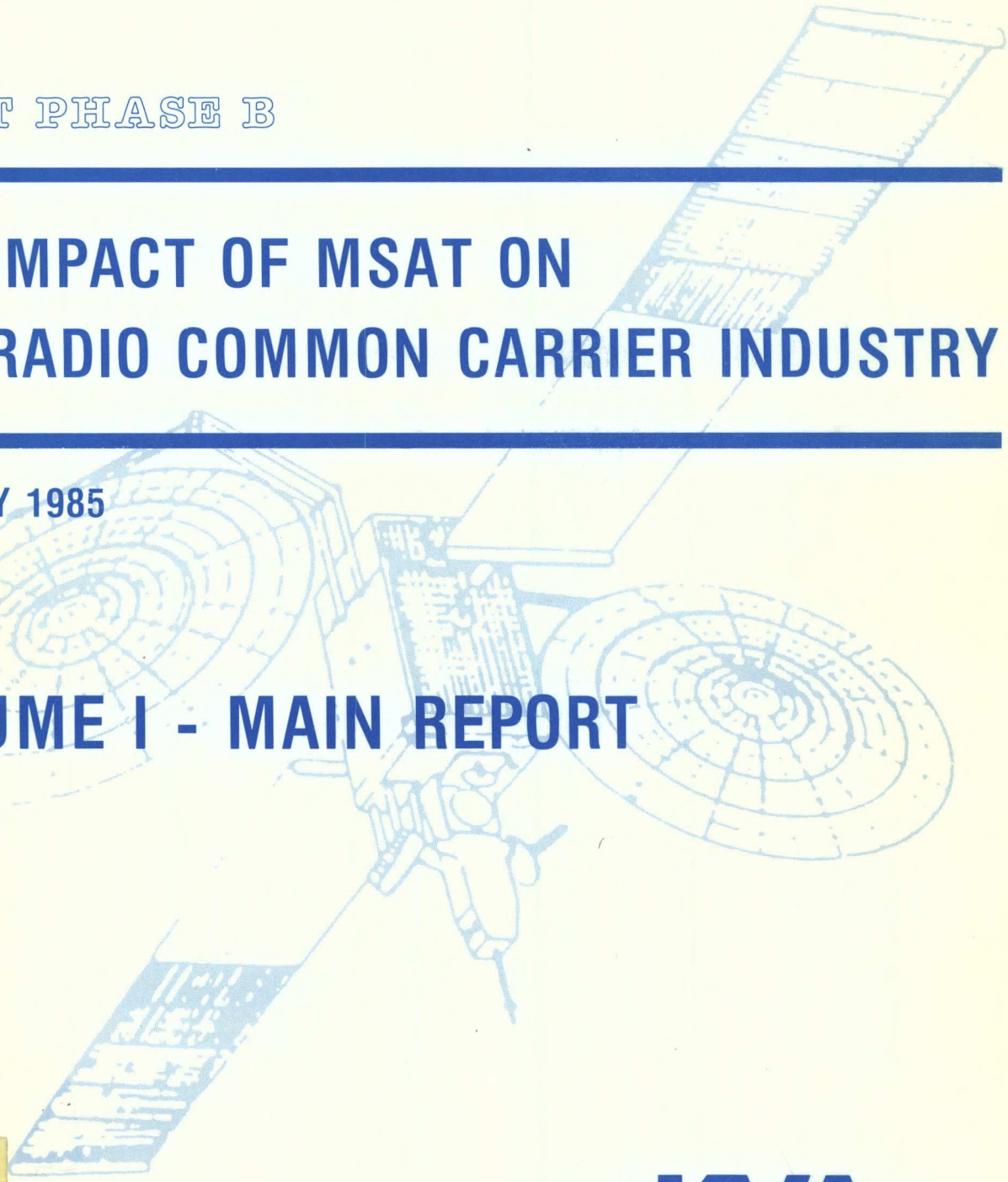
DEPARTMENT OF COMMUNICATIONS

MSAT PHASE B

THE IMPACT OF MSAT ON THE RADIO COMMON CARRIER INDUSTRY

JANUARY 1985

VOLUME I - MAIN REPORT



KVA

KVA Communications and Electronics Co.

Radio Communications System Specialists

DEPARTMENT OF COMMUNICATIONS

MSAT PHASE B

(2)

THE IMPACT OF MSAT ON THE RADIO COMMON CARRIER INDUSTRY

JANUARY 1985

VOLUME I - MAIN REPORT

FINAL REPORT

APRIL 1985

KVA

KVA Communications and Electronics Co.

Radio Communications System Specialists

IN COLLABORATION WITH: WARD MALLETTE CHARTERED ACCOUNTANTS

KVA Communications
and Electronics Co.
364 Supertest Rd.
Downsview, Ontario M3J 2M2
Tel. (416) 661-6644

KVA

June 5, 1985

Mr. John Braden
Manager, MSAT Economic Studies
Department of Communications
300 Slater Street
Ottawa, Ontario
K1A 0C8

Dear John:

Re: Contract OSM83-00008
Study to Assess the Impact of
MSAT on Radio Common Carriers

The study team of KVA COMMUNICATIONS AND ELECTRONICS CO. in conjunction with WARD MALETTE CHARTERED ACCOUNTANTS is pleased to submit the final report for the "Study to Assess the Impact of MSAT on the Radio Common Carriers Industry."

The report is presented in 3 volumes;

Volume I - Main Report
Volume II - Methodology and Attachments
Volume III - Modelling Data

The study shows that MSAT represents a substantial opportunity for the Radio Common Carrier Industry in Canada. The significant benefits in employment and industry growth that could be realized, far exceed the investment risk of MSAT to the RCC's.

Through time, MSAT could represent a substantial portion of the RCC business. The study shows that in order for this significant impact to be realized, major regulatory, institutional and policy issues will have to be reviewed and decisions implemented that will ensure the RCCs can compete with other service providers on an equal basis.

The findings of this study, in addition to the other industrial and social impact findings, emphasize in our opinion, the need for MSAT services in Canada and the commercial viability of the project.

Yours truly,
KVA COMMUNICATIONS AND ELECTRONICS CO.

Kedar

Mike Kedar
Vice-President

MK/tlt
encl.

Government of Canada
Department of Communications

Gouvernement du Canada
Ministère des Communications

Your file Votre référence

Our file Notre référence
6977-6-11

DOC CONTRACTOR REPORT DOC-CR-85-022

DEPARTMENT OF COMMUNICATIONS - OTTAWA - CANADA

TECHNOLOGY AND INDUSTRY SECTOR

TITLE: Study to Assess the Impact of MSAT on Radio Common Carriers

AUTHOR(S): M. Kedar
S. Flynn

ISSUED BY CONTRACTOR AS REPORT NO: N/A

CONTRACTOR: KVA Communications and Electronics Co.

DEPARTMENT OF SUPPLY AND SERVICES CONTRACT NO: OSM83-00008

DOC REQUISITION NO: 36100-3-0150

DOC SCIENTIFIC AUTHORITY: John H.C. Braden

CLASSIFICATION: Unclassified

DATE: April 1985

Canada

SPECIAL ACKNOWLEDGEMENT

As the study director, I would like to express my special thanks to Ward Mallette Chartered Accountants for their diligence and support, in particular, Phil Chopp and Dr. D. Williamson, as well as to Tony Bonney, P. Eng., the MSAT/CRCCA working group and the D.O.C. MSAT Socio Economic team, in particular, J. Braden and E. Staffa, for their contributions.

M. Kedar

Mike Kedar
January 1985

MSAT/RCC Impact Study

Volume I - Main Report

Table of Contents

1.0 INTRODUCTION

This study describes and quantifies the opportunities and impacts represented by the proposed mobile satellite (MSAT) services to the Radio Common Carriers (RCCs) . These services will be available through a first and second generation commercial MSAT system operating from 1989 to 2002. The study objectives included assessing the economic viability of MSAT service provisioning by the RCCs, investigating policy, institutional and regulatory issues as well as considering the technical aspects such as interconnection to existing terrestrial systems and billing and collection arrangements.

The RCC Industry is relatively new, with the establishment of most businesses occurring after 1970. Rapid advances and changes in telecommunication technology in general, and mobile communication technology in particular, has precipitated a rapid growth in this industry. The RCCs are independent, unregulated (although licenced) entities, who number approximately 600 today and provide a variety of mobile communication services, primarily in mobile radio and mobile paging. Most RCCs operate a common system to which a number of end users are provided access for a fixed monthly fee. Other related services offered by RCCs include sale, rental, maintenance, installation and repair of mobile and fixed equipment.

The proposed mobile satellite (MSAT) system could provide an opportunity for the RCCs to offer enhanced services to existing subscribers and also to expand their existing subscriber base. This study examines the commercial viability of MSAT including mobile radio, mobile telephone, mobile data and paging, and a number of related issues from the RCCs point of view.

This study is one several MSAT Phase B studies involving system definition and economic studies. This study will provide inputs to the Overall Socio-Economic Benefit Study and the overall results of MSAT Phase B studies including the results of this study, will be used by DOC as a basis for recommending to Cabinet whether or not to proceed with the implementation phase of the MSAT system.

2.0 OBJECTIVES AND METHODOLOGY

2.1 Study Objectives

The objectives of this study were to describe and quantify the opportunities and impacts represented by MSAT services to the Radio Common Carrier Industry in each province. For the purpose of simplification the Atlantic provinces were grouped together as one entity.

Specifically, the study objectives included:

1) The description and market projection of the existing and proposed mobile radio systems, including projections of revenues and required levels of investment for the years 1987-2002, without MSAT.

2) The review of MSAT operating, billing and technical interface arrangements necessary to integrate MSAT with existing RCC networks.

3) Determination of the impact of MSAT on the RCCs in terms of market opportunities, revenues, expenses and investment, and quantification of the potential size and nature of the economic and financial impacts.

4) Identification, description and analysis of the impact of marketing, policy, institutional, and regulatory issues.

5) Development of recommendations as to the business opportunities of MSAT for the Radio Common Carriers.

2.2 Study Assumptions

Study assumptions were based on two documents. The first one is entitled, "The Socio-Economic Study Assumptions on Costs, Traffic and Service", published by DOC 1, (See Volume II, Section 16) which includes all cost and system capacity assumptions. The second document is entitled, "MSAT Service Description and Competitive Environment", (See Volume II, Section 18), which describes the operation of MSAT services, and was presented to the RCCs during the data collection process. An abbreviated version is presented below.

2.2.1 Competitive Environment/Service Provisioning Scenario

The profitability and market share of the various services will depend on the competitive environment within which the RCC must operate. For the purposes of the MSAT study, the following competitive scenario was considered:

Both the RCCs and Telcos can provide end-user services. Telesat is primarily restricted to selling MSAT services through the end-user service providers but may sell directly to large nationwide users.

Initially, two other competitive scenarios were to be considered. These included one scenario in which competition would be between the RCCs and the Telcos (ie. Telesat would not be a service provider) and another in which the RCCs would compete with Telesat (ie. the Telcos would not be a service provider). As the study progressed, it was decided that only the most likely competitive outcome, involving all three service providers would be considered.

Each potential MSAT service was described as follows to the RCC's:

Mobile Radio Service (MRS)

Mobile radio service would be provided by accessing one or more MSAT terminals through a UHF private base station or an SHF base station via the satellite. In the case of common SHF base stations (ie shared by a number of users), private dispatchers may either be connected to the common RCC base station via a dedicated or switched telephone line or via radio links.

UHF-to-UHF communications paths will require a double hop connection which results in higher airtime costs.

Mobile Paging Service (MPS)

MSAT would provide extended area coverage of existing systems by connecting existing systems together through MSAT links. Existing paging base repeater equipment and units could be used. A base station would be required to allow receive and transmit capability to MSAT and would provide the interface to the paging terminal and the public switched telephone network (PSTN).

The concept of fixed links is not a statement of DOC policy and in fact may not be feasible from a regulatory perspective. However, this assumption was presented in order to allow the RCCs the widest choice of service offerings on which to base their forecast projections.

Mobile Telephone Service (MTS)

Mobile telephone service would be provided by signalling a mobile telephone through an MSAT SHF gateway. This gateway which would also provide connection to the public switched telephone network (PSTN).

All calls from an MSAT mobile telephone will be received downlink from MSAT by the nearest gateway to the destination as determined by the called party telephone number. All calls from a fixed location (telephone) will enter the PSTN at the telephone serving office as determined by the originating telephone number and will be routed on to the PSTN serving office and SHF gateway as determined by the terminating number.

These assumptions, provided for the clarification of RCCs, are not a matter of policy and details concerning call routing, particularly as they apply to toll bypass, have yet to be worked out with the carriers. Changes to the underlying assumptions could impact the cost of providing service or the market forecast projections.

Mobile Data Service

Two forms of data service would be offered:
1. Data Acquisition and Control Service (DACS)
2. Data Enhancement of an MRS/MTS Terminal (MDS)

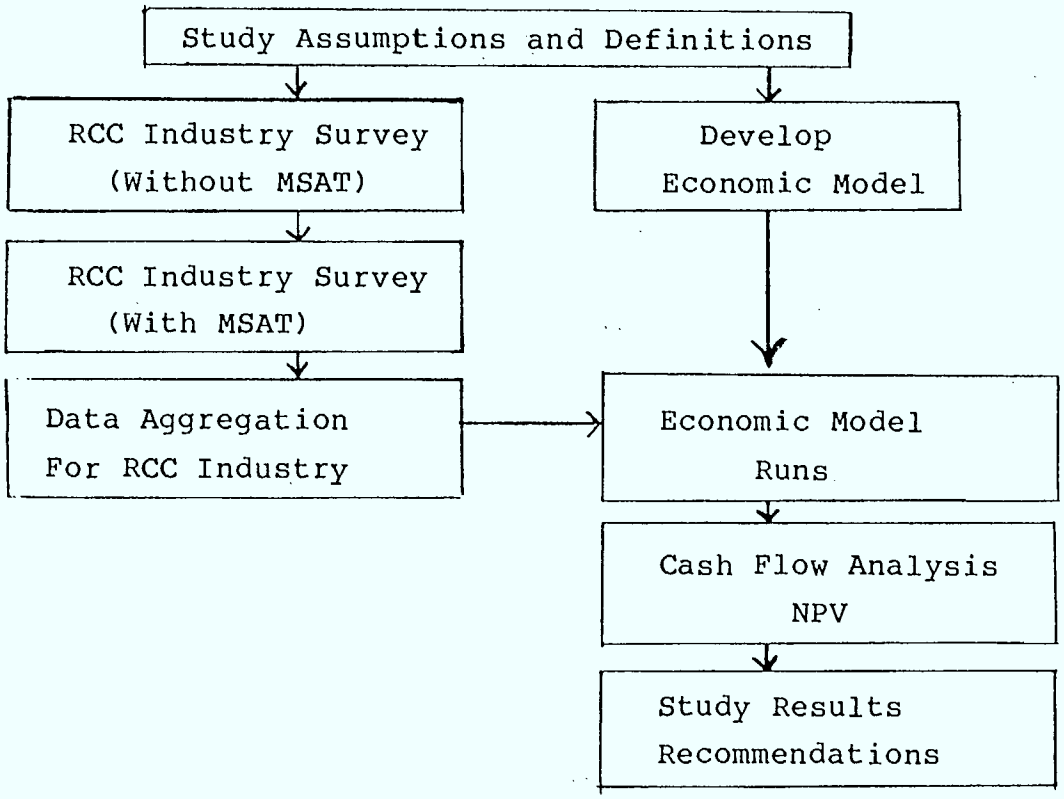
DACS could be offered as a polling or an alarm service. With polling service remote points equipped with DACS terminals send data when polled to the RCC's SHF base station which routes the information to the user's location by a choice of paths which might include common carrier packet switched networks, private user radio channels, dedicated telephone lines or autodial connection via the public switched telephone network. With an alarm service offering, data reporting is event-triggered but sent in the identical manner as polled data.

With data enhancements, a subscriber's MRS or MTS terminal would be enhanced to provide data communication. Users can establish a two-way data communications path to the base station location using any of the same choices given above. Communication paths between base stations and data enhanced MSAT mobile terminals will have the same bandwidth as voice circuits and can carry data at speeds up to 2.4 kb/s.

2.3 Study Approach

Most of the data required for this study was obtained through questionnaires and personal interviews and was based on the input of both RCCs and their representative Association (Canadian Radio Common Carrier Association). Figure 2.3.1 illustrates the study approach.

Figure 2.3.1
Study Approach



As a first step study assumptions and definitions were developed which provided the guidelines required to develop the survey questionnaires. These questionnaires were used for data collection which was carried out in two stages. In stage I, an industry survey questionnaire was sent to 200 of approximately 600 RCCs based on size and provincial distribution. The purpose of this questionnaire was to collect data on revenues, investment and future trends in the RCC industry without MSAT.

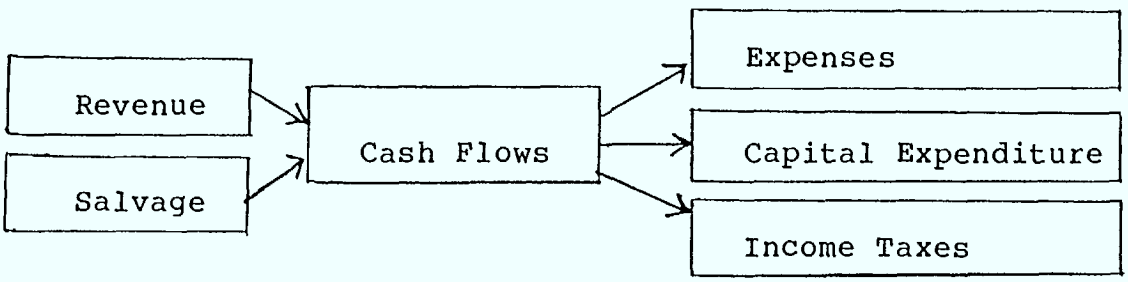
Table 2.3.2 outlines the selection criteria used to obtain the sample of 200 RCCs.

TABLE 2.3.2
RCC Sample Selection Criteria

A)	100% CRCCA REGULAR MEMBERS	114
B)	100% RCC LICENCEES WITH OVER 3 BASE STATIONS (109 TOTAL, 53 INCLUDED IN A)	56
C)	33% OF 191 RCC LICENCEES WITH 2 - 5 BASE STATIONS (60 INCLUDED IN A AND B)	3
D)	15% OF 324 RCC LICENCEES WITH 1 BASE STATION (21 INCLUDED IN A)	27
		200

To the 200 mailed questionnaires, 80 responses were received. The input data was aggregated by computer and averaged for all respondents. A copy of the industry survey questionnaire and the computerized results are included in Sections 10.0 and 11.0 of Volume II.

In stage II of the data collection process, 30 of the largest RCCs (based on yearly revenue) from the 80 initial responses, were selected to be interviewed personally. The data collected provided the necessary inputs to the economic model, from which the economic impact of MSAT on the RCCs was determined through a cash flow analysis, as illustrated below:



A complete description of the economic model is included in the financial analysis, Section 4.3 Volume I. To ensure the high quality of results, the data collection process was carefully structured and is consistent for all participants.

Section 12.0, Volume II, shows the detailed study plan upon which the in-depth interview process was based. Section 13.0, Volume II is a copy of the in-depth questionnaire. The detailed data collected from the participants was aggregated to represent the total RCC population, and provided the provincial inputs to the economic model. Sections 14.0 and 15.0, Volume II contain a copy of the economic model and a description of the aggregration process.

3.0 EXISTING RCC INDUSTRY MAKEUP AND FUTURE PROJECTIONS (Without MSAT)

3.1 Historical Update

Since the success of the RCCs in establishing direct dial access service for paging and since their involvement in cellular and other interconnected services, the total mandate of the RCCs has changed. Today the accepted definition of a Radio Common Carrier is as follows:

"A radio common carrier is any individual, company, or corporation holding a radio common carrier licence issued by the federal Department of Communications for the purpose of selling addressed communications services to the public at large."

The RCC service providers have evolved from different service backgrounds. The present industry can be divided into 3 categories:

I) Operators who have expanded from TAS (Telephone Answering Service) into radio paging. Most in this group do not yet provide MRS and do not have any agreements with any particular mobile radio manufacturer. Maintenance and service is largely provided by others.

II) Operators who have graduated from service organizations providing mainly mobile radio maintenance to RCCs serving both MRS and MPS. Some liaison with particular manufacturers is evident in this group.

III) Mobile radio manufacturers who have established RCC operations primarily to enhance the distribution of their products. This group provides mainly MRS services.

It is interesting to note that some of the largest RCCs in Canada belong to Category III - the manufacturers - which is quite different from the make-up of the U.S. RCC industry.

Since 1970 when the CRCCA was founded by a group of RCCs headed by Al Perser, the CRCCA has been the spokesperson for its various members. The rapid growth in the RCC industry has been accompanied by equally rapid growth in its Association. Between 1978 to 1983 membership doubled and the CRCCA today has approximately 200 members.

Many changes in the RCC industry will occur in the next 5 years as a result of new developments in technology and the opening of new RF bands resulting in new services such as:

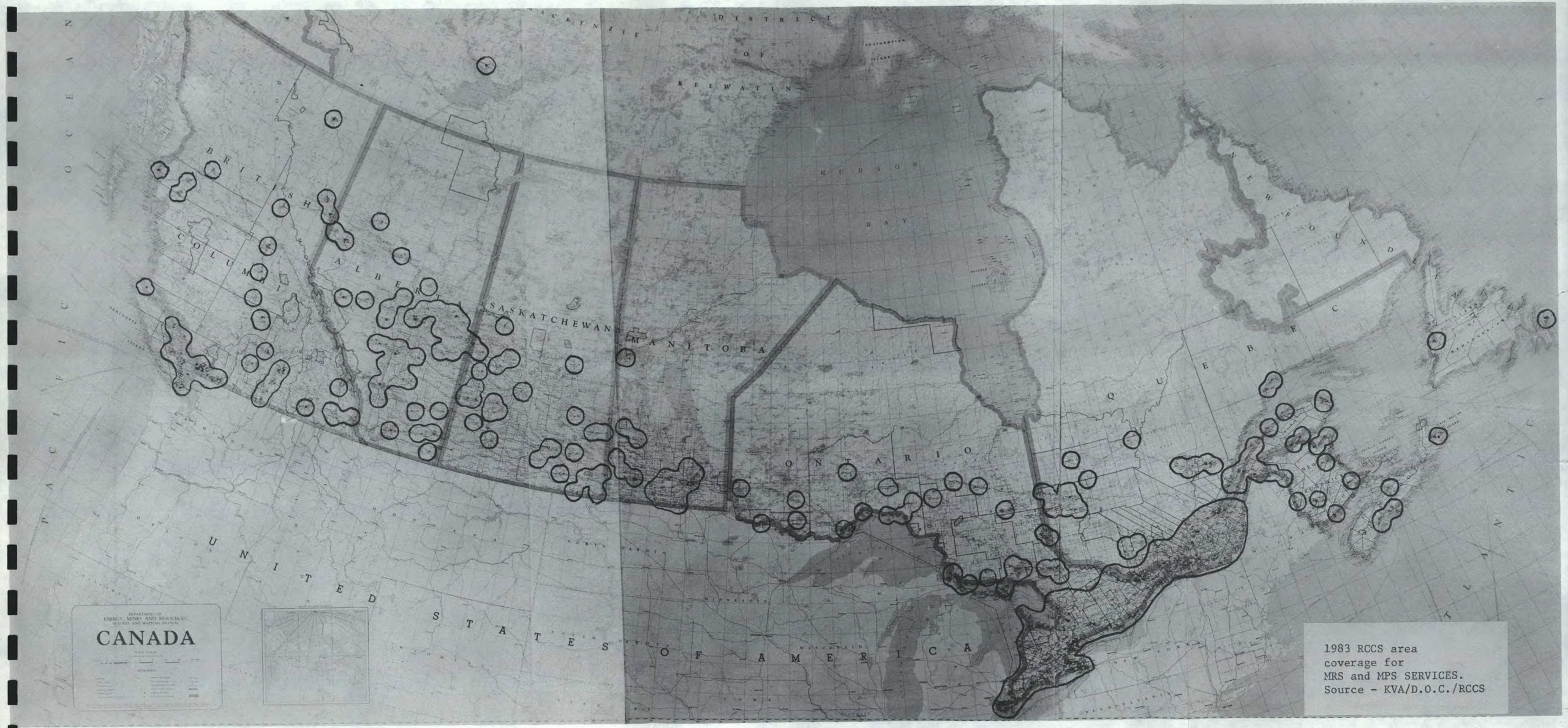
- o Cellular Mobile Telephone Service (CMTS)
- o Nationwide Paging
- o MRS Trunking Services
- o Paging on FM Sub-carrier and VBI
- o Personal Radio Communication Services (PRCS)
- o New Bands for Linking

These changes will be fundamental, bringing into the industry new financing, new interests, and most likely causing a spree of acquisitions of smaller RCCs by new business interests or by existing, larger organizations.

3.2 Industry Makeup

The total population of RCCs in Canada as compiled from DOC licencing data was 587 in December 1982. The fact that about 41% of all RCC licenced base stations about 47% of all RCC licenced frequencies are concentrated within the operations of the 37 major RCCs is indicative of the makeup of the industry.

The accompanying map shows the location of RCC operations. Each dot represents an RCC providing either mobile radio or paging services or both. The coverage provided by existing terrestrial systems throughout Canada is also illustrated. A more detailed description of the major RCCs and their location and distribution in Canada is presented in Section 19.0 of Volume II.


DISTRICT OF KEEWATIN
HUDSON BAY
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
UNITED STATES OF AMERICA
PACIFIC OCEAN
ATLANTIC
CANADA
1983 RCCS area
coverage for
MRS and MPS SERVICES.
Source - KVA/D.O.C./RCCS

3.3 MRS/MPS Subscriber Projections

As previously noted, RCCs currently provide two major services, consisting of mobile radio service (MRS) and mobile paging service (MPS). Unit forecasts for these services were compiled based on DOC licencing data and the sampled RCC input. The terrestrial forecast for MRS and MPS for various point years, beginning in 1983 and ending in 2002 is shown in Table 3.3.1 and Graph 3.3.1.

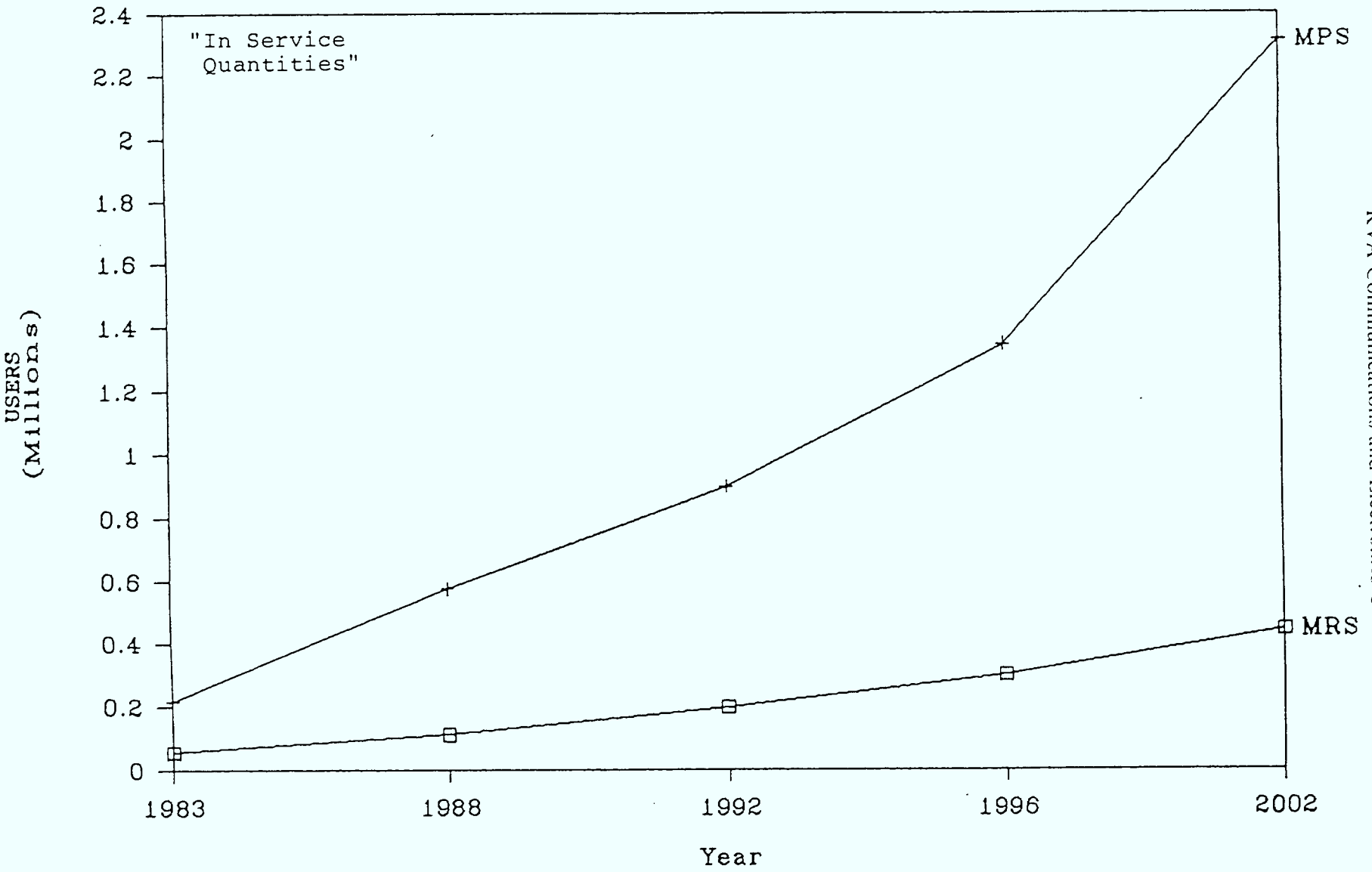
TABLE 3.3.1
RCC MRS and MPS Forecasts (000's)

	CANADA				
	1983	**1988**	**1992**	**1996**	**2002**
MRS	55.3	112.2	198.1	301.3	442.2
MPS	215.7	577.5	894.9	1341.6	2312.5

Graph 3.3.1

RCC Terrestrial MRS and MPS Forecasts

Canada



MRS - MOBILE RADIO SERVICE
MPS - MOBILE PAGING SERVICE

The annual growth rate in mobile radio and paging units, for Canada is shown in Table 3.3.2.

TABLE 3.3.2.
ANNUAL GROWTH RATE IN RCC MRS and MPS UNITS
CANADA

	1983-1988	1989-1992	1993-1996	1997-2002
MRS	15.2%	15.3%	11.1%	6.6%
MPS	21.8%	11.6%	10.7%	9.5%

Annual growth rates over the next four years are expected to be quite high due to additional and enhanced service offerings.

The anticipated growth is the result of new technologies and innovations including such services as trunked mobile radio systems, and nation-wide paging services.

The provinces of Alberta, Ontario and Quebec contribute most significantly to the projected growth. This is attributed to the anticipated needs of Alberta's oil and gas exploration and to the expected demands of Ontario and Quebec's dense population corridor.

For mobile radio service, this growth will be sustained well into 1992; if as expected, services become affordable to the average consumer *. The growth in paging units serviced by RCCs will decline after the initial high growth phase. For both mobile radio and paging, the annual growth rate will return to historic values beyond 1992.

* Both Cellular Mobile Telephone and a new generation of Citizen Band Mobile Radio are expected to be sold for less than $500 per unit by 1998.

3.4 Financial Data

Table 3.4.1 shows the RCC industries 1983 Revenue and Investment figures.

These tables distribute revenue and investment by the 4 major services provided by RCCs:

1) Mobile Radio Service
2) Mobile Paging Service
3) Maintenance and Installation
4) Telephone Answering Service and Others

Revenue and investment are highest for Alberta, Ontario and Quebec, which have the highest concentration of MRS and MPS units.

TABLE 3.4.1
RCC INDUSTRY REVENUE AND INVESTMENT FIGURES (1983)
CANADA

	REVENUE (millions)	INVESTMENT (millions)
MRS	23.0	7.8
MPS	74.3	26.0
MAIN & INST.	19.6	4.1
TAS & OTHERS	40.6	4.0
TOTAL *	157.5	41.9

* Excluding Equipment Sales - estimated revenue 200 M (1983)

- Source KVA -

3.5 RCC Market Opportunities and Trends

(See Section 17.0, Volume II for a detailed discussion of new technologies and applications)

The RCCs are entering an exciting new era, where technology development, increased spectrum availability, and interconnection privileges have created a number of new service options and investment opportunities. The RCCs will be monitoring these developments closely and will inevitably have to decide which services will yield greater and faster returns on their investment dollars.

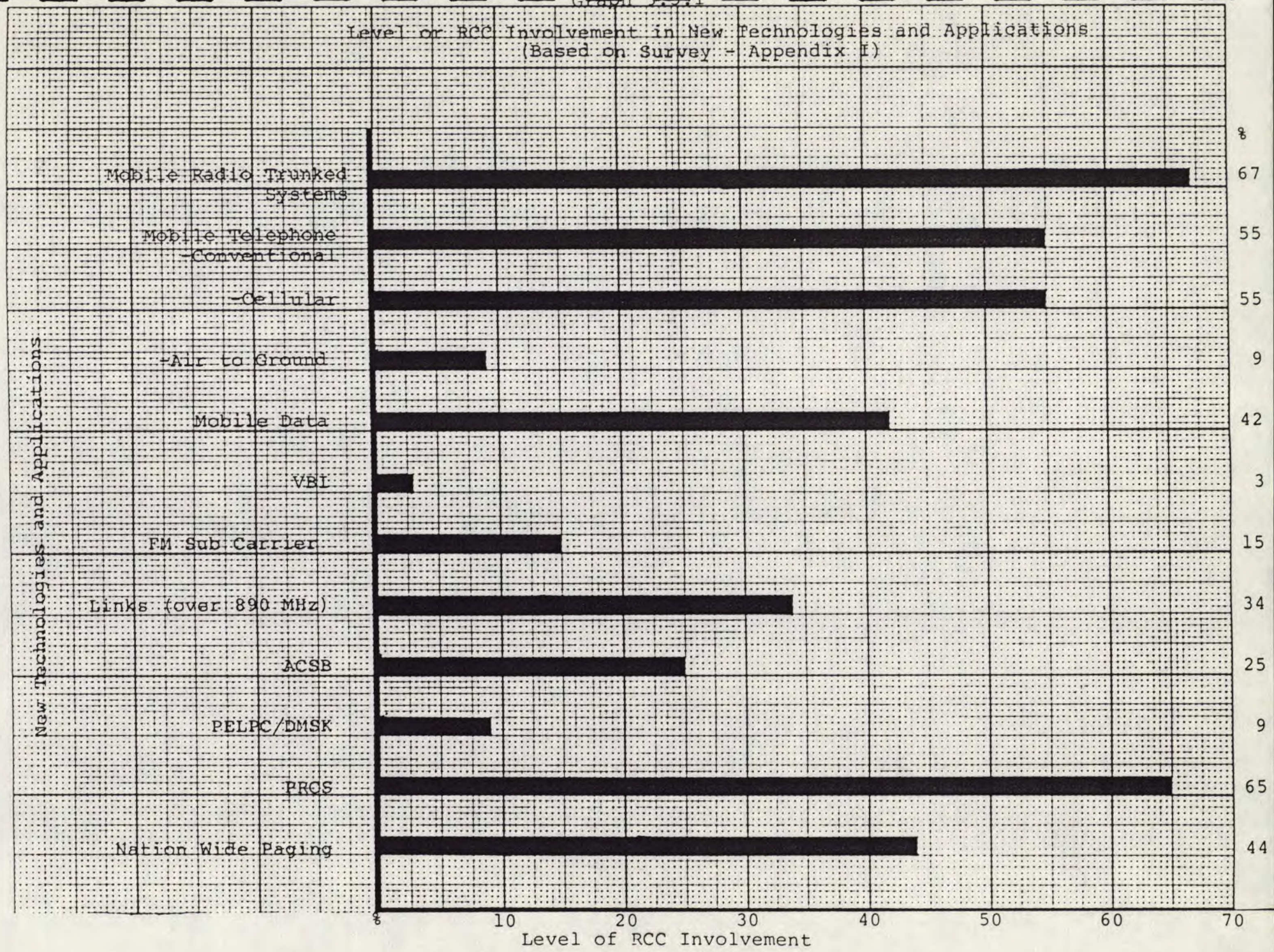
With the majority of RCCs (over 70%) having begun service after 1970, it is not surprising that the changing economic environment has presented one of the greatest difficulties to RCCs in developing their business. Competition and the lack of frequency spectrum were cited as other major difficulties. However, over the next several years, with the many technological advances proposed, the RCCs, like many others in the communication industry, expect their greatest difficulty will be in keeping up with the many changes.

Traditionally, the major competitor to the RCC has been the manufacturers, with the Telcos and other RCCs running a close second. However, over the next several years RCCs expect competition largely from the Telcos and other new large RCCs. This is consistent with the perceived role of the Telcos increasing due to such service offerings as cellular mobile telephone and the reduction in numbers of smaller RCCs due to consolidation and take-over. Many RCCs felt consolidation would be beneficial to the industry.

Graph 3.5.1 shows the percentage of RCCs intending to invest in new technologies, primarily within the next 3 years. As illustrated by the graph, trunked mobile radio systems and PRCS (Personal Radio Communication Systems)(*) generate the greatest interest amongst RCCs. These are closely followed by Mobile Telephone, both conventional and cellular, Mobile Data, and Nation wide paging.

Note * - With the FCC decision to disallow allocation in the 900 MHz band to PRCS (dated Nov 21, 1984), the future of PRCS in Canada is questionable. However, the results of this report demonstrate that in Canada, interest by the RCCs in this service is very real.

Graph 3.3.1


Level of RCC Involvement in New Technologies and Applications
(Based on Survey - Appendix I)
New Technologies and Applications
Mobile Radio Trunked Systems
Mobile Telephone -Conventional
-Cellular
-Air to Ground
Mobile Data
VBI
FM Sub Carrier
Links (over 890 MHz)
ACSB
PELPC/DMSK
PROS
Nation Wide Paging
%
67
55
55
9
42
3
15
34
25
9
65
44
%
10
20
30
40
50
60
70
Level of RCC Involvement

The following is a summary of the key findings on major new technologies and application trends within the RCC industry, as depicted in Graph 3.5.1.

Paging Systems

The RCC industry has shown considerable interest in becoming involved in a nation wide paging operation and those interested indicated a preference for a consortium of RCCs to manage and operate such a system, as opposed to one national service provider.

Many RCCs have experienced difficulty in expanding paging system coverage due to difficulties in obtaining link frequencies. This situation is expected to worsen. One of the major alternatives to radio links that exists today is the use of wireline facilities. Few RCCs consider this a viable alternative since the increased cost of wireline can only result in increased subscriber rates. However, as will be indicated later in the study, many RCCs are looking to MSAT to provide relief in the area of link frequency allocation.

There is also a definite trend towards greater utilization of digital and tone pagers.

Mobile Radio Systems

The trend in mobile radio systems is toward the establishment of trunked systems with the expectation that at least 50% of subscribers will operate through trunked systems within the next ten years. The greater efficiency of trunked systems will benefit RCCs by allowing more subscribers per channel while maintaining the same grade of service and will also benefit the subscriber by reducing waiting times and by providing additional privacy.

Dispatch type operations will be the prime users of mobile radio systems which are characteristically a one-to-many means of communication. However, there are occassions when MRS users desire interconnection to the Public Switched Telephone Network(PSTN), requiring one-to-one communication. With the latest Telecom Decision CRTC 82-14, RCCs in the Federally regulated territories may now interconnect on a "limited basis" through automatic dial access for both conventional and trunked systems.

Mobile Telephone Systems

RCCs are interested in both conventional and cellular mobile telephone systems. Many RCCs feel conventional systems can compete with cellular systems where subscribers do not have extended area coverage requirements because of lower subscriber rates.

The exact role the RCC will play in cellular mobile telephone has not been clarified by Cantel or the Telcos, the only two licence holders for this service. However, most RCCs desire a larger role than renting/selling and maintenance/installation of mobile telephones and hope to take part in the resale of services.

Another potentially new service offering in mobile telephone is air to ground(*) radio telephone service.

Note * - Similar to PRCS, air to ground MTS has been deferred by FCC and its future in Canada is certainly unclear.

Mobile Data Systems and DACS

The need for greater and more accurate retrieval of data by subscribers has increased over the years and will continue to do so. Data communication is more efficient, allowing more users to access the system and/or a larger volume of messages to be sent in comparison to voice communication. Thus the trend is toward greater provision of Mobile Data Services. This includes dedicated in-vehicle mobile data terminals, enhancements to mobile radio and mobile telephone units to provide data services and data access and control systems. A substantial increase in alarm monitoring and remote control requirements is projected as equipment and systems become more reliable and less costly.

Personal Radio Communication Systems - PRCS *

Personal radio communication systems (PRCS) could potentially attract untapped markets in the private sector. PRCS is intended for a different market segment than conventional or cellular mobile telephone and as such, could be competitive even if offered in the same service areas. However, many issues associated with the introduction of PRCS have yet to be addressed or resolved. These issues include: the number of service providers within a given Metropolitan Area, subscriber access to systems and billing and collection. Co-ordination and organization amongst RCCs will be required if economies of scale, improved utilization of spectrum, and an overall, more appealing service offering is to be achieved.

Note * - With the FCC decision to disallow allocation in the 900 MHz band to PRCS (dated Nov 21, 1984), the future of PRCS in Canada is questionable.

Conclusion

The RCC industry in Canada is undergoing a transformation in preparation of the next decade and is starting to embark on a drive for collective planning in light of the on-going changes in the technology, regulation and market place demand for personal communications.

Changes in the industry are imminent. The trend toward integration of communication services operating now on different radio bands in different configurations will probably become the most predominant factor in the mobile radio industry in the next ten years.

The drive towards this development will undoubtedly be governed by economies of scale made possible with the advent of LSI and new integrated circuit developments.

The dramatic pace, with which end user products such as portable pagers and mobiles will be transformed, will require high investment in the network end of the systems in order to make these new products operational anywhere. It is here - the network end - where the RCCs will have the greatest difficulties to keep up, and in many cases, will be unable individually, to provide service to meet the demand.

4.0 MSAT PROJECTIONS FOR THE RCC INDUSTRY

In responding to the initial questionnaire, as presented in Section 3.0, RCCs provided inputs on mobile communication trends affecting their industry. The concept of mobile satellite (MSAT) service was only superficially introduced at that time. It was clear from this process, that RCCs would be receptive to any new economical service offering that could expand their subscriber base and provide, as yet, unavailable services. Since MSAT had the potential of being just that, we embarked on a detailed review of MSAT with the RCCs to determine the potential market and to analyze the economic impact on the industry, based on that market.

Through this process, a sample of RCCs were presented with a pricing structure for MSAT services, consisting of mobile radio (MRS), mobile telephone (MTS), mobile paging (MPS) and data aquisition and control (DACS). These RCCs assessed the need for MSAT within potential user groups and determined, based on the pricing structure, the number of users who would subscribe to MSAT on a yearly basis over the project study period - 1989 to 2002.

The study team interpreted the data collected and produced an RCC industry wide market forecast. The RCCs also provided system costing information related to maintenance and servicing functions such as mobile repair, installation and removal.

Although, data was collected on all four service offerings, the MSAT overall viability studies are primarily based on revenues from mobile radio and telephone services. The remainder of this section will therefore focus on the RCCs as potential MSAT MRS and MTS service providers and any further discussion of DACS and MPS will be deferred until Section 4.4, MSAT Sensitivity Analysis.

4.1 RCC MSAT Market Opportunities

Many RCCs identified particular communication needs of customers that cannot effectively be met today but could be met with the introduction of MSAT. That is, RCCs have customers who would sign up for MSAT today, if it existed and met the criteria as specified in the study assumptions.

The major areas identified in this study, where it was felt that MSAT could be successfully employed include:

1) Dispatch services to intercity trucking companies.

2) Emergency situations involving natural disasters such as forest fires.

3) Data Aquisition and Control Systems for remote data collection of environmental conditions including weather and water levels.

4) Voice and data communication with remote and isolated exploration and mining camps including those that operate on a roaming basis.

5) Voice communication in the wilderness for trappers, hunters and fishers.

6) Law enforcement agencies in rural and remote areas.

7) Fire protection services in rural and remote areas.

8) True wide area paging through fixed link applications.

9) Mobile telephone service on public transport vehicles ie. buses, trains, aircraft etc.

10) Wide area ability to interface with existing terrestrial data systems ie TWX/TELEX, packet switching etc.

11) Offshore exploration.

During the early years of MSAT, the subscriber base is expected to consist of the following:

38%	switching from terrestrial RCC units
10%	brand new users
52%	from private systems including both new units added on and units switching from terrestrial
100%	

As the system matures this mix will change, with fewer and fewer subscribers switching from existing terrestrial systems in favor of new subscribers.

Thus MSAT will allow the RCCs access to new market segments, particularly private system users, who currently make up 72% of the terrestrial MRS market.

4.2 RCC Industry Forecasts for MSAT MRS and MTS - 1989/2002

As currently proposed, the RCCs will be one of three MSAT service providers with the Telcos and Telesat (limited to large national accounts) being the other two. The market forecasts presented here are those achievable by the RCCs and therefore only represent a share of the total market. Further, at the time this study was conducted, the official Woods Gordon/Telesat view of the total market was unavailable. To provide a useful reference, the RCC industries view of the total market was obtained. Comparison of the RCC share to the total market as perceived by the RCCs and to the official Woods Gordon/Telesat view will be presented later.

Table 4.2.1 and Graph 4.2.1 show the Canadian RCC MSAT MRS and MTS forecast for the years 1989 to 2002. It should be noted that the MTS forecast assumes interconnection in all provinces. Existing provincial regulations in some provinces do not allow interconnection. If this were extended to include MSAT, the impact on the MTS forecast would not be substantial ie a reduction of less than 5% to the year 2002. Provincial forecast data is presented in Section 20.0, Volume II.

Table 4.2.1
RCC MSAT MRS and MTS Forecast
Number of Users
Canada

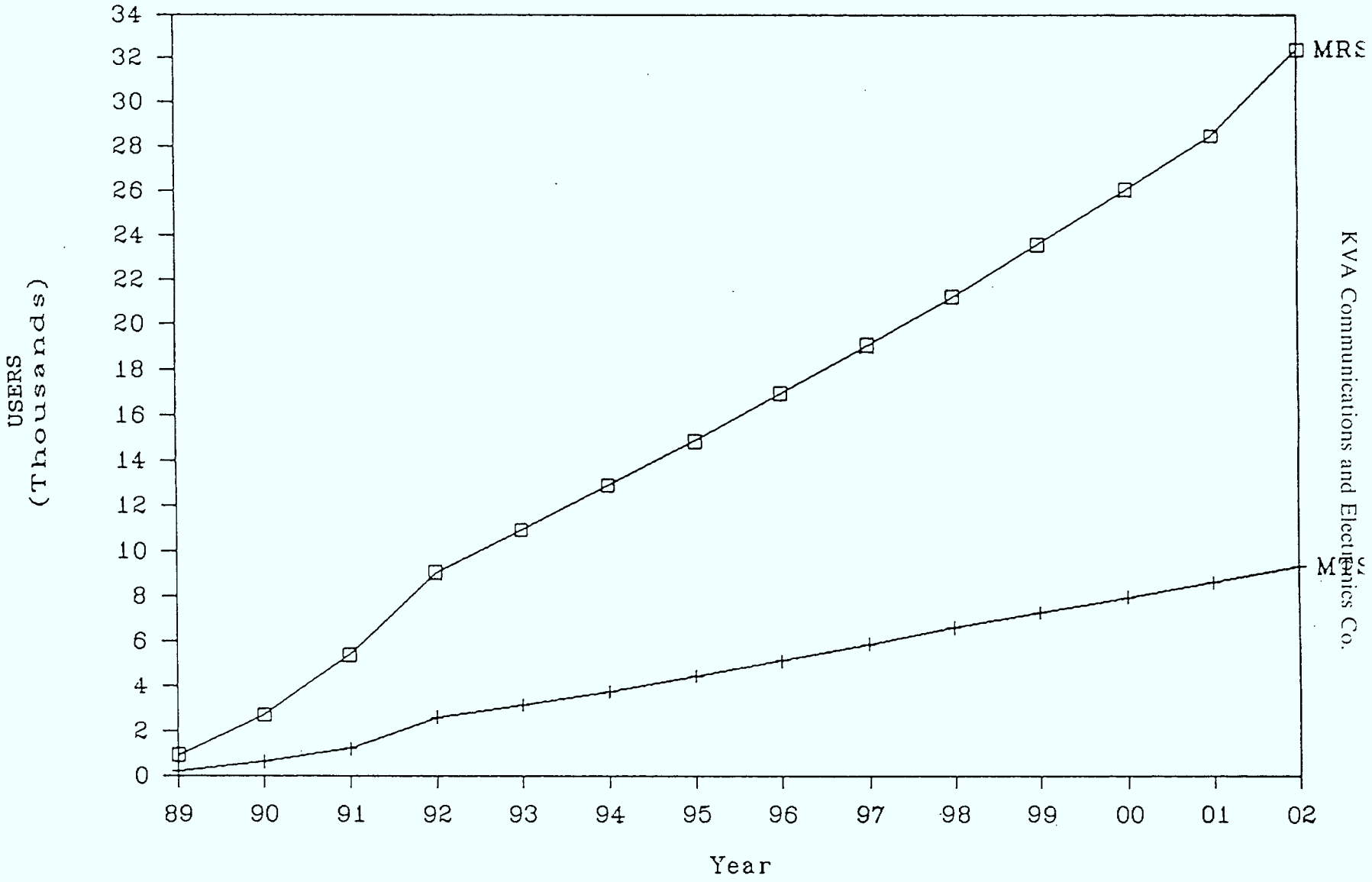
	1989	1990	1991	1992	1993	1994	1995
MRS	923	2,701	5,389	9,077	10,951	12,911	14,842
MTS	204	606	1,210	2,603	3,114	3,370	4,424

	1996	1997	1998	1999	2000	2001	2002
MRS	16,934	19,072	21,192	23,539	26,010	28,446	32,339
MTS	5,123	5,868	6,584	7,250	7,924	8,599	9,324

Source - KVA

MSAT RCC Forecast- MRS & MTS

Canada



MRS - MOBILE RADIO SERVICE

MTS - MOBILE TELEPHONE SERVICE

Comparison of this forecast to the the RCCs view of the the total forecast in the year 2002 provides some interesting insights. This data is presented below:

RCC Forecast Share vs RCC Total Forecast Projection 2002

	RCC Share	% of Total	Total Forecast (RCC View)
MRS	32,339	75	43,000
MTS	9,324	73	13,660

As indicated in the table, the RCCs perception of the RCC MSAT market is in the order of 42,000. Based on their belief that their share of the total market is fairly substantial, ie. 75%, implies a total market of approximately 57,000 users by the year 2002.

On current terrestrial systems the RCCs have 12% of the MRS market, the Telcos have 16% and the remaining 72% belongs to private system users. Keeping in mind that MSAT services will only be offered through service providers (ie no private system users), and that over half of the MSAT subscribers will be current private users, there is no doubt that the RCC share of the MSAT market will be considerably higher than it is for terrestrial. However, 75% would appear optimistic, particularly in light of the weak position of the many smaller RCCs and the potential competition from the Telcos and other possible service providers.

Further, the RCCs projected 73% of the MTS market appears clearly optimistic. At present, the Telcos have 100% of the terrestrial MTS market since existing regulations prevent RCC participation. Because of this the Telcos have the advantage of experience, expertise and resources and are expected to actively pursue maintaining market dominance.

This leads to the conclusion that either the RCCs market share prediction is too high or their view of the total forecast is conservative. It is our opinion that the RCCs view of the total forecast is a conservative one.

As mentioned earlier, at the time this work was conducted, the official Woods Gordon/Telesat view of the market was not available. It has since been published and presents a higher total forecast than that of the RCCs, further confirming our deduction of an RCC conservative view. The RCCs share of the official total MRS and MTS market would be 59%.

The major difference between the two total forecasts results from the differing ideologies of end users vs service providers. That is, the official forecast is based on end user perceptions while the RCCs total forecast is based on the views of a service provider. We would expect end users to have a better appreciation of the operational applications of MSAT compared to the RCCs particularly since 72% of the existing terrestrial MRS market belong to private end users. The RCCs have a better understanding of technical incompatibilties and operational unknowns and with MSAT only conceptually designed, the RCCs have many technical questions as yet unanswered.

Further, RCCs are extremely cost sensitive and more aware of the competitive environment compared to end users. The pricing structure presented to the RCCs was an important determinant in arriving at the market forecast. Generally, MSAT's pricing strategy was quite different than that of existing terrestrial services. Specifically, the strategy involved keeping subscribers fixed monthly charges as low as possible and recovering costs as well as profit through markups on monthly variable costs such as Telesats airtime charges. To lower fixed monthly costs, markups on equipment, such as common base equipment and mobile terminal rentals were limited to 25% of the costs and charged over the economic life of the equipment.

By RCC industry standards these markups are quite low (ie compared to 50% markups on existing terrestrial services). In addition, RCCs do not currently charge for airtime and this would present quite a change for existing subscribers.

Lastly, because the RCC industry is relatively young, many RCCs still plan on a short term basis and do not have the experience of end users in longer 5 to 10 year planning. Projecting MSAT forecasts to the year 2002 proved to be a difficult task for many RCCs.

Collectively, these factors would tend to produce a conservative RCC total forecast. Further, it is our opinion that the official forecast may also be conservative, since it was based on supplementing terrestrial services which are typically available within a 100 mile radius of each urban centre. However, MSAT could provide effective service in the immediate outlying areas of urban centres and depending on the pricing strategy could attract many subscribers who operate in this area.

4.3 RCC Industry MSAT Financial Analysis

The market forecast and the revenue and cost variables as determined from the pricing strategy provided the inputs to the economic model. Development of an appropriate economic model was key to the success of this study and considerable time and effort was expended to ensure its relevance. Dr. David Williamson of Western Ontario University and DOC, were key contributors in the development of the model.

4.3.1 MSAT Economic Model

The economic model is based on the financial and accounting algorithms suitable for a cash flow analysis. It uses revenue and cost variables corresponding to the incremental nature of the MSAT investment. As such, the model deals only with the specific impact of MSAT rather than attempting to provide the total RCC profitability (or loss) incurred in providing all MSAT and non-MSAT services.

The model calculates incremental cash inflows and cash outflows and determines the net present value of the RCCs share of the MSAT system. The NPV of a project is determined by discounting the cash inflows and outflows by an appropriate discount rate and subtracting cash outflows (including the initial cash outlay) from cash inflows. The resulting NPV indicates by how much the industry is better off due to the proposed investment. The annual cash flows were calculated in current and constant dollars. In the case of constant dollar projections, the real discount rate used was 6.0%. In current dollars, assuming a 5% inflation rate, the discount rate exceeded 11.0%.

If an analysis shows the NPV to be greater than zero, the project is at least making the minimum rate of return required.

In order to determine the impact of MSAT on the RCC industry, all **incremental** revenues, expenses and capital expenditures relevant to MRS, MTS, MPS and DACS service offerings were used in the analysis. Each component of revenue, expense or capital expenditure were developed in considerable detail. The components of each are illustrated below:

Revenue	Expense	Capital Expenditure
airtime fees	airtime costs	fixed capital
access fees	access costs	user capital -
mobile eqpt sales	advertising/	rental units
mobile eqpt rentals	promotion	replacement
mobile repairs	selling	stock
mobile installation	billing/collecting	
	mobile repair	
	mobile installation	
	mobile removal	
	non revenue earning	
	inventory	
	labour training	
	maintenance	

For example, mobile repair and installation revenue were calculated based on material costs, the cost of labour and the labour hours expended, as well as a 25% markup. It should be noted that the sales figure for new mobile equipment is understated for the second generation of MSAT (ie. 1996 - 2002) since no allowance was made for end user resale when the old mobiles reach their economic life of seven years.

Components of the cash inflows and outflows used in calculating the NPV are illustrated below:

Cash Inflows	Cash Outflows
Revenue	Expense
Equipment Salvage	Capital Expenditure
	Income Taxes

As discussed earlier, the NPV = PW(cash inflows) - PW(cash outflows) where PW is defined as the cumulative present worth of the cash flows, where the annual discounted value is equal to the cash flow multiplied by $1/(1+i)^n$, where i equals the discount rate, and n the number of years out from the starting point of the study to the year in question.

The salvage value was calculated based on the remaining life of the equipment. In this study, mobile terminals were assumed to have a 7 year life and fixed equipment (base stations and gateways) a 15 year life. For example, in calculating the salvage of fixed equipment, all aquisitions aquired in the last year of the project were assigned a salvage value of 14/15, while aquisitions in the second last year of the project had a salvage value of 13/15 and so on back to the beginning year of the project, in constant dollars. The current dollar salvage values were determined by adjusting the constant dollar salvage values for the rate of inflation.

Taxable income, in current dollars, was determined as follows:

Taxable Income = Revenue - Expense - Capital Cost Allowance(CCA) - Interest on Debt

The following process was used to determine the CCA:
CCA = CCA rate times (undepreciated amount at start of year + 1/2 the value of equipment added during year)
The CCA rate for fixed equipment was set at 20% and for mobile equipment was 25%.
The interest on debt was set at 9.32%.
Income taxes were calculated as follows. In current dollars the taxable income was multiplied by the marginal income tax rate. The rate used was 50 %. Constant dollar income taxes were determined by deflating the current dollar taxes by the assumed inflation rate of 5 %.

The economic model and all associated equations are included in Section 14.0 Volume II.

4.3.2 Revenues, Expenses and Investment

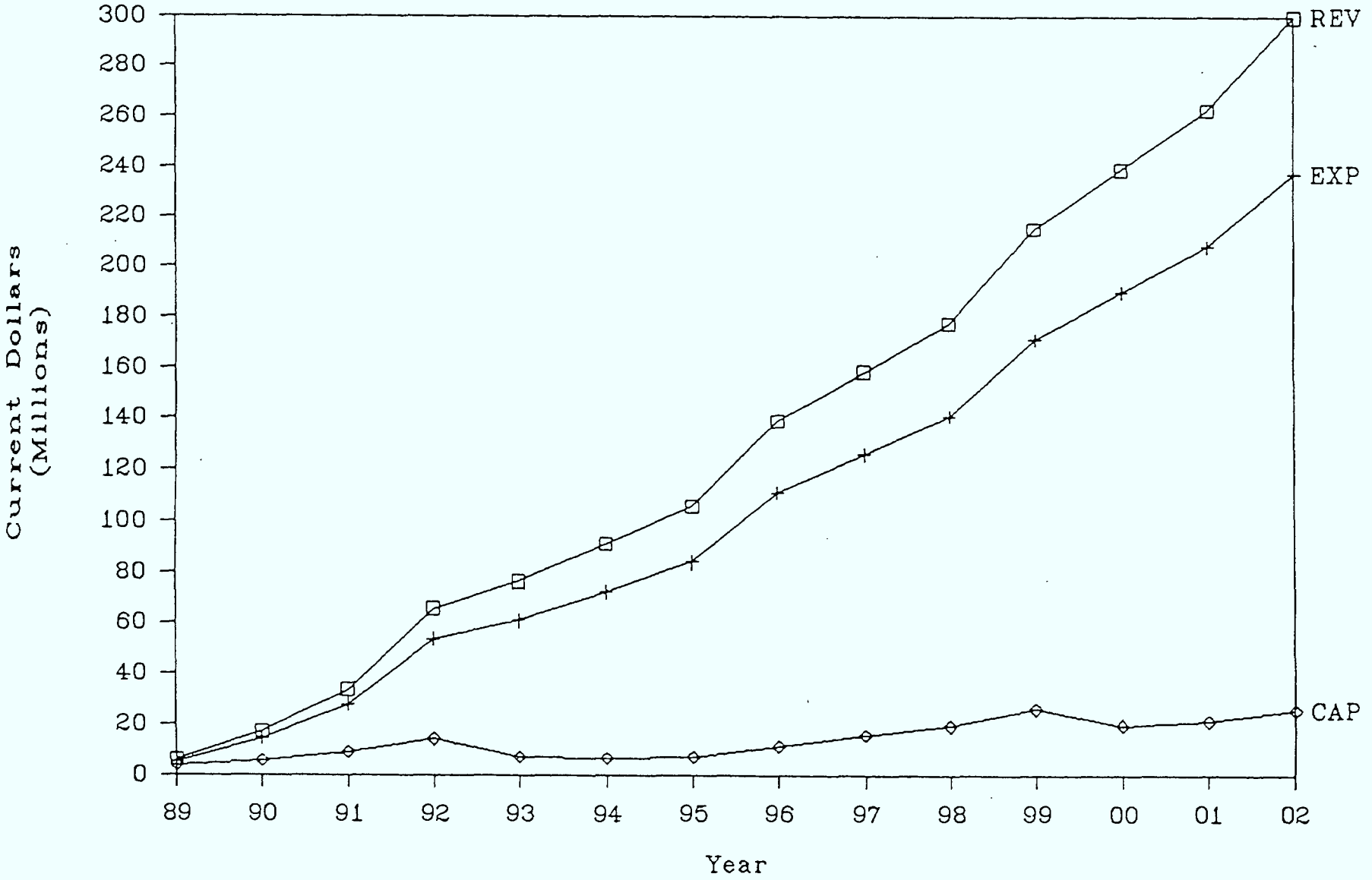
The following discussion is based on the economic model results as presented in Volume III, Run 1. All figures are in current dollars.

Graph 4.3.2.1 shows the RCCs revenue, investment and expense figures projected on a Canada wide basis for the years 1989 to 2002. Provincial data is presented in Section 20.0, Volume II.

GRAPH 4.3.2.1
MRS & MTS

MSAT RCC ANNUAL REVENUE, EXPENSE, CAPITAL

Canada



MRS - MOBILE RADIO SERVICE
REV - REVENUE
MTS - MOBILE TELEPHONE SERVICE
EXP - EXPENSE
CAP - CAPITAL INVESTMENT

Revenue

Revenues are comprised of a 25% markup on recoverable expenses, as well as a recovery component for capital investment, including fixed (ie base stations) and mobile terminal equipment rented to end users. Since the largest single contributor to revenue is end user airtime charges, any change in the study assumptions such as:

1) forecasted units
2) markup on airtime
3) monthly airtime usage per mobile (traffic level)

will have a significant impact on the NPV calculation of the MSAT program.

Both the forecast and the markup have been discussed previously. The artime usage assumption is important because of its potential impact on the cash flows. For the purposes of this study, 150 minutes/month/subscriber is the assumed airtime usage. Our own study results indicated a slightly lower airtime usage per month, however, the difference had minimum impact on the cash flows and was therefore considered unimportant.

Expenses

The largest expense items in order of significance are Telesat airtime costs, Telesat access costs and advertising/promotion and selling costs. Cumulatively they account for 92% of the expenses to the year 2002. All expenses are recovered, primarily through a 25% markup of airtime and access costs. Advertising/promotion and selling costs are not directly recoverable. They account for approximately 7% of the cumulative expenses and approximately 6% of the cumulative revenue and as such are in line with current industry expenditures. These costs represent what the industry feels it must spend to successfully promote MSAT and to achieve the projected forecasts.

All other expenses, such as : installation, repair, billing/collection costs, labour training and the cost of "non-revenue" earning inventory are recovered through a 25% markup. These expenses are also based on current industry standards and there is no reason to suggest that this would change with MSAT.

Capital Investment

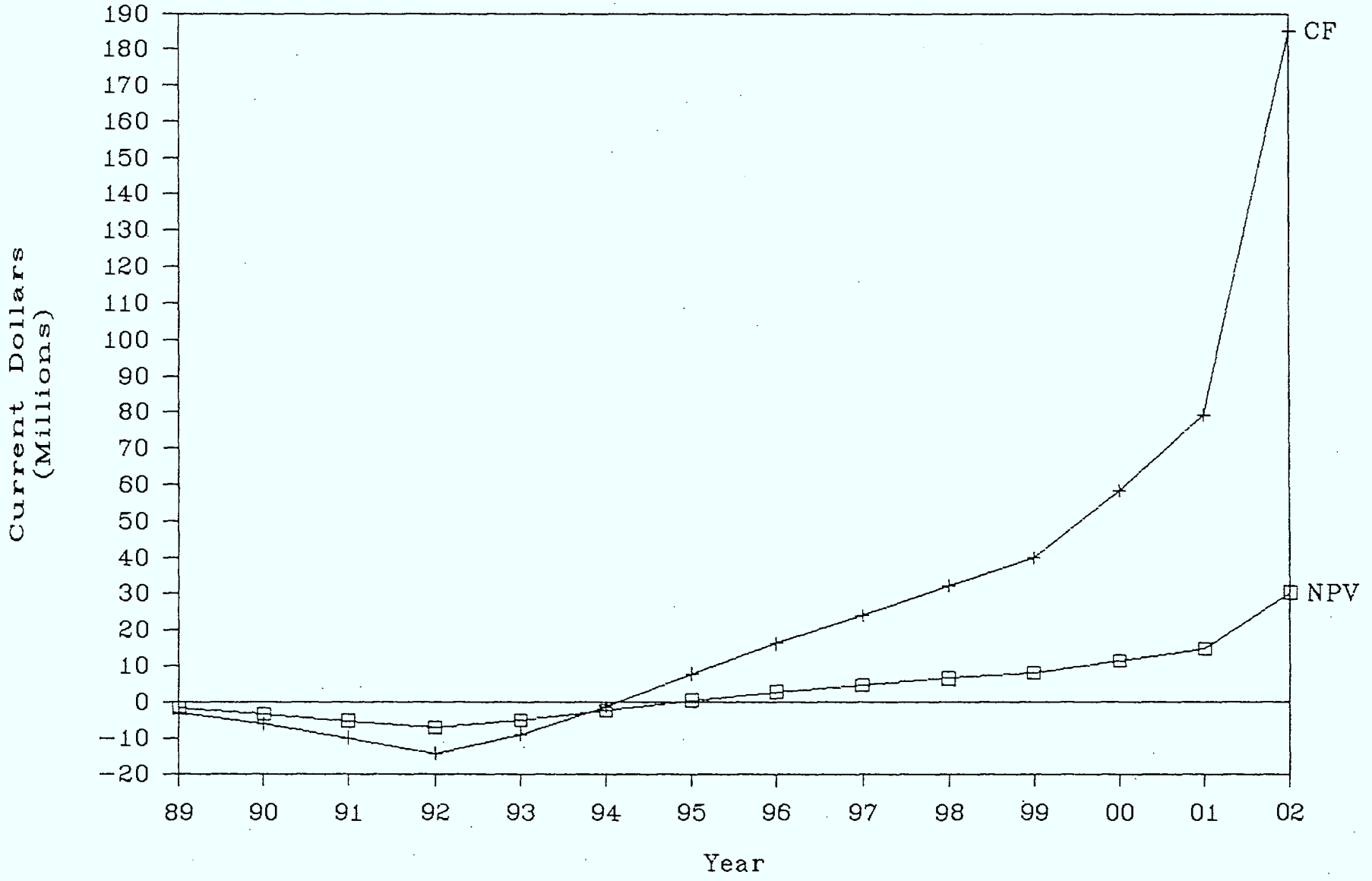
MSAT requires a very large capital investment on the part of the RCCs. The actual accumulated investment by the year 2002, including fixed equipment (ie base stations, terminal equipment for rental, replacement and stock units), is in the order of **190 million** dollars; a figure which is almost one half the total cumulative satellite investment by the year 2002. Thus, for all service providers combined, the ground network would represent the largest investment to be made in MSAT.

Investment by the RCCs in mobile terminal equipment for rental to the end user accounts for approximately 85% of the total required investment. This is based on the assumption that 50% of the forecasted units will be rented to end users. This is an important assumption, since it has considerable impact on the cash flows and is directly related to the pricing strategy. To maintain a pricing strategy of low monthly fixed end user costs, mobile rental charges were based on a 25% markup of the costs charged over the life of the equipment. The large size of this investment and the slow rate with which it is charged off, requires a fairly heavy and sustained investment by the RCCs. Projections indicate that MSAT will comprise approximately 8%-10% of the business of the total RCC industry and a much higher percentage of those service providers involved in MSAT by the year 2002. Therefore the nature of the business for those RCCs involved in MSAT will become more capital intensive.

GRAPH 4.3.3.1
MRS & MTS

MSAT RCC Cumulative Cash Flow and NPV

Canada



MRS - MOBILE RADIO SERVICE
MTS - MOBILE TELEPHONE SERVICE
CF - CUMULATIVE NET CASH FLOW
NPV - CUMULATIVE NET PRESENT VALUE

4.3.3 Financial Analysis

Graph 4.3.3.1 shows the cumulative cash flows and the associated net present value on a Canada wide basis for the years 1989 to 2002. Provincial data is presented in Section 20.0, Volume II.

As the graph indicates, it takes four years for the net cash flows, and six years for the cumulative net cash flows and the present worth of the net cash flows to turn positive. These results are attributable to the substantial investment, particularly in mobile terminal equipment for rental. Further, as previously discussed the pricing strategy employed results in a recovery of capital investment that is very slow, particularly by existing industry standards.

Once the NPV equals zero the industry is earning its required rate of return. A positive NPV indicates returns in excess of that required. Therefore, beyond the six year point where the cumulative NPV exceeds zero, the results are extremely favorable for the industry in general and the return on this project far exceeds the required rate of return on which the investment decision will be based. The only major consideration will be whether a firm can sustain the negative cash flow position that MSAT will impose in the first four years of operation. It is probable that only the very largest RCCs could effectively manage this position and that there could be a considerable shakeout amongst RCCs in the early years of the project, if individual RCCs venture to become service providers individually rather than as a consortium.

The results for the final year of the project (2002) are shown below:

	Net Cash Flow	Cumulative Net Cash Flow	Cumulative NPV
Canada (000's)	**106,063**	**185,320**	**30,209**

It is clear that the net incremental cash flows and the present worth of them are quite significant. It should also be noted that a significant salvage value, in the order of 97 million dollars, exists in the final year of the project (2002). While the cumulative NPV in the year 2002 is somewhat inflated by this salvage, most importantly, the NPV is positive well before 2002 and the conclusion drawn from the cash flow analysis is that MSAT would generate a significant return that would benefit the RCC industry.

4.3.4 RCC Industry Profit Trends

This study makes some basic assumptions concerning the implementation of MSAT services by the RCCs, which could impact the profitability of MSAT. The results are based on minimizing user costs by achieving efficiency in the network. This will require RCCs to coordinate and cooperate together in establishing shared SHF base stations and gateways.

While study results show MSAT to be a profitable business for the RCC Industry as a whole, negative cash flows in the first four years, will require other sources to provide the necessary cash for continued MSAT investment. Many RCCs will not have the resources to support MSAT until it becomes profitable with the possible result that MSAT may not evolve as predicted above. The two most likely paths of MSAT evolution are discussed below.

First, RCCs could begin MSAT service by providing small UHF base stations, the majority of which would be customer owned and concentrate primarily on selling customer owned terminals. Investment by the RCC would therefore be minimal and positive cash flows could be expected earlier. However, end user costs will be higher than projected in this study, because end users will be investing in smaller and therefore less efficient base stations. In

addition, UHF airtime costs are estimated to be 1.6 times that of SHF on a per minute basis and study results indicate that for a 30% increase in airtime costs the market forecast will decrease by 20%. As such, it is not clear what the impact will be on MSAT network evolution. Whether the RCCs would continue to push small user owned base stations or would attempt to provide a network of larger shared base stations is difficult to predict.

Secondly, RCCs could begin to provide MSAT services as projected in the study results. This means RCCs would group together and mutually invest in larger common base stations as the market developed. The MSAT network would therefore grow in an efficient manner with reasonable assurance of reaching the forecast projections. While it is possible that the RCCs, with the support of their association, could overcome the considerable fragmentation that exists in their industry to achieve such a degree of cohesiveness, it may be preferable to licence one umbrella organization under which all other RCCs would participate in MSAT. Certainly, efficient network evolution and growth can most likely be achieved if only one or a few RCCs are actually involved in network planning.

4.4 MSAT Sensitivity Analysis

To test the sensitivity of the MSAT cash flow results to various input changes, a number of sensitivity runs were produced, as outlined below. The results of these runs are included in Volume III.

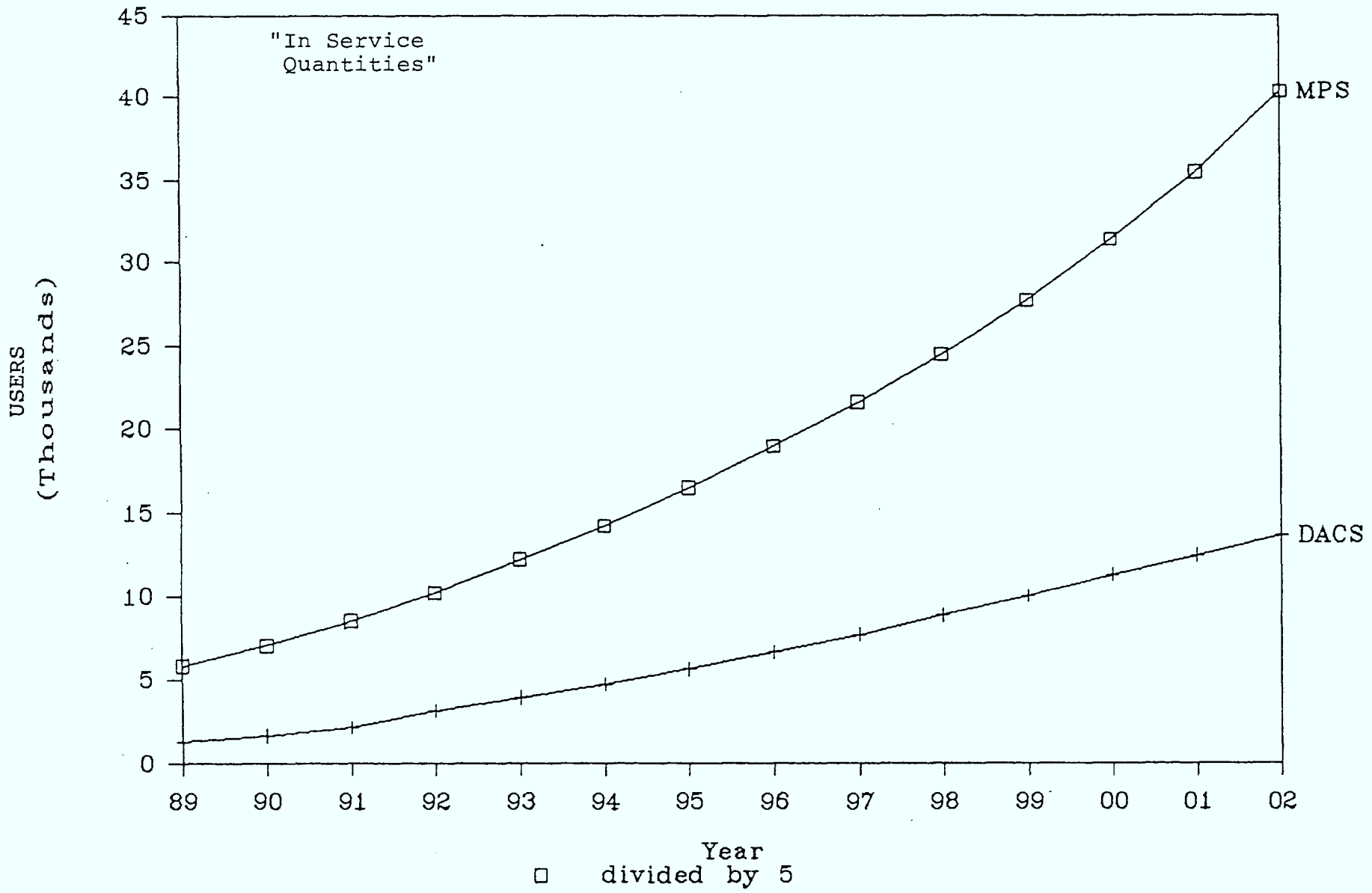
DACS and MPS

The first sensitivity run (Run 2, Volume III) includes the DACS and MPS inputs produced through the data collection process. Specific point year forecasts for these two services are shown below. Graph 4.4.1 shows the yearly MPS and DACS forecasts.

Graph 4.4.1

MSAT RCC MPS and DACS Forecast

Canada



MPS - MOBILE PAGING SERVICE

DACS - DATA AQUISITION AND CONTROL SERVICE

Yearly MSAT MPS and DACS Forecasted Users

	1989	1992	1996	2002
DACS	1,287	3,135	6,626	13,660
MPS	29,111	51,326	94,716	201,481

The economic model results show the cumulative NPV to the year 2002 in current 1984 dollars to be 15.1 million. The significance of this figure is somewhat misleading due to the substantial capital investment which remains undepreciated in the year 2002 as measured by its 231 million dollar salvage value. Thus, with the addition of DACS and MPS, it takes eight years for the net cash flow to turn positive and 15 years for the cumulative net cash flow and the NPV to turn positive.

These economic results are a direct consequence of the pricing strategy which includes a 25% markup on all recoverable expenses and on the costs of the capital investment which is charged over the life of the equipment. This markup is sufficient to generate the required return on investment for MRS and MTS, however, is insufficient to support DACS and MPS services. Most of the revenue from MSAT is obtained through airtime charges to the end user. While the average MRS or MTS subscriber will use the system for 150 minutes/month, the average MPS subscriber requires only 6 minutes/month and only 2 minutes or 16 minutes/month for DACS alarm and polling, respectively. This low airtime usage provides less revenue to offset the substantial capital investment required. Given more time and effort, a suitable pricing strategy could have been developed for DACS and MPS. The RCC industry forecasts clearly demonstrate a demand for these two services. We would strongly encourage development of appropriate charges through future MSAT studies that will allow users the option of all four MSAT services.

Market Sensitivity Analysis

Volume III, Runs 3, 4, 5, and 6 provide the outputs to the relevant market sensitivity runs. Input changes to Run 2, are as follows:

Input change	Run 3	Run 4	Run 5	Run 6
Forecast	-20.4%	+16.7%	-29.0%	+20.1%
Airtime	+30.0%	-30.0%		
Mobile Eqpt Cost			+30.0%	-30.0%

The cumulative NPV results for these market sensitivity tests are:

	Cumulative NPV ($ 000's) 2002
Run 3	17,051
Run 4	2,025
Run 5	11,449
Run 6	8,443

The sensitivity runs illustrate the importance of airtime revenue and the input parameters which determine the size of this revenue.

In Run 3, the market forecast in all services was reduced by 20% and both the cost of airtime to the RCC and the cost to end users was increased by 30%. The result is a 2 million dollar increase in the cumulative NPV to the year 2002. This suggests that the optimum pricing and marketing strategies warrant further investigation most likely through future MSAT studies.

In Run 4, the market forecast was increased by 16.7% for all services and airtime costs were decreased for both the RCCs and end users by 30%. The revenue generated by the additional units is insufficient to make up for the lost airtime revenue. Thus, the cumulative NPV is reduced by over 13 million dollars.

The results of Runs 5 and 6 illustrate that the retail and wholesale prices of mobile units also affect the profitability of MSAT since two effects are taking place; one as a result of the revenue generated by selling mobile units and the other as a result of the airtime revenues generated.

In Run 5, the market forecast was reduced by 29% because of the 30% increase in the retail and wholesale price of mobile units. Again the decrease in airtime revenue as a result of the forecast decrease is only partially offset by the additional revenue generated by increasing mobile unit prices and the cumulative NPV is reduced by approximately 3.5 million dollars.

In Run 6, the market forecast was increased by 20% while the retail and wholesale prices of mobile units was reduced by 30%. The increased market forecast results in greater airtime revenues. Revenues from mobile sales decrease in spite of the market forecast increase. The result is a 6.5 million dollar reduction in the cumulative NPV.

Clearly, the pricing strategy has a substantial impact on the profitability and viability of MSAT.

4.5 Job Impacts

There are other benefits to be realized from the MSAT program which reach beyond the pure economic analysis. MSAT participation will require an extensive support system, including installation, maintenance, and administrative personnel. This will create jobs for:

- technicians
- engineers
- sales personnel
- clerks
- secretaries
- managers

This new infrastructure will require the skills of a number of disciplines to be successful. The workforce involved in the RCC industry today, cannot provide the necessary manhours required to support MSAT and many new jobs will result. On a yearly basis, we have estimated the number of new jobs created, as a result of RCC participation in MSAT to be as follows:

Year	89	90	91	92	93	94	95	96	97	98	99	00	01	02
No. of new jobs	28	34	40	62	0	0	8	26	19	16	27	22	18	54

As a comparison, the 1984 RCC workforce has been estimated at about 5000.

The manufacturing industry will also benefit as a result of RCC participation in MSAT. The manufacturing industry relies on volume purchases to achieve economies of scale and this translates into aggressive marketing and selling. The RCCs have proven themselves to be successful entrepreneurs even where other carriers have failed in promoting a new product or service and they have the existing infrastructure that will assist in achieving the necessary market penetration. More importantly, the RCCs are often a contributing factor in new product innovations. Their expertise in mobile communication and their understanding of user needs, has often led the manufacturers to respond with research and development, resulting in the creation of new products or services.

Another important benefit is the improvement in existing communication services that will occur as a result of MSAT. The RCCs are interested in offering a total mobile communication package to their customers. They have been unable to meet the needs of some of their customers, in this area, because either the cost was too high or the technology did not exist. With MSAT, an end user could obtain local, regional or nationwide coverage depending on their particular needs. MSAT allows them this choice at a much more affordable cost. Thus, MSAT will benefit the RCCs through an improvement in their existing communication business thereby allowing RCCs to become total mobile communication service providers.

5.0 RCC MSAT Service Provisioning - Major Issues

The following is a summary of the major issues identified by the RCCs during the course of this study and relating to their role as potential MSAT service providers. Suggestions on behalf of the industry relating to the issues raised are also included.

5.1 Ownership

It is proposed that Telesat be the sole owner and operator of the MSAT space segment *, consistent with its current role in providing Canadian satellite services. However, it might be beneficial if some of the risk associated with MSAT were distributed to other private investors, such as the RCCs. The risk to Telesat could be reduced if service providers were to become investors in the space segment which in turn could reduce the subsidy required from the federal government in the early years of the program.

5.2 Operational

It is proposed that Telesat will have exclusive control of the space segment telemetry and control functions needed to maintain the satellite in proper orbit, to monitor performance and to command transponder coupling according to traffic requirements. The operation and control of the Demand Assignment Multiple Access (DAMA) operation by Telesat has raised the issue of equal access to all service providers. As noted earlier, the study scenario presented to the RCCs included Telesat as a competing service provider, albeit limited to large national accounts. The RCCs require assurance of an equal access arrangement that guarantees no preferential access to Telesat customers, should Telesat be a service provider, prior to any formal committment to MSAT.

* The space segment includes the Demand Assignment Multiple Access System.

The creation of a working relationship between Telesat and the MSAT Service providers; a relationship that would include management and operation of the MSAT spectrum, has been suggested and is certainly worth considering.

One possible scenario could be a call for license applications to construct, own and operate the MSAT network, under a monopoly or duopoly arrangement. The successful carrier(s) would enter into an agreement with the space segment operator, namely Telesat. This agreement would ensure proper access fees to Telesat to cover the space segment capital investment, operating costs and adequate return on investment in accordance with CRTC regulations. This agreement would also include possible sharing of spectrum with the U.S. Mobile Satellite carriers to ensure maximum North American MSAT spectrum efficiency. The licensing of MSAT carrier(s) under a DAMA equity ownership arrangement would undoubtedly result in proper planning of MSAT system capacity and proper ground segment network establishment, since such a carrier would likely complement existing services with MSAT services rather than try to compete with those services.

5.3 Institutional

The issue of who will be the designated service providers for MSAT has yet to be finalized. The scenario presented to the RCCs is only one of several possibilities, one of which is the monopoly or duopoly service provisioning arrangement, as previously suggested. The designation of MSAT service providers is important for two reasons; first, these service providers must work together in planning and implementing the ground network which is a critical aspect of MSAT service, and secondly, service providers must consider the competitive arrangements fair and equitable.

Should Telesat be designated as one of the prime service providers, then the scope of their mandate must clearly be defined, so that competitive arrangements are fair and equitable. RCCs feel that if large users are allowed to deal directly with Telesat on the same basis as the RCCs, ie. at the same costs, then a large portion of the MSAT market may be lost to the RCCs and the remainder may not provide the necessary incentives to justify the investment. One suggestion to ensure the RCCs competitive position is to sell them airtime on a bulk basis. For example, RCCs could commit to purchase a certain yearly airtime at a bulk rate, while end users dealing directly with Telesat could not purchase airtime on the same basis.

5.4 Marketing

Marketing of MSAT is an important issue to the RCCs who are interested in offering a total communication package to their customers. This suggests that there be no restrictions on the services to be offered by any one service provider. RCCs would not want end users to have to deal with two different service providers when subscribing for MSAT services. Such an arrangement could be wasteful and inefficient and would be in contrast to the trend on terrestrial systems were customers are seeking one stop shopping.

RCCs also feel that effective marketing of a service includes not only selling the product, but also supporting the product ie. maintenance, repair, training etc. A strong local presence is necessary to assure customers that the support required is available. RCCs through terrestrial service offerings have established such a presence and have created an infrastructure ideally suited to the marketing of MSAT.

The RCCs themselves will require assurance from Telesat on service availability and standards, such as blocking rates, access times etc, particularly if they have no control or say over these system parameters. Thus, RCCs will need clarification from Telesat on the conditions and terms of the contract before committing themselves to MSAT. Therefore, confidence levels can be further increased if these terms and conditions are worked out early in the MSAT program.

A further marketing issue is the potential stand alone aspect of MSAT. New allocations in 800 and 400 MHz for terrestrial trunked MRS services and optional interconnection arrangements of MRS to the PSTN, as well as growing interest in wide area and nation wide paging and data services could represent viable alternatives to MSAT services, even in rural Canada. If MSAT services are offered as stand alone services, and are not offered as part of a total communication services package, ie. based on a one stop shopping concept, the identification and segregation of the MSAT market segment will be extremely difficult.

5.5 Billing

The proposed MSAT billing arrangement is an issue of concern to the RCCs. Currently, it is assumed that Telesat will have exclusive control of the space segment telemetry and control functions including DAMA and airtime billing. Telesat will issue bills to the service providers, who in turn will directly invoice their end users. This arrangement will require careful consideration if a workable arrangement is to be implemented. In regard to billing, the service provider is somewhat of an intermediary, yet in all other aspects, he is the prime customer interface responsible for dealing with questions and resolving problems. To be effective, service

providers, such as the RCCs, must have access and control over their customer records and billing data. This information is critical to the operation of any communication system and must be readily accessible particularly for planning and accounting purposes. Should Telesat retain control over billing, RCCs should be provided with direct access to the billing database. This will allow RCCs immediate access so that changes can be made on a daily or hourly basis as necessary. Any other interface, such as telephone or mail would be inefficient and timeconsuming.

Since MSAT is to be a competitive service offering, RCCs will require assurance that billing data is secure and will be kept confidential. Disclosure of such data could affect the ability of a service provider to effectively compete in the market place.

5.6 Technical

RCCs have many reservations concerning the non-compatibility of MSAT terminals with terrestrial terminals, particularly for MRS and MTS services. Many mobile radio and mobile telephone users require contiguous service beyond urban coverage areas to extended and rural areas.

The stand alone aspect of MSAT renders the integration of MSAT and terrestrial services, such as cellular mobile telephone service (CMTS) or trunked mobile radio service (TMRS), very difficult. Because the proposed MSAT service will employ a 5 kHz channelling plan using ACSB or low rate digital voice coding, present technology will require users, who wish to use both MSAT and terrestrial services, to install multiple mobile terminals. This arrangement which is cumbersome, difficult to operate, and expensive, would be unattractive to many users. Compatibility between MSAT and terrestrial equipment would allow a single integrated service offering to the user.

The allocations for cellular mobile telephone service (CMTS) and trunked mobile radio service (TMRS), in the 800 MHz band, offer a unique opportunity to provide, even in the first generation of MSAT, compatible service with CMTS and TMRS. Although the limited UHF spectrum available for MSAT would benefit from the higher efficiency attainable with new narrow band modulation technologies, we believe substantial benefits, particularly increased market penetration, would result from the compatibility of terrestrial and MSAT services.

Further, the move today is towards technically more sophisticated, but operationally simpler and more efficient telecommunications products. Major benefits could be gained if a subscribers mobile unit could operate on the different RCC common carrier bands (150 Mhz, 450 MHz, 800MHz) and be able to adhere to different modulation techniques including 5KHz and 30 KHZ compatible terminals.

Additionally, if the use of the L band (1500 MHz) is proposed for future MSAT operation on second generation satellites, then a combined UHF and L band terminal would be desirable .

It would also be beneficial to have all MSAT services offered on a compatible basis, not only across Canada, but across North America. Many Canadian MSAT users will require coverage into the US and user acceptance of MSAT could be increased with North American compatibility. At the very least MSAT should be compatible across Canada.

5.7 Regulatory

MSAT User Terminal Licensing

RCCs would prefer that the licensing of MSAT mobiles be done through a "point of sale" licensing arrangement by any authorized MSAT service provider. A lengthy procedure requiring an individual license to be issued by DOC for each MSAT subscriber, is less desirable, since it could delay utilization of the service and complicate related marketing and sales activities. It is understood that type approval by the manufacturer would be required for all equipment which in turn would require industry standards to be established for the equipment.

Fixed Earth Station Licensing

Establishment of an efficient ground network, consisting of base stations and gateways, will be a major undertaking in the implementation of MSAT. Licensing policies must ensure that this ground network is not established in an adhoc fashion. Further, restrictions on the ownership of fixed stations that currently exist and would affect the establishment of an efficient nationwide ground network, must be reviewed with the appropriate regulatory bodies.

Service Accessability

RCCS would want assurance that as much as possible, all MSAT services would operate within the DAMA operation on a first come, first serve basis. Where necessary, a priority structure for special public safety and essential services could be instituted to ensure priority of service as needed. It may also be necessary to suballocate the spectrum for dedicated channel(s) assignment to major users, who for reasons of "security" or "essential services", cannot operate as part of the DAMA system.

5.8 Policy

It would be to the RCCs advanatage if, the policies associated with MSAT service provisioning were addressed and resolved by a policy working group that included service provider representatives. In addition to the many items associated with MSAT service that have already been discussed, there are other issues, such as priority channel access schemes and dedicated channels, that must also be resolved. These two issues alone could impact the availability of MSAT to an end user even on a DAMA basis. Policies developed by a working group that included RCC representatives, would maximize acceptance and improve understanding by both end users and service providers.

6.0 Conclusions

MSAT is a viable service offering providing substantial returns to the RCC industry based on the following study assumptions:

- the MRS and MTS market forecasts are achievable through a pricing structure which reflects low fixed monthly end user costs
- negative cash flows can be sustained in the early years of the program
- competition between the potential MSAT service providers, including Telesat, fair and equitable
- substantial prelaunch marketing and advertising are undertaken
- network planning is cooperative effort by all service providers

7.0 Study Findings

MSAT Service Forecasts

1. MRS MSAT interconnect and operating arrangements in the various regions of the country and the MTS billing and service provisioning scenarios have not yet been worked out pending many policy issues.

   In the study teams view, the MSAT MTS and MRS forecast as provided in this study could vary following resolution of interconnection policy and decisions on MTS MSAT toll charges, throughout the country.

2. DACS services have not been well received and understood by RCCs who traditionally are not in the Data Aquisition and Control business.

The DACS forecast as provided in this study could vary following resolution of the operational and implementation issues. It is a common belief by the RCCs that data services as an enhancement to MRS/MTS service will grow in demand. However, the need for dedicated data services has not been fully explored, by the RCCs.

3. Paging could be a major market for MSAT if RCCs can enhance their local paging systems with MSAT links. Similar to DACS point-to-point monitoring and control in remote areas, wide area paging links to remote areas is a viable market for MSAT.

4. RCC interest in MSAT varies with each new MSAT operational scenario change and/or economic cost and revenue assumption variation. The market forecasts reflect this level of uncertainty and future MSAT studies should be able to attain a higher degree of accuracy once operating assumptions are better defined.

Financial

5. The financial projections clearly show that this venture represents a large investment for the industry, coupled with a potential for substantial returns.

Table 7.1 : Summary of Financial Projections

Period	Cum. Revenue(1) in Constant 1984 Dollars	Cum. Invest. in Constant 1984 Dollars	Cumulative NPV
1989-1995	$132,968,000	$ 18,653	$402,000
1996-2002	$246,114,000	$ 22,961	$29,807,000(2)
TOTAL	$379,082,000	$ 41,614	$30,209,000

Note 1: Includes airtime, access, repair, billing, installation etc.

Note 2: Includes salvage of $14,242,000

This evaluation is based on a 25% operating margin proposed as part of the overall assumptions. The results shown, exclude DACS and paging services.

6. MSAT represents one of many new telecommunication opportunities to RCCs in Canada and can compete effectively with Cellular MTS, Trunking MRS, Nationwide Paging and other new services as far as the investment capital of the RCCs is concerned.

Marketing

7. MSAT represents a major opportunity for the RCCs. Failure by the industry to consolidate and form a common front to implement this opportunity could have one or all of the following consequences:

   - The majority of MSAT business will remain in the regulated hands of Telcos and Telesat.
   - The RCC status as a new class of carriers with regional and nationwide capabilities will be harder to achieve.
   - New entrepreneurs not part of the RCC industry will undertake MSAT service provisioning and could take over some traditional RCC markets by providing a greater choice of services.
   - A nationwide MSAT carrier similar to CANTEL will compete with traditional RCCs and eventually takeover some traditional paging and MRS/RCC markets.

8. Telesat in their Assessment of the Commercial Viability Study underlined one of the forecast assumptions as follows: a "significant prelaunch marketing effort is required". Marketing forecasts for the early years of the MSAT program could be overstated if this prelaunch marketing effort is not effective.

9. RCCs see MSAT as an opportunity to extend coverage for their existing subscribers and to enter new common carrier markets where terrestrial mobile communications is currently not economically viable and/or to the private markets where upgrading and enhanced coverage is needed.

Planning

10. Because the implementation of MSAT is still a distant proposition and MSAT service in comparison to terrestrial service is relatively expensive, there is little serious planning taking place, with the exception of a handful of major RCCs.
11. The terrestrial network for access to MSAT services (UHF, SHF stations and Gateways) requires detailed planning in order to ensure the most cost effective service to the users through the evolution of the MSAT network from small stations to larger SHF stations.

Technical

12. The MRS dispatch operating scenario as seen by the RCCs should be a simplex "one to many" open speaker system as currently used on terrestrial systems. The present operational scenario seems to be based on a "one to one" individual communication, similar to cellular MTS. This is not suitable for dispatch operation.

13. The stand-alone aspect of MSAT, (i.e. being incompatible with terrestrial systems) could potentially reduce MSAT marketability.

Operational

14. The designation of MSAT service providers is an important issue yet to be finalized. Of particular concern to the RCCs is whether Telesat will be designated as one of the prime service providers. If so, then the scope of their mandate must be clearly defined, so that competitive arrangements are fair and equitable. RCCs feel that if large users are allowed to deal directly with Telesat on the same basis as the RCCs ie. at the same costs, then a large portion of the MSAT market may be lost to the RCCs and the remainder may not justify the investment.

8.0 Recommendations

Marketing

1. A marketing plan should be developed, with the participation of RCC representatives, on a region by region and on a nationwide basis and presented for action as part of Telesats business plan.

2. A promotion plan should be created to bring the MSAT concept closer to the industry. Any marketing plan must be strongly supported by advertising which promotes the business opportunities of MSAT. We suggest that the CRCCA, Telcos, DOC and Telesat work jointly in the development of this plan.

3. As part of the prelaunch marketing effort, an extended area coverage network, should be established, even on a limited traffic capacity basis, that would simulate MSAT operation using existing satellite capacity.

   It is possible to use existing earth station technology combined with traditional mobile radio and mobile telephone technology to provide a simulated mobile satellite service. One approach would be to use a traditional mobile radio or telephone repeater operating at either 150, 450 or 800 MHz connected to a Ku-band earth station. A vehicle within range of the repeater, would transmit using traditional mobile equipment. The message would be received at the repeater and through connection to an earth station, transmitted via satellite to a dispatcher or other central location. Thus as an interim measure, existing satellite capacity could be used to provide communication between terrestrial systems and in addition, could test the need for truly wide area coverage.

4. In future MSAT implementation phases, Telesat, DOC and potential service providers including the RCCs should cooperatively establish the details of an acceptable arrangement which ensures fair and equitable competition for everyone.

Technical

5. MSAT service should be compatible across Canada and if possible, across North America. Every endeavour should be made to make MSAT terminals compatible with existing terrestrial terminals.

Policy

6. The policy rule making associated with MSAT service must be clarified. Any planning must be based on clearly defined rules such as:

   - Competition
   - Interconnection
   - Wholesale/retail prices
   - Terrestrial boundaries (between service providers)
   - Price level/regulations
   - Point of sale licencing
   - After sale service
   - Ground station ownership (gateways)
   - Billing processing and monitoring
   - Access control
   - Service priorities

   A policy working group should be established, with representatives from the RCC industry, to address and resolve the many policy issues associated with the implementation of MSAT service.

7. Future MSAT studies should determine the appropriate pricing policies for DACS and paging services in order to incorporate them into the overall MSAT service offering without affecting the viability of the project.

Planning

8. Telesat and DOC should intensify their consultation with the CRCCA and individual RCCs to increase the understanding of the nature of the RCC business and further analyze the RCCs capabilities of service provisioning and interest in MSAT.

9. Telesat in cooperation with the CRCCA should enter into a dialogue with CANTEL/CNCP, Telecom Canada and other nationwide operators to gain insight into the organization, procedures, support and promotion associated with nationwide services.

Regulatory

10. RCCs should not be restricted from offering any of the MSAT services. Regulatory restrictions that currently exist need to be resolved on a provincial basis through the appropriate regulatory bodies.

REFERENCES

1. "The Socio-Economic Input Study Assumptions", MSAT Program office, J. Braden, October 1984.

2. "Radio Licensing Policy for Cellular Mobile Radio Systems and Preliminary Mobile-Satellite Planning in the band 806-890 MHz", DOC Discussion Paper, September 1981.

3. "The Canadian Mobile Satellite Program", P.M. Boudreau, R.W. Breithaupt, J.L. McNally, IEEE National Telesystems Conference, Galveston, Texas, Nobember, 1982.

4. "Land Mobile Satellite Service Concept Policy and Regulatory Issues", Jerry Freibaum, NASA, Conference Proceedings, International Telecommunications and Computer Exposition, Los Angeles, California, 10 - 13 November, 1980.

5. "The Market Potential for an Integrated Terrestrial Land Mobile Satellite System", Harry Loats, ECOsystems International, Inc., ibid.

6. "Advanced Mobile Phone Service", F.H. Belcher, IEEE Transactions on Vehicular Technology, Vol. VT-29, No. 2, May, 1980.

7. MSAT Concept Document, MSAT Project Document, 1982.

8. MSAT Phase B Project Plan, DOC Publication, March 1982.

9. "Cellular Systems and Alternatives for Mobile Radio Communications", Frost & Sullivan, December 1980.

10. "User Requirements for a Mobile Satellite System Operating in the 806-890 MHz Band", Vol. I - Report, Vol. II - Tables and Appendices, Woods Gordon Management Consultants, Toronto, Ontario, September 1981, DOC-CR-SP-81-025.

11. "User Cost Benefit Study for a Mobile Satellite Radio System", Systemhouse Limited, Ottawa, Ontario, June 1982, DOC-CR-SP-82-028.

12. "MSAT Commercial Viability Study", ADGA/Touche Ross and Partners, Ottawa, Ontario, March 1982, DOC-CR-SP-81-046.

13. "Land Mobile Satellite System Considerations", J.D. Keisling, General Electric Co., ibid.

14. "Technology Considerations for a Mid-1990's Operational Land Mobile Satellite Service", William J. Weber III, Firouz Naderi, A.M. Goldman Jr., Jet Propulsion Laboratory, ibid.

15. "International Telecommunications Union (ITU) Radio Regulations, Geneva 1982", ISBN 92-61-01221-3.

16. "MSAT Canadian Demonstration Spacecraft - Report and Baseline Performance Document", Spar Aerospace Ltd., Ste. Anne-de-Bellevue, Quebec, December 1981, DOC-CR-SP-81-047A.

17. "MSAT Spacecraft Conceptual Design Studies - Executive Summary", Spar Aerospace Ltd., Ste. Anne-de-Bellevue, Quebec, December, 1981, DOC-CR-SP-81-047B.

18. "MSAT Gateway Station Study - Canadian Option", SED Systems Ltd., Saskatoon, Sask., October 1981, DOC-CR-SP-81-049A.

19. "A Study of the MSAT Central Control Station Requirements", SED Systems Ltd., Saskatoon, Saskatchewan, November 1981, DOC-CR-SP-81-050.

20. "MSAT Mobile Terminal Study", ADGA Ltd., Ottawa, Ontario, April 1982, DOC-CR-SP-82-034.

21. "Analysis of the Trucking Industry Market for a Land Mobile Communications Satellite Service", ECO Systems, 11 January 1981, prepared for NASA Headquarters, Washington, D.C.

22. A Listing of MSAT Issues. MSAT Program Office, September 1982.

23. Working Paper on Policy Issue Analysis and Production of Policy Proposals, D. Gilvary, MSAT Program Office, CR-6980-14-6.

24. MSAT Policy Data Base (PDB): Task 2 Report on communications Policy Analysis and Definition (WP2.6) MSAT Program Office, October, 1982.

25. "System Availability Study for MSAT", Telesat Canada, Ottawa, Ontario, February 1982, DOC-CR-SP-82-006.

26. "System and Service Capability Document", D. Athanassiadis, MSAT Program Office. (A Draft Document.)

27. "Land Mobile Satellite Communications Via MSAT", A.E. Winter, D.J. Sward and M. Zuliani, Telesat, prepared for the 35th Congress of the International Astronautical Federation, October, 1984.

28. "Future Private Land Mobile Telecommunications Requirements", FCC Planning Staff, Private Radio Bureau, August, 1983.

29. "Discussion Paper Telecommunications Policy Proposals for Mobile Satellite Service", Notice No. DGTP-007-84, DOC.

30. "A Satellite Based Mobile Communications System for Canada", Telesat, Supplement to Notice No. DGTP-007-84.

31. "Satellite Provided Customer Premises Services: A Forecast of Potential Domestic Demand Through the Year 2000", Western Union Telegraph W, August 1983.

32. "The Market for MSAT Services - Market Projections and User Cost-Benefit Analysis", Woods Gordon, prepared for DOC, February, 1984.

RCC MSAT RESPONDENTS

1. Capital Communications & Multi Services Ltd.
   Fredericton, N.B.

2. Telephone Answering Service CB Ltd.
   Sydney, N.S.

3. Harrison-Nowell Mobile Radio Services Ltd.
   Winnipeg, Man.

4. Imperial Radio Service Ltd.
   Brandon, Man.

5. Unicorn Services Inc.
   Brandon, Man.

6. Beacon Tower Electronics Ltd.
   Grande Prairie, Alta.

7. Bridgecom Electronics Ltd.
   Lethbridge, Alta.

8. Citipage Ltd.
   Edmonton, Alta.

9. E.S.P. Communications Corp. Ltd.
   Mynarski Park, Alta.

10. Mariglen Communications Ltd.
    Red Deer, Alta.

11. Mayflex Ltd.
    Calgary, Alta.

12. Morad Communications Ltd.
    Hinton, Alta.

13. Air Northwest Telecommunications Ltd.
    Yellowknife, N.W.T.

14. A.C. Operations
    Dawson Creek, B.C.

15. Canadian Telecom Inc.
    Vancouver, B.C.

16. Callmark Radio Paging Services ltd.
    Nelson, B.C.

17. Okanagan Personal Paging
    Vernon, B.C.

18. Peace Country Telecoms and Skeena Telecoms Ltd.
    Prince Rupert, B.C.

19. R.J. Electronics ltd.
    Fort Nelson, B.C.

20. RSM Communications Ltd.
    100 Mile House, B.C.

21. TASCO Communications Inc.
    Vancouver, B.C.

22. V.I. Paging Services Ltd.
    Victoria, B.C.

23. Beeper People
    Don Mills, Ont.

24. Christie and Walther Electronics Limited
    Ottawa, Ont.

25. Alliance Communications
    Kingston, Ont.

26. A.V. Communications Inc.
    Chatham, Ont.

27. Brant Telecommunications Ltd.
    Brantford, Ont.

28. Bridgeview Electric Ltd.
    Windsor, Ont.

29. Canadian Electronics Service ltd.
    Toronto, Ont.

30. CAS Communications Services Ltd.
    Toronto, Ont.

31. COM-TECH Radio Inc.
    Burlington, Ont.

32. Diversified Communications
    Peterborough, Ont.

33. Industrial Guard Services limited
    Toronto, Ont.

34. KEL Communications
    Windsor, Ont.

35. PasWord Communications Inc.
    Hamilton, Ont.

36. Radio-Com Communications
    Orillia, Ont.

37. Ri-Del Communications Limited
    North Bay, Ont.

38. Tas-Page Communications
    Peterborough, Ont.

39. Thunder Bay Communications & In-Touch Paging & Leasing Ltd.
    Thunder Bay, Ont.

40. Trans Provincial Communications
    Ottawa, Ont.

41. Washago Communications
    Washago, Ont.

42. Windsor Communications Company
    Windsor, Ont.

43. Wodlac Communications Limited
    Barrie, Ont.

44. Electronique Mercier ltee.
    Riviere Du Loup, Que.

45. Service Des Ondes Limitee
    Laval, Que.

46. Comm-Phase (Division of Communication Phaser Inc.)
    Ville St. Pierre, Que.

47. 123842 Canada Inc. Communications Mt. Bruno
    St. Bruno, Que.

48. Communications SR Inc.
    Chicoutimi, Que.

49. IES Telecom Ltdd.
    Ste-Fay, Que.

50. M. Leduc Ltee.
    Amos, Que.

51. Lord Radio Service Inc. (Communication L.R.S. Inc.)
    St. Jean-sur-Richelieu, Que.

52. Pagetel Inc.
    chicoutimi, Que.

53. Reynolds Radio Inc.
    Trois-Rivieres, Que.

54. Tele-Communications Trois-Rivieres, Ltee.
Trois-Rivieres, Que.

55. Teleonde Inc.
Ste-Fay, Que.

*56. Communication Systems Ltd.
St. Johns, Nfld.

*57. VIP Communications Ltd.
Winnipeg, Man.

*58. Brantford Telephone Answering Service Ltd.
Brantford, Ont.

*59. Colcom Communications
Montreal, Que.

*60. Communication Le Bocher Inc.
Grand Mere, Que.

*61. Communication Services (Royal) Inc.
Sherbrooke, Que.

*62. Dialcom Communciations Ltd.
Barrie, Ont.

*63. Distacom Communications Ltd.
Burnaby, B.C.

*64. MacLean Hunter Paging
Toronto, Ont.

*65. The Message Network ltd.
Kingston, Ont.

*66. Motorola Canada Limited
North York, Ont.

*67. Millman's Communication Services (1964) Ltd.
Edmonton, Alta.

*68. Fox Radio Systems Ltd.
Chilliwack, B.C.

*69. Laval Communications Inc.
Laval, Que.

*70. Northern Commercial Electronics Ltd.
Orillia, Ont.

*71. Oxford Communications Ltd.
Woodstock, Ont.

*72. Pagette Airsignals Ltd.
Toronto, Ont.

*73. National Telesystem Ltd.
Ste-Fay, Que.

*74. Radio-Phones Ltd.
Toronto, Ont.

*75. Runke Radio Communications (1980) Ltd.
Kitchener, Ont.

*76. Scotcomm Radio Inc.
Montreal, Que.

*77. Steel Electronics Ltd.
Sudbury, Ont.

*78. Systel Electronics Ltd.
Drayton Valley, Alta.

*79. Till Communications Ltd.
Lloydminster, Alta.

*80. Time Communications Ltd.
Ottawa, Ont.

*81. Total North Communications
Whitehorse, Yukon

*82. Two-Way Communications (1983) Ltd.
Waterloo, Ont.

*83. West Can Electronic Services ltd.
Calgary, Alta.

*84. Williams Communication Services Limited
Oshawa, Ont.

*85. WR Communications Ltd.
Vancouver, B.C.

*86. York Telecommunications Ltd.
Toronto, Ont.

*Participated in in-depth interviews

KEDAR, MICHAEL.
--The impact of MSAT on the radio common carrier industry : final report

KVA

KVA Communications
and Electronics Co.
364 Supertest Rd.
Downsview, Ontario
M3J 2M2