrier's facilities all the way back to civilization. They maintain that in the frontier areas, where no landline facilities exist, or where exploration activities are too transitory to justify telephone construction, that it is essential that mobile and portable radios have interconnection through their base station facilities to the nearest telephone network.

In some instances Bell have offered to provide interconnected fixed radio facilites, but under terms apparently less attractive than private ownership. In other cases the desired mobile facilities simply are not allowed interconnection.

There may be other categories of private systems in which interconnection would be advantageous - however, these are likely to be random applications.

With the lack of privacy that mobile radio now suffers, many potential users in highly competitive business activities are loathe to use radio, whether interconnected or not. Adoption of available technology which would assure complete privacy might of course drastically change things.

... 33

Network Loading

Just as in message relay service, network traffic from interconnected private mobile radio will be channel (spectrum) limited rather than trunk limited. Present state of the art does not permit more than about 2,000 channels to be allocated in any given geographical area. With the possible exception of two or three major metropolitan centres, it appears highly unlikely that most of these will be used for many years, certainly not in this decade.

It is doubtful if as many as 10% of the private systems in Canada would want interconnection. As a consequence the number of interconnected private system channels, even in Montreal or Toronto, would probably be in the order of 100 to 120. Even with 100% of these seeking network access in peak periods, the effect on the network would be minimal.

Furthermore, interconnection of emergency services to date have been predominately for night use only, a factor which could in fact result in greater utility being derived from the public network, rather than having detrimental effects.

Needed Safeguards

As in the other services the telephone companies are fearful that interconnected radio systems will be used to bypass toll. Some large users already have extensive private radio, private telephone and tie-line facilities which bypass toll. It is questionable

... 34

in such cases if any effective method can be found for prohibiting a greater amount of toll bypassing through interconnected mobile radio. Contractual terms and appeal to user integrity appear to be the most suitable means of control. See Appendix J.

On the other hand the majority of mobile users have only one base station. Their use of mobile radio is confined to the primary area of reliable coverage - usually from 10 to 30 miles radius. While they may be in some cases be able to span more than one local calling zone by means of radio, this ability does not differ from that which is provided by the carriers themselves in the General Land Mobile Services. However, in these single base station systems deliberate toll bypassing which might be accomplished by externally linking two or more interconnected base stations would normally be out of the question and economically unfeasible. It does not therefore appear to be nearly as serious a threat to carrier toll revenue as has been represented.

It would seem reasonable in private systems to impose contractual and/or licensing conditions which specifically prohibit the interconnected licensee from selling service to others.

Summary For Private Mobile Services

Private mobile systems vary widely in size, scope and needs. There are justifiable circumstances for interconnection of mobile systems operated by emergency service agencies, utilities and

... 35

resource development organizations operating on the frontiers.

Other categories of private mobile may or may not need interconnection and most will not want it.

Network loading would be channel limited rather than trunk limited and is unlikely to become a problem for the telephone companies.

Facilities for toll bypassing are already available to many large organizations and it may be necessary to rely on contractual terms of interconnection to further restrict it. Prohibition of toll bypassing in small systems operating from a single base station is not likely to be difficult.

Network standards and hardware type approval standards similar to those required for interconnected public commercial mobile services should be adequate to protect network integrity and ensure acceptable performance.

... 36

SECTION VI

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Public Radio Paging, and Public Multi-User Shared Two-Way Radio Services (RCCMRS) are authorized by DOC Restricted Public Commercial licences on a competitive basis. Both the monopoly telephone carriers and independent operators are engaged in providing these services.

Independent operators providing Radio Paging Services are at a distinct economic disadvantage, relative to the telephone companies, in that they must provide one or more full-time employees to take messages and encode the paging calls at a considerably greater expense than would be incurred if subscribers could dial directly into the paging terminal. Telephone companies on the other hand with few, if any, exceptions provide dial acces to their paging facilities. There does not appear to be any justification, other than the suppression of competition, for the telcos to continue to deny interconnection to the independents. Pressure for interconnection is building up and there is evidence that the independents may force the issue by taking advantage of loop holes in the carriers tariffs, by open defiance or by litigation. It appears likely that some of the carriers will take the initiative to resolve the problem, and unless the DOC sets down some guidelines, the opportunity to realize potential economies in spectrum usage may be lost.

... 37

Public Multi-User Message Relay Services provide operators to intercept and relay messages to and from subscribers. This desirable feature, which is not generally provided by telephone companies holding RCCMRS licences, fills a definite need for small business operators and professionals, and should be encouraged. Interconnection of these services with authorization to operate within radio range of the base station would further enhance the service for the subscriber and would reduce air time and network hold time for a given message. Interconnection of such service should be authorized subject to providing, at the outset, a high standard of service including two-way automatic dialing, automatic trunking of channels and privacy.

Most private mobile systems do not have a need for interconnection. Some agencies which perform emergency services already enjoy limited interconnection privileges. Some other organizations to whom interconnection would be valuable are denied interconnection. Provision should be made for interconnection of private mobile base stations where there is a demonstrated need.

Since the number of mobiles trying to get access to the switched network at any one time, will never be greater in the worst case than the number of radio channels available, there is no danger of mobile interconnection creating an overload on the telephone network or in a central office.

The DOC in the past has functioned primarily as an issuer of licences. Technology has advanced significantly over the past twenty years and the time is ripe for the DOC to set minimum service standards for all public commercial mobile radio and radio paging services as well as for private systems being authorized to interconnect.

Recommendations

1. Under existing legislation, the carriers have the authority to permit interconnection of independent public commercial radio paging services, as a tariffed offering, subject only to regulatory approval. As a pre-legislative measure, it is recommended that the DOC:

   a) Encourage the federally regulated carriers to permit, through their tariffs, the interconnection of non-carrier owned and maintained public radio paging terminals for the provision of public commercial paging services, subject to compliance with DOC technical specifications, service standards, and licensing requirements.

   b) Encourage the federally regulated carriers to permit, through their tariffs, the interconnection of non-carrier owned and maintained public multi-user two-way radio systems offering an operator

... 39

attended message relay service, subject to compliance with DOC technical specifications, service standards and licensing requirements.

c) Prepare and publish public two-way radio system and radio paging system specifications that will ensure, through the use of available technologies commensurate with the market potential in the locale involved, the optimization of radio channel utilization, network hold time and subscriber satisfaction. The specifications might allow some variability, depending on the nature of the individual markets, with the different requirements possibly tied to one or more of the carriers' rate groups.

d) Bring the carriers together with the independent operators (probably the Radio Common Carriers Association of Canada (RCCA) and the DOC to iron out suitable contractual and/or DOC licensing terms which would protect the essential interests of all parties.

e) Leave the choice of end-to-end or dial outpulsing signalling to be negotiated between the carrier and the paging operator. Where end-to-end signalling is employed the carrier should provide a DTMF (touch-tone) telephone or attach a data type DTMF pad to the existing telephone, as a tariffed offering.

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f) Develop a new licensing plan which provides a separate class of licence for each of the three services currently being authorized under a Restricted Public Commercial license.

g) Maintain the existing prohibition on interconnection of Multi-user direct dispatch two-way radio services.

h) Draft minimum service standards aimed at providing optimum use of air time and affording as a minimum "fleet" privacy for subscribers to public multi-user direct dispatch services.

II At such time as a federal government policy on interconnection is embodied in legislation, it is further recommended that:

a) The regulatory agency be empowered to require the federally regulated carriers to permit the interconnection of the foregoing service.

b) In view of the possibility of severe spectrum shortage in the larger metropolitan areas, the DOC take the initiative to require independent paging operators to share interconnected high capacity "tone only" terminal facilities and radio frequency channels, as a condition of authorizing their interconnection.

... 41

c) The DOC authorize interconnected "tone plus voice" service to share the channel with "tone only" service only in circumstances where the total probable paging market is small enough to be handled by one channel. Otherwise interconnected "tone plus voice" service should be authorized only on channels separate from interconnected "tone only" channels.

APPENDIX A

History and Scope of Land Mobile Services

The first significant step toward the achievement of satisfactory land mobile radio operation was made in 1928 when a student, Robert L. Batts and a Detroit policemen Kenneth Cox persuaded the Detroit Police Department to rebuild their originally unsatisfactory self-excited transmitter into a crystal-controlled Master Oscillator Power Amplifier (MOPA). Simultaneously they solved some of the earlier basic receiver problems of instability and lack of sensitivity that had contributed to unsatisfactory performance of one-way radio networks. In 1933, a New Jersey policeman, Lieut. Vincent Doyle became the first to transmit over two-way radio (REL AM equipment on 33.1 MHz). On October 13, 1937 the Federal Communication Commission issued Order No. 19 allocating 29 VHF channels to law-enforcement agencies (30.50 - 39.9 MHz). By this time use of crystal control had become universal in both transmitters and receivers. RCA, GE, FM LINK Co, and Motorola had entered the field.

F.M. transmission for land mobile service was introduced in North America at an early date. Using one carrier frequency for the base station transmitter and another frequency for mobile transmitters, the FM system made it possible for several separate geographically spaced base stations to operate simultaneously without significant interference. Initially, however, receiver I.F. selectivity was extremely broad being 50 KHz wide (6dB down) and 200 KHz wide (60 dB down). Furthermore, transmitter deviation and spurious radiation were uncontrolled. In those days of uncrowded spectrum, these shortcomings did not hamper system performance.

As late at 1940, there were only a few thousand transmitters operating in the U.S. In Canada, use of land mobile radio gained momentum after World War II and has grown at a phenomenal rate. After a slow start in the first fifteen years, the mobile population (see Table 1) in Canada increased from 14,875 in 1961 to 146,400 in 1972. Growth in any given year has ranged from about 14% to over 31% with only two years below about 20% during that period. In the year ending March 31, 1972, 17,600 (13.7% growth) new equipments, not including replacements, were put into service.

New technology and new user applications continue to create significant additional demands for spectrum with land mobile becoming the fastest growing sector of communications in recent years. This increased demand with the resultant increase in spectrum loading brought with it the necessity to further refine equipment

design to reduce the interference problem as well as spurious transmitter radiation and receiver responses, improve receiver selectivity, diminish transmitter noise, minimize desensitization and intermodulation interference, and provide instantaneous deviation control. Technical improvements, incorporated through somewhat higher cost equipment, have halved channel spacing of most land mobile services, while keeping interference at an acceptable level.

The 150-174 MHz band is, at present time, the most heavily utilized and is approaching saturation in some parts of Canada. Consequently the DOC has been discouraging channel assignments in this band and making allocations to a greater extent in the 410-420 and 450-470 MHz bands which are in the Ultra high Frequency Range.

A breakdown of land mobile usage by industry segments gives some indications of the overall importance of land mobile radio to industry. (See graphs No. 1 and No. 2) The transportation sector is by far the major user of mobile (38,000 mobiles in use in 1971) and will probably continue to be so. Taxi services is one of the main user segments in the transportation sector but growth is limited by the fact that most municipalities keep tight control over the number of taxi licences issued. Construction, public administration and services, manufacturing and forestry account for the larger part of the remaining users. Growth has been rapid and can be expected to continue. It is interesting to note however that the 1973 per capita use of mobile radio in Canada was roughly equivalent to the per capita usage in the U.S.A. some 10 to 12 years earlier.

Economic Importance

Mobile radio has become a virtually indispensable tool to many industries which use motor vehicles to service their public. For example, approximately 75% of all taxis operating in Canada are equipped with mobile units and this figure is expected to reach 85% by 1980. Mobile radio contributes greatly to the operational efficiency of police, fire departments and trucking firms. It has been estimated that four trucks with mobile radio can perform approximately the work of five trucks without mobiles.

The land mobile manufacturing industry employs approximately 1,000 people, including about 200 salesmen. Annually the industry generates an estimated $18,000,000 in new equipment sales plus an additional $7,000,000 to $10,000,000 in replacement sales. Total estimated replacement value as of 1972 was about $100,000,000.

Sources of Hardware

The suppliers of mobile radio equipment include:

Motorola - Canadian production supplemented by some U.S. imports;

General Electric - Canadian production supplemented by some U.S. imports;

Canadian Marconi - Canadian design and production;

Pye Electronics - Imported from Great Britain;

International Systcoms - Canadian owned company, design and manufacture in Canada.

E.F. Johnson - Imported from the USA and sold through a Toronto distributor with some assembly in Toronto;

R.C.A. - Imported from the USA and sold though a Vancouver distributor.

In addition there are several minor suppliers including Spilsbury and Tindall who import some radio equipment and accessories from the U.S., Great Britain, Denmark or Japan, plus one recent Canadian entrant to the manufacturing scene, Vectron Limited working out of Montreal. Spilsbury and Tindall have recently announced its intention to design and manufacture mobile radio in Canada. The Japanese have made only slight penetration in the business mobile market, possibly due to lack of effort or interest.

Projected Growth

In 1961 the Canadian mobile population was only 14,875, largely in taxis. By 1972 it had expanded to 146,400, with an arithmetic average growth increment of 23.2% per year. In an eleven year period it has increased to approximately ten times the size of the 1961 figure. The Economic Policy Planning Unit of the DOC has forecast approximately 100% cumulative growth by 1980 in the Toronto and Montreal regions. Historically national growth has taken place at more than twice the rate experienced in the Montreal and Toronto regions. Even if national growth slows down to the Montreal and Toronto rate there will be over 300,000 mobiles by 1980. This is supported by the Electronic Industries Association of Canada which has estimated that 330,000 mobiles will be in service in Canada by 1980.

Although the Canadian population is approximately 10% of that in the USA, total mobile radio usage and annual sales is only about 5% of that in the USA. This suggests that the Canadian market capacity may be as much as twice as great as has been demonstrated to date. If this is the case, some acceleration in growth may be anticipated which would tend to bring the per capita usage more into line with American experience.

MOBILE POPULATION, ALL CANADA MARCH, 1973

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Agriculture (1)	61	88	117	156	210	289	481	674	821	981	1,171	
Forestry (2)	1,221	1,383	1,697	2,372	3,644	4,638	5,885	6,819	8,126	9,630	12,173	
Fishing & Trapping (3)	19	47	49	74	183	192	230	298	331	374	419	
Mines & Oil (4)	596	748	1,027	1,316	1,772	2,351	2,961	3,862	4,915	6,268	7,532	
Mfg. Industry (5)	782	1,096	1,523	2,090	3,055	4,449	5,395	6,358	7,688	8,947	10,386	
Construction (6)	441	651	925	1,348	2,136	2,933	4,140	5,474	7,195	9,196	12,381	
Transportation (7)	6,623	7,762	9,441	12,041	14,019	17,256	20,841	24,176	28,831	33,187	38,355	
Communications (8)	414	665	1,176	1,631	2,071	2,720	3,186	3,693	4,466	4,994	5,743	
Utilites, Gas Electricity, Water (9)	2,209	2,489	3,111	3,627	4,154	5,984	7,185	8,242	8,957	9,394	10,461	
Trade (10)	376	587	801	1,138	1,500	2,135	2,960	3,939	4,916	5,885	7,017	
Finance, Insurance Real Estate (11)	7	12	23	37	64	98	151	291	443	641	825	
Commercial Business Personal Service (12)	219	348	478	669	928	1,328	2,005	2,845	4,009	5,362	7,292	
Public Administration & (13)	1,357	1,807	2,210	3,111	4,017	5,219	6,205	7,263	8,460	9,393	11,006	
Defence (not individually licenced)	550	700	800	1,200	1,600	2,000	2,400	2,800	3,200	3,500	4,000	140,852
Total Canada	14,875	18,383	23,378	30,810	39,353	51,592	63,925	76,734	92,358	107,752	128,761	146,400
% Annual Growth	Ref.	23.7	27.1	31.7	27.7	31.1	23.9	20.0	20.4	16.6	19.49	13.7
Annual Increase		3,508	4,995	7,432	8,543	12,239	12,333	12,809	15,594	15,394	21,609	17,639

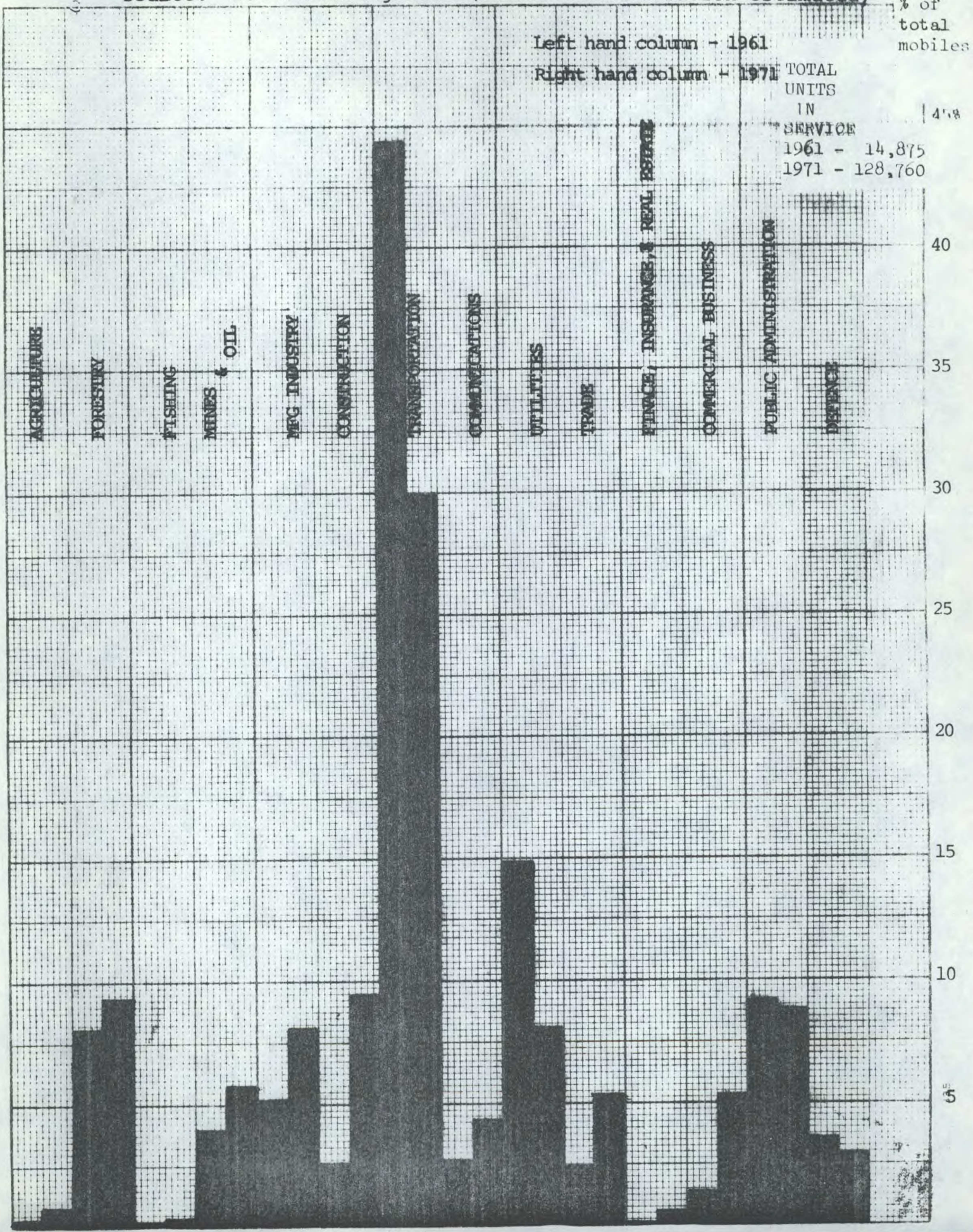
Not available at time of publication

TABLE I
MOBILE RADIO POPULATION

Source: DOC Licensing Data (Public Administration Estimated)

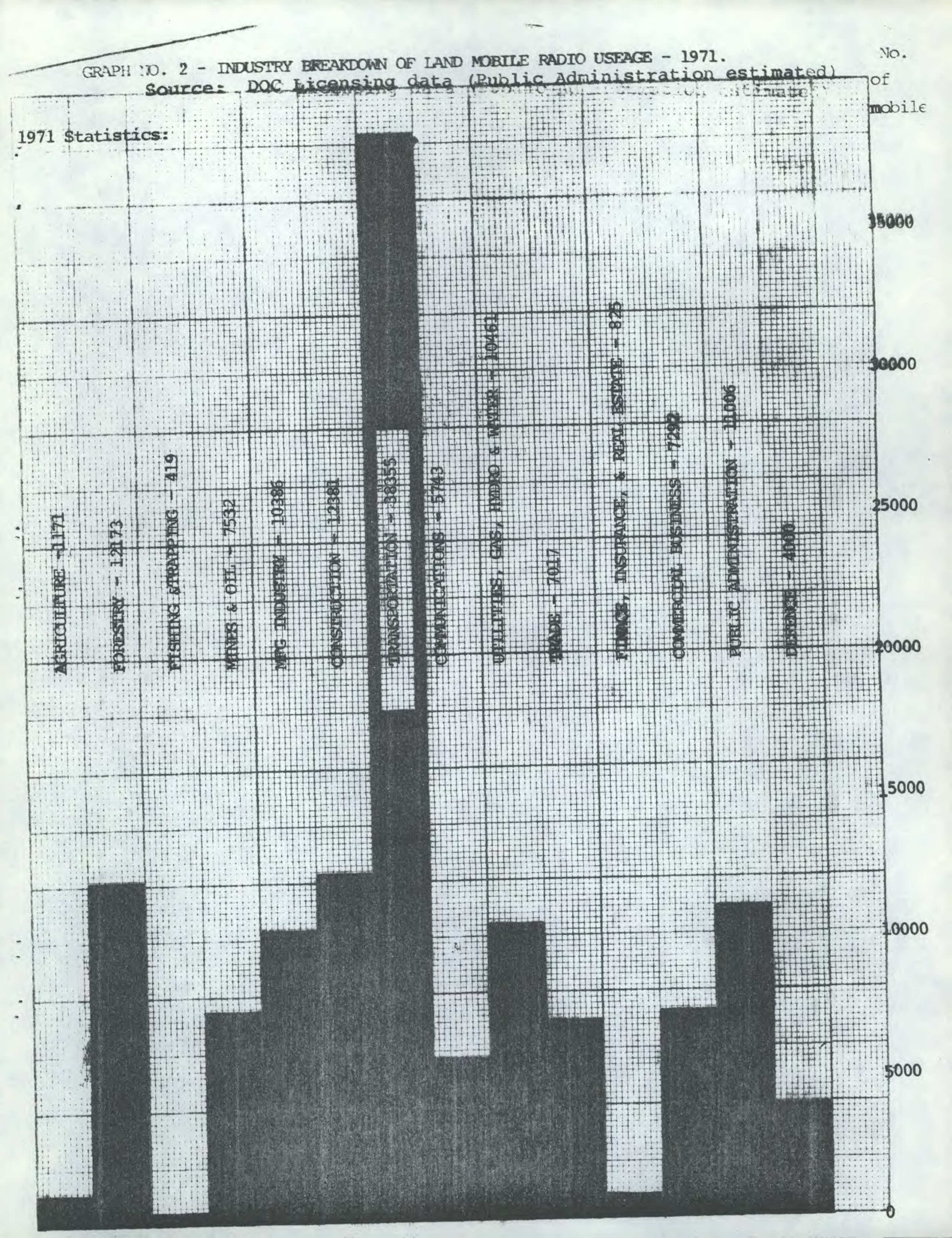
GRAPH NO. 1-INDUSTRY BREAKDOWN OF LAND MOBILE RADIO (BY % 1961 & 1971). IN CANADA

Source: DOC licensing data (Public Administration estimated)



GRAPH NO. 2 - INDUSTRY BREAKDOWN OF LAND MOBILE RADIO USEAGE - 1971.

Source: DOC Licensing data (Public Administration estimated)



APPENDIX B

Mobile Radio Viewed as Terminals, Multi-Station Systems or Networks

Objections on the part of the carriers have been raised to the DOC's consideration of mobile radio interconnection on the grounds that mobile radio services are networks, not terminals.

By careful examination of private mobile operations it is apparent that the majority of them are single frequency simplex systems served by a single base station within a reliable coverage zone of 10 to 25 miles radius. Mobiles generally can hear messages from the base station to other mobiles, and occasionally, at close range of 5 - 10 miles, may talk with the other mobiles. There is no provision in such systems for talking through the base station from mobile to mobile.

The operational characteristics of these sytems are virtually the same as those of an elementary wired intercommunications system whose main function is to provide communications between the master units (base station) and the individual extensions (mobile station). Such a radio system being intra-urban in range of coverage, operates more or less in a local calling zone subject of course to the customary vagaries of VHF or UHF radio propagation. Its characteristics more nearly resemble those of a terminal than any other device, and should be considered in that context for interconnection purposes. Radio paging terminals which inherently provide one-way communications only are in a similar category.

Some private mobile systems and all of the restricted public commercial mobile services operate in the simplex mode on duplex frequency pairs. Many of these regularly, or on request, use the main base stations as a repeater for vehicle-to-vehicle or vehicle-to-auxilliary base station communications. Functionally they are multi-station systems closely resembling a multi-way intercom. Apart from that, they are normally confined to intra-urban territory within the primary reliable coverage zone of the base station, corresponding more or less to the local calling zone of the telephone companies. Thus, if interconnected, they would have the characteristics of a PBX terminal whose extensions are mobile within the local calling zone.

Operators of some private systems and of a minority of restricted public commercial mobile services have acquired privately owned lines or point-to-point radio links which have the capability of extending mobile radio over inter-urban long distance routes. These augmented

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radio systems have ceased to be simply terminals and are a form of network. The economic implications of interconnecting them are significantly different from those of a simple intra-urban single base station mobile radio system, or inter-urban where a carrier provided leased line, WATTS, DDD or foreign exchange is involved.

This paper does not deal with the inter-urban or long haul category which lies outside the scope of this particular inquiry.

APPENDIX C

RADIO PAGING SERVICES

Background

The use of radio for the personal paging of individuals has become widespread over the last twenty years. Made feasible initially by the advent of sub-minature electronic vacuum tubes, pocket sized radio receivers are typically worn in a jacket or shirt pocket, or clipped to a belt. When there is a requirement to have the user make some pre-arranged response (such as "call your office"), a unique address code is sent via a radio paging transmitter. The user's receiver responds to the code and emits a beep or similar warning sound (tone only).

In a further refinement of the technique the warning sound is triggered, and a short voice message, containing more explicit directions follows (tone plus voice).

Both "in-plant" paging systems and "City-wide" paging systems are in use. In the majority of cases, city-wide paging is provided by commercial paging enterprises who cater to a large number of individual subscriber pagees. "In plant" paging may be privately owned, obtained on a rental basis from the common carrier, or leased from some other suppliers.

Commercial radio paging services are provided by independent operators, often in conjunction with landline telephone answering services, and by some, but not all, of the major telephone companies. The latter are frequently supplied under the name of "Bellboy" service.

As of mid 1973, there were 120 public commercial radio paging operations licensed. Of these about 20 are operated by the common carriers. The remainder are operated by independents. The number of paging receivers in use on a giveh system varies from less than a dozen in some towns to several thousand in cities like Toronto, Montreal and Vancouver. The average for Canada lies near 200 receivers per paging station.

A recent common carrier (Bellboy) offering which is in its developmental stages provides System Wide Area Paging (SWAP) whereby a subscriber can be paged simultaneously locally and in one or more distant regions across Canada.

Virtually all city-wide paging involves someone in the subscriber's office making a telephone call to the paging company in order to initiate the page. Most telephone company paging transmitters are directly connected to the public switched network and can be activated automatically by the subscriber who dials a number code assigned to his paging receiver.

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Independent radio paging enterprises in Canada are denied, by existing telephone company rules, access to the switched network. Instead, one or more operators are kept on duty to manually record telephoned paging instructions and to activate the encoding apparatus and paging transmitter on request. Privately owned in-plant paging systems are currently permitted connection to telephone extensions on a carrier owned PBX or PABX system, but network access is denied.

During the period from May 1972 to July 1973 nine separate requirements for interconnection of commercial paging terminals have been brought to the attention of the Department of Communications. These range from routine licence applications, and formal briefs, to direct requests to the Department for intervention. At least one Canadian company is understood to have installed a dial interconnect paging terminal, operating it manually, in the hope that authorization to interconnect may be received at some future date. Another company has apparently devised a means of providing its subscribers with direct access to the paging terminal without requiring a physical connection and without violating the carrier's tarifs. The company has indicated that it intends to market the system nationally. There is a great deal of unrest in this sector and the immediate attention of the DOC is warranted.

Characteristics of Services

Technical

Early paging systems typically employed Amplitude Modulation in the 27 MHz band, using a transmitter radiating several hundred watts. Subsequently, Frequency Modulated systems in the 35MHz band (low band) came into use.

The development of suitable VHF and UHF transistors and integrated circuits combining the features of miniaturization and low battery drain made practical the use of pocket sized high band (approx 150 MHz) FM paging receivers with chassis sensitivites comparable with those of the much larger tube type mobile receivers of earlier years. The modern trend is toward widespread use of these 150 MHz FM paging systems.

For carrying convenience, pocket type paging receivers are fitted with internal (suppressed) antennas. The less efficient antenna reduces effective sensitivity by about 15 to 20db and imposes a severe limit on the reliable coverage zone. As a consequence although a single well sited transmitter will usually be adequate to cover a small city of 50,000 or so, it may require up to four or five strategically located transmitters to cover an area the size of Metropolitan Toronto.

Manually operated paging systems are rather straight forward, involving not much more that the basic transmitter station, a suitable encoding unit and associated controls. Manual operation, especially the message taking function is severely limited by the number of paging calls that a human operator can handle. The addition of a computer "store and forward"

facility in "tone only" paging systems could allow multiplication of operators each with his or her own telephone trunk, to handle higner levels of traffic, all on a single radio frequency channel. The economics of such an arrangement are not, however, generally attractive.

There are two well developed systems of providing interconnected paging services. One of them, known as end-to-end signalling permits all subscribers to access the paging transmitter by dialing a common seven digit number. The subscriber then, by means of tone signalling (DTMF) buttons on his telephone, or in the case of a dial phone, by a data type tone pad attached to the telephone, initiates his own code to signal the appropriate pocket receiver.

The other system uses network outpulsing signalling (sometimes called "selector level signalling"). In this arrangement, a block of central office code numbers is allocated to the paging service. Each subscriber is assigned his own 7 digit number within that block, and a paging call is initiated by merely dialling the number. Typically the first 3,4 or 5 digits (depending on the particular coding arrangement and its capacity) are collected by the Central Office and the remaining digits are passed on to the paging transmitter to generate the unique customer code. This system is commonly employed by the carriers in the provision of Bell Boy or equivalent paging services. In the U.S.A. it is employed by some interconnected independent public paging services.

Terminal Capacity

The number of subscribers which can be handled on a single radio channel depends on the number of unique signalling codes that can be provided in the apparatus in use, and the maximum number of paging calls that the terminal is physically capable of handling in a reasonable period of time during peak periods.

In the case of an interconnected "tone only" paging terminal, with "store and forward" facilites, and 100 to 150 trunks, capacities of up to 100,000, using digital codes, are achievable because the time that an individual paging signal actually ties up the transmitter is reduced to milliseconds. "Tone plus voice" drastically reduces capacity to about 450 - 500 subscribers per channel because of the longer holding time on the paging transmitter. At the present time the majority of Canadian radio paging stations serve less than 300 receivers. About a dozen, including two telephone companies, have surpassed the 1,000 mark. Among the independents, lack of interconnection privileges inhibits capacity.

Theoretically manually operated "tone only" paging terminals equipped with suitable "store and forward" facilities are capable of handling about as many subscribers as interconnected ones, given enough additional trunks to compensate for the greater holding time and longer response time. A single operator can usually

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handle in peak periods, about 200 subscribers. Hence about 500 operators with as many trunks would be necessary to fully utilize a 100,000 capacity terminal on a manual basis.

Nature of Subscriber

The people who use paging services represent a very wide range of occupations from delivery truck drivers through salesman, professional people and business executives. A form of "tone plus voice" paging using identical techniques, sometimes with larger sized fixed or portable receivers is prevalent among voluntary fire departments, emergency measures (civil defence) personnel, voluntary ambulance brigades and similar emergency organizations. These latter groups may use either privately owned systems or subscribe to public paging services.

There appears to be some minor differences between subscribers to "tone only" and "tone plus voice" services. In a cross-Canada survey of a sample of public paging subscribers, the DOC identified the following average characteristics:

	TONE ONLY	TONE PLUS VOICE
Average number of employees in company or department concerned	20.3	5.5
Number of pagers in use	2.6	2.5
Average reliable coverage radius	20 miles	23 miles
Percentage of working time pagee spends in coverage area	98%	97%
Expected additions within 1 year	0.2 pagers	1.7 pagers
Expected additions within 5 years	1.2 pagers	3.9 pagers

Subscribers to "tone plus voice" showed some inclination toward exchanging the paging service for some other form of communications, generally two-way radio, within 5 years. "Tone only" subscribers on the other hand did not reveal any intentions to replace the pagers.

Range of Coverage

Typically, a public paging service is designed to give reliable coverage throughout the given urban area with a reasonable penetration into the suburbs.

DOC's user survey indicated that coverage of 20 to 23 mile radius is provided, and that about 98% of the users' working time is spent within that zone.

Channel Capacity

Technically the paging services have the potential for serving a very large number of subscribers using relatively few radio channels. A fully automated interconnected "tone only" terminal can accommodate as high as 100,000 subscribers on a single channel. "Tone plus voice" and manually operated terminals are much less efficient, but can still cater to several hundred on a channel.

Many of the paging transmitters, in order to get required coverage, are operated at about 250 watts ERP, consequently tend to have greater interference creating potential than 2-way radio fixed stations.

Common Carrier Paging - SWAP

The System Wide Area Paging offering recently introduced by TCTS members provides simultaneous subscriber paging in major Canadian cities. This system is directly interconnected with the switched network. Paging is accomplished by DDD which accesses one or more regionally located computers. The computer in turn relays the paging command to each of the cities in which the subscriber has arranged for service.

Other less recently introduced carrier offerings, usually called "Bellboy" service, are local in nature and are generally dial accessed directly without involving a human operator. Telephone company services are usually of the "tone only" variety.

Sources of Hardware

Paging transmitters are usually standard VHF FM (some are A.M.) equipment similar to those used for two-way radio communications and are available from most of the major two-way radio manufacturers. Pocket sized paging receivers are similarly available from some of the same sources. In Canada these later include: Canadian Motorola Electronics Limited
E.F. Johnson (Canadian distributor A.C. Simmonds & Sons)

In addition several foreign manufacturers such as Bell and Howell, Martin Marietta, Zenith, Multitone, et al manufacture radio paging receivers. Japan is also competing for this market.

Interconnect paging terminals of a more specialized nature are required to interface the paging transmitter and the

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telephone switched network. Canadian Suppliers of interconnect paging terminals include: Canadian Motorola Electronics Limited
Acme Devices (Canadian owned in Montreal)
Omicron (Montreal)

Several U.S. companies including Motorola, Amcor, Secode and Martin Marietta are in the market. Apart from a limited sale to the common carriers, there is at present no significant market in Canada for interconnect terminals. Canadian manufacturers find themselves in the unusual situation of selling almost their entire output to the U.S.A.

Apparatus is highly developed to be fully compatible with North Amercian telephone networks, so that there is no apparent problem from either the availability or compatibiltiy standpoints.

Economic Importance

Radio paging has undergone rapid expansion in recent years. There are now over 100 licensed Restricted Public Commercial Paging Stations across Canada. By 1980 this figure may have doubled. Paging subscribers now number over 20,000 and are increasing at a rapid pace. Its popularity among institutional and business concerns indicates that it has great operational and economic value, and the number of paging receivers could eventually out-grow the quantity of two-way radios in use.

The basic paging transmitter station represents an investment of about $3,000. Paging receivers are sold in the $300 to $400 bracket. Thus the new capital investment in basic transmitters and receivers over the next 8 years could gross about $6,300,000.

Write-off of paging receivers due to exposure to external damage and outright loss runs about 2% per year while obsolescence and wear out probably account for about 8%. Hence the replacement market alone is about 10% of the total pager population or about $600,000 annually.

Maintenance costs typically run to $2.50 per month per unit i.e. $600,000 annually.

Subscriber charges for service run from about $18.00 to $27.00 per month. Thus annual revenues from subscribers amounts to about $7,800,000.

In summary, the public paging industry now accounts for about $1,400,000 annual investment and generates about $7,800,000 in

... 7

gross revenues. By 1980, without interconnection, it is estimated that equipment replacement value will have reached $12,000,000 generating $15,600,000 annually in revenues.

Basic interconnected paging terminals cost about $15,000. Hence assuming that 50% of the independent operators will interconnect by 1980, if permitted, additional terminal investment resulting from interconnection will reach $1,500,000. Assuming that the economics of interconnected operation will permit lowering of subscriber rates and thus will stimulate usage another 25%, interconnection would account for an overall increased investment of about $4,000,000 by 1980 with a corresponding increase in operator revenues of about $1,560,000, assuming a 20% reduction in existing rates within the interconnected segment.

Projected Growth

Historically public commercial radio paging has grown from negligible proportions in the 1950's to over 100 stations with over 20,000 subscribers in 1973. Without interconnection these might reach 200 and 40,000 respectively by 1980. With interconnection these figures may be nearer 250 and 50,000.

Some communications companies are known to be studying the consumer aspects of this market. It may be that the combination of increased affluence, easy access to paging terminals and lowered cost of apparatus and paging services could attract a whole new market segment, vastly increasing the market penetration beyond the above estimates.

Users Needs

Surveys* conducted by the DOC indicate that users of "tone only" services are generally well satisfied. Some users of "tone plus voice" had no particular reason for having the voice facility, and there is generally less satisfaction than with "tone only". One major source of discontent is the absence of confirmation that the paging message, which typically does not have a pre-determined meaning as with "tone only", has been received. This discontent is further evidenced by a generally expressed intention to eventually drop the "tone plus voice" service in favour of full two-way radio.

Other complaints had to do mostly with the quality and intelligibility of the voice message.

From the user standpoint there does not appear to be any significant difference in the interconnected service provided

* "A review of RCC Mobile Radio Service, City Wide Radio Paging, Private Commercial Mobile Radio" - R.K. Walker and R.J. Crowder March 1973.

... 8

by the telephone companies and the manual service provided by the independents. If anything, subscribers are rather neutral about the whole thing and it can be concluded that there is no subscriber pressure for interconnection of radio paging terminals.

At the same time, among existing subscribers to either carrier or independently provided services, the Department was not able to identify a demand for paging services beyond the primary 20 to 23 mile radius. This appears to indicate that if there is a significant demand for extended range or multi-city paging it will come from outside of existing paging subscribers.

For the most part, subscribers to "tone plus voice" paging services do not give paging access information to the public, although it might be feasible to do so to a limited extent. Because "tone only" paging does not provide for any variations in the user's response, it does not appear to be desirable to advise the public how to access it.

APPENDIX D

MULTI USER SHARED PRIVATE DISPATCH SERVICES
(Remote Dispatch Class Of Service)

Background

In the early stages of mobile radio development, it was customary for each licensee to provide his own base station by which communications were established with his mobile units. VHF and UHF radio propagation is virtually line-of-sight and the user, because of the topographical characteristics of his area of operation very often found it necessary to invest a considerable amount in base station antenna structures. If his dispatch offices were not strategically located, a private user might find it necessary to buy or lease land on some remote hill top to gain sufficient antenna altitude for the required coverage. Such expense often had the effect of precluding the use of mobile radio for the small scale business operator who wanted to operate only one or two mobile units. At that period of time prior to channel splitting conservation of frequencies was an important consideration.

One solution to the small fleet needs was introduced in 1954 in the form of a Restricted Common Carrier Mobile Radio Service (RCCMRS). In the RCCMRS system, an entrepreneur provides a radio base station, generally strategically located on a prominent hill top, high rise building or a low mountain. Small business operators use this base station to dispatch their mobiles units, on a time-shared basis, and typically pay the owner a monthly subscription fee for the privilege. In many cases the subscriber also rents his mobile equipment from the RCCMRS operator.

Under the category of a Restricted Public Commercial Service the license issued for this service by the Department of Communications permits the licensee to provide:

1) A Remote Dispatch Class of Service to enable a subscriber to communicate directly with his vehicle utilizing a leased wire line or radio link through a common base station (repeater); and

2) A Message Relay Class of Service, to enable a subscriber to pass messages to and from his vehicles through the intermediary of an operator who has direct control of the base station.

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The word "Restricted" applies in that:

a) Two-way communications are authorized only between the licensed land station and subscribers' mobile stations specifically licensed for communications with it.

b) Communications are not authorized between the subscribers who time-share the RCCMRS land station.

c) The service itself is limited to the primary coverage area.

d) Interconnection with the public switched network is not authorized.

The first such license was issued to an applicant in British Columbia in 1954. Since that time, the number of RCCMRS systems has increased steadily. As of mid 1973, there was a total of 101 individuals or corporations holding RCCMRS licenses. Fifty-five of these were licensed for one channel* only on a single site. Twelve were licensed on two channels, six on three channels, eleven on four channels, five on five channels and five on from six to nine channels. Seven licensees, individually authorized on from 10 to 51 channels, accounted for the remainder. In total these licensees occupied 253 sites, operating about 374 transmitters. Their scopes range from purely local to multi-station operations in all of the provinces and the North West and Yukon Territories. See Table II for RCCMRS population 1957-1972.

In 1972, there were approximately 6,000 mobile units being dispatched through these facilities. However, the average loading per channel was only 19.4 mobile units. It does not appear that, with the exception of a half dozen or so RCCMRS systems, that the DOC objective of conserving frequencies by this means has been achieved.

The majority, possibly 90%, of RCCMRS licensees provide only the Remote Dispatch Class of Service. Recent surveys conducted by the Department of Communications reveal significant differences between the Remote Dispatch and the Message Relay Class of Service. For that reason the remaining discussion in this Appendix deals only with the Remote Dispatch Class. Message Relay Service will be dealt with separately in Appendix E.

Characteristics

Technical

The Department of Communications has reserved fourteen VHF pairs and seven UHF pairs of frequencies for RCCMRS service. The two frequencies within a pair are spaced approximately 4 MHz

* Channel as used herein means the number of transmitters, whether co-sited on separate frequencies, or operated on different sites on the same or different frequencies.

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apart in the VHF spectrum and approximately 5 MHz in the UHF spectrum. This spacing permits the base station to simultaneously receive and re-transmit, in an automatic repeat or talk-through mode, using relatively economical filtering devices in the antenna circuits to avoid interference between the receiver and the transmitter.

In its original concept, a subscriber was provided with a remote control unit in his office, hard wired via private leased telephone lines to the remote site of the RCC base station.

An alternative form of subscriber control, which has since been introduced, utilizes a radio link provided by a low powered simplex auxilliary base station using a relatively simple antenna located at the subscriber's office. This permits the subscriber to transmit directly through the RCCMRS base station acting as an automatic repeater and his message is retransmitted to the mobile unit. The mobile operator wishing to reply or to initiate a contact with his dispatch office does so by an identical process and his transmitted message is retransmitted to be picked up by the receiver in the dispatcher's auxilliary base station.

This system, which imposes no physical limit on the number of auxilliary base stations, is generally suitable for use over any line-of-sight path and cost is not normally a function of distance from the RCCMRS repeater station.

Leased telephone line monthly rentals are typically directly proportional to mileage at about $4.00 to $8.00 per mile. Some RCC operators have estimated that the equivalent annual cost of the radio link becomes equal to or less than the equivalent annual cost of a remote control unit plus line charges beyond a certain distance, sometimes as short as five miles. At the present time, with only a few exceptions, control by a radio link is the most prevalent form in use.

There is little if any deliberate attempt to allocate carrier frequencies in a manner that would permit mobility or roaming between the systems of different RCCMRS licensees. Some of the larger operators such as Mclean-Hunter employ the same frequency pairs at different locations, so that a roaming subscriber could presumably access a repeater at more than one location. Most operators however assign a given group of subscribers to a dedicated channel. Channel sharing accompanied by automatic trunking which potentially could increase the efficiency of channel usage has not been attempted in Canada.

Capacity

The number of mobile subscribers who can be accommodated by a given automatic repeater varies with the nature of the subscribers' business activities. Some repeaters accommodate as

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many as sixty mobile units whereas others are operating near full capacity with forty mobiles. Optimum use of air time is achieved by the subscriber exercising fairly strict self-discipline in confining use of the radio to essential business and keeping messages as short as possible. Typically most of the traffic occurs during business hours. Some subscribers maintain a fairly uniform level of traffic through the day, while others have peak periods occuring at certain times of the day, followed by periods of relatively low usage. To date there has been little, if any, trend toward digital data transmission, lockout, automatic trunking or queing apparatus which could contribute to increased channel capacity.

Nature of Subscriber

The typical remote dispatch subscriber is a small to medium scale business operator employing anywhere from one to a half dozen or so mobiles. He is large enough to have a full time office staff, who can take care of fleet dispatching either on a part time or full time basis.

A user survey recently conducted by the DOC across Canada revealed that the "average" subscriber has an average of 1.5 office locations, 19.3 vehicles, 1.1 auxilliary base dispatch stations and has mobile radio in 6.4 vehicles. That part of his organization or department to which the radio system pertains has 78.8 employees, 12.1 of whom are concerned with the radio communication facilities.

The average subscriber anticipates adding one additional radio within the next year and 3.3 units over the next 5 years. About 25% of those interviewed indicated an intention to change the service, generally to a private system in about 5 years.

Range of Coverage and Long Distance Needs

The same survey revealed that the zone of reliable radio coverage has an average radius of 29 miles, and that 92% of the working time of the vehicles is spent within this zone. There appears to be only a very small demand for occasional coverage up to 100 miles distance. Typically the subscriber has alternate means, such as telephoning ahead to the intended destination, for communicating with his vehicles on the few occasions that they may be out of radio range. Consequently extended range is generally not of sufficient value to make him willing to pay extra for it.

Restricted Public Commercial licences are issued to enable the provision of a purely local service. Linking of repeater stations, in order to enable a subscriber to remain in contact with his office over distances greater than the primary coverage areas of the local RCCMRS base station, is not intended nor

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authorized by the licence.

A survey of forty existing remote dispatch subscribers revealed only one who had attempted to get any form of extended coverage. He had subsequently discontinued his subscription because it was of insufficient value to him.

There does not appear to be any significant pent-up demand among existing subscribers for extended radio range such as might be achieved if individual repeater stations were permitted to interconnect with each other by radio link or land line.

Communications Between Subscribers

The whole concept of the RCCMRS is based on the provision of a time-shared facility by which a private mobile radio user communicates between his office and his own vehicles, i.e. radio stations located on his private property. From the Department of Communications standpoint there is no intention that any subscriber use this facility to communicate with the office or vehicles of another subscriber.

The group-call facility, such as tone coded squelch, normally precludes communication between subscribers except by pre-arranged or chance defeat of the tone control. Consequently, most RCCMRS systems do not lend themselves to inter-subscriber traffic.

On very rare occasions a subscriber who has happened to be listening after hours has been known to provide assistance to the driver of another subscriber's vehicle whose own dispatch office was closed down for the night. The Department's surveys indicate that there really is not a demand on the part of existing subscribers for inter-subscriber communications.

Proportion of Vehicle-to-Vehicle Traffic

On the average about 17% of the traffic is between vehicles in the same fleet with the remaining 83% between the dispatcher's base station and his mobiles. Habits of individual subscribers, however, range all the way from 0% to 100% vehicle-to-vehicle traffic.

Privacy

Although a few of the less sophisticated systems provide a completely "open speaker" type of service where all mobiles and bases hear every message, this type of facility is generally not acceptable to the subscriber. Such a system requires continuous monitoring in order to know to whom messages are being addressed. At the same time there is no form of privacy whatever. Such a system might be compared to a rural party line on which every telephone is equipped with a loudspeaker instead of a distinctive or unique ringing signal.

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The more prevalent system, and also the more satisfactory, uses group call. This is usually accomplished by using sub-audible continuous tones (tone-coded squelch) to activate the receiver being addressed. Each subscriber's fleet is assigned a distinctive tone and all of his mobile radio operators hear all messages from his office or from any other vehicle in his fleet. Individual vehicles or drivers are usually addressed orally by a code name or number.

It is a requirement of the Department of Communications that any operator must first monitor the channel to make sure that it is clear before transmitting. This is typically accomplished by a "defeat" switch manually depressed by the dispatcher or automatically activated in the vehicle when the microphone or handset is lifted from its rest.

Privacy of other subscribers' messages is of course violated when the "defeat" switch is activated, consequently the subscriber who uses the radio for strictly confidential messages does so at his own peril. On the other hand, the probability of eavesdropping is greatly reduced by the tone-coded system. At the same time the vehicle operators and the dispatchers are relieved of the tension of monitoring all messages in order to identify those intended for themselves.

This lack of complete privacy is one of the shortcomings that subscribers have to tolerate with the systems in common use. This becomes more important when business competitors share the same channel. Technology is readily available to provide privacy if the operating companies were to choose or were required to provide it.

Operator Discipline

Generally the subscribers are aware of the need for self-discipline in order to maximize the availability of air time. Each tends to be somewhat critical however, of the others who time-share the system. Some progressive RCCMRS operators have shown considerable initiative in encouraging proper use and some have in extreme cases been known to terminate the contracts of unco-operative subscribers.

Use of Air Time

Referring again to the recent survey, the subscriber's fleet uses an average of about 43 minutes airtime per day, or 6.7 minutes per mobile unit. Assuming an eight hour day, this works out to approximately 0.8-minutes per hour per mobile unit. With this amount of usage, the limiting capacity figure of about 60 mobiles can be readily deduced, confirming the earlier figure which has been empirically determined.

The manner in which the dispatcher and mobile operator communicate is a dominant characteristic of this class of service. In a typical situation, the dispatcher determines by listening

(while depressing a tone-code "defeat" switch), that no one else is on the air, then calls the mobile unit using some form of identifying name or number for the called party. All vehicles in his fleet hear the message. If the mobile operator is in his vehicle, response is almost immediate and with only two or three exchanges of brief conversation, often using number codes such as 10-4 etc., the contact is terminated. Ability to access the system with a minimum waiting time is a prime requisite. This becomes more important as the size of the subscriber's fleet grows. The other subscribers tend to feel that the larger fleet is "hogging" the air time. Eventually if the subscriber gets from 15 to 20 mobile radios in operation, he is no longer willing to share air time with another 20 to 30 mobiles and typically acquires his own private radio system and terminates his subscription to the RCCMRS service.

APPENDIX E

MULTI-USER MOBILE RADIO SERVICES WITH MESSAGE RELAY (Telephone Answering Service)

Background

Two-way mobile radio services authorized under existing policy by a Restricted Public Commercial licence include a Message Relay Class of service. This typically is provided in conjunction with a landline telephone answering service. The answering service operator manually intercepts and records all telephone calls to the subscriber. The subscriber calls in by radio when convenient and finds out who has called.

In addition to offering the economic advantages from the capital investment standpoint, the message relay class of service makes it possible for the subscriber to be in radio contact with his customers, through the answering service operator, without necessarily maintaining his own full-time office staff.

Message relay service is normally provided only by those RCCMRS licensees who also operate a landline telephone answering service. These represent about 10% or less of all the RCCMRS licensees. It is estimated that approximately 10% of the subscribers to Restricted Public Commercial two-way radio service may be using message relay service, totalling about 600 mobiles in all Canada.

Characteristics

Technical

In most instances, message relay subscribers have a mobile radio in the car but may not necessarily have either a remote control unit or an auxilliary base station in their own office. Most or all communications are received from, or directed to, the telephone landline via the telephone answering service operator.

The answering service is equipped with the facilities for transmitting and receiving messages and generally performs the function, on behalf of the subscriber, that would be performed by the subscriber's own staff in the Remote Dispatch Class of Service described in Appendix D.

Since direct interconnection of the radio base station to the landline is not permitted by Canadian wireline carriers, all messages are taken by the answering service operator. The operator then verbally relays the message to the mobile subscriber.

In some cases the mobile subscriber wishes to communicate with a landline telephone subscriber. To do this the mobile calls in to the answering service. The answering service operator then dials the desired number and acting as the message bearer, verbally relays the conversation back and forth between the two parties.

Capacity

The number of mobile subscribers who can be accommodated on a given channel is about 20 to 25, approximately half that of a comparable private dispatch service. This is partly because most of the traffic which is either in the form of inhibited (by the human interface) two-way telephone conversations or relayed telephone messages is of a time consuming nature. In the case of the telephone conversation, each party's statements are repeated by the operator, at least doubling both the radio system and the telephone network holdtime. Furthermore calls to the landline are delayed, after initial radio contact has been made, while the operator dials the called party.

The nature of the calls is significantly different from those in remote dispatch service and there is a variability in the conversants where landline telephone calls are involved; consequently much of the strict discipline in the use of air time that is characteristic of the remote dispatch is absent in message relay service.

Nature of Subscribers

The subscriber to message relay service typically does not operate a "big spread". More often than not, there are relatively few employees, or at least there is not a full time office staff. The subscriber is frequently absent from the telephone and requires the services of a telephone answering service to intercept and pass on messages.

A DOC user survey of about a dozen subscribers revealed that the "average" subscriber in that small group has 1.4 office locations, 4.6 vehicles, no auxilliary base station or remote control unit and has mobile units in 1.6 vehicles. That part of the subscriber's organization to which the mobile radio pertains has 10.8 employees who are concerned with the radio communication facilities.

Range of Coverage and Long Distance Needs

The survey revealed that, among the subscribers contacted the reliable coverage radius is about 30 miles and that 95% of the working time of the vehicle is spent within that zone. Although the subscriber generally does not want multi-city radio coverage, nor greater coverage than he now has, some of the respondents indicated that from 10% to 70% of the calls originating in the mobiles would be over the toll network.

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Communications Between Vehicles

Since the main function of the message relay service is to provide a link between people in vehicles and landline, it follows that there may be occasions to communicate with other people in vehicles. Many of the existing message relay services do not have facilities by which any vehicle-to-vehicle communication can be conducted, and inter-vehicle communications, even between employees of the same subscriber, is almost non-existent.

Proportion of Traffic To and From Subscribers Staff

The subscribers surveyed indicated that an average of 64% of all calls which originated in the vehicle were to the subscriber's own staff. Similarly 55% of the calls originating on the landline to the vehicle were from the subscriber's staff. In either case, this indicates that although traffic involving landline telephones other than those of the mobile subscriber is not in the majority, it is nevertheless substantial.

Privacy

Where dispatching by the answering service is done over a private wire line to the transmitter, only the outgoing half of the conversation can be heard by other mobile subscribers. Where the answering service uses an auxilliary base station working through the repeater, both sides of the conversation can be heard at the mobiles. If tone-coded squelch systems are used, only the called subscriber will normally hear, although there is nothing to prevent deliberate eavesdropping.

Several of the existing message relay services operate without benefit of tone-coding, hence afford less privacy than is normally enjoyed by most of the direct dispatch service subscribers.

Technologically, the provision of privacy on interconnected systems is quite feasible. It is understood that many of the U.S. independent radio carriers use full IMTS terminals and mobile units which provide full privacy. In addition, IMTS provides automatic trunking (channel search), dial tone, automatic subscriber identification for ticketing, and full duplex mode of operation.

Use of Air Time

The typical subscriber uses about 21 minutes of air time per day, or 13.1 minutes per mobile unit. Assuming an eight hour day this works out to a bit more than 1.6 minutes per hour per mobile unit, tending to confirm that about 30 mobiles are all that can be accommodated on a channel.

Distribtuion of Traffic

In the manually interfaced services surveyed by the DOC 95% of the traffic was between the landline and the vehicle. In one instance the subscriber reported that 20% of the traffic was between vehicles, but most of the subscribers did not have facilities for vehicle-to-vehicle communications.

APPENDIX F

PRIVATE MOBILE RADIO SERVICES

Background

Private Mobile as used herein includes virtually all mobile radios except those provided under Ship-to-shore radiotelephone, Aeronautical mobile, Public Commercial, Restricted Public Commercial, and the General Mobile Radio Service categories. About 90% of all land-mobile equipment in use in Canada is in the private category.

General Characteristics

A private system may consist of a single base station and a single mobile unit on one channel, operated by a small business within a 10-30 mile radius, or it may encompass several hundred mobiles and portables widely dispersed geographically complete with numerous base stations, repeaters and control centres operating on several channels. Basic radio equipment used is identical to that employed in the public commercial sector. Typically it does not employ much, if any, sophisticated accessories. Some of the larger fleets tend to use group calling or selective calling devices either to facilitate reaching a particular person or group of persons, or as partial insurance against co-channel interference.

In recent years a trend has begun toward use of digital data and visual displays in heavily loaded services such as in some Montreal taxis fleets and the Metropolitan Toronto Police Communications system.

Expected Growth

About 130,000 mobiles now operate in private systems. The figure will probably reach 260,000 by 1980. About 30% of these are in the transportation industries with taxis accounting for a major part. Forestry, mining, manufacturing, construction, utilities, trade, commercial business and public administration account for another 60%.

The remainder is employed mainly in defence with a very minor contribution coming from fishing, finance, insurance and real estate.

Economic Importance

Because private systems constitute 90% of the total mobile business, the private sector represents the most important part of the mobile market, and its needs will tend to influence the general direction that mobile technology will take.

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Interconnection Status

Some Agencies which provide emergency or safety services operate on a scale which does not permit round-the-clock staffing of an office. Direct access to or from their vehicles by telephone, at least during certain hours would solve a serious communications problem.

In the larger centres, a telephone answering (message relay) service may be used, but most small communities do not have telephone answering services. Agencies in this category include fire departments, police, ambulance, emergency measures, emergency maintenance and security organizations.

Telephone companies offer a Radio Extension Service option which provides for interconnection of some of these agencies, where the telephone company is the exclusive supplier of equipment. They also offer interconnection privileges to privately owned base stations in these emergency categories. To date there are no published technical standards for the latter. For some reason, possibly because of telephone company marketing emphasis or possibly subscriber ignorance of its existence, almost no such agency has availed itself of the privilege of using customer-provided equipment. On the other hand, there are 5 such interconnections in British Columbia, 40 in Alberta, 6 in Ontario and 64 in Quebec - mostly with municipal police. The facilities are for the most part owned by the telephone company except in B.C. The telephone company generally does not restrict the hours of use, but in actual practice the facilities are used mostly during the night.

Major utilities such as Ontario Hydro have had needs for interconnection arrangements between a base station and the telephone network, usually for the use of night partrolmen or maintenance personnel. To some extent they have been successful in arranging a suitable contract with the telephone company, although the general impression is that an excessive amount of negotiation has sometimes been involved.

APPENDIX G

TOLL BYPASSING

There have been some instances in which independent mobile radio or paging companies have utilized radio links to extend paging calls to distant transmitters rather than use WATTS, DDD or private lines leased from the telephone company. Apparently this trend has caused concern to the telephone companies on the basis that if interconnection privileges were granted, these radio facilities would be used to siphon telephone calls off the toll network. If such interconnected systems were to become prevalent, it is argued that common carriers could suffer loss of toll revenue.

On the other hand, it is already common practice for large users to link their offices in distant cities by means of leased lines, foreign exchange or WATTS using facilities provided by the telephone companies. The toll network is bypassed, but the carrier derives revenue from the other facilities. It is understood that the carriers would not find it objectionable if interconnected mobile services were linked in a similar manner as long as the linking facilities were provided by the common carrier.

The landline carrier's fears of toll bypassing remains a serious deterrent to the interconnection of mobile services. Assuming that the preservation of the carrier monopoly on toll is in the public interest, prohibition of toll bypassing will be necessary, possibly through one or more of the means suggested under Regulatory Implications in Appendix H. Such a prohibition will mean that the independent operator will be authorized to provide only a local service within the reliable coverage area of his base station and will not be permitted to link base stations by private radio link, privately owned wire or other non-carrier provided means to form another network substantially outside the local calling zone of the interconnected telephone company. Conversely any organization proposing to network its Restricted Public Commercial stations through non-carrier provided facilities would be denied interconnection privileges.

APPENDIX H

REGULATORY IMPLICATIONS OF INTERCONNECTION

There are a number of hypothetical situations which might be accepted as justification for government regulation of interconnected independent mobile radio services. These include:

a. Monopoly - where too little competition exists if left to free market forces. In such cases regulation has been deemed necessary to protect the user against exploitation by the economic power of a monopolist. High start up costs or technical limitations such as shortage of spectrum might place limits on the number of competitors. Free competition now exists and there is no obvious need for a regulatory agency to intervene.

b. Instability - where the services offered by competitors are nearly identical, entry is easy and destructive price cutting develops. Regulation might then be deemed necessary to avoid deterioration of service through financial instability. However, the history of the industry does not reveal any evidence of instability.

c. Cream-Skimming - where unregulated competition with the regulated carrier results in the unregulated service being offered only in the highly lucrative areas. An examination of the mobile services now offered by the major carriers leads one to the conclusion that they too have avoided the non-lucrative areas, apparently having no obligation to provide general land mobile service unless they choose to do so. There does not, therefore, appear to be any justification for imposing regulation on this count.

d. Toll Bypassing - the common carriers have expressed the fear that interconnected independent public mobile service might be used to bypass toll and siphon off carrier revenue. This is technically possible unless specifically prohibited through interconnection contracts with carriers, provisions of the authorizing radio licence or regulatory rules. In the latter case, the independent operator would have to be subject to an appropriate regulatory agency. However, the interconnection contract should be adequate for this purpose provided that the government backs the carrier in its enforcement. See Appendix I for a sample Interconnection contract.

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e. Billing for Carrier Services - the interconnection of regulated common carriers with unregulated mobile radio carriers could necessitate some arrangement whereby the radio carriers would bill their respective subscribers for services rendered at least in part by other carriers. Such an arrangement would have potential for abuse, unless some form of regulation of the Radio Carrier be one of the alternatives. This resale of carrier services would be comparable to established practice in the field of hotel and motel telephone services, which have not apparently needed regulation.

None of the above situations have existed to such an extent, or seem likely to become sufficiently unmanageable by other means, that regulation need be considered necessary at this time. Should consolidation of ownership, in the future, give rise to monopoly or near monopoly then the need for regulation might be re-examined.

Regulatory Jurisdictions

A legal opinion from within the Department's Legal Branch concluded that federal jurisdiction exists over those specialized common carrier undertakings in which radio is the dominant feature. Where the radio aspect is dominant (as opposed to being merely incidental) it was further concluded that the Canadian Transport Commission is the appropriate existing federal authority to exercise jurisdiction.

In the case of the wireline companies, the federal government has exercised jurisdiction only over those three companies which are federally chartered to provide inter-provincial telecommunications services.

Should some of those independent companies who presently hold RCCMRS licenses enter the interconnected radio common carrier field, the issues related to jurisdiction are not entirely clear. The majority of existing RCCMRS licensees are provincially chartered and provide services in only one or two communities. There are on the other hand, a few RCCMRS licensees including several manufacturers of mobile radio equipment, who are federally chartered and provide local services in a number of municipalities in two or more provinces.

There is no doubt about the Federal Government's jurisdiction in so far as the issuing of radio licences is concerned. There may however be practical problems in the administration of other forms of regulation that can be more adequately dealt with by the same regional bodies who are presently regulating purely local or regional telephone companies. These are areas that will require

... 3

resolution through Federal - Provincial consultation before any steps are taken toward the establishment of any form of interconnected radio common carrier services. Consideration might be given to requiring the carriers to form arms-length subsidiaries for provision of competitive services, to avoid cross-subsidization and to ensure that competitors are all on an even footing.

A P P E N D I X I

Sample Contract Between Telephone Companies and Interconnected Independant Public Radio Paging Services.

MISCELLANEOUS COMMON CARRIER INTERCONNECTION AGREEMENT - PAGING

This AGREEMENT is made this _____ day of _____, 19___, between _____ Telephone and Telegraph Company, (hereinafter referred to as the "Company") and _____ _____, (hereinafter referred to as the "Carrier").

WHEREAS, the Company owns and operates a telecommunications system in certain _____ towns and cities and, through agreements with Associated and/or Connecting Companies provides telecommunications services throughout the State of _____ and in other states; and

WHEREAS, the Carrier operates a one-way selective signaling (paging) system pursuant to a license issued by the Federal Communications Commission to the Carrier as a Miscellaneous Common Carrier in the Domestic Public Land Mobile Radio Service; and has obtained a certificate of convenience and necessity from and has filed tariffs with the appropriate Regulatory Commission of the State of _____ and the Carrier represents that it is complying with the rules and regulations of said commissions; and

WHEREAS, the Carrier, in order to facilitate the handling of its business as a Miscellaneous Common Carrier, desires connection between its system and the Company's system giving dial access from the Company's system to the one-way selective signaling common carrier communications system operated by the Carrier;

NOW, THEREFORE, in consideration of the covenants and understandings hereinafter contained, it is mutually agreed as follows:

1. Definitions

For Purpose of this Agreement, the following definitions shall apply:

A. Base Station. A fixed transmitter licensed by the Federal Communications Commission from which radio communications are transmitted to the Carrier's radio receivers.

B. Control Point. A Control Point is an operating position under the control and supervision of the Carrier at which an operator responsible for the operation of the transmitter is stationed.

C. Point of Connection. A point on the premises of the Carrier within the Reliable Service Area of the Carrier's System at which the one-way selective signaling (paging) system of the Carrier joins the Company's system. The Point of Connection is usually at the Control Point of the Carrier.

D. Primary Serving Telephone Exchange. The Company's telephone exchange wholly or partly within the Reliable Service Area of the Carrier's System, designated by the Carrier as the primary exchange from which connecting circuits will be furnished to the Carrier.

E. Secondary Serving Telephone Exchanges. The Company's telephone exchanges (other than the Primary Serving Telephone Exchange) wholly or partly within the Reliable Service Area of the Carrier's System from which connecting circuits may also be furnished.

F. Reliable Service Area. The area within which radio communications are reliably sent to the Carrier's paging receivers as defined in Part 21.504 of the Rules and Regulations of the Federal Communications Commission.

G. Interconnecting Arrangement. An interface furnished by the Company to interconnect the Company's Serving Telephone Exchange and the Carrier's paging terminal.

H. Paging Terminal. The equipment and circuitry furnished, operated and maintained by the Carrier in which the Interconnecting Arrangement terminates and which controls the radio paging transmitter(s) of the Carrier.

I. Company's System. The Company's System is the exchange and toll network of the Company and its interconnecting companies.

J. Carrier's System. A one-way selective signaling (paging) network, in the Land Mobile Service. The network may employ more than one Base Station when served by a single point of connection.

K. Intercept. A recorded message to inform the calling party of disconnected, invalid, or unassigned numbers.

The Company will interconnect its system with the Carrier's System for the purpose of handling one-way telephone traffic originating in the Company's System and terminating in the Carrier's System described herein.

Interconnection will be accomplished through an Interconnecting Arrangement provided by the Company. Traffic handled through such interconnecting Arrangement will be restricted to calls to radio receivers within the Carrier's Reliable Service Area.

3. Point of Connection

The Point of Connection between the respective systems of the Company and the Carrier for the handling of traffic to the Carrier's System shall be located on premises at _____ _____.

4. Telephone Numbers

Telephone numbers assigned to the one-way signaling system of the Carrier will be assigned at the Company's option and may be changed at any time as required by the Company's service and equipment requirements. Notice will be given by the Company to the Carrier at least 30 days prior to any such number change.

The Company will furnish numbers to the Carrier in groups. The initial group shall consist of _____ numbers and each subsequent group shall consist of _____ numbers which will be assigned by the Carrier to his one-way selective signaling subscribers. Unassigned numbers shall be "intercepted" by the Carrier. Persons having dialed such a number will then be informed either by appropriate recorded announcement or by an operator that the number is reserved and presently unassigned.

Additional numbers, when required by the Carrier, will be furnished by the Company after such time as the Company has determined that it has sufficient equipment available for this purpose, but will not be unreasonably withheld.

5. Rates and Charges

Rates and charges for connecting circuits, number groups, equipment or service furnished by the Company for the provision of the one-way selective signaling service described herein, shall be in accordance with Schedule E (Schedule of Charges).

Rates are based upon the size of the number groups and reflect consideration for an average holding time of 50 seconds. If this holding time is exceeded, the rates agreed upon herein shall be subject to renegotiation.

5. Rates and Charges (Continued)

All Carrier charges will be handled directly between the Carrier and his customers.

The Carrier is responsible for payment, monthly, of all charges for facilities and services furnished by the Company for the Carrier.

6. Facilities

Each party will construct, equip, maintain and operate its system so that good and adequate service will be furnished to the public at all times.

Certain components of the Carrier's System are set out in the Carrier's current radio station license or licenses attached hereto as Schedule A. The Carrier will promptly furnish the Company with every reissuance of said license of licenses and all modifications thereof for attachment to this Agreement as a revision of Schedule A. A map showing the Reliable Service Area of the Carrier's System is attached hereto as Schedule B.

The connecting circuits for the interchange of traffic will be furnished to the Carrier from the Primary Serving Telephone Exchange to the Point of Connection, designated in Section 3 hereof and will be used only for the handling of traffic hereunder. Interconnection is furnished on the condition that the Carrier obtain adequate connecting circuits to permit the use of this service without injurious effects upon it or any other service rendered by the Company. At the Carrier's request, additional connecting circuits may be furnished by the Company after such time as the Company has determined that it has sufficient equipment available for the purpose.

Connecting circuits, mode of operation, Base and other classes of stations associated with the Carrier's System and their relative locations, Control Point(s), and Point of Connection are shown on Schedule C (Operational Diagram) attached hereto. Notice of any significant changes to be made in the Carrier's System, as described in Schedule C, shall be given to the Company in advance, and in no case later than ten days after an application has been filed with the Federal Communications Commission for said changes. The Carrier also agrees to promptly furnish the Company proposed revisions of Schedules B and C to reflect any significant changes to be made in its system.

7. Connecting Circuits

All traffic between the Company's System and the Carrier's System shall be interconnected solely over the circuits and facilities authorized by this Agreement and in accordance with the terms and conditions of this Agreement and the Company's applicable tariffs.

The Carrier will handle all traffic over the connecting circuits to be provided under this Agreement (which are specifically designated for the interconnection use on Schedule C attached hereto), and will not without the consent of the Company use any local telephone exchange line, foreign telephone exchange line, Wide Area Telephone Service line, or private line in connection with one-way signaling traffic.

8. Transmission and Protection

In order to prevent excessive noise and crosstalk in the Company's System, and to insure a reasonable degree of quality in the Carrier's System, the Carrier agrees to conform to the transmission parameters detailed in Schedule D (Transmission and Protection Criteria) attached hereto.

Each of the parties hereto will take reasonable precautions in the location, construction and maintenance of its facilities for protection against hazard or injury and so as not to interfere with services or facilities furnished by the other party. The Carrier agrees to conform to the minimum protection standards listed in Schedule D (Transmission and Protection Criteria) attached hereto.

The Company may make reasonable tests and inspections and may upon notice to the Carrier, interrupt the service being rendered by means of the facilities being tested or inspected, or may, without such notice, interrupt the service rendered hereunder in case the facilities of the Carrier fail for any reason to operate in accordance with the requirements hereunder, until the situation is corrected. The Carrier will indemnify and save the Company harmless from and against any claims or demands of any nature arising out of the operation or maintenance of the Carrier's facilities or arising out of any interruption made in accordance with this paragraph.

9. Records and Information

Each party will keep accurate records of its transactions hereunder, and such records will be subject to inspection by the other at all reasonable times. Each party will furnish to the other such information relating to the interchanged traffic covered herein as may reasonably be required.

10. Defaults or Violations

If either party hereto defaults or violates any provision of this Agreement, and if such default or violation shall not have been corrected within thirty (30) days after written notice thereof is given to the defaulting party, the other party may terminate this Agreement forthwith, with or without any additional notice.

11. No Waiver

The failure of either party to enforce any of the provisions of this Agreement or the waiver thereof in any instance shall not be construed as a general waiver or relinquishment on its part of any such provision, but the same shall, nevertheless, be and remain in full force and effect.

This Agreement shall be effective as of the date first herein mentioned and, unless sooner terminated as herein provided, shall continue in force until terminated by ninety (90) days prior written notice from either party to the other.

13. Notices

Notices under this Agreement may be given by posting in first class mail to the Carrier addressed as follows:

_____

_____

_____

_____

and to the Company address as follows:

Mountain States Telephone and Telegraph Company

_____

_____

14. Assignment

This Agreement may not be assigned or transferred by either party without the prior written consent of the other; provided, however, that the Company may assign or transfer this Agreement to its successor, associated or affiliated companies without the prior written consent of the Carrier; and provided further that such consent will not be unreasonably withheld.

IN WITNESS WHEREOF, the Company has caused this Agreement to be executed in its behalf this _____ day of _____, 19__, and the Carrier has caused this agreement to be executed in its behalf this _____ day of _____, 19__.

By _____

Title _____

THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

By _____

Title _____

SCHEDULE A

Attached to and made a part of

INTERCONNECTION AGREEMENT

Between TELEPHONE AND TELEGRAPH COMPANY

and _____

Effective as of _____

Copy of License

Identified and Approved this
_____ day of _____, 19__

By _____

Title _____

By _____

Title _____

SCHEDULE B

Attached to and made a part of

INTERCONNECTION AGREEMENT

Between TELEPHONE AND TELEGRAPH COMPANY

and _____

Effective as of _____

Map of Reliable Service Area

Identified and Approved this
_____ day of _____, 19__

By _____

Title _____

By _____

Title _____

SCHEDULE C

Attached to and made a part of

INTERCONNECTION AGREEMENT

Between TELEPHONE AND TELEGRAPH COMPANY

and _____

Effective as of _____

Operational Diagram, Facilities & Equipment

Identified and Approved this
_____day of _____, 19__

By _____

Title _____

By _____

Title _____

Attached to and made a part of

INTERCONNECTION AGREEMENT

Between

and _____

Effective as of _____

Transmission and Protection Criteria

Transmission Requirements

The equipment of the Company and of the Carrier shall be of such character and shall be installed, operated and maintained by each so as not to cause induced sound or crosstalk to or from circuits of the other. In addition the equipment of the Carrier shall be of such character and shall be installed, operated and maintained so as not to cause number selection errors in, or malfunctions of, the Company's switching equipment.

The control equipment utilized by the Carrier which is to be connected with the Company is to be fabricated in accord with generally accepted "telephone quality" standards. In addition, the control equipment must, in the opinion of the Company, be completely compatible with the central office with which it is to be connected.

At the point of connection with the connecting circuit facilities furnished hereunder, the Carrier shall furnish for each radio one-way selective signaling circuit to be connected, a balanced two-wire facility through a 900 ohm source impedance. In order to protect the telecommunications network and the services furnished to the general public by the Company from harmful effects, any signal applied to the Interconnecting Arrangement from the Carrier provided equipment must comply with the following criteria:

a. To prevent excessive noise and crosstalk in the network it is necessary that the composite power of the signal which may be applied by the Carrier provided equipment to the Company may not exceed 12dB below one milliwatt at the Company's central office when averaged over any three second interval. The composite power level at the point of connection will be derived by the Company by adding connecting cable losses to the above figure and will be specified in writing. In no case will the maximum level at the point of interconnection exceed 0dBm when averaged over any three second interval.

b. To protect other services it is necessary that the signal which is applied by the Carrier provided equipment to the Company connecting arrangement located on the Carrier's premises meet the following limits:

(1) The power in the band from 3,995 Hertz to 4,005 Hertz shall be at least 18dB below the power of the signal as specified in a. above.

(2) The power in the band from 4,000 Hertz to 10,000 Hertz shall not exceed 16dB below one milliwatt.

(3) The power in the band from 10,000 Hertz to 25,000 Hertz shall not exceed 24dB below one milliwatt.

(4) The power in the band from 25,000 Hertz to 40,000 Hertz shall not exceed 36dB below one milliwatt.

(5) The power in the band above 40,000 Hertz shall not exceed 50dB below one milliwatt.

c. To prevent the interruption or disconnection of a call or interference with network control signaling, it is necessary that the signal applied by the Carrier provided equipment to the Company's facilities at no time have energy solely in the 2,450 to 2,750 Hertz band. If signal power is present in the 2,450 to 2,750 Hertz band, it must not exceed the power present at the same time in the 800 to 2,450 Hertz band.

Connecting Circuit Requirements

A connecting circuit termination shall be provided by the Carrier for each connecting circuit furnished as part of the Interconnecting Arrangement by the Company. The connecting circuit termination shall comply with the following criteria:

a. Battery and ground shall be provided to the Interconnecting Arrangement through balanced primary and secondary windings of a Western Electric Company 292B relay or equivalent. (As used in this exhibit, "battery" means the negative terminal of a direct current (D.C.) source whose voltage is within 45 to 50 volts and whose positive terminal is grounded. "Ground" as used in this exhibit is a conducting connection, whether intentional or accidental, between an electrical circuit or equipment and earth, or to some conducting body which serves in place of earth.)

b. Off-hook and on-hook conditions shall present the following conditions to the Interconnecting Arrangement.

Off-Hook-Battery on Tip Conductor (first conductor)
Ground on Ring Conductor (second conductor)

On-Hook -Ground on Tip Conductor (first conductor)
Battery on Ring Conductor (second conductor)

c. The Off-Hook condition must be provided from the time a call is accepted for storage or radio transmission until the telephone connection is released by the terminal.

d. The On-Hook condition must be provided at all other times, including the dial pulsing interval and intercept.

e. The alternating current impedance from tip conductor of the connecting circuit termination to ground shall be equal to the impedance from the ring conductor to ground. The connecting circuit termination will, thus, present a balanced termination with respect to ground.

f. The connecting circuit termination must tolerate 30,000 ohms of leakage resistance between conductors or either conductor to ground. //

Signaling and Supervisory Signals

a. Seizure by the Company's switching equipment shall consist of a shunt between tip and ring conductors of the Interconnecting Arrangement. The total resistance of the loop (connecting circuit and terminating circuit) must not exceed ____ ohms. Release by the Company's switching equipment shall consist of opening the aforementioned shunt.

b. Pulsing consists of momentary removals of the loop shunt. Pulsing characteristics of the Company's switching equipment is as follows:

Pulsing Rate	9 to 11 Pulses per second
Pulse Shape	59.5 to 67.5% Break
Interdigital Time	540 to 660 milliseconds

c. The Company shall transmit (3) three digits to the Carrier. The nature of these digits is determined by the type of switching equipment employed by the Company to serve the Carrier. Therefore, in certain cases, one of the three digits may not correspond directly to a dialed digit.

d. An audible "fast" busy signal shall be returned to the calling party by the Company's switching equipment when all the connecting circuits of the Interconnecting Arrangement are busy. The "fast" busy signal conforms to the following:

Interruptions	120 per minute
Frequency	combined 480 Hz and 620Hz, each ± 5%

e. All the connecting circuits of the Interconnecting Arrangement are periodically tested for the proper Battery and Ground conditions. When such tests show that the connecting circuits do not have the correct voltages, the circuits thereby found defective shall be removed by the Company from service.

f. Each connecting circuit termination shall have the ability to accept numbers pulsed to it by the Interconnecting Arrangement without delay. The Company's switching office shall out-pulse digits to the Paging Terminal as soon as it seizes the connecting circuit.

g. The Paging Terminal shall be arranged to return to the calling party an appropriate recorded announcement indicating that the one-way selective signaling call has been sent or is being processed.

//

h. The Paging Terminal shall be arranged to return "ringing tone" to the calling party during such interval as may occur between pulsing completion and the return of a recorded announcement.

"Ringing Tone" shall consist of the following:

Frequency	420Hz ± 10%
Modulation	40 Hz

Protection Requirements

a. Surge Voltage Protection

The Carrier is responsible for providing protection, internal to his equipment and facilities, against surges and hazardous voltages from his equipment and facilities applied to the Company's facilities.

b. Voltage Limitations

If it is necessary for the Carrier to apply an operational voltage to facilities interconnected with the Company's facilities, the following limitations are provided to protect personnel and Company facilities.

Steady-state voltages applied by the Carrier shall not exceed the following maximum voltage, any conductor to ground or conductor to conductor: dc 135 volts, ac 50 volts (RMS).

c. Grounding

To prevent the connecting circuit being at an indeterminate potential with respect to ground, it is mandatory that commercially powered equipment be grounded in accordance with applicable electrical codes, and bonded to the telephone protector ground with a continuous (unspliced) wire. This lead shall not be fused.

Identified and Approved this
_____ day of _____, 19__

By _____

Title _____

By _____

Title _____

SCHEDULE E

Attached to and made a part of

INTERCONNECTION AGREEMENT

Between

and _____

Effective as of _____

Schedule of Charges

Item	Charge or Tariff Reference

Identified and Approved this
_____ day of _____, 19__

By _____

Title _____

By _____

Title _____

A P P E N D I X J

Sample Contract Between Telephone Companies and Interconnected Independent Public Mobile Radio Services.

MISCELLANEOUS COMMON CARRIER INTERCONNECTION AGREEMENT-DIAL MOBILE

This AGREEMENT is made this _____ day of _____, 19__, between The Mountain States Telephone and Telegraph Company, (hereinafter referred to as the "Company") and _____ _____, (hereinafter referred to as the "Carrier").

WHEREAS, the Company owns and operates a telecommunications system in certain _____ towns and cities and, through agreements with Associated and/or Connecting Companies provides telecommunications services throughout the State of _____ and in other states; and

WHEREAS, the Carrier operates a land mobile service system pursuant to a license issued by the Federal Communications Commission to the Carrier as a Miscellaneous Common Carrier in the Domestic Public Land Mobile Radio Service; and has obtained a certificate of convenience and necessity from and has filed tariffs with the appropriate Regulatory Commission of the State of _____ and the Carrier represents that it is complying with the rules and regulations of said commissions; and

WHEREAS, the Carrier, in order to facilitate the handling of its business as a Miscellaneous Common Carrier, desires connection between its system and the Company's system for the interchange of traffic over the telecommunications network of the Company and its Associated and/or Connecting Companies;

NOW, THEREFORE, in consideration of the covenants and understandings hereinafter contained, it is mutually agreed as follows:

1. Definitions

For Purpose of this Agreement, the following definitions shall apply:

A. Auxiliary Base Station. A supplemental Base Station which is located in such a way as to enhance or increase the Reliable Service Area of the principal Base Station. It operates simultaneously with, and on the same frequency as, the principal Base Station.

B. Base Station. A fixed transmitter licensed by the Federal Communications Commission from which radio communications are transmitted and received to and from the Carrier's mobile stations.

C. Carrier's System. The Carrier's System is a two-way communications network, in the Land Mobile Service, which serves a single community of interest. The communications network may employ Auxiliary Transmitters, and may employ more than one Base Station when served by a single Point of Connection. Mobile Stations, licensed Rural Subscriber Stations, and Temporary Fixed Stations as defined in the Rules and Regulations of the Federal Communications Commission may be employed as part of the Carrier's System.

D. Company's System. The Company's System is the exchange and toll network of the Company and its interconnecting Companies.

E. Control Point. A Control Point is an operating position under the control and supervision of the Carrier at which an operator responsible for the operation of the transmitter is stationed.

F. Intercept. A recorded message to inform the calling party of disconnected, invalid, or unassigned numbers.

G. "Interchanged" traffic. Communications effected through a direct electrical, acoustical, inductive or mechanical connection between the system of the Company and the system of the Carrier including messages relayed by the Carrier's operators by means of a recording device.

H. Interconnecting Arrangement. An interface furnished by the Company to interconnect the Company's System and the Carrier's System.

I. Primary Serving Telephone Exchange. The Company's telephone exchange wholly or partly within the Reliable Service Area of the Carrier's System, designated by the Carrier as the primary exchange from which connecting circuits will be furnished to the Carrier.

J. Point of Connection. A point on the premises of the Carrier within the Reliable Service Area of the Carrier's System at which the land mobile service system of the Carrier joins the Company's System. The Point of Connection is usually at the Control Point of the Carrier.

K. "Relayed", "forwarded" or "dispatched" messages. Messages taken by the Carrier's operators from a party calling on one system and repeated after a time interval to a party on another system.

L. Reliable Service Area. The area within which radio communications are reliably sent and received between Carrier's mobile stations and the Base Station as defined in Section 21.504 of the Rules and Regulations of the Federal Communications Commission.

M. Secondary Serving Telephone Exchanges. The Company's telephone exchanges (other than the Primary Serving Telephone Exchange) wholly or partly within the Reliable Service Area of the Carrier's System from which connecting circuits may also be furnished.

2. Traffic Interchanged

The parties shall interchange traffic between the system operated by the Company and the system operated by the Carrier upon the terms and conditions stated in this Agreement.

The traffic to be interchanged under this Agreement shall only be such traffic as may be transmitted to or received from mobile stations at locations within the Reliable Service Area of the Carrier's System as defined in Section 1 hereof and as shown on the map attached hereto and marked Schedule B.

The Point of Connection for the interchange of traffic through the Carrier's System described in Section 3 is located on premises at _____.

The Carrier will not interchange traffic from or to any communications system other than the Carrier's System described in Section 3 hereof and then only as specifically authorized and agreed herein. The Carrier shall not perform landline switching.

3. Facilities

Each party will construct, equip, maintain and operate its system so that good and adequate service will be furnished to the public at all times.

The connecting circuits for the interchange of traffic will be furnished to the Carrier from the Primary Serving Telephone Exchange to the Point of Connection designated in Section 4 hereof and will be used only for the interchange of traffic hereunder. At the Carrier's request, additional connecting circuits may be furnished to the Carrier from Secondary Serving Telephone Exchanges to the Point of Connection.

Certain components of the Carrier's System are set out in the Carrier's current radio station construction permit or license or licenses attached hereto as Schedule A. The Carrier will promptly furnish the Company with its radio license when available (if not attached at the time this Agreement is executed) and with every reissuance of said license or licenses and all modifications thereof, for attachment to this Agreement as a revision of Schedule A.

A map showing the Reliable Service Area of the Carrier's System is attached hereto as Schedule B.

3. Facilities (Continued)

Connecting circuits, mode of operation, Base and other classes of stations associated with the Carrier's System and their relative locations, Control Point(s), and Point of Connection are shown on Schedule C attached hereto. Notice of any significant changes to be made in the Carrier's System, as described in Schedule C, shall be given to the Company in advance, and in no case later than ten days after an application has been filed with the Federal Communications Commission for said changes. The Carrier also agrees to promptly furnish the Company proposed revisions of Schedules B and C to reflect any significant changes to be made in its system.

4. Rates and Charges

Rates and Charges for connecting circuits, interconnection equipment and other associated items as designated in Schedule C are shown on Schedule E (Schedule of Charges) and shall be in accordance with the appropriate company tariff or in absence of filed tariff, special charges will apply as indicated.

Timing and Ticketing of Long Distance Message Telecommunications Service (LDMTS) traffic originating at points in the Carrier's System, will be performed by the Company. On interchanged LDMTS traffic the Company will bill the Carrier the lawful LDMTS tariff charges for messages sent paid from, received collect to or charged to, points on the Carrier's System.

All Carrier charges will be based upon the Carrier's records and will be handled directly between the Carrier and its customers.

The Carrier will be responsible to the Company for the payment of all charges of the Company incurred by the Carrier's customers.

5. Connecting Circuits

All traffic interchanged between the Company's System and the Carrier's System shall be interconnected solely over the circuits and facilities authorized by this Agreement and in accordance with the terms and conditions of this Agreement and the Company's applicable tariffs.

The Carrier will handle all interchanged traffic over the connecting circuits to be provided under this Agreement (which are specifically designated for the interconnection use on Schedule C attached hereto), and will not use any local telephone exchange line, foreign telephone exchange line, Wide Area Telephone Service line, or private line in connection with interchanged traffic.

6. Transmission and Protection

In order to prevent excessive noise and crosstalk in the Company's System, and to insure a reasonable degree of quality in the Carrier's System, the Carrier agrees to conform to the transmission parameters detailed in Schedule D (Transmission and Protection Criteria) attached hereto.

Each of the parties hereto will take reasonable precautions in the location, construction and maintenance of its facilities for protection against hazard or injury and so as not to interfere with services or facilities furnished by the other party. The Carrier agrees to conform to the minimum protection standards listed in Schedule D (Transmission and Protection Criteria) attached hereto.

The Company may make reasonable tests and inspections and may upon notice to the Carrier, interrupt the service being rendered by means of the facilities being tested or inspected, or may, without such notice, interrupt the service rendered hereunder in case the facilities of the Carrier fail for any reason to operate in accordance with the requirements hereunder, until the situation is corrected. The Carrier will indemnify and save the Company harmless from and against any claims or demands of any nature arising out of the operation or maintenance of the Carrier's facilities or arising out of any interruption made in accordance with this paragraph.

7. Payment of Charges

The Carrier is responsible for payment monthly, or on demand, of all charges for facilities and services furnished the Carrier.

If the bill is not paid within 30 days following the date of the bill, the Company may, upon 5 days written notice, terminate this Agreement and sever interconnection with the Carrier.

8. Records and Information

Each party will keep accurate records of its transactions hereunder, and such records will be subject to inspection by the other at all reasonable times. Each party will furnish to the other such information relating to the interchanged traffic covered herein as may reasonably be required.

9. Number Assignments

Telephone numbers for interconnected lines will be assigned at the Company's option and may be changed to meet the Company's service and facility requirements from time to time. If feasible, notice of at least 30 days will be given by the Company prior to any such number change.

14. Assignment

This Agreement may not be assigned or transferred by either party without the prior written consent of the other; provided, however, that the Company may assign or transfer this Agreement to its successor, associated or affiliated companies without the prior written consent of the Carrier.

IN WITNESS WHEREOF, the Company has caused this Agreement to be executed in its behalf this _____ day of _____, 19__, and the Carrier has caused this Agreement to be executed in its behalf this _____ day of _____, 19__.

By _____

Title _____

THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

By _____

Title _____

SCHEDULE A

Attached to and made a part of

INTERCONNECTION AGREEMENT

Between THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

and _____

Effective as of _____

Copy of License

Identified and Approved this
_____ day of _____, 19__

By _____

Title _____

THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

By _____

Title _____

SCHEDULE B

Attached to and made a part of

INTERCONNECTION AGREEMENT

Between THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

and _____

Effective as of _____

Map of Reliable Service Area

Identified and Approved this
_____ day of _____, 19__

By _____

Title _____

THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

By _____

Title _____

SCHEDULE C

Attached to and made a part of

INTERCONNECTION AGREEMENT

Between THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

and _____

Effective as of _____

Operational Diagram, Facilities & Equipment

Identified and Approved this
_____day of _____, 19__

By _____

Title _____

THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

By _____

Title _____

SCHEDULE D

Attached to and made a part of

INTERCONNECTION AGREEMENT

Between THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

and _____

Effective as of _____

Transmission and Protection Criteria

Transmission Requirements

The equipment of the Company and of the Carrier shall be of such character and shall be installed, operated and maintained by each so as not to cause induced sound or crosstalk to or from circuits of the other. In addition the equipment of the Carrier shall be of such character and shall be installed, operated and maintained so as not to cause number selection errors in, or malfunctions of, the Company's switching equipment.

The control equipment utilized by the Carrier which is to be connected with the Company is to be fabricated in accord with generally accepted "telephone quality" standards. In addition, the control equipment must, in the opinion of the Company, be completely compatible with the central office with which it is to be connected.

At the Point of Connection with the connecting circuit facilities furnished hereunder, the Carrier shall furnish for each radio line circuit to be connected, a balanced two-wire facility through a 900 ohm source inpedance. In order to protect the telecommunications network and the services furnished to the general public by the Company from harmful effects, the signal from the Carrier provided equipment must comply with the following criteria:

a. To prevent excessive noise and crosstalk in the network it is necessary that the composite power of the signal which may be applied by the Carrier provided equipment to the Company may not exceed 12dB below one milliwatt at the Company's central office when averaged over any three second interval. The composite power level at the point of connection will be derived by the Company by adding connecting cable losses to the above figure and will be specified in writing. In no case will the maximum level at the point of interconnection exceed 0dBm when averaged over any three second interval.

b. To protect other services it is necessary that the signal which is applied by the Carrier provided equipment to the Company connecting arrangement located on the Carrier's premises meet the following limits:

(1) The power in the band from 3,995 Hertz to 4,005 Hertz shall be at least 18dB below the power of the signal as specified in a. above.

(2) The power in the band from 4,000 Hertz to 10,000 Hertz shall not exceed 16dB below one milliwatt.

(3) The power in the band from 10,000 Hertz to 25,000 Hertz shall not exceed 24dB below one milliwatt.

(4) The power in the band from 25,000 Hertz to 40,000 Hertz shall not exceed 36dB below one milliwatt.

(5) The power in the band above 40,000 Hertz shall not exceed 50dB below one milliwatt.

c. To prevent the interruption or disconnection of a call or interference with network control signaling, it is necessary that the signal applied by the Carrier provided equipment to the Company's facilities at no time have energy solely in the 2,450 to 2,750 Hertz band. If signal power is present in the 2,450 to 2,750 Hertz band, it must not exceed the power present at the same time in the 800 to 2,450 Hertz band.

Rotary Dial Signaling Requirements

Rotary dial signaling and control equipment provided by the Carrier which is connected to the Company's equipment shall be arranged for full duplex transmission utilizing a separate balanced two wire line for each mobile unit and comply with the following criteria:

a. Minimum insulation resistance between leads of the Connected balanced pairs is 15,000 ohms.

b. In the "on-hook" condition, an open circuit shall be presented to the facilities of the Company. In the "off-hook" condition, the dc resistance presented to the Company's facilities by the Carrier's equipment shall not exceed ___ ohms.

c. The Carrier's equipment shall be compatible with _____ of the Company's central office equipment.

d. Dial pulses shall consist of the alternate removal and reapplication of a shunt, not exceeding ____ ohms, across the Connected balanced pair. The repetition rate of these open pulses shall be not less than 9.5 nor more than 10.5 per second with a 58 percent ± 4 percent, break ("on-hook").

e. When all the mobile channels are in use, the Carrier's equipment shall respond to a ringing signal from the Company's equipment on any line by applying a dc shunt not exceeding 550 ohms across the line for a period not exceeding 22 seconds, after which the Carrier's equipment shall apply an audible telephone busy signal which conforms to the following:

interruptions	120 per minute
frequency	combined 480 Hz and 620 Hz each ± 5%
harmonic distortion	40dB below fundamental
level	-36dBm (at central office)

f. To prevent permanently tieing up a line circuit in the event a mobile unit drives out of the coverage area while connected, the Carrier shall arrange his equipment to be automatically disconnected after 3 minutes lapsed time with loss of signal from the connected mobile unit.

Protection Requirements

A. Surge Voltage Protection

The Carrier is responsible for providing protection, internal to his equipment and facilities, against surges and hazardous voltages from his equipment and facilities applied to the Company's facilities.

B. Voltage Limitations

If it is necessary for the Carrier to apply an operational voltage to facilities interconnected with the Company's facilities, the following limitations are provided to protect personnel and Company facilities.

Steady-state voltages applied by the Carrier shall not exceed the following maximum voltage, any conductor to ground or conductor to conductor: dc 135 volts, ac 50 volts (RMS).

C. Grounding

To prevent the connecting circuit being at an indeterminate potential with respect to ground, it is mandatory that commercially powered equipment be grounded in accordance with applicable electrical codes, and bonded to the telephone protector ground with a continuous (unspliced) wire. This lead shall not be fused.

Identified and Approved this
_____day of _____, 19__

By _____

Title _____

THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

By _____

Title _____

SCHEDULE E

Attached to and made a part of

INTERCONNECTION AGREEMENT

Between THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

and _____

Effective as of _____

Schedule of Charges

Item	Charge or Tariff Reference

Identified and Approved this
_____ day of _____, 19__

By _____

Title _____

THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

By _____

Title _____

APPENDIX K

EXTRACT FROM GENERAL REGULATIONS APPLICABLE TO BELL CANADA

Rule 3 - The Company does not transmit messages but merely provides the service and equipment which enable those entitled to use them so to do.

Rule 42 - In the case of mobile telephone service, the Company undertakes, in connection with signalling service, only to transmit a signal for the purpose of activating a signal on the mobile unit, and accepts no responsibility for the transmission of further intelligence.

REPORT ON POSSIBLE INTERCONNECTION OF MOBILE RADIO SERVICES WITH THE PUBLIC TELEPHONE NETWORK