14/12 GHz MARKET STUDY

FINAL REPORT

SEPTEMBER 1981

CANADIAN ASTRONAUTICS LIMITED

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Government of Canada
Department of Communications

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Ministère des Communications

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1. EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

This report contains the findings of a study to determine the market for the 14/12 GHz remote telephony single channel per carrier (14/12 GHz telephony terminal) terminals currently under government supported development at SPAR Aerospace Limited and SED Systems Ltd. Much of the information presented in this report was collected from the 51 interviews conducted across the country with organizations considered to be probable users of the terminal.

The objectives of the study were to quantify the market for the 14/12 GHz telephony terminal under development and also to identify and quantify markets which could not be satisfied by the present terminal.

It is projected that there is a market for approximately 600 14/12 GHz telephony terminals over the 1983-1993 time period. Almost one half of the terminals will be used by the natural resources industry who, because of inadequate service in the past, feel they must own and operate the terminals for the service to be feasible.

This projected market assumes competing influences from the terrestrial facilities which adequately serve the southern populated belt of Canada. In addition the projected market may be impacted by competing alternative satellite systems such as the proposed MSAT mobile satellite system and the presently operating 6/4 GHz ANIKOM terminal system. The MSAT system is probably better suited that the 14/12 GHz telephony terminal for application in the forestry and exploration phase of the oil industry as well as for the northern operations of the federal agency in the public sector.

During the study two other markets were identified. One was for a terminal to provide a single communication capability integrating voice, data, facimile, video and audio conferencing, and communicating word processors for the business/industrial industry who look to "office of the future" concepts to reduce operating costs. This market is seen to be between 500 and 1000 terminals over the next ten years. The second market was for a high volume, one-way, broadcast information service for stock market information similar to the Reuters Business Monitor Service currently operational in the United States. The projected market for this terminal is between 1800 and 2000 terminals.

2. INTRODUCTION

2.0 INTRODUCTION

2.1 BACKGROUND

Telesat Canada, the first domestic satellite carrier in the world, was founded in 1969 to provide commercial satellite communication service throughout Canada.

The first satellite, ANIK Al, operated in the 6/4 GHz frequency band. It was launched in November 1972 and the system went into service in January 1973. The initial service consisted of heavy route message trunking along the southern tier, medium density message trunking for large northern communities and television and radio program distribution, in both English and French, throughout the country.

Telesat also evolved a thin route message service in February 1973 using a single channel per carrier (SCPC) approach to reach the remote communities in the northern areas of Canada. In addition a transportable station called Anikom terminal was developed in mid-1976 for rapid deployment and air transportation by small aircraft.

Since its introduction, the 6/4 GHz thin route message service has slowly evolved to comprise approximately twenty-five Thin Route terminals and twenty-four Anikom terminals (includes the 12 ANIKON terminals under construction for AGT with a regional port station at Calgary).

In the early 1980's, a new generation of satellites, ANIK C's will make possible the use of the 14/12 GHz frequency band for commercial communication. Bridging the transition to commercial applications have been two satellites, HERMES and ANIK B both conceived and funded by the Department of Communications. Numerous experiments and pilot projects carried out over the past few years through these satellites have demonstrated the advantages of 14/12 GHz frequency bands for certain applications. With the launch of ANIK C1 scheduled for September 1982, commercial operation should start in early 1983.

In anticipation of this, the Department of Communications is funding SPAR Aerospace Limited (SPAR) and SED Systems Limited (SED) to develop a low cost telephony terminal for service4in Canada and abroad.

A contract was let to Canadian Astronautics Limited, with Tamec Inc. as subcontractor, to conduct a study of user requirements and market potential for this type of service in Canada. This report contains the findings of this study, which was conducted from January 1981 to June 1981.

2.2 OBJECT

The object of the study is to provide an assessment of the market potential and service features for a 14/12 GHz telephony terminal in Canada and in particular to provide an assessment of the Canadian market potential for the telephony terminal which is being developed by SED and SPAR.

2.3 SCOPE

The study determines and analyzes the Canadian market potential and service requirements for the SPAR/SED type low cost 14/12 GHz telephony terminals for a 10 year period starting in 1983.

In addition, the Canadian market potential and product features of terminals not satisfied by the present SPAR/SED designs is assessed for the same time period.

The study also addresses the distribution of the terminals within business segments, the systems configuration assumed for different applications and the projected voice and data flow requirements pertaining to each application.

2.4 REPORT OUTLINE

The remainder of this report logically follows the phases of the market survey undertaken and reports the findings of the study.

Section 3 describes the methodology of the study as a whole, generally stating how the survey was carried out and specifically identifying the questions that needed to be answered.

Section 4 presents the system and cost models which were used to initiate discussion with the interviewees.

Section 5 delineates the potential Canadian market for the 14/12 GHz telephony terminal presently under development. The total market is broken down into segments and each is analyzed with respect to their communications requirements and any other pertinent considerations.

Section 6 addresses markets uncovered during this survey which cannot be serviced by the particular 14/12 GHz telephony terminal under development at the present time.

Section 7 describes a number of alternative products and services with which the 14/12 GHz remote telephony terminal will compete and assesses their effect on its potential market.

Section 8 contains the conclusions of this report.

2.5 ACKNOWLEDGEMENTS

We wish to express our gratitude to Mr. J. Carson, Space Planning Branch of the Department of Communications, the Scientific Authority on this project and Mr. R. J. P. Douville from the Space Electronics Directorate of the Communications Research Centre for their advice and guidance throughout the project. We also extend our appreciation to the various organizations and their representatives, especially SPAR and SED, whose cooperation was forthcoming.

3. METHODOLOGY

3.0 METHODOLOGY

3.1 INTRODUCTION

The approach used in the market study was to develop a system model and service cost estimation based on discussions with and material provided by Telesat Canada, SED Systems Ltd. and SPAR Aerospace Ltd. pertaining to the foreseen applications of the 14/12 GHz telephony terminal.

In addition, a literature review was performed to aid in the development of the system model and service cost estimation, identify prospective users, potential applications, geographic distribution and approximate market potential. The reference material used during the review is listed in Appendix C.

From the review and information provided by the Department of Communications a list of organizations to be interviewed was compiled and submitted for approval to the Department. The list was broken down into major user business categories detailed below:

- Telecommunication
  - Telephone Companies
  - Common Carrier
- Public Service
  - Federal Government
  - Provincial Government
- Resource
  - Oil and Gas
  - Forestry
  - Mining
- Business/Industrial
  - Financial/Insurance
  - Manufacturing
  - Transportation
  - Retail
  - Computer Service 8

A complete list of the organizations and their representatives interviewed is provided in Appendix A of this report.

3.2 INTERVIEWS

The interviews were performed using a semi-structured question form. The form covered the basic topics needed for the survey, yet allowed the interviewee to effectively express his particular telecommunication application, needs, and growth. It was felt that this informal approach provided the direction needed to meet the objectives of the survey. A form outline is provided in Appendix D.

The topics covered during the meetings were designed to:

- identify the organization, size, growth and area of business as well as name, position and responsibility of interviewee
- determine present telecommunication requirements, technology, cost, traffic, distribution, performance, network requirements, potential growth
- assess the applicability of the low cost telephony terminal as presented in Section 4.0
- explore additional features not present on current terminal configurations
- assess corporate policy on rental versus ownership and economic criteria in selection of new equipment

In total, 51 interviews were conducted during the study (48 were personal, 3 were telephone interviews).

3.3 ANALYSIS

The raw data collected from the interviews had to be collated and analyzed. The analysis concentrated in three main areas. The first was to assess the market for the 14/12 GHz telephony terminal presently being developed by SPAR and SED. The second pertained to additional service and terminal characteristics required to expand the market base. The third concerned other potential markets requiring facsimile transmission, communicating word processors, video and audio conferencing, etc.

In general the analysis concentrated on:

- user applications
- traffic flow and growth
- system and terminal configuration
- market segments, service and product requirements
- market size and growth over a 10 year period
- elasticity of demand by market segments
- institutional and political considerations

4. SYSTEM & COST MODELLING

4.0 SYSTEM AND COST MODELLING

4.1 GENERAL

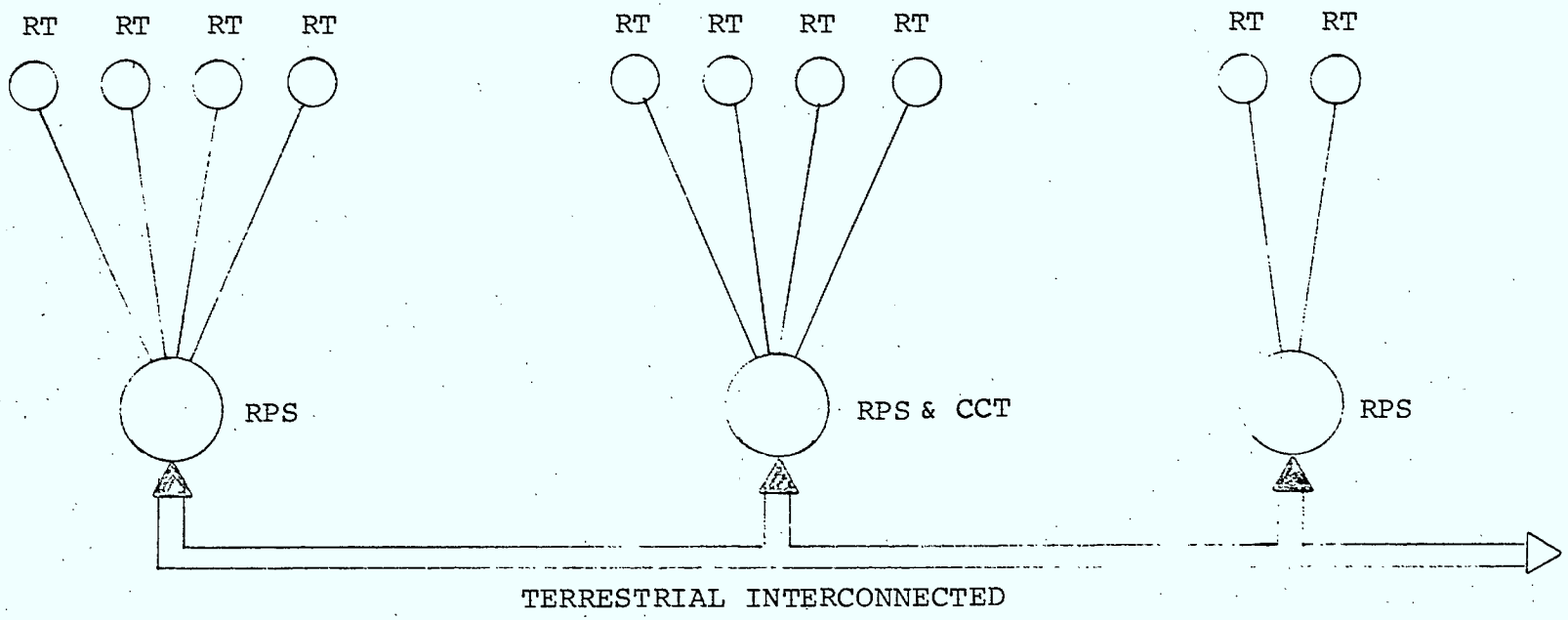
As a focus for discussion and to provide the interviewee with potential service offerings and possible service costs, a simplified system and cost model was developed. The model reflected the terminal presently under development and the cost information available. The system configuration of the model is not necessarily technically complete or optimal, but was deemed sufficient for discussion in the interviews and provide the market data base.

4.2 SYSTEM CONFIGURATION

The system model is a distributed nodal network with regional port satellite ground stations at the nodes connecting the remote terminals and the terrestrial switched network. In this manner the nodes are interconnected by the switched network and the system can be seen as an extention of the terrestrial network (Figure 4.1). The model assumed 500 14/12 GHz telephony terminals, 10 regional ports and a central control station which serves as a regional port.

The system was assumed to operate in a pre-assigned multiple access (PAMA) mode but with the capability of being easily converted to demand assigned (DAMA) operation if system operation characteristics later warrent it. PAMA operation was chosen because the assumed number of units was small, the traffic was expected to be predominately north-south and the desire to keep terminal unit costs to a minimum. If the number of units were to rise to over 1200, or it was found that a large percentage of the traffic was from remote terminal to remote terminal, then it would be economically feasible to use DAMA. A DAMA network would require that the remote terminals be able to transmit and receive in a frequency agile and dual polarized manner. Those additional capabilities would necessarly make the SCPC terminal more complex and expensive.

The system was configured with 10 regional ports and a central control station to maintain the operational autonomy of the telephone companies and common carriers and reduce the back-haul long distance charges which are associated with one central regional port now in existance with the 6/4 GHz ANIKON system.



RT - REMOTE TERMINAL
RPS - REGIONAL PORT STATION

SYSTEM CONFIGURATION

FIGURE 4-1

4.3 STATION CONFIGURATION

The system consisted of four main types of stations which are linked via the satellite to form the communications network. These are, a single subscriber remote terminal, a multiple subscriber remote terminal, a community remote terminal, and the regional port station. These units are described in the following subsection and in greater detail in Appendix B.

4.3.1 SINGLE SUBSCRIBER 14/12 GHz TELEPHONY TERMINAL (SSRT)

The most basic of terminals, this unit would supply a single telephone circuit or the equivalent data capability on a single RF channel. Some of the main features are:

- Single channel per carrier
- 2.5 meter antenna
- Voice activation
- Non-redundant equipment
- Single subscriber operation
- Single RF channel
- Simple operation, highly transportable
- DAMA add on capability

4.3.2 MULTI-SUBSCRIBER 14/12 GHz TELEPHONY TERMINAL (MSRT)

This terminal is identical to the SSRT except for an integrated switcher which enables up to four subscribers to access a single RF channel.

Some of the main features are:

- Single channel per carrier
- 2.5 meter antenna
- Voice activation
- Non-redundant equipment
- Single RF channel
- Integral switcher for four subscriber operations
- Simple operation, highly transportable
- DMA add on capability

4.3.3 COMMUNITY 14/12 GHz TELEPHONY TERMINAL

The community 14/12 GHz telephony terminal is used when customer needs exceed the requirements provided by the SSRT and MSRT. The terminal can be equipped with 1 to 16 RF channel and could satisfy the trunking requirements of remote northern communities.

Some features are:

- Single-channel per carrier
- 4.5 meter antenna
- Voice activation
- Redundancy of common component
- PABX
- Operation by semi-skilled personnel
- DAMA add on capability

4.3.4 REGIONAL PORT STATION

The Regional Port Stations would be located one per telephone company operational area, to allow regional access to the DDD network. The station can be equipped with 12 to 64 RF channel and satisfies the interface to the DDD network.

Some of the operational features are:

- Single channel per carrier
- 4.5 meter antenna
- voice activation
- common equipment redundancy
- capability to remotely test terminal stations
- DAMA add on capability

4.4 SERVICE CONSIDERATIONS

The system and terminal configurations were assumed capable of providing the following service features individually or in combinations thereof:

- voice transmission with a subjective noise level of 10,000 pwp (CCIR Rec 353-2)
- low speed data up to 4.8 kb/s with a bit error rate of 1 in 10^7
- high speed data from 4.8 kb/s to 56 kb/s with a bit error rate of 1 in 10^7
- video with a signal/noise of 35 dB unweighted in 4.5 MHz bandwidth
- radio with a signal/noise of 4.5 dB in a 10 kHz bandwidth (no companding)

4.5 COST MODELLING

4.5.1 GENERAL

The cost data base for the ground and space segments of the model is based on available costs of the terminal and stations from the manufacturer's and Telesat's Anik A transponder charges. The terminal manufacturing costs reflect production quantities of approximately 500 units. In some cases, assumptions have been simplified in order to linearize subcomponents of the model and to reflect the costs of a typical installation in the overall network rather than any particular hardware installation. All capital costs have been amortized using a 5 year economic life(1) and annual interest rates of 15%. The effects of a longer economic life (7 years) and a larger network were also examined.

Cost data was developed for a system configuration comprised of:

- 500 single subscriber 14/12 GHz telephony terminals
- 10 regional port stations
- 1 central control station

and takes into account four components of cost which are; capital cost of the basic terminals, regional ports and central control station; space segment annual charges; maintenance and general administrative costs; estimated back-haul charge.

(1) Price Waterhouse have indicated that life ranges from 3 to 10 years.

4.5.2 BASIC TERMINAL

The monthly cost of the single subscriber 14/12 GHz telephony terminal is estimated to be $1600. The amount is based on the following:

- full amortization of the $40,000 terminal over the five year period
- maintenance and service charges; these were estimated on an annual basis at 15% of the $40,000 purchase price; such a sum would in our opinion be sufficient to ensure prompt service from any supplier in case of failure of the equipment and for normal maintenance.
- taxes and unforeseen expenses which have been estimated at 10% of the two previous categories of expenses.

Table 4-1 Monthly Cost of the Basic Terminal

	Monthly Cost
Amortization	$ 952
Service and Maintenance	$ 500
SUB-TOTAL	$1,452
Taxes and unforseen at 10%	$ 145
Basic Terminal Cost	$1,597

4.5.3 INCREMENTAL COST PER CHANNEL

The incremental capital cost per channel is estimated to be $10,000. Using the same approach taken for the single channel 14/12 GHz telephony terminal, the monthly cost per incremental channel is $400 as illustrated in the following table.

Table 4.2 Monthly Cost Per Incremental Channel

	Monthly Cost
Amortization	$ 238
Service and Maintenance	$ 125
SUB-TOTAL	$ 363
Taxes and unforseen at 10%	$ 36
Basic Terminal Cost	$ 400

4.5.4 REGIONAL PORT AND CENTRAL CONTROL STATIONS

The network would be served by 10 regional port and 1 central control station. The capital cost associated with these facilities is $9 million (1) which is amortized over 500 single subscriber 14/12 GHz telephony terminals served by the system.

Table 4-3 Costs of Regional Port and the Central Control Station

ITEM	UNIT COST $000	NUMBER	TOTAL COSTS $000
Regional Port Station	$ 200	10	$2,000
Central Control Station	$7,000	1	$7,000
Total Capital Cost	----	--	$9,000

(1) The Central Control Station cost includes a DAMA control processor. Although the system configuration is PAMA orientated, no attempt was made to remove this cost element since the DAMA processor cost component is difficult to estimate (no processor has yet been built) and the error introduced is believed to be within the accuracies of thhe cost model data base.

On a monthly basis, this translates to a cost of $750 including an allocated overhead markup. This overhead markup is estimated at 75% of the amortization charges and covers the maintenance, profit and general administration expenses associated with the system operation.

Table 4-4 Monthly Cost per Channel for Regional Port and Central Control Station

	Monthly Cost
Amortization	$ 428
Overhead Markup (75%)	$ 321
Total Monthly Cost	$ 749

4.5.5 SPACE SEGMENT COSTS

Space segment costs were estimated from the present Anik A annual cost of approximately $2 million per year per protected transponder. Using a projected transponder capacity of 500 RF channels and a premium rental charge of 25% for partial transponder rental we derived the following monthly space segment rates.

Table 4-5 Space Segment Costs

	Monthly Cost
Monthly Basic Cost per Channel	$ 333
Premium of 25% for less than Full Transponder usage	$ 83
Monthly Cost	$ 416

Throughout the rest of this report a monthly cost of $425 was used.

4.5.6 AVERAGE BACKHAUL CHARGE

The inclusion of ten regional ports and a central control station will minimize the backhaul charges but not totally eliminate them. Therefore, some cost must be included in the cost model. While the actual cost to the user will be specific to his situation, an average backhaul distance of 150 miles has been assumed. Taking long distance tariffs to be $3.00 per voice circuit mile per month, an average backhaul charge of $450/month was included in the cost model.

4.5.7 TOTAL MONTHLY COST

The estimated monthly cost of the 14/12 GHz terminal is presented in the following table. It varies between $3,200 per channel for a 1 channel unit to $1,400 per channel for a 16 channel unit.

Table 4-6 Total Montly Cost of Terminal

COST CATETORY	NUMBER OF CHANNELS							
	1	2	3	4	5	10	12	16
Single Chan. Term.	$1600	1600	1600	1600	1600	1600	1600	1600
Incremental Channel Cost	$ ---	400	800	1200	1600	3600	4400	6000
Regional Ports and Central Control Station	750	750	750	750	750	750	750	750
Space Segment	425	850	1275	1700	2125	4250	5100	6800
Average Backhaul	450	900	1350	1800	2250	4500	5400	7200
TOTAL	3225	4500	5775	7050	8325	14700	17250	22350
Per Channel	3225	2250	1925	1763	1665	1470	1438	1397

4.5.7 OTHER POSSIBLE ASSUMPTIONS

The following table illustrates the effects of different assumptions of economic life (7 years instead of 5 years) network size (1000 instead of 500 14/12 GHz telephony terminals) on the monthly cost and for a single channel 14/12 GHz telephony terminal.

Table 4-7 Effect of Service Life & Network Size

	5 year life		7 year life	
	500 units	1000 units	500 units	1000 units
Basic Terminal	$1600	$1600	$1400	$1400
Regional ports and Central Control	750	375	610	305
Space Segment	425	425	425	425
Average Backhaul	450	450	450	450
Monthly Cost per Single Chan. Term.	3225	2850	2885	2580

4.5.8 CONCLUSIONS ON COST MODELLING

The monthly cost of a single channel 14/12 GHz telephony terminal can range from $2,500 to $3,200. This range however, is highly dependent on achieving:

- a mature product price of $40,000 per single channel 14/12 GHz telephony terminal in manufacturing quantities of 500 units.
- maintenance & service charges of the 14/12 GHz telephony terminal must be controlled to 15% of the equipment purchase price.

5. PROJECTED CANADIAN MARKET

5.0 PROJECTED CANADIAN MARKET

5.1 MARKET OVERVIEW

The projected market for the 14/12 GHz telephony terminal, is estimated at 264 units from 1983 to 1988 and 343 units from 1989 to 1993 for a total of 607 units over the 10 year period (1983-1993). This market is divided into four broad segments; 1) telecommunications, 2) public service, 3) resource industry, 4) business/industrial.

The resource industry segment accounts for approximately 48% of the market and is primarily located in Western Canada (British Columbia and Alberta) with isolated pockets in the Northwest Territories, Yukon and the Maritimes. The telecommunications, public serice and business/industrial segments each account for approximately 17% of the market with a distribution throughout the sparsely populated northern regions of Canada. A summary of the market, by segments is provided in Table 5-2.

The market projections are based on the sample of potential users interviewed during the study and literature review. Table 5.1 indicates the number of organizations interviewed in each segment and the total number of interviews performed to complete the study. A detailed list of the individuals interviewed in the organizations is provided in Appendix A of this report. This market is based on a $3,000 to $4,000 per month charge range for service of a single subscriber 14/12 GHz telephony terminal.

The results from the organizations interviewed were extrapolated based on the percentage of the total industry they represented in each segment to arrive at the total market size. While this could introduce errors in the market size, particularly with small samples, the results correlated with the telco's and carrier's anticipated market size. The projected market for the period also took into account the expected growth of the organizations interviewed.

The following sections provide general background information and service requirements by market segment.

Table 5-1 Organizations Interviewed by Market Segments

SEGMENTS	ORGANIZATIONS INTERVIEWED
Telecommunications	
• Telephone Companies	11
• Common Carrier	2
Total Telecom	13
Public Services	
• Federal Government	8
• Provincial Government	4
TOTAL Public Services	12
Resource Companies	
• Oil & Gas	4
• Forestry	4
• Mining	2
TOTAL Resource Comp.	10
Business/Industrial	
• Financial/Insurance	6
• Manufacturing	4
• Transportation	2
• Retail	3
• Service	1
TOTAL Business/Industrial	16
TOTAL INTERVIEWS	51

Table 5-2 Projected Canadian Market

SEGMENT	UNITS 1983-1988	UNITS 1989-1993	TOTAL UNITS 1983-1993
Telecommunications			
• Telephone Companies	29	62	91
• Common Carrier	4	10	14
Total Telecom	33	72	105
Public Services			
• Federal Government	25	38	63
• Provincial Government	14	28	42
TOTAL Public Services	39	66	105
Resource Companies			
• Oil & Gas	110	90	200
• Forestry	20	40	60
• Mining	22	13	35
TOTAL Resource Comp.	152	143	295
Business/Industrial			
• Financial/Insurance	25	35	60
• Manufacturing	5	12	17
• Transportation	10	15	25
• Retail	0	0	0
• Service	0	0	0
TOTAL Business/Industrial	40	62	102
TOTAL	264	343	607

5.2 MARKET SEGMENTS - TELECOMMUNICATIONS

5.2.1 TELEPHONE COMPANIES

Interviews were conducted with 11 major telephone companies (telco's), all are TCTS members, except for SOTEL, and combined they account for 95.0% of the 16.5 million telephones in Canada.

The telco's provided an overview of the possible requirements and application of a 14/12 GHz telephony terminal in their respective operational areas. The major use of the terminal as seen by the telco's was to meet service needs to the resource industry, primarily the oil and gas sector.

Since the end users were interviewed as well, care was taken not to double count the 14/12 GHz telephony terminal applications forecasted by the telco's. The telco's were used primarily to forecast the plain old telephone service (POTS) requirement in the remote northern communities and served to validate the data obtained from the end users.

The configuration proposed suited the POTS, however since remote POTS is politically and not profit driven the telco's are reluctant to extend service. The price elasticity in this context is also difficult to establish.

The market for POTS service within the Telco's is assessed to be 29 units for the 1983-1988 period and 62 units for the 1989-1993 period. The companies interviewed account for 93% of the total telephone companies. Table 5.3 shows the breakdown of this forecast in more detail. The market is primarily seen as replacement of UHF and HF radio telephone service in the extension of POTS service to rural and remote parts of northern Canada.

Table 5-3 Market Forecast for Telecommunication Segment

COMPANY	UNITS 1983-1988	UNITS 1989-1993
TELEPHONE COMPANIES		
SOTEL	1	2
MT&T	2	4
MTS	4	8
NFLD. TEL	2	4
SASK. TEL	4	8
BELL	4	10
AGT	1	2
BC TEL	5	10
NORTHWEST TERRA NOVA	4	10
OTHERS TELCO'S	2	4
SUBTOTAL	29	62
COMMON CARRIERS		
CNCP	4	10
SUBTOTAL	4	10
TOTAL	33	72

5.2.2 COMMON CARRIERS

Interviews were conducted with 2 carriers, CNCP Telecommunications and Telesat Canada. CNCP, a long haul voice trunking and data services carrier did not foresee a large requirement for the 14/12 GHz telephony terminal in their network. Note that the network predominantly services the urban populated centers of southern Canada. A possible application was data traffic feeds to business/industrial users with remote sites away from the main CNCP trunking routes.

The terminal proposed had a capacity of up to 56 kb/s which suited CNCP requirements. The potential market is seen to be 4 units in the 1983-1988 period and 10 units in the 1989-1993 period. Table 5-3 shows the forecast in more detail.

Telesat provided a summary of all telephone companies and common carrier satellite requirements. Their forecast agreed closely with the projected market from the end users data.

5.2.3 SUMMARY

It can be expected that the telecommunications segment will require 33 units in the 1983-1988 period and 72 units in the 1989-1993 period. The telephone companies account for 86.7% of this market segment which in turn is 17.3% of the total projected market. This segment is sparsely distributed in the rural and remote areas of northern Canada.

5.3 PUBLIC SERVICES

5.3.1 FEDERAL GOVERNMENT

Interviews were conducted with 8 federal government departments groups which were thought to have possible requirements for the terminal. The groups interviewed were: Transport Canada -Coast Guard, - Northern Airfields; Energy, Mines and Resources - Polar Continental Shelf Project, - Geodetic Surveys, - Seismology Division; Indian Affairs and Northern Development; Emergency Planning Services; and the Government Telecommunications Agency.

The Government Telecommunications Agency is the body which coordinates and supplies the integrated common telecommunication network for all government departments except DND. They saw a small requirement for the 14/12 GHz telephony terminal for remotely located government groups but primarily they were interested in an integrated services network similar to that provided by American Satellite and Satellite Business Systems in the United States. Emergency planning Services saw a need for emergency communications required when disaster strikes, as in the Mississauga train derailment. These requirements would be 1 to 2 units in each captial on call for emergency with specifically assigned emergency frequencies.

The Energy Mines and Resource departments require seasonal voice and possibly low speed data during the field surveys and geological exploration which takes place from May to October of each year. They presently use VHF and HF radio and link to Resolute or Frobisher Bay. These requirements are limited with no growth and require a terminal which is simple to operate, rugged, easily installed and transportable (must fit into Twin Otter aircraft), reliable and economical to operate. The extremely low cost of radio voice communication prevents satellite systems from competing in this area. Even if the users are not totally satisfied with the service provided by radio quite a bit of hardship will be endured before a jump to a satellite usage at approximately 80 times the cost of HF radio is considered.

The Transport Canada departments have possible application for the 14/12 GHz in supplying communications between the VHF stations spread across Canada for shore to ship communications. They are presently upgrading their VHF control network and could require up to 10 terminals. Presently services leased from telephone companies or carriers are tied to Resolute or Frobisher Bay.

The market requirement in Federal Government is assessed to be 25 units in the 1983-1988 period and 38 units in the 1989-1993 period. The interviews conducted within the Federal Government represented a large sample of potential users and the 'others' grouping accounts for those agencies not interviewed. Table 5-4 provides the forecast in more detail.

5.3.2 PROVINCIAL GOVERNMENT

Interviews were conducted with four provincial governments; Nova Scotia, New Brunswick, Ontario and British Columbia. Like the Federal Government departments, the provincial governments have a requirement more for an integrated services terminal rather than the 14/12 GHz telephony terminal. They saw the terminal as a possible link to remote department offices. New Brunswick, Nova Scotia, Ontario and British Columbia saw a relatively small need for the 14/12 GHz telephony terminal. The interests were for tele-education distribution and medical tele-diagnostic requiring one-way video with interactive audio facilities.

The market in the provincial governments is assessed at 14 units in the 1983-1988 period and 28 units in the 1989-1993 period. Table 5-4 provides the forecast in more detail.

5.3.3 SUMMARY

The public services segment is assessed to be 39 units in the 1983-1988 period and 66 units in the 1989-1993 period and accounts for 17.3% of the total market. The federal government represents 64% of the market in the initial 5 year period and 58% in the final 5 year period. This segment like the telecommunications segment is sparsely distributed primarily in the remote regions of northern Canada except for the emergency planning requirements which are localized in the provincial and federal capital regions.

Table 5-4 Market Forecast for Public Service

AGENCY	UNITS 1983 - 1988	UNITS 1989 - 1993
FEDERAL		
COAST GUARD	4	6
EMR	2	4
DIAND	0	0
EPC	10	10
G.T.A.	5	10
D.O.T.	2	4
OTHER GOV'T DEPT'S.	2	4
SUBTOTAL	25	38
PROVINCIAL		
ONTARIO	2	4
NOVA SCOTIA	1	2
NEW BRUNSWICK	1	2
BRITISH COLUMBIA	5	10
OTHER GOV'T	5	10
SUBTOTAL	14	28
TOTAL	39	66

5.4 RESOURCE COMPANIES

Canada's geographically widespread primary industry would appear to be a likely candidate in the market for the 14/12 GHz terminal. As telecommunications requirements differ substantially by type within the industry, three market segments are identified: oil and gas, forestry, and mining.

5.4.1 OIL AND GAS

Interviews were conducted with Shell Canada Limited, Dome Petroleum Limited, Williams Electronics and Petrocan. Financial highlights of the companies interviewed are summarized in the following table.

TABLE 5.5 Rating of Oil and Gas Companies Interviewed

ORGANIZATION	RANK BY SALES	SALES ($M)	ASSETS ($M)	NET INCOME ($M)
Shell Canada	9	3962	3449	355.0
Dome Petroleum	55	1144	5079	237.2
Petrocan	62(1)	975.4	3767	55.7

Source: Canadian Business, Top 500 July 1981

Interview content is limited to upstream oil and gas operations. Shell Canada Limited, for instance, is a fully integrated oil and gas company with significant communication requirements in many aspects of its operation. Williams Electronics, a telecommunication consultant and supplier, was selected to determine communications needs for the many junior oil and gas producers.

(1) Petrocan, a Crown Corporation, is ranked by assets in the Canadian Business magazine amongst crown corporations only.

The oil and gas companies have need of a highly reliable, quality communication link between their main offices and the drill rigs. This link would allow them to keep fewer personnel on the job site while still maintaining effective control over their operation. Reliability and service of equipment are of extreme importance because a few hours of down-time could mean many thousands of dollars in lost production.

The people interviewed felt they needed a simple, rugged, transportable unit which was maintainable by semi-skilled labour. The ability to carry voice transmissions was imperative but there was a need for some slow speed and high speed data as well. The physical size of the device should be minimized and there would be a need for stabilization platforms for off-shore rigs. The oil and gas people believe that satellite technology could provide the service they require but only if the needed reliability and flexibility could be ensured by owning, operating, and maintaining the units themselves.

There are 400 to 600 drilling rigs in seasonal operation across Canada. There is no growth expected in this number over the next ten years and about one half are seen as potential users of satellite terminals since 50% of the rigs can be adquately served by terrestrial facilities. The companies involved can justify four to eight thousand dollars per month for this service.

The oil and gas industry presents the largest potential market for the 14/12 GHz telephony terminal with 20-25 units a year in the first five years and 10-20 units per year in the next five years (Table 5-6). The use of regional port station to reduce backhaul costs presently associated with 6/4 GHz Anikom terminals would help induce the oil and gas industry to use satellite communication.

The development of this market segment is very dependent on the question of terminal ownership and the relationship of the terminal operators, Telesat and the telco's. It is this issue as well as maintainability and service cost which will make or break satellite usage in this segment.

Table 5-6 Market Forecast for Oil and Gas Segment

COMPANY	UNITS 1983 - 1988	UNITS 1989 - 1993
DOME	30	10
SHELL	25	10
PETROCAN	20	10
WILLIAMS	10	10
OTHER OIL COMPANIES	25	50
TOTAL	110	90

5.4.2 FORESTRY

Interviews were conducted with 4 forestry companies - Great Lakes Forest Products Limited, Abitibi Price Inc., British Columbia Forest Products Limited, MacMillan Bloedel Limited. Financial highlights of the companies interviewed are summarized in the following table.

TABLE 5.7 Ranking of Forestry Companies Interviewed

ORGANIZATION	RANK BY SALES	SALES ($M)	ASSETS ($M)	NET INCOME ($M)
MacMillan Bloedel	22	2,436	2,075	113.2
Abitibi Price	45	1,365	1,394	83.8
BC Forest Products	80	850	1,018	60.5
Great Lakes Forest	113	539	520	81.4

Source: CANADIAN BUSINESS, Top 500, July 1981

The logging operations which provide the raw materials for the mills are two tier organizations comprized of logging divisions and logging camps. The logging divisions are permanent operational headquarters for the more mobile logging camps. Communications between camp and division is provided by H.F. radio and no market is seen in this application for an 14/12 GHz telephony terminal. A more likely application for the terminal would be providing the link between the mill site and the logging divisions.

Communications between the mill site and logging divisions require four to eight voice circuits and could require a 9.6 k baud data line when operations are computerized. For the most part forestry operations in this country are run in a very decentralized manner with the mills operating independently of the parent corporation. This situation not only minimizes the communications requirements of the companies involved but also breaks up the rather large financial base into many smaller ones less capable of supporting the costs of an a 14/12 GHz telephony terminal.

To facilitate analysis, the forestry industry has been separated into two regions, Eastern and Central Canada, and Western Canada. Table 5 8 shows that the two regions divide the country's production approximately in half (53%/47%).

Table 5-9 shows that the vast majority (70%) of operations in the eastern and central region are handled by smaller independent operators who see no need for and could not support the costs of a 14/12 GHz telephony terminal. Of the other 30% there is a potential market that exists. This market is seen to be five units in the first five years and double that for the next five years.

In the western region the operations are fewer in number but larger in production capacity than their eastern counterparts, thus increasing the demand for communications and increasing their ability to support communication costs. In this region there is seen a need for 15 units in the first five years and 30 in the next five years operating mostly in the British Columbia Interior and along the coast.

Table 5-8 Canadian Forestry Activity 1980-1990

REGION	RANGE IN OUTPUT IN UNITS (1) 1980-1990 (000)	AVERAGE OUTPUT IN UNITS (000)	%
Eastern Central Canada	20,000 - 30,000	25,000	47%
Western Canada	26,000 - 30,000	28,000	53%
TOTAL	46,000 - 60,000	53,000	100%

(1) One Unit = 100 cubic feet = 1.17 cords of wood

Source: Forest Engineering Research Institute of Canada

Table 5-9 Eastern Central Canada Potential 14/12 GHz Application

TYPE OF ORGANIZATION	LOGGING EXTRACTION IN UNITS		MARKET CRITERIA	POTENTIAL 14/12 GHz APPLICATION	
	(000's)	%		UNITS 1983-88	UNITS 1989-93
Independants	17,500	70	no market application average campsite output 10,000 units annually	--	--
Company Owned Operations	7,500	30	limited market application; adequately serviced by terrestrial facilities	5	10
TOTAL	25,000	100	---	5	10

In total the forestry industry can be expected to require 20 terminals in the first five year period and 40 in the following five years. Table 5.10 provides a detailed breakdown of the forecast.

Table 5.10 Market Forecast - Forestry

COMPANY	UNITS 1983-1988	UNITS 1989-1993	TOTAL UNITS 1983 - 1993
Eastern			
Great Lakes Paper	2	5	7
Abitibi	0	0	0
Other Companies	3	5	8
SUBTOTAL	5	10	15
Western			
MacMillan Bloedel	10	15	25
B. C. Forest Products	0	0	0
Other Companies	5	15	20
SUBTOTAL	15	30	45
TOTAL	20	40	60

5.4.3 MINING

Interviews were conducted with 2 base metal companies - Noranda Mines Limited and Cominco Limited. The following table summarizes the financial highlights of the companies interviewed.

Table 5.11 Ranking of Mining Companies Interviewed

ORGANIZATION	RANKING	SALES ($M)	ASSETS ($M)	NET EARNINGS ($M)
Noranda Mines	16	2,889	3,938	408.4
Cominco	42	1,443	1,644	169.3

Source: Canadian Business, Top 500, July 1981.

The mining and metallurgical operations of Noranda are spread throughout Canada in over 15 mining complexes. They are involved in the production of all non-ferrous metals and iron ore. Cominco's facilities are primarily centered out West and are involved principally in the extraction and production of zinc.

Mining operations can be divided in three stages which are:

- exploration
- development and pre-production
- production

The potential market for the 14/12 GHz telephony terminal is discussed for each of these stages.

a) Exploration Phase

This phase of operation will usually involve a very small team of people in surveying, testing and drilling: Communications requirements at this stage are small and, if cost justified, would be satisfied by mobile equipment. There is no potential market for the 14/12 GHz telephony terminal during the mining exploration phase.

b) Development and Pre-Production Phase

This phase usually involves a work force of 60 to 100 people involved in drilling, shaft development and townsite construction. It is at this stage that a 14/12 GHz telephony terminal would be most useful, will usually take up to six months to install land line facilities. The instant availability of communications at a reasonable cost make the 14/12 GHz telephony terminal attractive in this application.

Information gathered from Energy Mines and Resources and the Mining Association of Canada leads us to believe that there would be as many as 60 to 75 sites at any point in time that have reached this development and pre-production stage.

We thus estimate that the 14/12 GHz telephony terminal could compete with mobile and other terrestrial facilities in less than half of these sites. The potential market for the 14/12 GHz telephony terminal in the mining sector would thus be approximately 30 units over a 10 year period.

c) Production Phase

Once a mine site has reached the production phase, the population associated with it can easily reach 2,000 people depending on the type of operation considered.

Since the production phase will usually last 6 to 20 years, permanent, land based facilities can usually be envisaged to satisfy a requirement for 10 voice channels in the initial stages and 20 to 30 such channels later on. The market for the 14/12 GHz telephony terminal is thus very limited for mines which have reached the production stage because the terminal is not designed to handle more than 16 channels and terrestrial facilities will usually be more cost effective.

The forecast thus calls for 5 units over a 10 year period in producing mines that will be unusually remote and/or have a very short life expectancy.

d) Summary of the Mining Markets

In summary we forecast a total market of approximately 35 units over a 10 year period in the mining sector; this forecast is illustrated in the following table:

Table 5-12 Market Forecast in The Mining Sector

STAGE	UNITS 1983-1988	UNITS 1989-1993	TOTAL UNITS 1983-1993
Exploration	0	0	0
Development and Pre-Production	20	10	30
Production	2	3	5
TOTAL	22	13	35

5.4.4 SUMMARY

In summary the resource industry market segment represents approximately 295 units or 48.5% of the total projected market of 607 units over the 10 year period. These results are illustrated in the following table:

Table 5-13 Market Forecast Resource Industry

SUBSEQUENT	UNITS 1983-1988	UNITS 1989-1993	TOTAL UNITS 1983-1993
Oil and Gas	110	90	200
Forestry	20	40	60
Mining	22	13	35
TOTAL	152	143	295

5.5 BUSINESS/INDUSTRIAL

The business/industrial market segment was broken down in five sub-segments which are:

- finance/insurance
- manufacturing
- transportation
- retail
- computer services

The potential market for the 14/12 GHz telephony terminal was found to be somewhat limited. In addition to competition from terrestrial facilities, techno-economic considerations and management philosophy greatly influence market potential.

For example, retail merchandising operations are more decentralized than banking operations or computer services, therefore such organizations have smaller requirements for voice or data. Even in market areas where typical operations would seem to lend themselves to large voice and data traffic, mangement philosophy played an important part in determining actual practices.

One corporation with sales exceeding $2 billion and with facilities dispersed throughout Canada was found to be able to meet its communications requirements with a minimum of WATS lines and regular long distance calls. Obviously this was associated with a decentralized management philosophy and a large amount of local autonomy. This type of management philosophy reduces communications requirements.

The market potential of the 14/12 GHz telephony terminal was felt to be limited to cases where it could compete on a strictly economic basis with terrestrial facilities. This does not mean that satellites communication in general have a limited market potential within this area, but rather that the proposed terminal would have to incorporate significant new features to prove feasible. These features are discussed in more detail in the following paragraphs.

5.5.1 FINANCE/INSURANCE

Interviews were conducted with 3 Canadian chartered banks, one insurance company and the Toronto Stock Exchange. The following table summarizes the importance of these institutions amongst the industry.

Table 5.14 Ranking of Financial Institutions and Insurance Companies Interviewed (1)

Organization	Ranking by Assets	Assets ($ M)	Revenue ($ M)	Net Income ($ M)
The Royal Bank of Canada	1	62,834	7,024	327
Bank of Montreal	3	48,842	5,218	263
National Bank of Canada	6	16,464	1,965	17
Metropolitan Life	(2)	2,368	550	N/A

Source: Canadian Business, Top 500, July 1981.

(1) The Toronto Stock Exchange is not included as it qualifies as a non-profit organization under the Income Tax Act.

(2) The Canadian Business ranks insurance companies separately from financial institutions. Among the 15 insurance companies Metropolitan Life ranks ninth.

All the banks interviewed have substantial voice and data communication requirements. In all cases separate facilities are used for data and voice communications. The Royal Bank for example is served by more than 22 different communication networks.

Data transmission facilities, for the most part, are leased from common carriers on an entirely dedicated basis, with transmission speeds ranging from 2.4 to 19.2 kb/s.

Although network configurations vary, the banks are actively seeking to connect all branches to a central computer through a data communication network capable of relatively low speed. The voice communication accounts for roughly 75% of the total communication requirements. Voice traffic between headquarters and divisional offices is normally served by a series of tie-line networks whereas the voice traffic from divisional office to local branches is normally met with WATS lines and DDD.

Other common communication requirements include facsimile machines, communicating word processors and video conferencing. The Bank of Montreal has approximately 100 communicating word processors used for general accounting and text editing. The Royal Bank presently owns video conferencing facilities between Montreal and Toronto, which are used for executive meetings.

The volume of voice/data traffic, as would be expected, lies between headquarters and regional offices.

Typical network applications include real-time banking,credit-checking, bank account status, company mail delivery and payroll data gathering. Table 5.15 summarizes the important banking categories of data communications by communication mode, typical application and transaction characteristics.

Table 5.15 Categories of Banking Data Communications (1)

Communication Modes	Applications	Typical Characteristics of transactions
Source data entry and collection	'on line' real time banking automatic teller machine (ATM) payroll data gathering	Transactions arrive frequently, demand response within a few seconds. Transactions collected several times per day or week
Remote Tab Job Entry (RJE)	local access to distant computer power	processing time over-night, transactions may take seconds or minutes
Information retrieval	credit checking banking account status	low-character volume per input transaction, response required within seconds. Output messages usually short
Message switching	company mail delivery and memo distribution	delivery time require-ments range from minutes to hours

(1) Classifications provided by Terry Fitzgerald, Tom S. Eason, "Fundamentals of Data Communications"

The following table displays the total number of branches by bank that are 'on-line' and able to perform 'real-time' banking.

Table 5-16 Real-time Banking

Bank	Total Branches	On-line with 'real-time' banking	
		No.	%
Bank of Montreal	1,300	1,235	95
Royal Bank	1,502	1,404	93.5
National Bank	770	481	62.5
TOTAL	3,572	3,120	87.3%

The total number of branches in Canada being approximately 7,400 our sample thus represents approximately 48% - 50% of total branches.

The branches which are not in 'real-time' are not necessarily in remote areas rather the majority of these banks are unable to meet the real requirements, i.e., the number of transactions, to justify source data and collection entry modes. These branches operate by either force delaying (1) or hand-posting (2) all transactions. The Royal Bank network, for example, includes 75 forced-fed and 22 hand posted branches.

As part of its multi-branch banking service, the Bank of Montreal is unique among other chartered banks in that it seeks to bring all its branches on-line with 'real-time' banking. Real-time banking requires an entirely dedicated network as opposed to a forced-delay system which operates on the public network. The Bank of Montreal calculates that, of

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(1) a dial-up system, transactions are usually collected on a daily basis.
(2) all ledgers are manually maintained, transactions may be collected weekly by courier.

the remaining branches to be brought on line, only 10 can be classified as true hardship cases where circuitry costs will exceed $2,500. The bank cited as an example that, it would cost between $5,000 to $6,000 to bring in one line to its branch in Whitehorse, Yukon.

The Royal Bank identifies between 14 to 16 potential 14/12 GHz telephony terminal applications in which circuitry costs could exceed $2,500 monthly. This estimate forms part of a scenario, in which the Royal Bank would bring all its branches 'on-line' (on an entirely dedicated network) with 'real-time' banking. The National Bank could not identify a market application for the 14/12 GHz telephony terminal since all their branches are located in populated areas.

We have projected a potential market for the total chartered banking system of 25 units in the first five years and 35 units in the following five years. A detailed forecast is provided in Table 5-22. This assumes that in the course of the following ten years all banks introduce multi-branch banking and subsequently bring all branches on-line with real-time banking. Our estimate is based upon a total market configuration of 6,500 branches which is roughly equivalent to the number of branches accounted for by the five largest banks. At best, 1% of the total market configuration can be classified as true hardship cases, i.e., remote branches in which circuitry costs could exceed $2,500 monthly.

Respondents expressed strong interest in satellite technology if the following service requirements could be met.

- reliability
  To meet the specified 99.85% reliability criteria the satellite system would need back-up.
- response time
  a maximum of 4.5 seconds.
- cost
  satellite services would have to be available on a contracted basis at rates competitive with terrestrial facilities.
- integration of services
  capable of integrating all their communication needs, present and future, i.e., voice, low speed and high speed data, audio conferencing, video conferencing, teletext, etc.

As an initial step in developing a fully integrated satellite network, the Bank of Nova Scotia, in conjunction with the Computer Communications Group, has agreed to launch a satellite transmission trial in June 1982. The bank during the trial will use the network to communicate between its offices in Toronto, Calgary and Halifax (1).

No immediate market application exists in the insurance area. Insurance branch networks are less extensive than in the chartered bank system as they engage in retail activity primarily within populated areas. Outside of these in-house operations the insurance retail business is extremely localized and is handled autonomously by brokerage firms.

The respondents were interested in a specific satellite application, its usage as part of a disaster recovery or back up system for actuarial and related information.

The Toronto Stock Exchange market information service network responds daily to over 350,000 enquiries entered at more than 1,800 terminals across Canada and U.S.A.(2) The most remote terminals are located in Whitehorse and Flin Flon. Transmission facilities to these areas are leased on an entirely dedicated basis at a speed of 110 b/s. The cost in bringing in the line is between $700 and $800. The exchange estimates from past enquiries, that if the costs of remote satellite package (the terminal plus service) could be brought down to $500 monthly a market could exist for 300 to 600 units.

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(1) Globe and Mail, Wednesday, June 17, 1981.

(2) D. R. Unruh, Canadian Exchange Stocks in a Mixed Trading Network.

5.5.2 MANUFACTURING

Interviews were conducted with four manufacturing companies; Alcan Aluminum Limited, General Motors of Canada Limited, C-I-L Inc., Westinghouse Canda Limited. Financial highlights of the companies interviewed are summarized in the following table.

Table 5-17 Ranking of Manufacturing Companies Interviewed

ORGANIZATION	RANKING BY SALES	REVENUES ($M)	ASSETS ($M)	NET INCOME ($M)
General Motors	2	9451	2662	55.0
Alcan Aluminum	5	6224	6530	647.0
Wesinghouse(Can)	108	570	298	29.8
C-I-L Inc.	66	1004	781	51.5

There is a very limited application for the 14/12 GHz telephony terminal because of competitive and reliable terrestrial facilities available to this category of users. At best the 14/12 GHz telephony terminal could serve hardship cases. The potential market is assessed at 5 units for the 1983-1988 period and 12 units for the 1989-1993 period. Table 5-21 provides a detailed forecast.

Every interviewee expressed significant interest in new features that could be associated with satellite services such as:

- integration of voice and data to eliminate network duplication
- video conferencing for corporate communication
- electronic mail and other similar services in the future

5.5.3 TRANSPORTATION

Two potential 14/12 GHz telephony terminal users were interviewed: Air Canada, and Canadian Pacific Limited. Financial highlights of the companies interviewed are summarized in the following table.

Table 5-18 Ranking of Transportation Companies Sampled

Organizations	Ranking by Sales	Revenues ($M)	Assets ($M)	Net Income ($M)
Canadian Pacific (1)	---	2,397	3,847	143
Air Canada	--- (2)	1,906	1,688	57

Air Canada, the nation's largest air carrier operates a sophisticated on-line reservation system for air and passenger rail, car rentals and accomodation. The service is subscribed to by Via Rail and every airline in Canada except CP Air.

The service is provided on a fully dedicated network, serving 7,000 CRT terminals and 1,000 printers. A typical transaction consists of 60 characters of input and 250 characters of output. The network presently can handle approximately 220,000 transactions per hour (60 per second) up from 40,000 transactions in the early 70's.

The network in operation since 1969 is a star configuration with all terminals being linked to a central facility in Toronto. Transmission facilities leased from common carriers range from 2.4 to 4.8 kilobaud. The network is considered out of date and a new network is being planned to handle requirements in the mid 80's to early 90's.

The new network will be nodal and include nodes in Montreal, Toronto and Winnipeg. System design will also allow growth in other parts of Canada. The new network will be able to handle from 500,000 to 1,000,000 transactions per hour.

Since such a network is of critical importance to the operations of Air Canada, a number of service requirements must be met:

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(1) Figures excludes the following CP Limited operations; CP Air, CP Telecommunications, CP Ships and CP Enterprises (If all operations are included Canadian Pacific would rank as the largest Canadian Corporation with almost $10 billion in sales annually.)

(2) The Canadian Business ranks Crown Corporations separately by assets; amongst crown corporations only, Air Canada would rank 18.

Reliability: any satellite system would need back-up to match the specified 99.85% reliability criteria.

Response time: 2 second

Cost: satellite services would have to be available on a contracted time basis as is the case with terrestrial facilities, providing significant cost reductions (in the order of 20% to 30%) before generating real interest.

Integration of services:

In addition to data requirements, Air Canada operates a substantial voice network costing approximately two million dollars annually. Satellites were thus perceived as a potential tool to integrate all communications requirements including:

- data
- voice
- facsimile
- video conferencing
- communicating word processors

Air Canada, to a large extent, is in competition with large U.S. carriers who are allowed access to a sophisticated communication network while Air Canada is not allowed the same flexibility. In the long run, this could jeapordize the competitive position of the company.

Again, future communication requirements point to integration of all services on a single network that could handle:

- voice
- data
- electronic mail
- video-conferencing

These future requirements are presently the subject of in-depth studies where satellite is only one of the technologies considered. Cost is probably the single most important factor in the choice of alternatives. For a new solution to replace an established one the company insists on a return on investment (discontinued cash flow method) of at least 14%.

The persons interviewed were able to identify some specific applications for the 14/12 telephony terminal in their rail operations (1). These would be limited to extreme cases such as the pilot project now underway in the Rocky Mountains, where avalanches in the Glacier/Revelstoke area have prompted the installation of one 6/4 GHz terminal with two voice channels at a monthly cost of $12,000. A total of 12 to 15 such applications were identified in the following areas:

- British Columbia: 3
- Northern Ontario: 3
- Northern Quebec : 3
- Northern Atlantic: 4

In addition the persons interviewed expressed interest in low speed data terminals used in monitoring applications (water levels under bridges for example). These applications would have to be extremely inexpensive, (on the order of $500 per month).

In our opinion the potential market for the 14/12 GHz telephony terminal is limited to rail transportation. Taking into account Canadian National and other railways we thus forecast a total market of approximately 25 units during the 10 year period. A detailed forecast is provided in Table 5-21.

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(1) The remarks in the present section pertain to RAIL operations only. The persons interviewed also discussed applications in mining, oil and gas, and forestry in which C.P. has substantial interests.

5.5.4 RETAIL

Three potential 14/12 GHz telephony terminal users were interviewed, two wholesale and retail distributors and one general merchandiser. Financial highlights of the company interviewed are summarized in the following table:

Table 5-19 Ranking of Retail Companies Interviewed

ORGANIZATION	RANKING BY SALES	REVENUES ($M)	ASSETS ($M)	NET INCOME ($K)
Provigo	20	2,631	460	24,595
Steinberg	24	2,247	759	27,961
Canadian Tire	61	1,057	748	37,727

Low profit margins (less than .5% of total sales) have forced the major food chains to take a hard-nosed attitude toward reducing operating costs. One solution to rising communication costs has been to treat each division as a stand alone operation. In general, the industry is extremely localized. Communication requirements between divisions are normally met with normal long distance calls. The same results were found with the merchandising candidate interviewed, although because of the importance of catalogue printing costs, interest was expressed for teletext distribution services.

Our conclusion regarding this area is that there is no market for the 14/12 GHz telephony terminal because:

- users are normally located in large urban areas and are well served by terrestrial facilities.
- facilities are operated in a decentralized mode which tends to limit the need for communications.

5.5.5 COMPUTER SERVICES

The company interviewed, Canada Systems Group (CSG) Limited, is engaged in the provision of data processing services as well as in the sale and installation of EDP hardware. Financial highlights of the company are summarized in the following table:

Table 5-20 Canadian Systems Group

REVENUES ($000)	ASSETS ($000)	NET INCOME ($000)
$77,885	$47,472	$2,010

Source: CSG Annual report 1980

The respondents questioned are associated with CSG's Multiple Access Division (Canada), a division which offers a wide range of computer data services to the engineering, scientific and business communities.

Data transmission facilities are provided via the switched network, (eg. Dataroute) and transmission speeds are 110-1200 baud (lowspeed) and 9.6 kb/s (high speed).

Offices are in each major city in Canada. No specific market application for the 14/12 GHz telephony terminal was found. Respondents were interested in new satellite features which would allow access to an RF channel at variable rates (i.e. TDMA) but a satellite network would have to provide cost savings (in the order of 10% to 15%) before generating real interest.

5.5.6 SUMMARY

In summay, the potential market in business/industrial segment is estimated to be approximately 102 units over a 10 year period, see Table 5-21.

Table 5-21 Market Forecast Business/Industrial Segment

COMPANIES	UNITS 1983-1988	UNITS 1989-1993	TOTAL UNITS 1983-1993
Finance/Insurance			
Travellers Canada	0	0	0
Royal Bank	5	10	15
Bank of Montreal	3	7	10
Bank National	0	0	0
Metropolitan Life	2	5	7
Toronto Stock Exchange	0	0	0
Other Institutions	15	13	28
SUBTOTAL	25	35	60
Manufacturing			
Alcan	1	2	3
Westinghouse	0	0	0
General Motors	0	0	0
CIL	2	5	7
Other Companies	2	5	7
SUBTOTAL	5	12	17
Transportation			
Canadian Pacific (Rail)	5	5	10
Air Canada	0	0	0
Other Companies	5	10	15
SUBTOTAL	10	15	25
Retail/Computer Service			
Provigo	0	0	0
Steinbergs	0	0	0
Canadian Tire	0	0	0
Canada Systems Group	0	0	0
SUBTOTAL	0	0	0
TOTAL	40	62	102

5.6 ELASTICITY OF DEMAND

The elasticity of demand was evaluated qualitatively for the various market segments. The three main factors affecting elasticity are:

- the quality and importance of services provided
- cost of service
- competitive alternatives providing the same services (HF, VHF, terrestrial facilities, 6/4 GHz ANIKOM service)

These factors were rated for the various market segments interviewed. A list of the rating assessed is provided in Table 5-22.

To quantify this elasticity judgement, weighting factors were assigned to the elasticity appraisal in order to calculate a demand curve. Table 5-23 provides elasticity versus the weighting factor.

MARKET SEGMENT	ELASTICITY	REMARKS
Communications Carriers	Medium	Sensitive to price but requirement to serve very remote areas
Public Services	High	Competition from VHF radio and eventually M SAT
Oil and Gas	Low	Could be higher if M SAT services were available
Forestry	Medium to High	Competition from VHF radio plus eventual M SAT competition
Mining	Low to Medium	Hardship cases only
Finance Insurance	Medium to High	Hardship cases only plus competition from terrestrial facilities
Manufacturing	High	Competition from terrestrial facilities
Transportation	Low to Medium	Hardship cases only, so there is little competition from other means
Retail	—	No market
Computer Service	High	Competition from terrestrial facilities

Table 5-22 Elasticity Factors by Market Segments

For each elasticity category, and with monthly cost ranges varying between $2,000 and $12,000, the reaction to price differentials was then evaluated quantitively.

To illustrate, the following calculations were performed using a $4,000 to $6,000 price range.

Table 5-23 Market Forecast for a $4,000 - 6,000 Monthly Price Range

ELASTICITY	ORIGINAL MARKET	WEIGHTING FACTOR	MARKET
Low	200	1	200
Low to Medium	60	0.9	54
Medium	105	0.7	74
Medium to high	120	0.6	72
High	122	0.5	61
TOTAL	607	- -	461

Thus if the monthly cost of the terminal was in the $4000 to $6000 range instead of $2000 to $4000 the market would be 461 units a reduction in the projected market of 146 units.

Detailed results are presented in the following table; they show that in the $10,000 to $12,000 range, where the ANIKOM service price range is situated, the market for the 14/12 GHz telephony terminal over a 10 year period is assessed at only 106 units.

Table 5-24 Market Forecast by Elasticity Category

Elasticity Category	Sub-Segment	UNITS 1983-1988	UNITS 1989-1993	TOTAL UNITS 1983-1993
Low	Oil and Gas	110	90	200
Low to Medium	Mining	22	13	35
	Transportation	10	15	25
	Sub-Total	32	28	60
Medium	Communications Carriers	33	72	105
Medium to High	Forestry	20	40	60
	Financial/ Insurance	25	35	60
	Sub-Total	45	75	120
High	Public Services	39	66	105
	Manufacturing	5	12	17
	Sub-Total	44	78	122
TOTAL		264	343	607

Table 5-25 Elasticity of Demand

ELASTICITY PRICE RANGE	LOW	MEDIUM TO LOW	MEDIUM	MEDIUM TO HIGH	HIGH	MARKET
$2,000 - $4,000	1	1	1	1	1	607
$4,000 - $6,000	1	0.9	0.7	0.6	0.5	461
$6,000 - $8,000	0.9	0.8	0.5	0.3	0.1	329
$8,000 - $10,000	0.7	0.4	0.2	0.1	- -	197
$10,000 - $12,000	0.5	0.1	- -	- -	- -	106

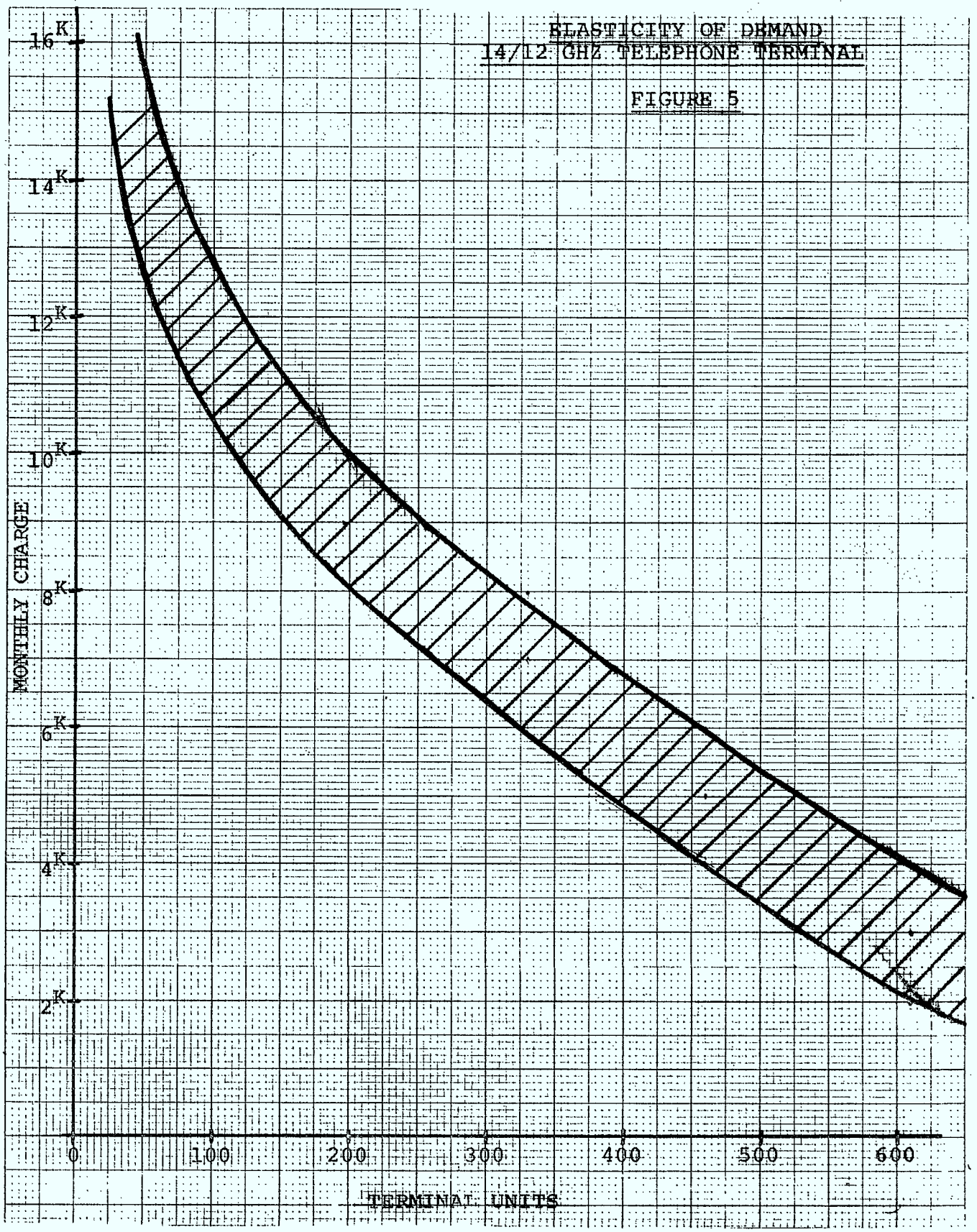


Figure 5.1 Elasticity of Demand

6. OTHER POTENTIAL MARKETS

6.0 OTHER POTENTIAL MARKETS

6.1 GENERAL

During the course of this study, two applications for 14/12 GHz technology presented themselves. These applications were of a nature that the present terminals could not satisfy their needs without substantial modifications which would, in fact, produce a new terminal entirely. This section describes these applications and their markets.

6.2 INTEGRATED SERVICES

Many organizations expressed a large interest for an integrated services terminal that would provide the following services: integration of voice and data to eliminate network duplication; roof-top to roof-top terminals to eliminate the local loop constraint on high speed data required for batch processing computer data, communicating word processors, and fascimile transmission; video and audio conference for corporate communication and personnel training; dynamic assignment of bandwidth (capacity) to optimize operations and make use of the difference in time zones.

What was suggested is a satellite communications network similar in concept but smaller in capacity to that provided in the United States by Satellite Business Systems and American Satellite Corporation.

The organizations interested in the above service were primarily the financial/insurance industry, federal government for their integrated communications netowrk and provincial government for tele-education and training.

This market size is difficult to evaluate precisely, however, it is felt to be on the order of 500 to 1000 terminals over the next ten years. The present service offerings and rates would have to be modified to provide the user with an established pricing arrangement which could be agreed upon for a number of years.

6.3 ONE WAY DATA TERMINAL

This service consists of distributing the stock exchange market information to brokers throughout the country during the business day. The service has a point to multi-point broadcast type requirement and was discussed during our visits in the Toronto Stock Exchange. Such a service is presently in operation in the United States. (The Reuters Business Monitor Service.)

The potential market, in our opinion could be 1000 to 2000 terminals, if the product costs were similar to the projected TVRO terminal.

7. COMPETITIVE ALTERNATIVES

7.0 COMPETITIVE ALTERNATIVES

7.1 INTRODUCTION

A number of technologies and the products they spawn compete to provide the various telecommunication services necessary in Canada. The markets available for exploitation of the 14/12 GHz technology have been specified, now alternative communications technologies will be discussed in an attempt to show how they could impact the market over the next ten years.

The competing telecommunications systems can be separated into terrestrial and other satellite alternatives.

7.2 TERRESTRIAL SYSTEMS

The terrestrial systems referred to are comprised of the cable and microwave networks which presently serve the country. This network, as a whole has the southern, east-west, populated belt in Canada very well covered. The large capacity of the present network, and its ability to expand that capacity readily, effectively shuts out that market against all other competitors. Satellite costs will have to be greatly reduced before they can compete with the terrestrial network in the south.

7.3 ALTERNATIVE SATELLITE SYSTEMS

There are a number of satellite systems, both proposed and in place which could seriously affect the 14/12 GHz market. The MSAT mobile satellite system, once operating, would probably erode more than half the resource and exploration market who want low cost and portable terminals. As this market segment is the single largest, the development of MSAT has grave implications for the feasibility of 14/12 GHz system.

The other major satellite system competitor is the 6/4 GHz ANIKOM system, where the facilities are already in operation and proven reliabile, more complete northern coverage is provided, and the costs of the terminals is approaching the estimated cost of 14/12 GHz telephony terminals. In addition, steps are being taken to reduce the backhaul charges, by establishing a 6/4 GHz regional port station at Forest Lawn near Calgary. This reduction in backhaul charges as well as the telecommunication operators reticents about promoting the 14/12 GHz telephony terminal usage while their 6/4 GHz equipment is not fully utilized could effect the 14/12 GHz service and market.

8. CONCLUSIONS

8.0 CONCLUSIONS

The projected market for the 14/12 GHz telephony terminal under development is assessed at 607 units over the ten years from 1983 to 1993. The Resource Industry, which represent 49% of the total market, is located in western Canada specifically British Columbia and Alberta and they require terminals capable of voice and low speed data transmission. In some cases high speed data (56-220 kb/s) is required during the exploration phases. The remainder of the market is divided equally between the Telecommunication, Public Service and the Business/Industrial segments. The Telecommunications segment requires mostly a voice transmission capability to augment telephone service to rural Canada. The Public Service segment predominately the Federal Government, sees limited use of voice transmission in emergency and disaster situations as well as extending the Government telephone network (voice, low speed data) to remote governmental offices. The Business/Industrial segment requires voice, low speed data and high speed data. Their application is to connect remote branch offices to the central computer networks. As with the Public Service, the services are in direct competition with terrestrial facilities and must be a cost effective solution to be implemented.

The oil and gas segment of the market (36 percent) is less price sensistive than the rest of the market, but their service requirements are such that it would be more beneficial if they owned the terminals. The other factor which will have a large impact on this segment, as well as the Public Sector is the MSAT mobile satellite program which, once operational, should capture a large part of both segments.

We estimate the market split for single subscriber versus multi-subscriber of 14/12 GHz telephony terminals by segments to be:

	Single	Multiple
Telecommunications	50%	50%
Public Service	75%	25%
Resources	20%	80%
Business/Industrial	5%	95%

The integration of a number of features to provide video conferencing, communicating word processor and facimile capabilities on a 14/12 GHz telephony terminal would increase its potential in the Business/Industrial segment greatly but only if the service cost was competitive with present terrestrial facilities.

The cost model, developed for this study was based on production runs of approximately 500 units. Since the market does not support the cost model assumptions, the terminal costs will rise to the $50,000 to $60,000 level of the ANIKOM terminals unless this base is augmented by international markets.

Since the existing 6/4 GHz system provides adequate northern coverage and present transponders are not fully utilized, there is reluctance on the part of some carriers to be involved in the 14/12 GHz satellite. In addition, the spot beams of ANIK-C with their dual polarization and questionable northern coverage requiring larger antennas make the 14/12 GHz telephony terminal less attractive for very remote application.

In summary, the terminal required for the markets identified should possess a combination of the following features and capabilities:

- rugged construction
- simplicity of operation
- transportability
- one to four RF channels
- slow speed data (less than 4800 bit/s)
- high speed data (9.6 to 56 k bit/s)
- extremely low cost

APPENDIX A

INTERVIEW LIST

TELCO AND CARRIERS

CARRIER	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Newfoundland Telephone	Don Tarrant	Supervising Engineer Corporate Planning		May 20 1981
Maritime Telephone and Telegraph	Glen Geldert	Chief Engineer	902-421-5464	May 21 1981
Terra Nova Tel. Northwestel	D.W. Bruce	Director, Planning CN Communications	416-860-2815	May 1 1981
Sotel	Michel Leger	Chief Engineer	514-284-0254	April 22 1981
Bell Canada	R. Montgomery	Director Satellite Services Development		
	H.P. Chamberlin	District Manager Satellite Services	613-560-3760	April 29 1981
Manitoba Telephone System	Don Newey	Manager, Current Plans	204-947-7629	May 7 1981

TELECOMMUNICATION

TELCO AND CARRIERS

CARRIER	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Alberta Government Telephone	Wayne McLean	Manager, Corporate Development	402-425-7311	May 11 1981
British Columbia Telephone	Ed Piekaar	Systems Development Manager	403-432-3473	May 12 1981
CNCP Telecommunications	M.J. Eric	Director-Policy Development, Regulatory and Government Matters	514-395-5260	April 23 1981
New Brunswick Telephone	M. Jones	Staff Engineer, Network Plans	506-693-6720	June 2 1981
Telesat	J. Underhill	Manager, Marketing	613-746-5920	April 30 1981
TCTS *	Refer to Bell Canada			
Telebec	Y. Cyr	Adjoint Technique Bureau d'etudes	514-729-5293	April 22 1981

Federal Government

AGENCY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Transport Canada - Coast Guard	J.L. Woodbury	Telecommunication and Electronics	613-996-7381	April 28 1981
	B. Tepper	Superintendant Point-to-Point Telecommunication Communications and Computer Division	613-996-7878	April 28 1981
-Northern Airfields	J. Thomas	Superintendant of Systems Requirement	613-996-0218	April 29 1981
Energy Mines Resources - Polar Continental Shelf Project	Frank Hunt	Supervisor Communications	613-996-4045	April 28 1981
- Geodetic Branch	J.R. Belanger	Terrain Service	613-995-4009	April 28 1981
-Seimology Division	R. Hayman	Head, Instrumentation Services	613-995-5526	June 2 1981
Indian Affairs and Northern Development	Howard Taylor	Secretary, Committee on Northern Affairs	613-997-0202	April 24 1981
Emergency Planning Services	N. Evanoff	Chief Communications	613-996-8120	April 30 1981
Government Telecommunication Agency	R.J. Arsenault	Head Technology Research Development	613-995-7227	
	D. Sun	Manager, Planning and Development		April 28 1981

PUBLIC SERVICE

Provincial Government

AGENCY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
British Columbia Government Ministry Universities Sciences, Commissions	T. Prentice	Director, Communication System Development and Regulation Branch	604-387-5446	May 12 1981
Ontario Ministry of Government Services	Glen Chung - Yan	Manager Engineering and Radio Services Telecommunication Services Branch	416-965-0475	May 1 1981
Nova Scotia Government Department of Transport	D.C. Colville	Director, Communications Policy	902-424-7678	May 21 1981
New Brunswick Government, Department of Transport	W.W. Steeves	Special Advisor, Communication Policy	506-453-2802	May 22 1981

PUBLIC SERVICE

Oil & Gas

COMPANY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Shell Canada Limited	Dayle Dixon	Telecommunications Engineer	403-232-4117	May 8 1981
Dome Petroleum Limited	Don Larsen	Manager, Communications	405-232-0041	May 8 1981
Williams Electronics	Ken Polansky	Manager	403-455-3858	May 11 1981
Petro Canada	Rand Ellis	Telecommunications Engineer	403-232-4570	May 5 1981

RESOURCES

Forestry

COMPANY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Great Lakes Forest Products Limited (1)	Refer to CANADIAN PACIFIC (RAIL) LIMITED (transportion section)			
Abitibi Price Inc.	M. Regan	Telecommunication Director	416-866-4333	
	A. Mitrowski	Manager, Technical Services	416-866-4463	June 2 1981
British Columbia Forest Products Limited	A. Brown	Manager, Office Services	604-665-6162	May 13 1981
MacMillan Bloedel Limited	W. MacDonald	Supervisor Communications	604-683-671	May 13 1981

(1) Through its investment in Canadian Pacific Investments Limited, CP Limited has a controlling interest in; - Great Lakes Forest Products Limited (54.28%) and - Cominco Limited (53.64%).

RESOURCES

Mining

COMPANY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Noranda Mines Limited	R.A. Ledsham	Director of Communications	416-867-7107	June 1 1981
Cominco Limited	Refer to CANADIAN PACIFIC (RAIL) LIMITED (transportation)			

RESOURCES

Financial/Insurance

COMPANY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Travelers Canada	Larry Dumont	Director of Communications	416-595-7087	June 1 1981
	Wilf Hindle	Director of Telecommunications and Office Services	416-595-7187	
Metropolitan Life	H. Wayne Dell	Assistant Vice-President Electronic Installations	613-231-3573	May 5 1981
	Emburgh B. O'Brien	Manager, Electronic Data Processing	613-231-3567	
Royal Bank	G. Heckman	Assistant General Manager, Processing System, Head Office	514-874-2183	April 25 1981
Bank of Montreal	R.J. MacDonald	Communication Systems Manager	416-498-8800	June 3 1981
National Bank	Claude Allaire	Assistant Director of Office Service	514-281-6611	May 29 1981
	David Brandrick	Director of System Operations		
Toronto Stock Exchange	Donald R. Unruh	Vice President of Operations	416-868-5252	June 2 1981

Manufacturing

COMPANY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Alcan Aluminum Limited	W.T. Wilkinson	Director of Communications Department: Office Services	514-877-2340	May 28 1981
General Motors of Canada Limited	Charles Hender	Supervisor of Communications and Minicomputers	416-644-6739	June 9 1981
C-I-L INC	J. Peter Willan	Real Estate Manager	416-226-7543	June 8 1981
	R. Maddeaux	Telephone and Telex Supervisor	416-226-7396	
	John Pearson	Supervisor Technical Services	416-226-7467	
Westinghouse Canada Limited	P.T. Forstner	Manager, Communications	416-528-8811	June 8 1981
	Ron Krieng	Telecom Specialist		

Transportation

COMPANY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Air Canada	N.T. Stoddard	General Manager Computer/ Communications	514-874-4700	April 22 1981
Canadian Pacific Limited (Rail)	E. Querel	Manager, Communication Systems	514-395-7841	May 27 1981
	D. Chan	Supervisor Network Planning and Analysis	514-395-7320	

Retail

COMPANY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Steinberg Inc.	David Kobayakawa	Director, Technical Services Information Systems	416-	June 8
Provigo Inc.	J.P. LaPerriere	Director of Data Communication	514-866-9781	June 4 1981
	Bob Gales	Assistant Director: Office Services		
Canadian Tire Corporation Limited	D.J. Harvie	Director of Central Supply Services	416-484-3193	June 2 1981

Computer Services

COMPANY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
Canada Systems Group Limited (Multiple Access Group)	Jean Phillips	Manager of Communications	416-443-3900	June 1 1981
	Chuck McGee	Communication Technician		

COMPANY	PERSON INTERVIEWED	TITLE	TELEPHONE	DATE
SPAR Aerospace Ltd.	W. Corless M. Morris	Manager, Equipment Engineering Manager, Engineering		April 15 1981
SED Systems Limited	D. Wohlberg L. James	Manager of Engineering Satellite Communications Group		June 3 1981

APPENDIX B

TECHNICAL CHARACTERISTICS

SINGLE/MULTI - SUBSCRIBER REMOTE TERMINAL (SSRT/MSRT)

Electrical Characteristics

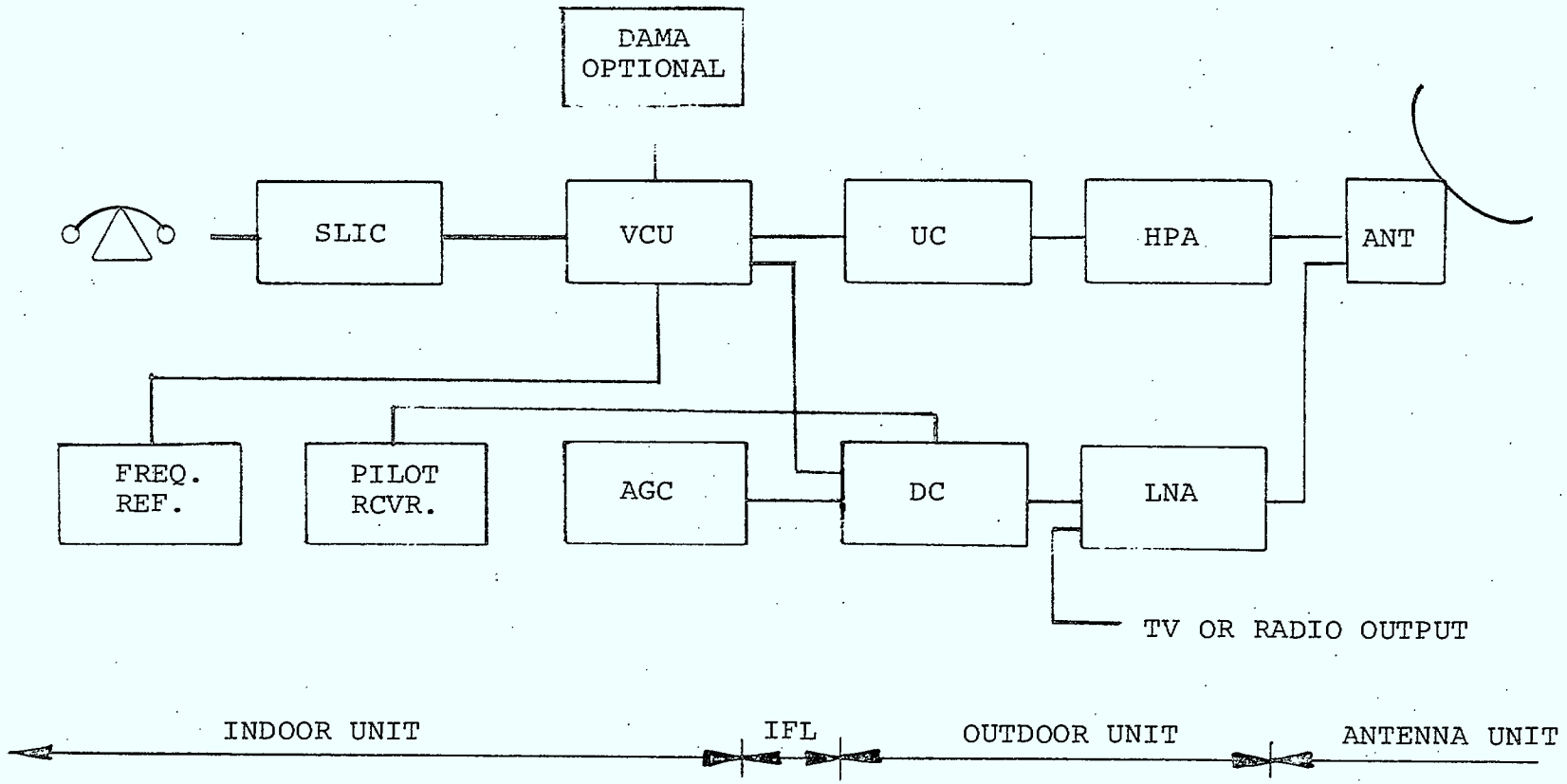
a)	Frequency	Tx:14.0 - 14.5 GHz Rx:11.7 - 12.1 GHz
b)	EIRP (min.)	48.5 dBW
c)	G/T	23.0 dB/k
d)	Ant. diameter	2.5 meter
e)	Ant. Gain	Tx:49.0 dB Rx:48.0 dB
f)	HPA output	1.0 W
g)	LNA noise figure	3.0 dB
h)	RF Channel Capacity	1 channel
i)	Interfacility link length	200 ft.
j)	VF chan. capacity	SSRT - one VF channel MSRT - four VF channel
k)	VF Interface	provide interface to standard Bell type 500 telephone set with rotary dial or push-button. Operation of the set should be equivalent to terrestrial based system. i.e., dial tones, busy tones, etc.
l)	Power	voltage 115 V ac ±20%; frequency 60 Hz or -24 V dc optional

Operational Characteristics

a) all solid state
b) high equipment reliability
c) no equipment redundancy
d) easily installed with unskilled labour and minimum piece parts.
e) simple operation, by unskilled labour in remote areas
f) remote testing capability from central control station
g) conversion to DAMA operation by addition of plug-in modules only
h) provision for additional TV and radio receiver chain at LNA output
i) capable of transmitting low speed data up to 4.8 KB/s.
j) low power consumption 100 watts maximum

Mechanical Characteristics

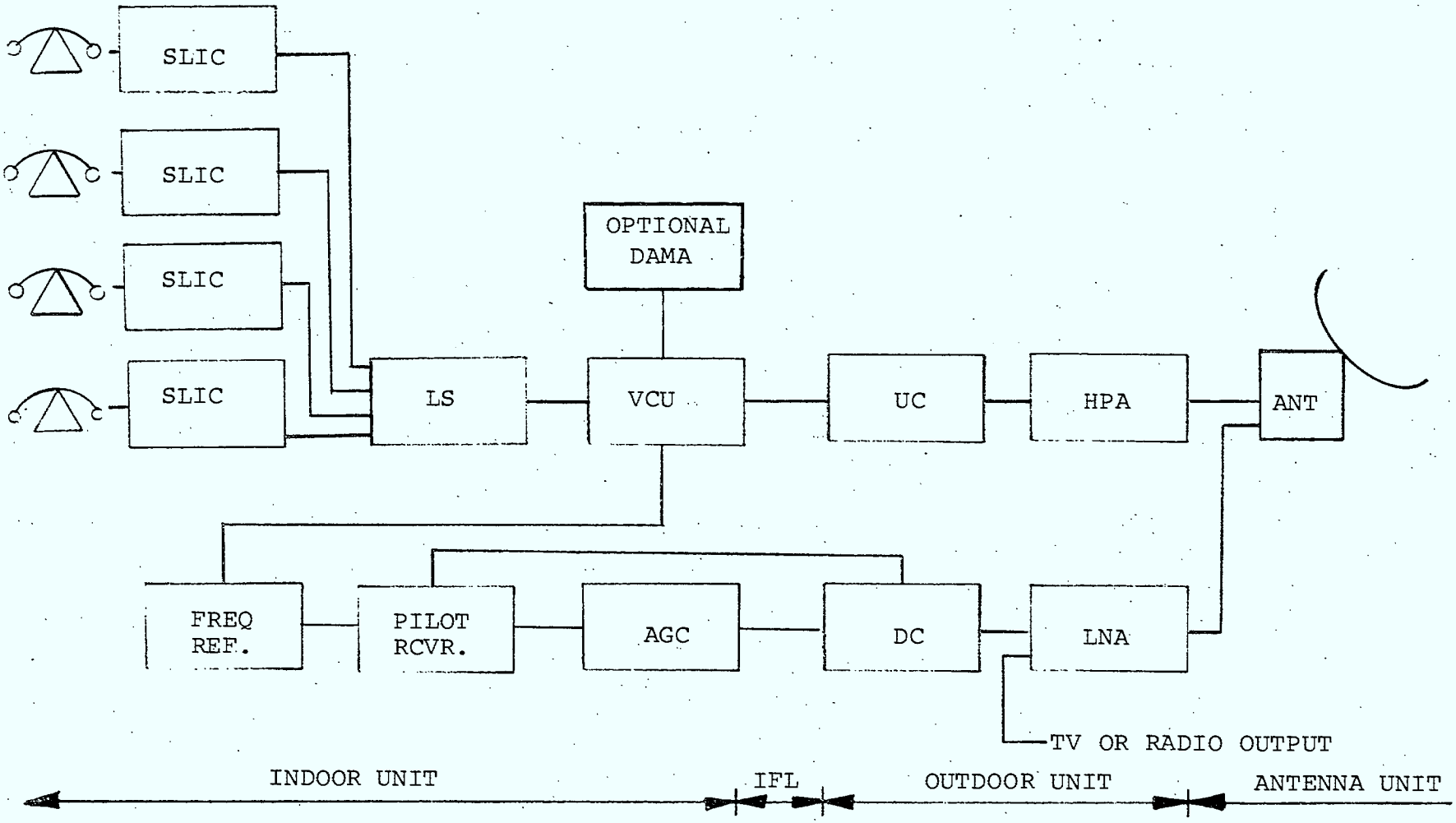
a) lightweight, rugged and transportable
b) capable of transporting all equipment in small aircraft
c) station to be self-contained antenna unit, outdoor unit and indoor unit.
d) antenna and outdoor unit designed to withstand extreme ranges of Canadian climate
e) two types indoor unit,
    i) highly transportable (SSRT) suitcase package applicable to climatic conditions of (d)
    ii) multi-channel rack mount applicable to central office controlled environment.



SINGLE SUBSCRIBER REMOTE TERMINAL

LEGEND

SLIC - SUBSCRIBER LINE INTERFACE UNIT
VCU - VOICE CHANNEL UNIT
UC - UPCONVERTER
DC - DOWNCONVERTER
HPA - SOLID STATE POWER AMPLIFIER
LNA - LOW VOICE AMPLIFIER
IFL - INTERFACILITY LINK



MULTI-SUBSCRIBER REMOTE TERMINAL

LEGEND

LS	- INTEGRATED SWITCH UNIT
SLIC	- SUBSCRIBER LINE INTERFACE UNIT
VCU	- VOICE CHANNEL UNIT
UC	- UPCONVERTER
HPA	- SOLID STATE POWER AMPLIFIER
LNA	- LOW VOICE AMPLIFIER
IFL	- INTERFACILITY LINK

COMMUNITY REMOTE TERMINAL (CRT)

Technical Characteristics

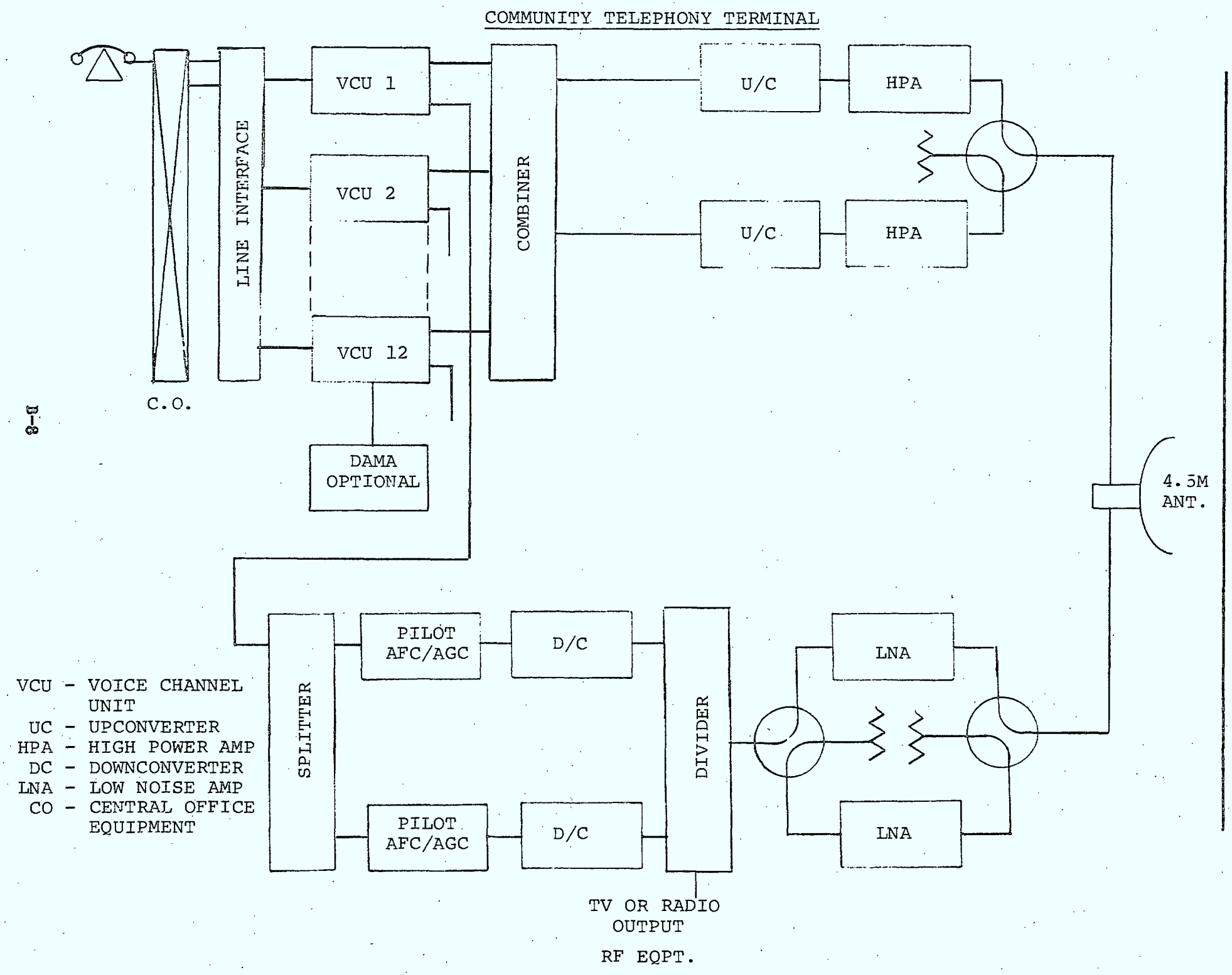
a)	Frequency	TX:14.0 - 14.5 GHz RX:11.7 - 12.2 GHz
b)	EIRP (min.)	48.5 dBW/carrier
c)	G/T	28.0 dB/°K
d)	Ant. diameter	4.5 m
e)	Ant. Gain	Tx:54.5 dB Rx:53.0 dB
f)	HPA output	10.0 W for 4 channels 50.0 W for 12 channels
g)	LNA noise figure	3.0 dB
h)	RF channel capacity	1 to 16 channel
i)	Interfacility length	50 ft
j)	VF channel capacity	1 - 84 VF channels
k)	VF interface	trunk interface required for class 5 office or equivalent
l)	Power source	-24 V or -48 V dc

Operational Characteristics

a) all solid state except for TWTA
b) high equipment reliability
c) common equipment redundnacy capability
d) simple operation by semi-skilled operators in remote areas
e) remote testing capability from central control station and self-diagnostic
f) conversion to DAMA operation by addition of plug-in modules only
g) provision for additional TV and radio receiver chain at LNA output
h) capable of transmitting low speed data up to 4.8 kb/s

Mechanical Characteristics

a) station to be self-contained antenna unit, outdoor unit and indoor unit
b) antenna and outdoor unit designed to withstand extreme ranges of Canadian climates
c) indoor unit rack mounted applicable to central office controlled environment.



VCU - VOICE CHANNEL UNIT
UC - UPCONVERTER
HPA - HIGH POWER AMP
DC - DOWNCONVERTER
LNA - LOW NOISE AMP
CO - CENTRAL OFFICE EQUIPMENT

REGIONAL PORT STATION

Technical Characteristics

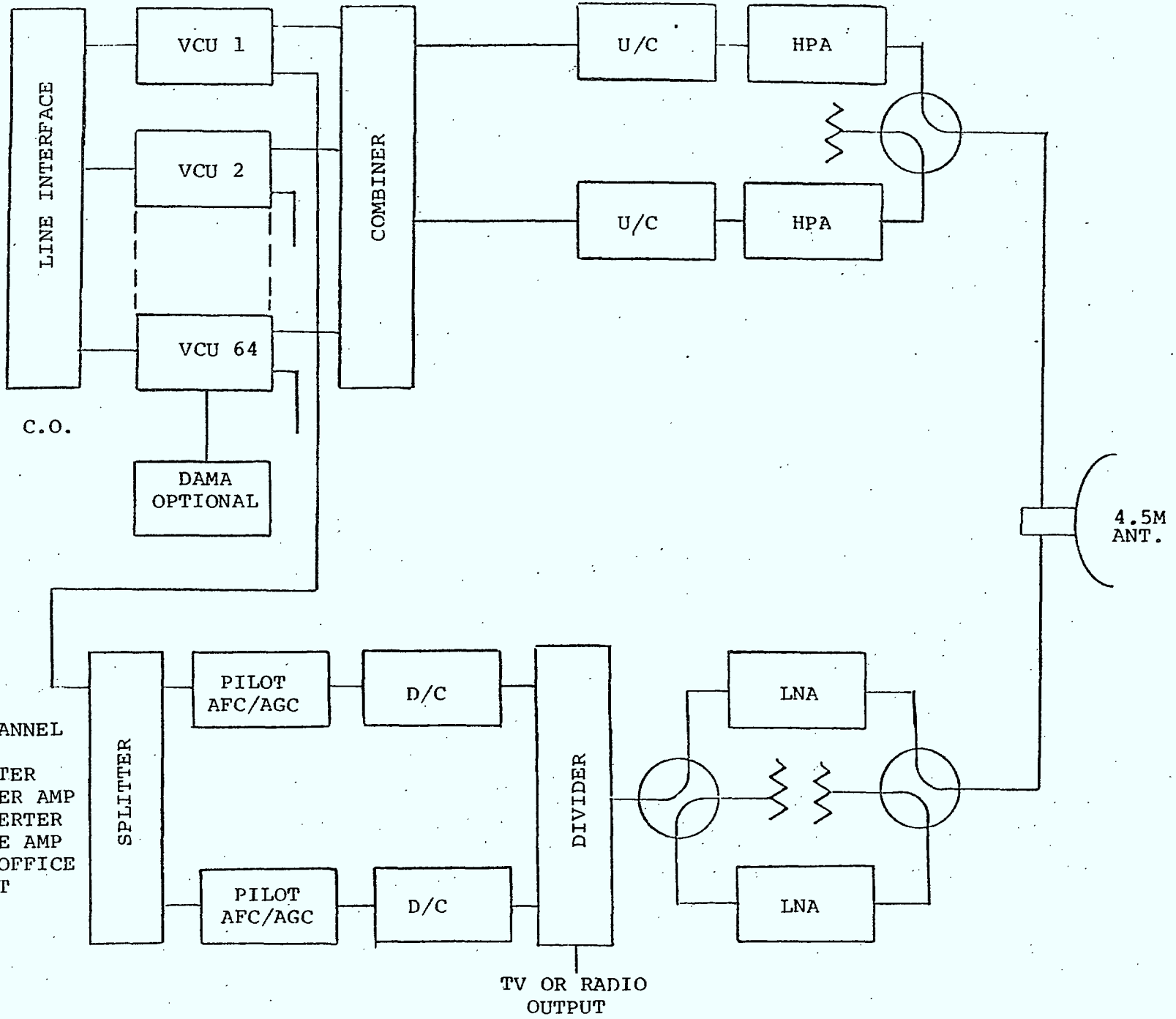
a)	Frequency	Tx:14.0 - 14.5 GHz Rx:11.7 - 12.1 GHz
b)	EIRP (min.)	48.5 dBW/channel
c)	G/T	27.0 dB/°K
d)	Ant. diameter	4.5 meter
e)	Ant. Gain	Tx:54.5 dB Rx:53.0 dB
f)	HPA output	30 W for 12 channels 100 W for 64 channels
g)	LNA noise figure	3.0 dB
h)	RF Channel Capacity	12-64 channel
i)	Interfacility link length	200 ft.
j)	VF interface	trunk interface required for class 5 office
k)	Power Source	-24 C or -48 V dc

Operational Characteristics

a) all solid state
b) high equipment reliability
c) coversion to DAMA operation by addition of equipment
d) common equipment redundancy
e) capable of remote testing and interrogating remote terminal stations

Mechanical Characteristics

a) Station to be self-contained antenna, outdoor and indoor equipment
b) Antenna and outdoor unit designed to withstand extreme ranges of Canadian climates
c) indoor equipments rack mounted and designed for controlled central office environment.



VCU - VOICE CHANNEL UNIT
UC - UPCONVERTER
HPA - HIGH POWER AMP
DC - DOWNCONVERTER
LAN - LOW NOISE AMP
CO - CENTRAL OFFICE EQUIPMENT

REGIONAL PORT STATION

APPENDIX C

LIST OF REFERENCES

APPENDIX C

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Present Status of Rural Communications in Canada, Inter-Branch Working Group On Rural Communication, Department of Communications, July 1976.

APPENDIX D

INTERVIEW FORM OUTLINE

APPENDIX-D

INTERVIEW FORM OUTLINE

I GENERAL INFORMATION

- General
  - company name
  - ownership
  - person(s) interviewed
  - annual report

- Financial Related Information
  - sales
  - products and/or service
  - employees

- Corporative and Administrative Structure in Canada

II PRESENT COMMUNICATION REQUIREMENTS

- Communication Facilities
  - voice
  - data
  - facsimile
  - communicating word processors
  - video conferencing
  - other

- Costs Associated With Present Requirements
  - telephony (basic service, DDD, Dedicated lines, watts)
  - data
  - other information related costs
    - courier, messenger services
    - travel, living expenses associated with company/agency meetings, training etc.

III FUTURE TELECOMMUNICATION REQUIREMENTS

- voice
- data
- facsimile
- communicating word processors
- video conferencing
- other

- Corporate Policy and Selection of Equipment
  - rental
  - leasing
  - ownership

Criteria in the selection of new equipment.