QUEEN
P
91
.C655
M549
1973
v.1

MICROWAVE SYSTEMS FOR CATV

VOLUME 1

P
91
C655
M549
1973
v.1

P
91
C655
M549
1973
v.1

1

MICROWAVE SYSTEMS FOR CATV

This study has been performed for the

DEPARTMENT OF COMMUNICATIONS

by

ASDA Limited
77 Metcalfe St.
Ottawa, Ont.

Industry Canada
LIBRARY
JUIL JUL 2 0 1998
BIBLIOTHÈQUE
Industrie Canada

MARCH 1973

COMMUNICATIONS CANADA
AOÛ AUG 13 1998
LIBRARY – BIBLIOTHÈQUE

PREFACE

The main objective of the study is the function of Microwave Systems in conveying TV signals from remote sources for distribution by Cable Systems.

This Report provides a large data base of information on Canadian CATV systems, obtained in part by direct survey, on which is based an estimate of Potential Demand for Microwave Systems. Configurations of such systems in various regions are outlined.

The role of such systems is examined in the context of emerging trends in communications.

ACKNOWLEDGMENT

Gratitude is expressed to all who have contributed to this study with their ideas and comments. The co-operation of CATV operators who have responded so generously to the survey is deeply appreciated.

P
91
C655
M549
1973
v.1

DD 5609278
DL 5609283

COMMUNICATIONS CANADA
AOÛT 13 1984
LIBRARY – BIBLIOTHÈQUE

Ordinarily, the text in this column appears next to the paragraph which it supports.

On occasion a paragraph is a continuation of the one appearing immediately above.

A two-volume format has been chosen to facilitate cross reference between volumes.

A two column format has been chosen for greater readability:

When the left column of the text appears shaded it merely supports the text of the right column.

Thus, shaded portions may be omitted on first reading without affecting the intelligibility of the report.

Notation

On some pages the right margin is reserved for references:

figure ..... F
table ..... T
bibliography ..... B.

These references are shown shaded if they are associated with the (shaded) text of the left column.

SUMMARY

CATV SYSTEMS

CATV systems have enjoyed a steady growth over the past 20 years. The geographical distribution of the 360 systems in operation is shown, in comparison with TV coverage and major communication networks.

Statistical data are given for operational systems, with respect to:

- o size and distribution
- o operating characteristics
- o TV signal sources
- o reception conditions
- o investment.

MICROWAVE SYSTEMS

Functional categories are established:

- o inter-city trunks
- o head-end extension
- o intra-city links.

System considerations are examined and likely system configurations in the various regions are outlined.

POTENTIAL DEMAND

The potential demand for microwave systems is examined on the basis of:

- o statistical analysis of:
  improvement of reception
  new channels, existing CATV systems
  new CATV systems
- o direct CATV survey.

This demand is very sensitive to the cost of microwave systems, particularly for small and medium sized CATV systems.

This elasticity is shown in the figure on the next page, based on generalized cost models and factors postulated for microwave systems of various cost levels.

IMPLICATIONS

The wider application of microwave systems, primarily for the introduction or improvement of U.S. derived signals, is not considered to have a significant social impact.

The major impact appears to lie elsewhere, namely in the introduction of new types of services.

VOLUME 1

MICROWAVE SYSTEMS FOR CATV

INDEX

Preface - Acknowledgment

Format - Notation

Summary

CATV SYSTEMS IN CANADA 1

- Overview 1.01
- Status 1.06
- Financial 1.18
- Social Implications 1.28

MICROWAVE SYSTEMS 2

- Overview 2.01
- Demand Analysis 2.03
- Demand Summary 2.18

SYSTEM CONSIDERATIONS 3

- General Aspects 3.01
- Regional Systems 3.09

CONCLUSIONS 4

- Perspectives 4.01
- Potential Demand 4.02
- Constraints 4.03
- Implications 4.04

Bibliography

INDEX

SECTION 1

	TEXT	TABLE	FIGURE	MAP
CATV SYSTEMS IN CANADA				
Overview	1.01		1.01	
Historical & Growth	1.02		1.03-1.05	
Status	1.06	1.07		1.08-1.11
Major Concerns of DOC			1.12	
Major Concerns of CRTC			1.13	
Analysis of Systems	1.14	1.15		
Reception Quality	1.16		1.17	
Financial Data	1.18, 1.19	1.20	1.21-1.24	
Improvement of Reception	1.25, 1.26		1.27	
Social Implications	1.28	1.29		
Penetration	1.30		1.30	
Future Expansion	1.31			
Future Trends	1.32			

INDEX

SECTION 2

	TEXT	TABLE	FIGURE
MICROWAVE SYSTEMS			
Overview	2.01		2.02
Potential Demand	2.03		2.04
Method I	2.05	2.06	2.07, 2.08
Demand Estimate		2.09-2.12	
Method II	2.13		2.14
Demand Estimate		2.15	
Method III	2.16	2.17	
Summary	2.18	2.19	2.20

INDEX

SECTION 3

	TEXT	MAP
SYSTEM CONSIDERATIONS		
System Configurations	3.01	
Performance	3.02, 3.03	
Optimization	3.04, 3.05	
Microwave Frequencies	3.06, 3.07	
System Integration	3.08	
Regional Systems	3.09	
British Columbia	3.10	3.11
Alberta	3.12	3.13
Saskatchewan	3.14	3.15
Manitoba	3.14	3.15
Ontario	3.16	3.17, 3.18
Quebec	3.19	3.20
New Brunswick	3.21	3.22
Prince Edward Island	3.21	3.22
Nova Scotia	3.21	3.22
Newfoundland	3.21	3.22

INDEX

SECTION 4

	TEXT
CONCLUSIONS	
Perspectives	4.01
Potential Demand	4.02
Constraints	4.03
Implications	4.04

CATV refers to either Community Antenna Television or Cable Television; the former term denotes primarily small off-the-air pick-up systems (eg. apartment buildings), the latter implies more comprehensive systems, and latterly gives way to the term "Cable Systems".

CATV or Cable System refer to the distribution of TV channels by coaxial cable

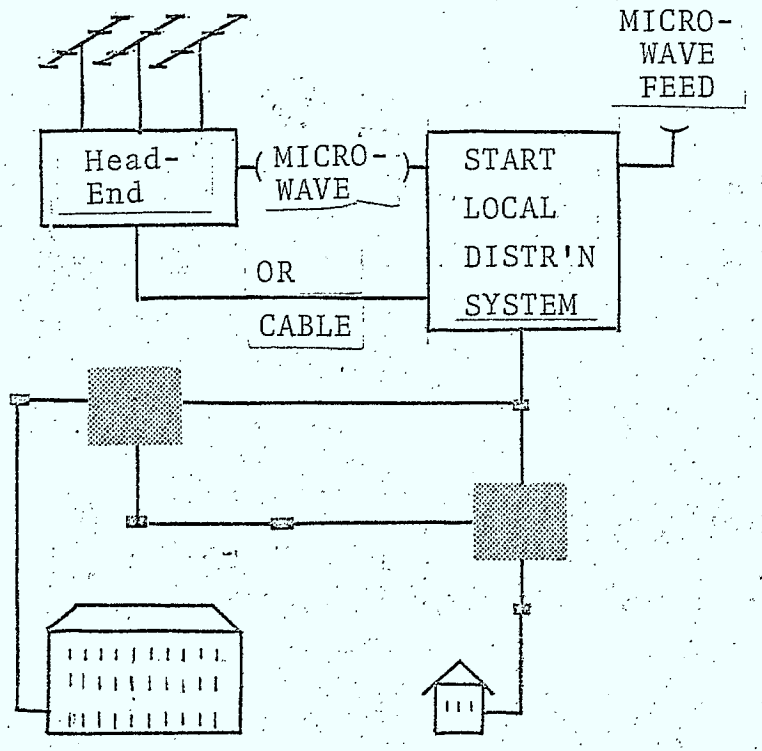
- o into individual subscribers homes
- o into individual units of multiple dwellings (apartments, houses, hotels, etc.)

The main elements of existing Cable System are:

- o Distribution system.
- o Head-end for off-the-air pick-up of TV signals.
- * o (Microwave) feed system.
- * o Local program facilities.
- * o FM radio.

The trend of future developments is in the direction of:

- o Improvement in the quality of signals.
- o Expansion of channel capacity.
- o Introduction of two-way capability giving the subscribers options of response or control.



* as applicable.

Growth, as here considered, refers only to the number of CATV systems, and not to the growth of individual systems, in terms of numbers of subscribers.

The emergence and success of cable systems is chiefly due to:

- o making accessible remote TV signals (of Canadian and particularly U.S. origin), which are not otherwise available.
- o distributing special programs (eg. education).
- o originating new services and programs of local or community interest.

The logarithmic scale used in this chart allows a direct comparison of growth rates.

Curves of equal slope correspond to equal growth rates.

To what extent this represents a natural saturation effect will be explored in a later section.

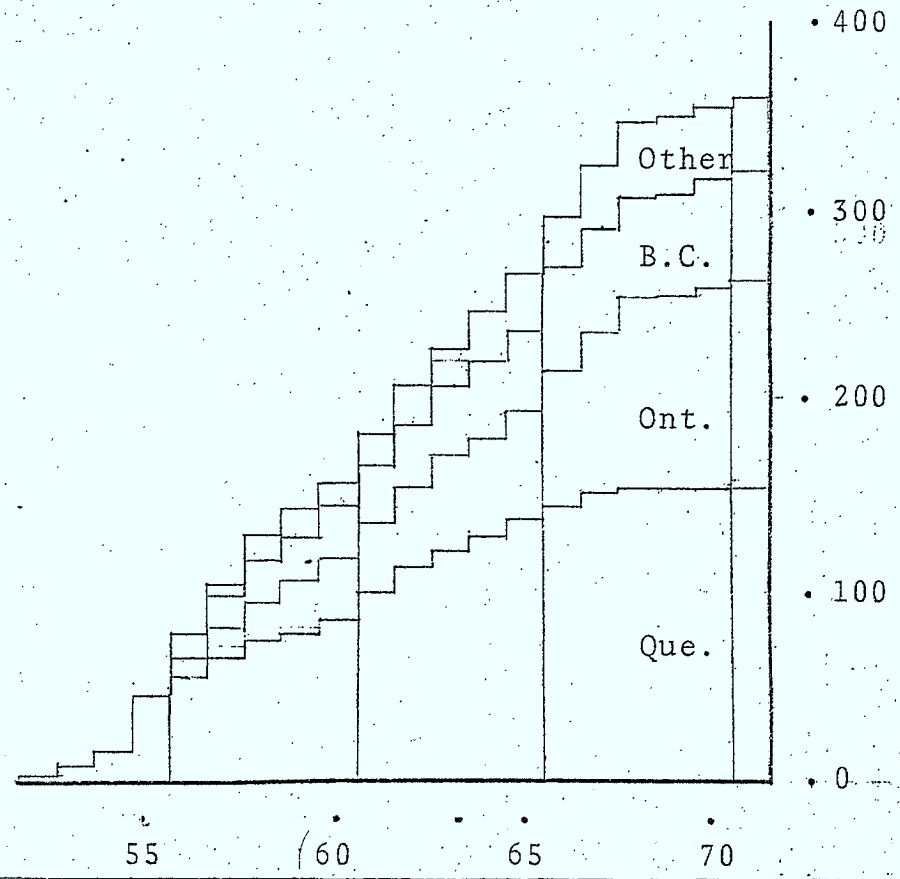
Cable Systems began operation about 20 years ago and have enjoyed a steady growth since. F 1.03

The chart shows that growth patterns are essentially similar F 1.03

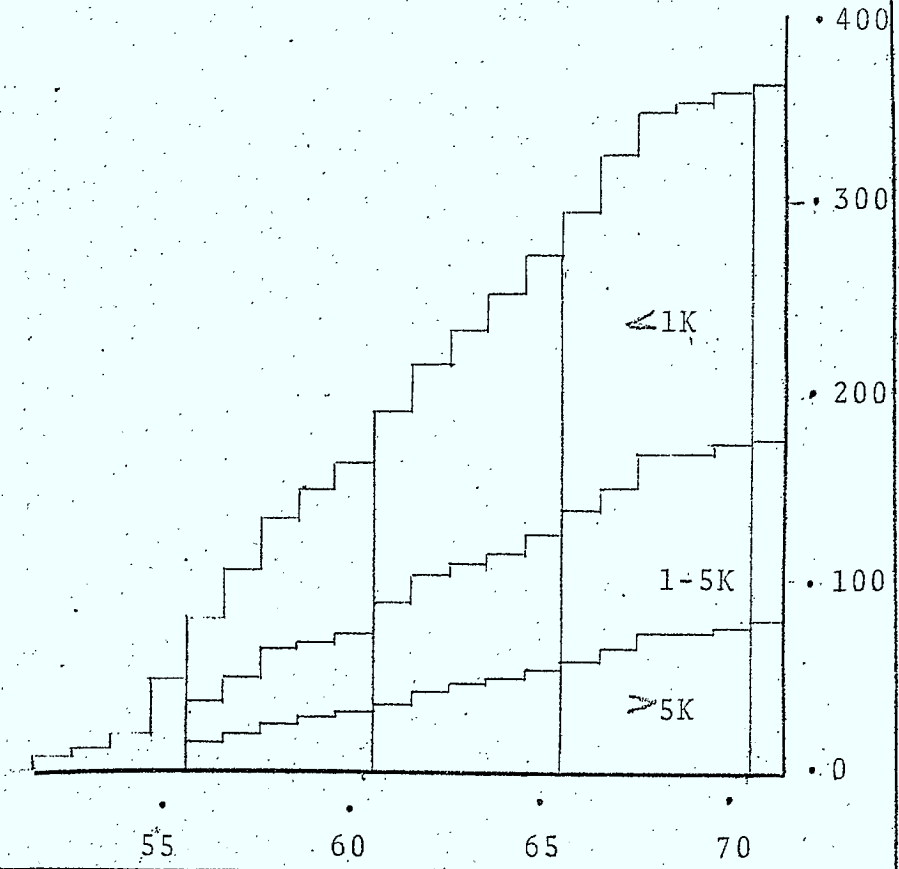
- o for CATV systems of all eventual sizes (in terms of numbers of subscribers).
- o in the three provinces where CATV systems show the greatest penetration (British Columbia, Ontario and Quebec).
- o in the remaining provinces, taken as a single group.

This growth pattern is typical for the development of communication facilities associated with TV broadcasting. F 1.04

In recent years the growth of cable systems appears to have slowed down.



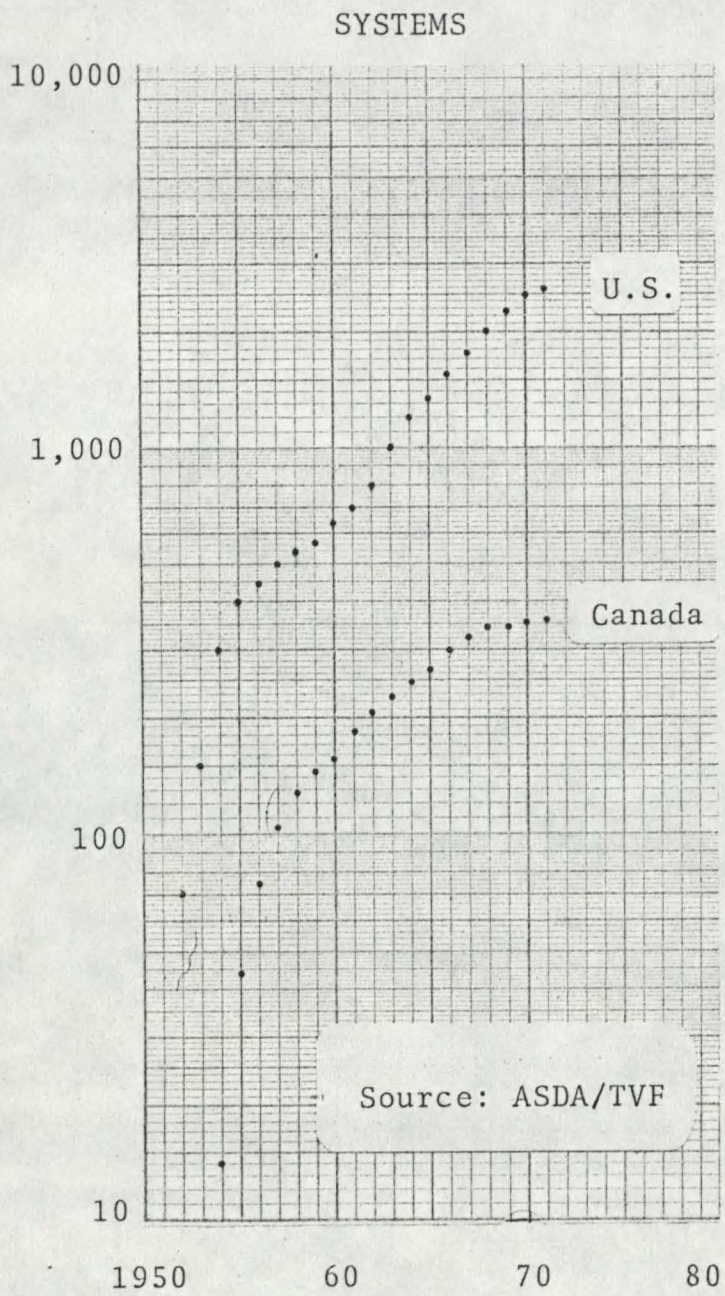
Distribution by Province

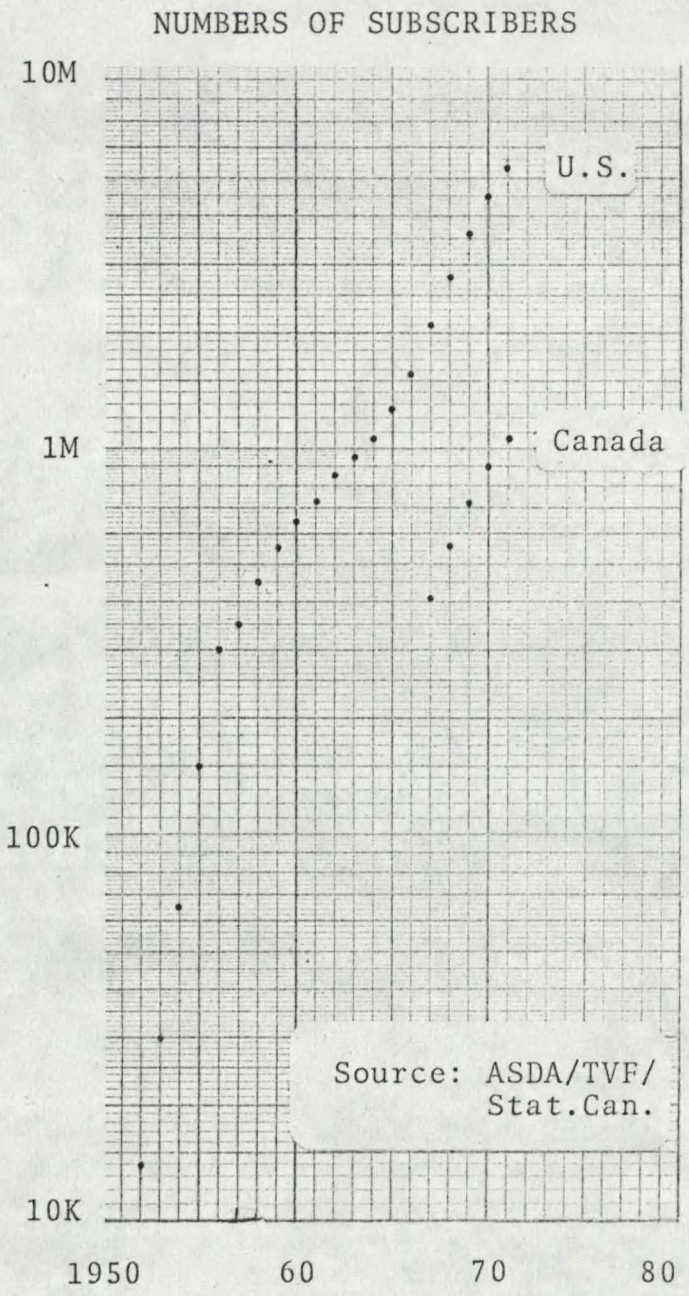


Distribution by System Size

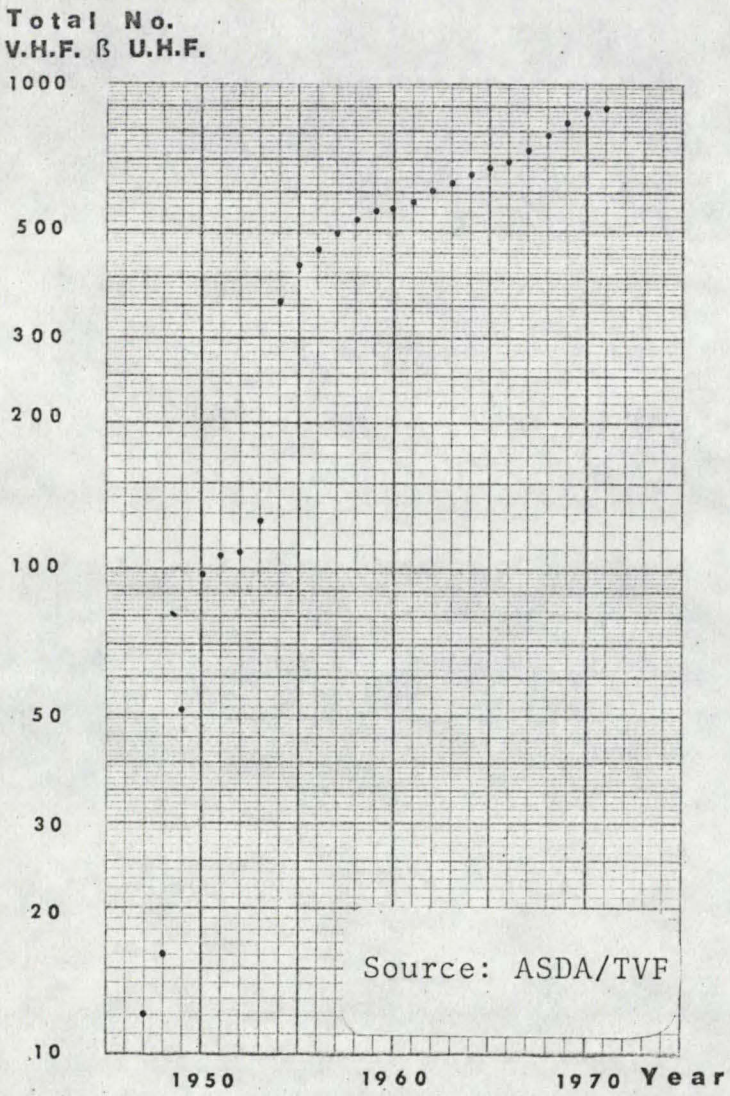
Source: ASDA/TVF

NOTE: The system size is taken as the size estimated for 1976, regardless of initial size.

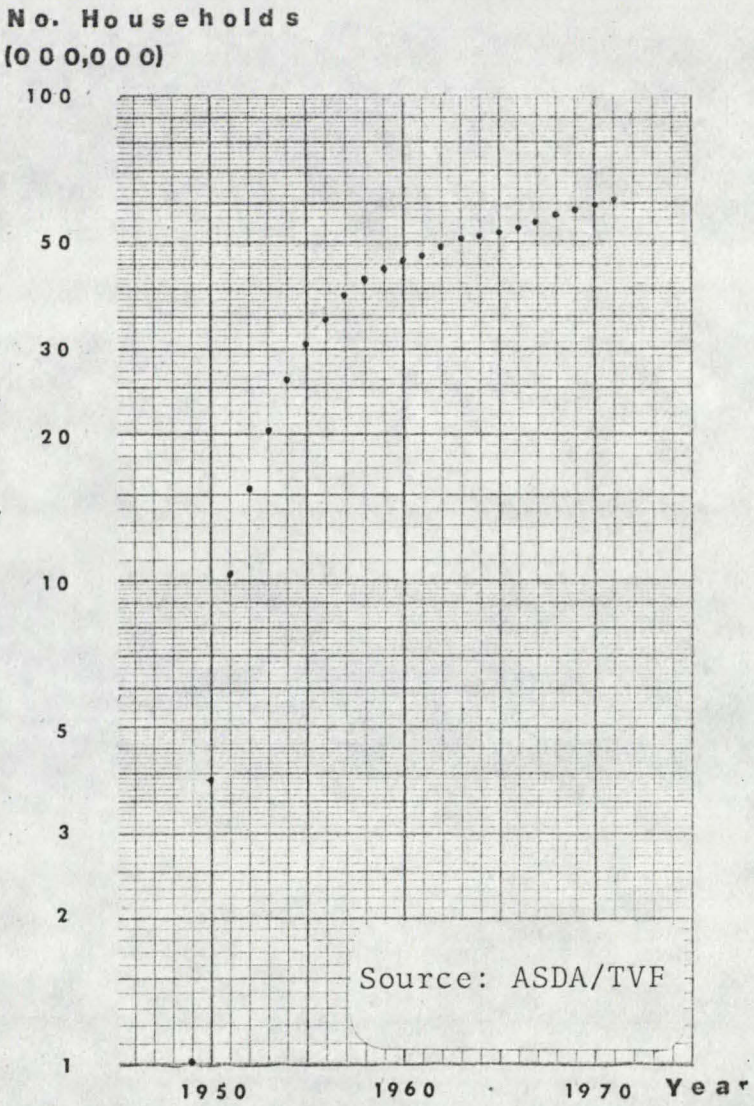

SYSTEMS
10,000
1,000
100
10
U.S.
Canada
Source: ASDA/TVF
1950
60
70
80
year


NUMBERS OF SUBSCRIBERS
10M
1M
100K
10K
U.S.
Canada
Source: ASDA/TVF/
Stat.Can.
1950
60
70
80

GROWTH OF T.V. IN U.S.A.



U.S. V.H.F. ß U.H.F. T.V. Stations on Air



U.S. T.V. HouseHolds

Small discrepancies between numbers of CATV systems will be noted in the table.

CRTC data (source 3) represent the actual number of CATV systems licensed, as of 31 March 1972.

The several components of these composite maps are shown separately in Volume 2.
The location of CATV systems, together with sources of TV signals in the U.S., is shown in greater detail for each Province in Section 6, Vol.2.

The vast majority of these signals are received off-the-air. Only very few microwave systems exist.

Basic configurations of communication systems to deliver these TV signals to CATV systems in each Province (or region) are shown in Section 3.

Salient statistics on the status of the CATV industry are shown in the following table. T 1.07

Items of greatest relevance to the current study are identified thus ▶

Geographical distribution of CATV systems is shown with relation to:

- o TV signal sources in the U.S. T 1.08
- o CBC TV coverage. T 1.09
- o Coverage of other Canadian TV networks. T 1.10
- o Major communication arteries. T 1.11

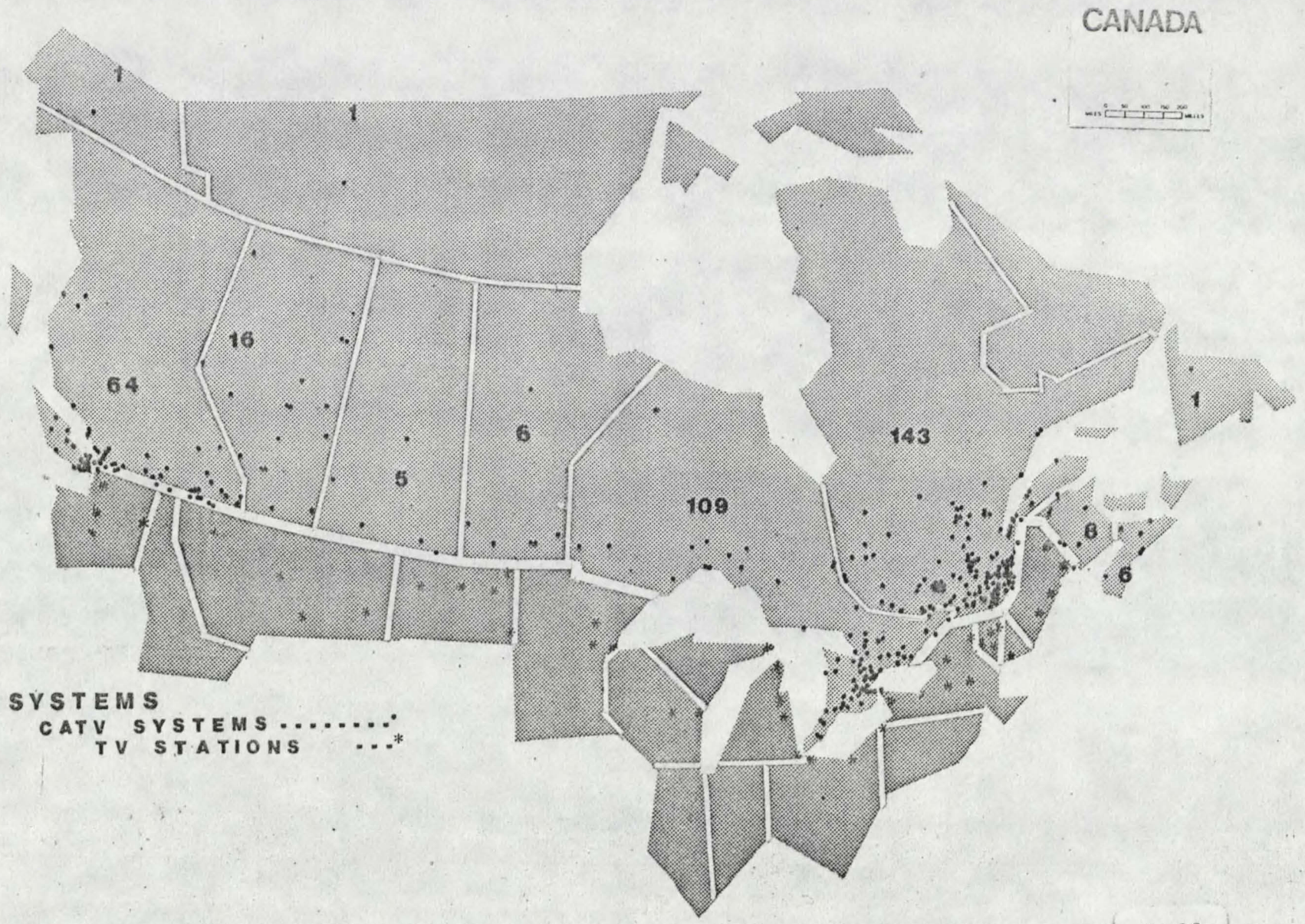
A strong correlation between concentration of CATV systems and their proximity to U.S. signal sources is evident. T 1.08 T 7.20 T 7.21
In a substantial number of cases, the reception of these signals could be greatly improved by conveying them via microwave from remote headends to distribution systems.

CATV SYSTEM STATISTICS - OVERVIEW

SOURCE	ITEM	CANADA # x1000	CANADA %	B.C. # x1000	B.C. %	ONT. # x1000	ONT. %	QUE. # x1000	QUE. %	OTHER # x1000	OTHER %
1.	POP'N	20,844.2		2,097.3		7,505.1		5,883.1		5,358.7	
	HOMES ▷	5,798.1	3.6*	647.1	3.2*	2,146.5	3.5*	1,544.7	3.8*	1,459.8	3.7*
	CATV HOMES ▷	1,321.5	23	320.0	50	598.0	28	324.0	21	79.5	5
	TV HOMES	5,596.3	97	617.5	95	2,086.6	97	1,508.3	98	1,383.9	95
	COLOUR TV HOMES	972.5	17	151.5	23	392.5	18	224.0	15	204.5	14
	FM RADIO HOMES	3,251.5	56	349.5	54	1,330.0	62	931.0	60	641.0	44
2.	LICENSED SYSTEMS	343		58		108		137		40	
	OPERATING SYSTEMS	326	95	58	100	104	96	131	96	33	83
	SUBSCRIBERS ▷	1,082.4	19	221.5	34	540.3	25	254.5	16	66.2	5
	MULTI-OUTLET UNITS	316.1	2	130.0	6	129.6	2	40.4	1	16.2	0
	SYSTEMS > 500 SUBSCRIBERS	254	78	48	83	87	84	98	75	21	64
	HOUSEHOLDS "IN VIEW"	2,681.3	46	448.4	68	1,211.0	56	833.9	54	188.0	13
	HOUSEHOLDS IN CATV ZONES ▷	3,095.6	53	485.5	74	1,480.7	69	915.8	59	213.5	15
3.	LICENSED SYSTEMS ▷▷	360		64		108		146		45	
4.	SYSTEMS	370		61		113		157		39	
	> 5000 SUBSCRIBERS ▷	77	26	16	31	42	45	12	10	7	21
	1000-5000 SUBSCRIBERS ▷	96	32	14	27	31	33	40	34	11	32
	< 1000 SUBSCRIBERS ▷	123	42	22	42	20	22	65	56	16	47
	NO DATA ON SIZE	74		9		20		40		5	
	SUBSCRIBERS	1,252	100	301	24	572	46	283	23	97	7

SOURCES: 1. BBM Sept. 70/Jan. 71
2. ASDA/STAT CAN 71
3. CRTC 71-72 Annual Report
4. ASDA/TVF 70-71

* Ratio



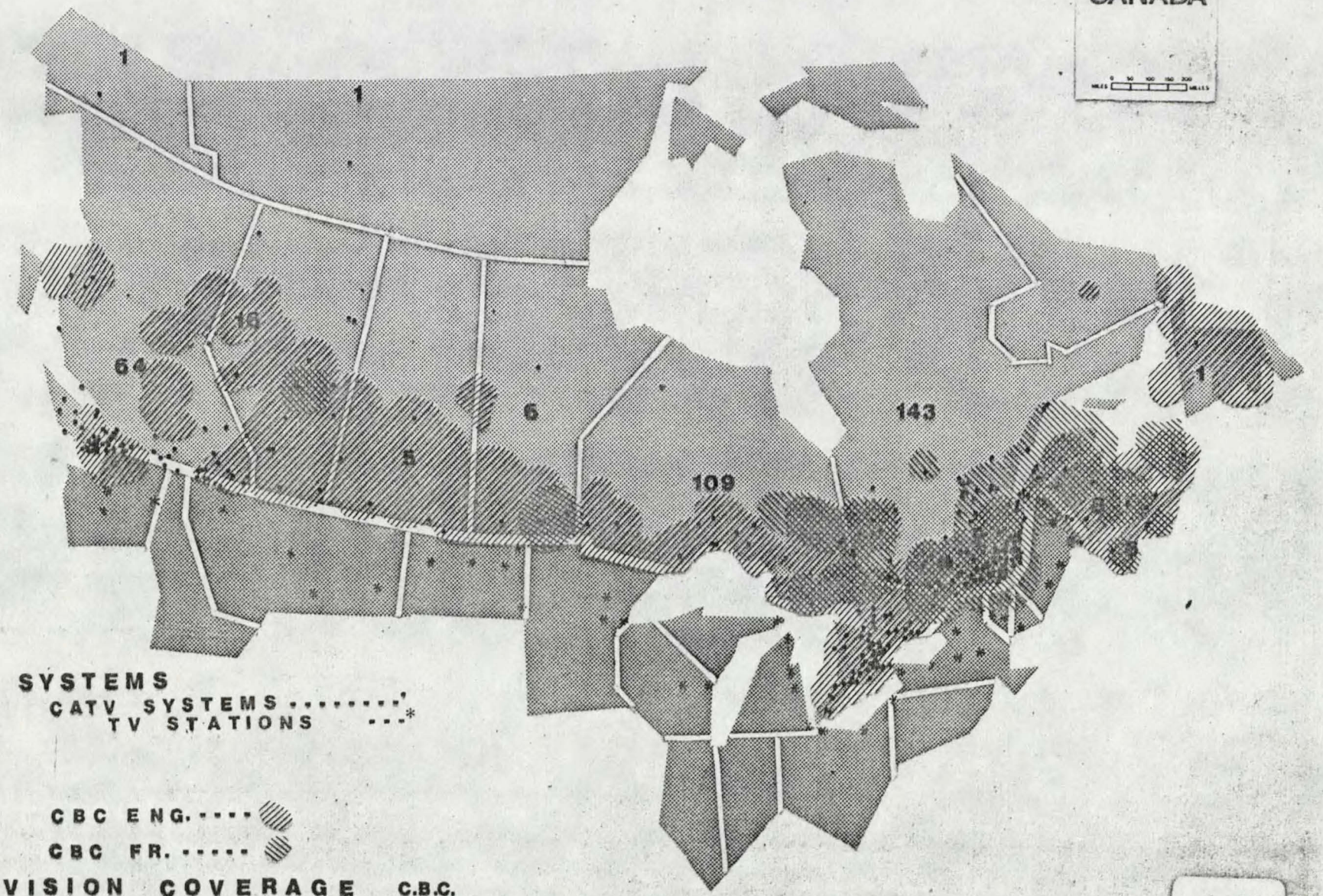
CATV SYSTEMS

CATV SYSTEMS .....•

TV STATIONS ---*

SOURCE: ASDA/CRTC

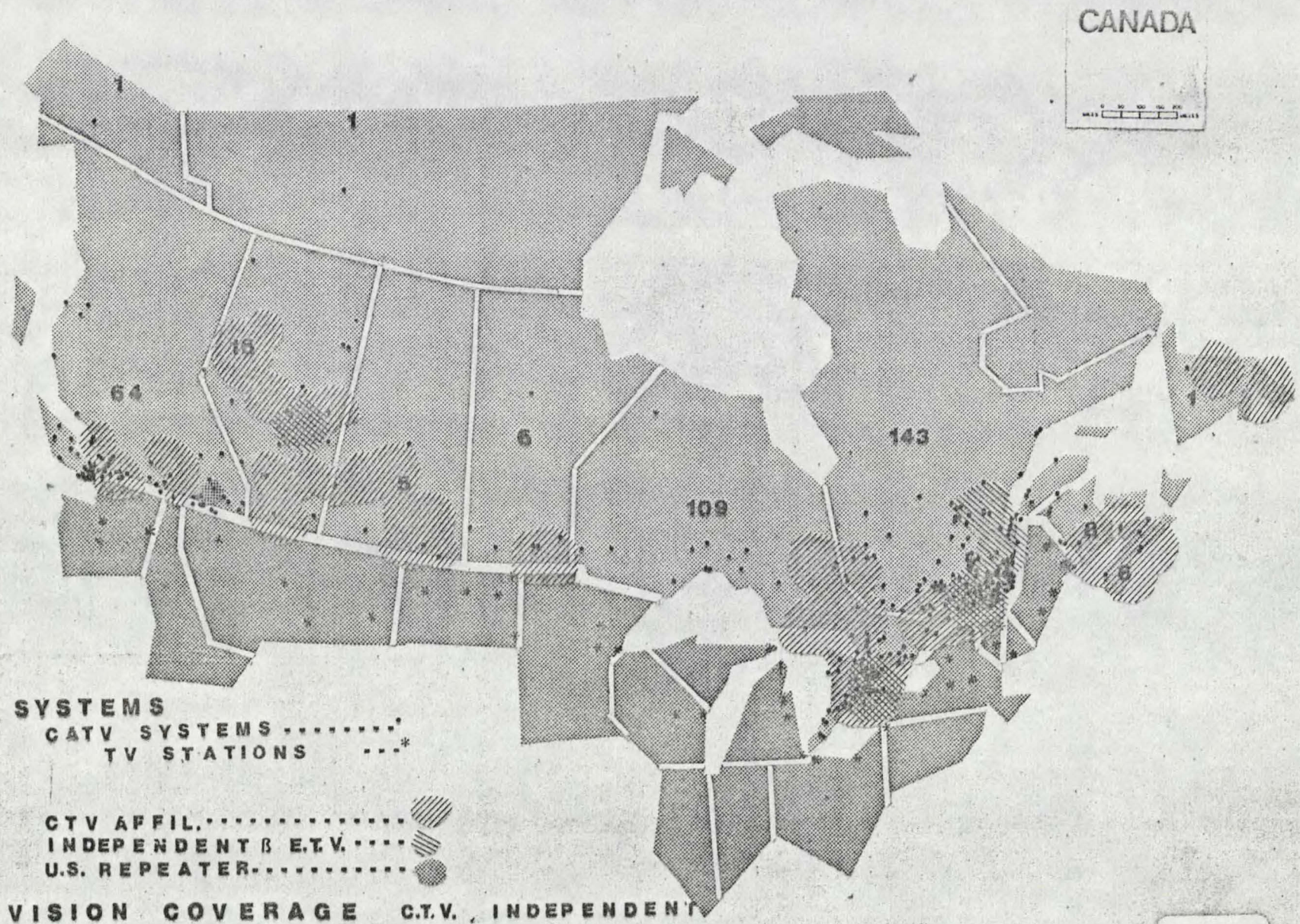
1.08
5.07



TELEVISION COVERAGE C.B.C.

SOURCE: ASDA/CRTC

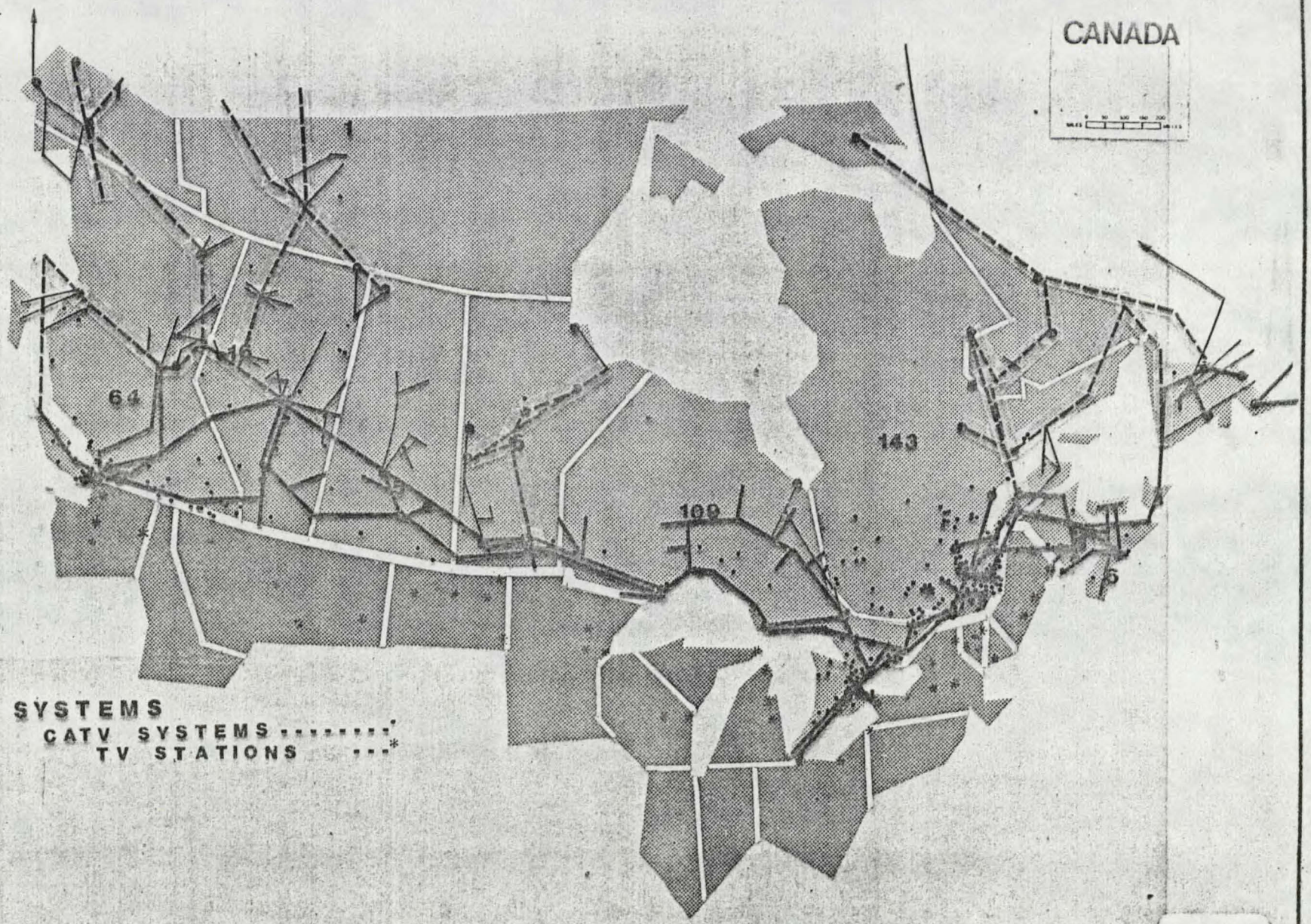
1.09
5.08



TELEVISION COVERAGE C.T.V., INDEPENDENT

SOURCE: ASDA/CRTC

1.10
5.09



CATV SYSTEMS

CATV SYSTEMS .....

TV STATIONS ---*

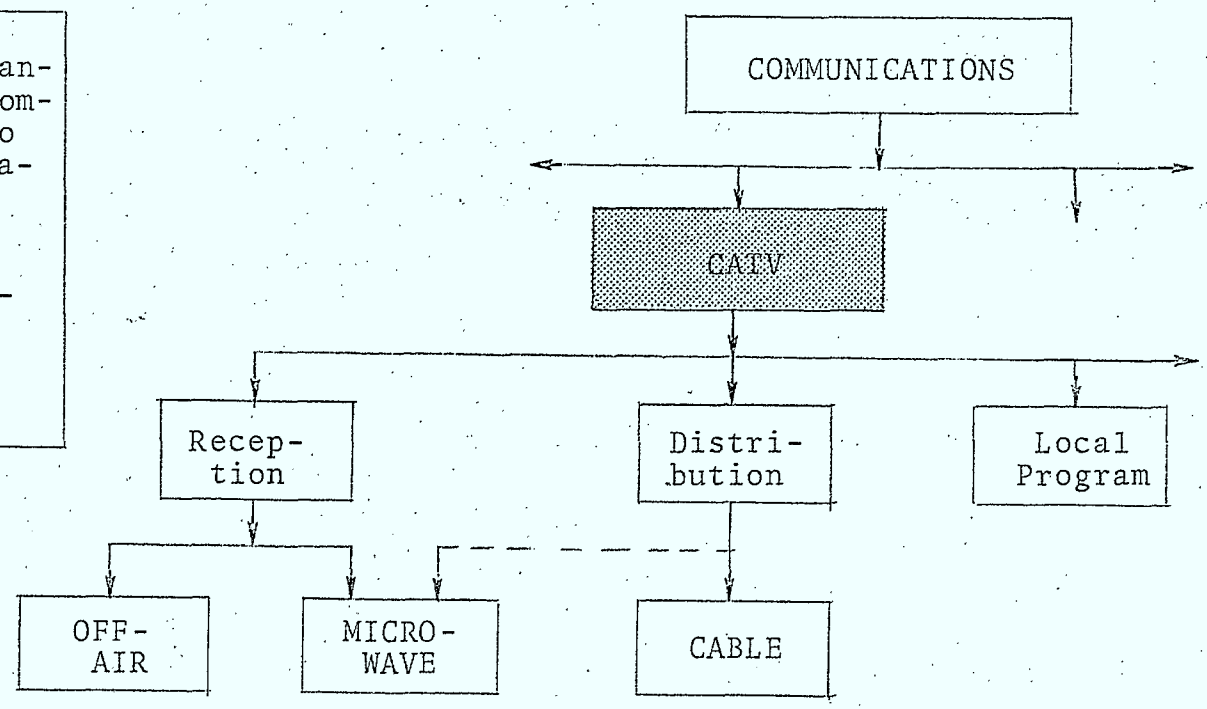
MAJOR OPERATIONAL SYSTEMS

SOURCE: ASDA/CRTC / DOC

1.11
5.10

Some major aspects of the mandate of the Department of Communications, which relate to CATV systems, are here summarized.

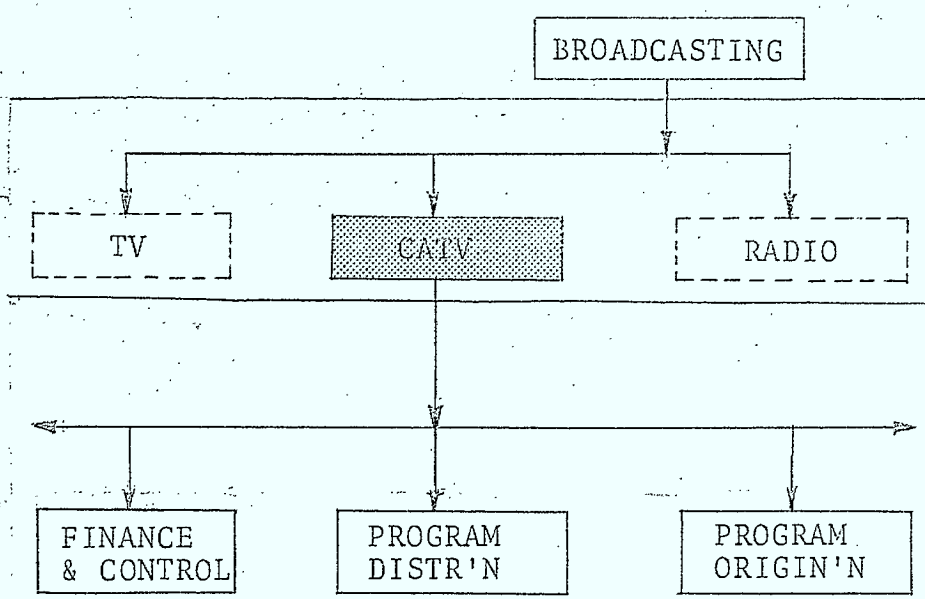
Specific aspects concerning microwave systems are considered in Section 3.



D.O.C. CONCERNS				
Performance Quality	Reception	System	System	Technical
Technical Standards	None	Approval	Approval	
Frequency Allocation		Approval		
Selection of Carrier		Approval		

Some major aspect of Policy of the Canadian Radio-Television Commission which affect CATV systems are here summarized.

Specific aspects concerning micro-wave systems are considered in Section 3.



CRTC CONCERNS

Ownership	approval		
Operation & Statistics	monitor		
Entertainment		monitor	encourage
Education & Community		encourage	encourage
Advertizing		control	control
U.S. Programs		limit	
Canadian Programs		regulate	encourage
Off-Air Pick-Up		no control	
Microwave System		control	

This analysis is confined to estimated expansion of existing systems.

- o No figures are given for provinces where the statistical base is not broad enough for meaningful forecasts, in terms of the average number of TV channels carried, and in terms of numbers of CATV systems carrying Canadian and U.S. programs.

This detail is shown in Volume 2.

OBJECTIVES

The main objectives of this summary analysis of CATV Systems are: T 1.15 T 5.12

- o To obtain an indication of likely expansion (in terms of numbers of subscribers) during the current 5 year period. T 5.13 T 5.14
- o To gauge the relative significance of Canadian and U.S. signal sources.
- o To obtain average figures for monthly rates charged.
- o To obtain a measure of how the above CATV aspects change
  - from one province to another.
  - for different size systems. T 5.12 T 5.13 T 5.14

CATV SYSTEMS ANALYSIS

ALL SYSTEMS

REGION	CATV total	POPULATION k (x1000) 1971	SUBSCRIBERS EST'D 1976 k	SUBSCRIBERS ACTUAL 1971 k	SUBSCRIBERS INCR %	US. ORIGIN MIN 1 CH #	US. ORIGIN MIN 1 CH %	US. ORIGIN 3 N'WK #	US. ORIGIN 3 N'WK %	CDN. ORIGIN CTV #	CDN. ORIGIN CTV %	CDN. ORIGIN LOCAL #	CDN. ORIGIN LOCAL %	AVERAGES US ch	AVERAGES CDN ch	AVERAGES CH cap	AVERAGES MO rate
Canada	296	21568.3	2214.8	1252.3	77	224	76	122	41	184	62	57	19	3.3	3.8	10.1	4.40
B. Col.	52	2184.6	397.3	300.8	31.4	47	90	34	65	35	68	10	19	3.1	2.3	9.7	5.19
Ont.	93	7703.1	1092.4	572.1	91.0	87	94	56	60	74	80	32	35	3.4	5.4	12.0	4.36
Que.	117	6027.8	500.8	282.5	77.5	69	59	29	25	51	44	10	9	1.3	4.1	8.7	3.90
Other	34	5652.8	224.3	96.9	132.	21	62	3	9	24	71	5	15	2.0	2.6	8.6	5.05
Alberta	12	1627.9	105.3	33.5		5	42	0	0	10		2	17	0.8	2.5	9.8	
Sask.	4	926.2	8.7	6.6		2	50	0	0	3		1	25	1.3	3.0	8.5	4.73
Man.	6	988.2	92.5	44.9		5	83	2	33	5		1	17	1.8	2.4	8.5	
	22		206.5	85.0		12	55	2	9	18		4	18	1.2		9.3	
N.B.	9	634.6	14.0	9.5		9	100	1	11	1		1	1	1.7	3.1	7.5	
N.S.	1	789.0	2.1	1.0		0	0	0	0	1		0		0	4.0	8.0	4.75
	10		16.0	10.5						2		1		1.7		7.8	
Nfld.	1	522.1	.3	.3											2.0	2.0	
Yukon	1	18.4	1.5	1.1													9.25
	2		1.8	1.4													

Data for CATV systems of three size categories are shown in tables 5.13-5.15.

P1006 / D.O.C.
source: ASDA / TVF

In view of the extensive basic coverage offered by Canadian TV systems the question concentrates on the reception of remote Canadian and U.S. stations, particularly the latter.

Available information is confined to theoretical design values.

This information is presented in Section 6 of Volume 2 for all provinces or regions considered.

The questionnaire is shown in Section 8 of Volume 2. Weighting factors used in subsequent analysis are quoted in Section 8 of Volume 2.

This information relates to individual channels received, regardless of CATV system.

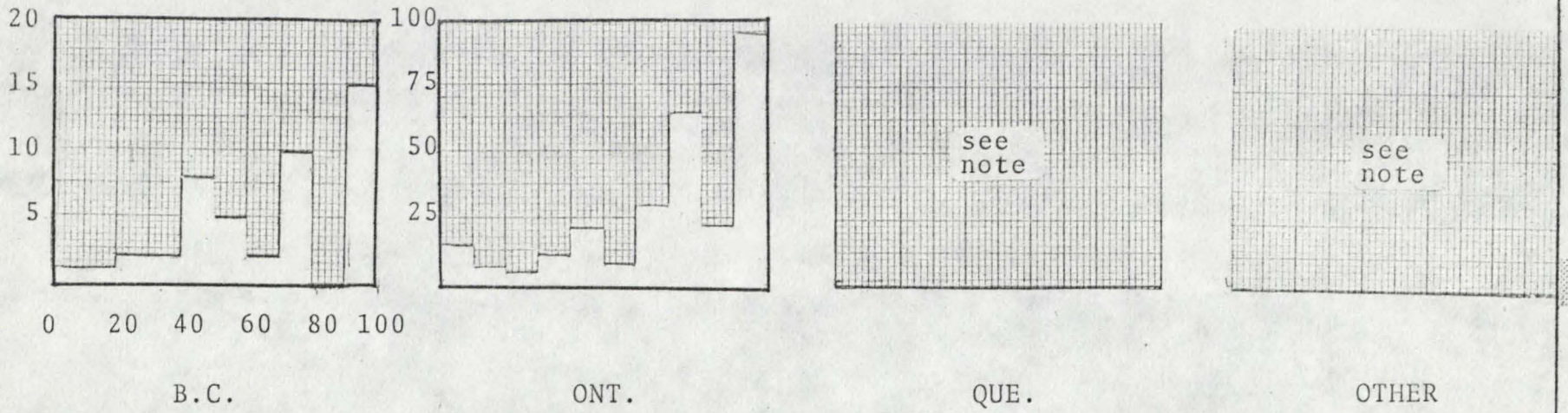
A central issue in determining the likely demand for microwave systems is the quality of desired signals received and distributed by existing CATV systems.

Because of the paucity of relevant available data, an extensive analysis was carried out, based on two basic methods:

- Summary statistical analysis, based on assumed correlations between reception conditions and distance from the desired TV station.
- A direct enquiry, by means of a survey directed to all CATV operators, seeking their subjective evaluation of reception quality.

The findings of this survey are presented in the table on the following page. T 1.17

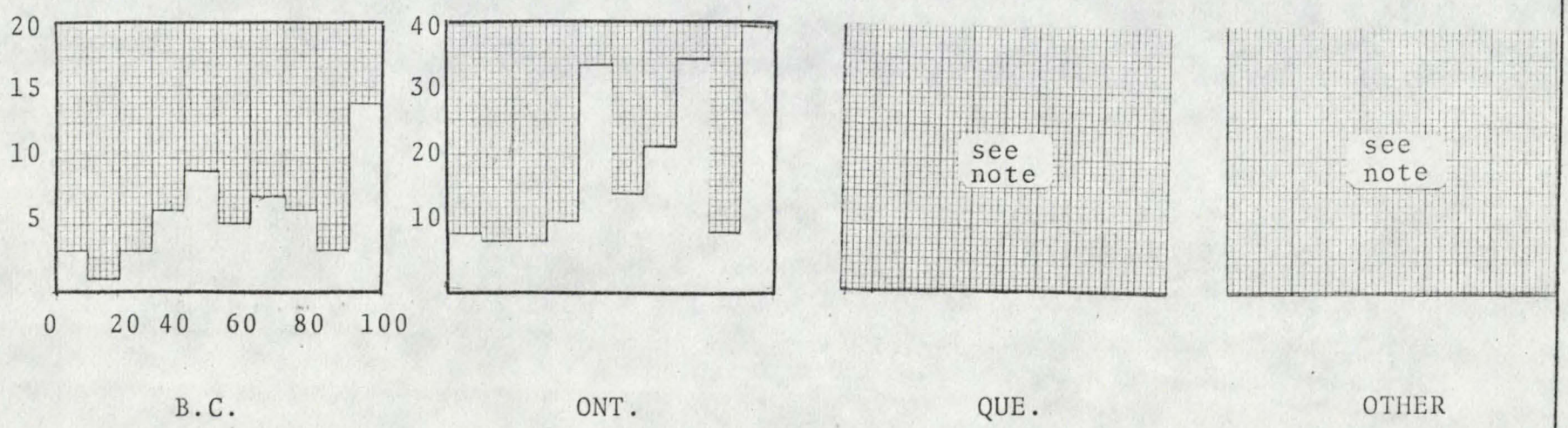
The findings of this analysis are interpreted as a measure of need, regardless of economic considerations.



CANADIAN TV SIGNALS

OFF-THE-AIR RECEPTION

Note: Insufficient data for meaningful statistics.



U.S. SIGNALS

OFF-THE-AIR RECEPTION

The assessment of economic feasibility of microwave systems, as given by CATV system operators in response to the survey, is used as corroboration of the analysis here described.

Financial categories considered by Statistics Canada are converted to approximately equivalent ranges of system size (in terms of subscribers).
The average number of subscribers for each category is denoted by a dot.
Some of these data were quoted only as percentages.

The dotted lines represent the limits of the shaded portion of chart F 1.22.

The dots represent actual system size (in terms of subscribers). The line extends to the estimated size in 1976.

Selected financial information on the CATV industry is of direct relevance as a measure of economic feasibility to implement any microwave facilities for which a need has been established.

Information on investment, revenue and profit are correlated with system size in the following table and charts.

Two methods are used:

- o Analysis based on data published by Statistics Canada. F 1.20
- o Analysis of information obtained directly from CATV system operators during the survey. F 1.21 F 1.22 F 1.23

Good agreement exists between data obtained by these alternative techniques. F 1.20

Most values for total investment lie in the shaded portion of the chart; this does, however represent quite a large spread (2.5:1). F 1.21

In general, the cost of the head-end installation increases with the remoteness of the desired signals.

The upper cost limit for off-air pick-up is largely determined by technical constraints.

The spread is even larger (10:1) in the case of head-end investment, as expected. F 1.22

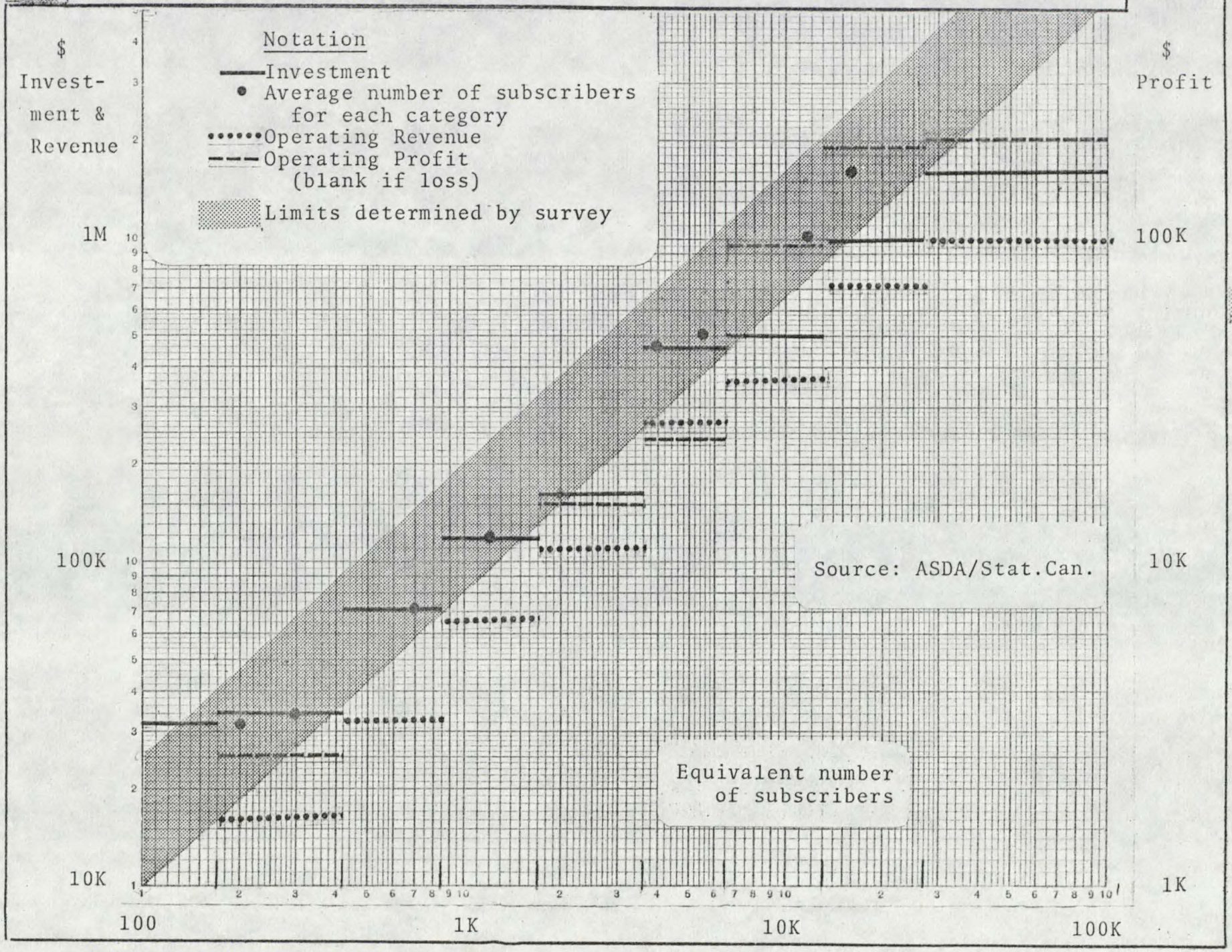
It is interesting to note that for large systems (more than 10,000 subscribers) the head-end cost tends to stay well within 10% of the total investment. F 1.23

Category $	12.5	25	50	100	200	400	800	1600
Subscribers (K)	.2	.4	.8	1.7	3.7	6.7	13.3	26.7

TOTALS (CATV System Groups)										Total/Avg.
Companies	70	27	40	38	26	24	15	10	11	261
Stations	77	30	45	44	33	27	23	16	31	326
Subscribers (K)	13.1	10.3	30.7	51.1	64.5	107.2	129.2	181.8	494.5	1082.4
Investment M$	2.7	1.6	4.6	9.7	7.4	16.0	15.6	24.0	78.2	159.8
Head-End M$	2.4	1.0	3.2	5.1	5.1	12.8	11.4	15.6	50.7	107.2
& Distribution %	89	63	70	53	69	80	73	65	65	67
Operating Revenue K$	403.0	482.2	* 1.5	* 2.9	* 3.8	* 6.6	* 8.2	*11.6	*31.3	*66.6
Net Operating Profit K$	(72.3)	74.3	(256.1)	(250.1)	480.2	644.5	* 2.2	* 3.1	* 6.2	*12.1

AVERAGES (per CATV System)										
Subscribers (K)	0.2	.3	.7	1.2	2.0	4.0	5.6	11.4	16.0	3.3
Investment K$	34.0	52.0	102.9	220.7	223.6	590.8	678.8	* 1.5	* 2.5	490.1
▷ Head-End & Distribution K$	30.7	34.3	71.1	114.9	153.9	474.4	493.8	975.8	* 1.6	329.0
▷ Operating Revenue M$	5.2	16.1	32.9	64.9	115.5	244.7	354.4	722.4	* 1.0	204.4
▷ Net Operating Profit M$	(.9)	2.5	(5.7)	(5.7)	14.5	23.9	96.4	191.1	199.5	37.1
Profit/Investment %	(17.9)	15.4	(17.0)	(8.6)	12.6	9.8	26.8	26.7	19.8	18.2
Profit/Subscriber $/mo.	(0.46)	0.60	(0.70)	(0.41)	0.62	0.50	1.42	1.42	1.04	.93

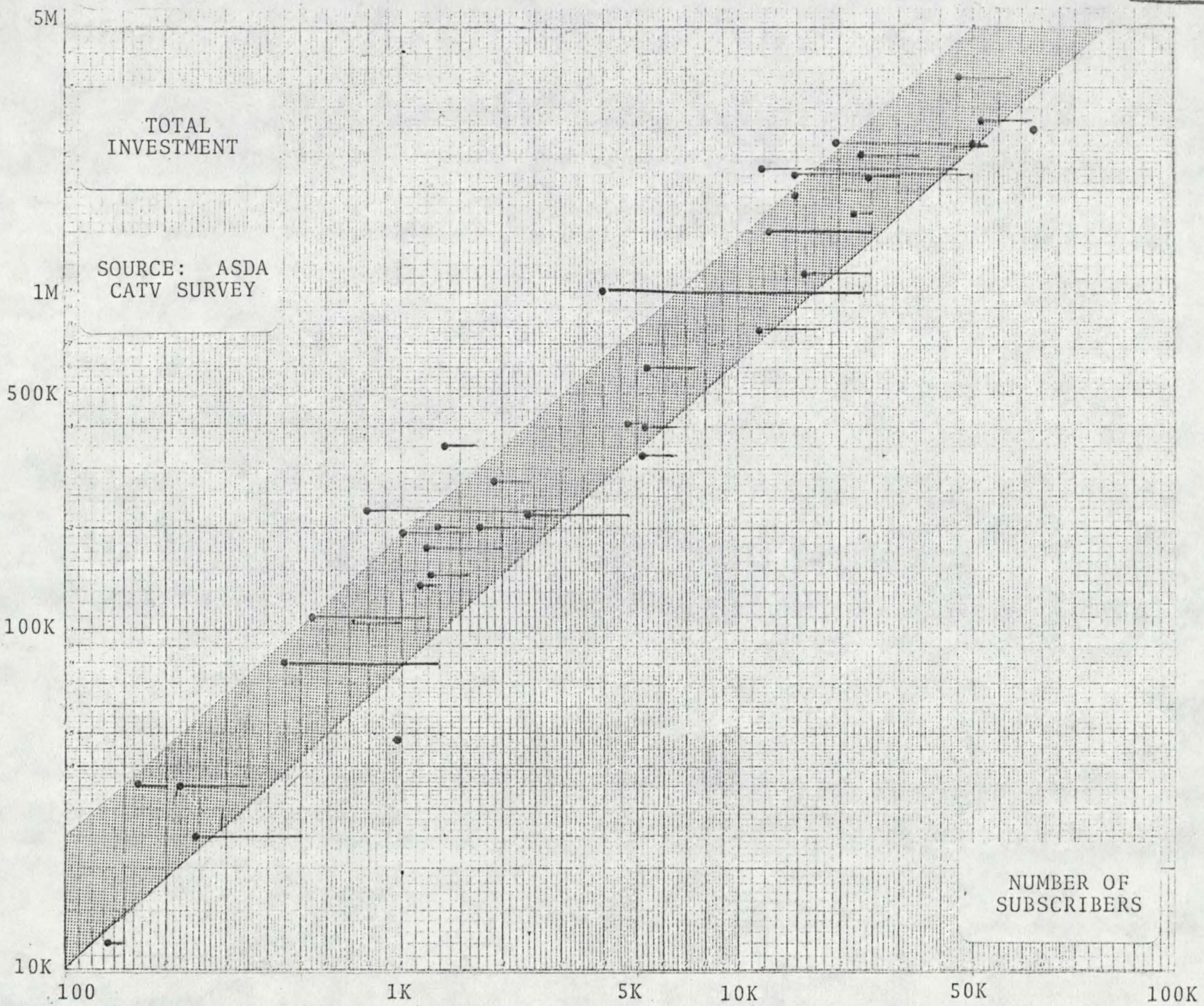
* M $ (data).....loss ▷ shown on F 1.21 Source: ASDA/Stat. Can.


$
Invest-
ment &
Revenue
$
Profit
Notation
Investment
Average number of subscribers for each category
Operating Revenue
Operating Profit (blank if loss)
Limits determined by survey
1M
100K
10K
100K
10K
1K
Source: ASDA/Stat.Can.
Equivalent number of subscribers
100
1K
10K
100K

INVESTMENT

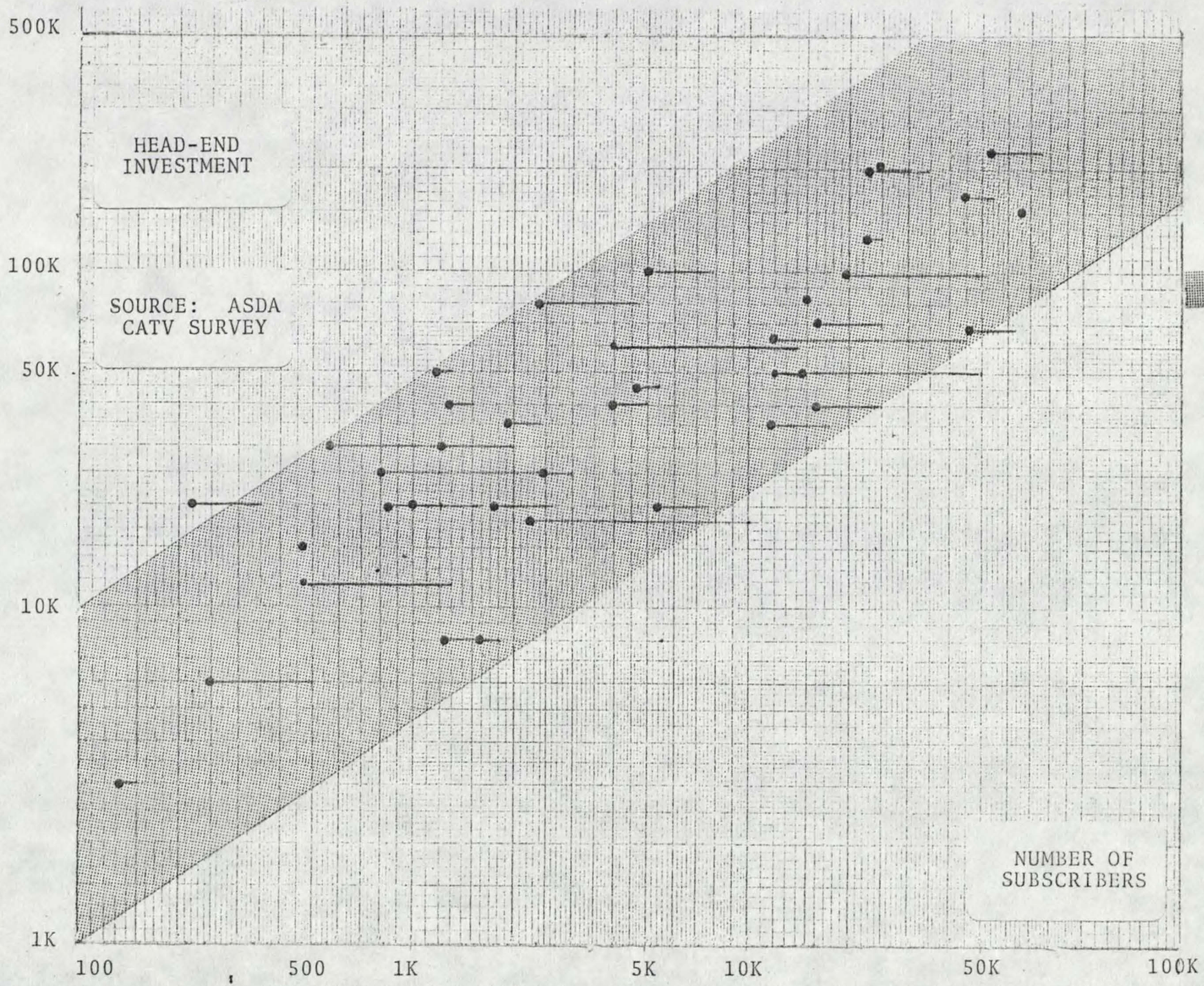
TOTAL INVESTMENT

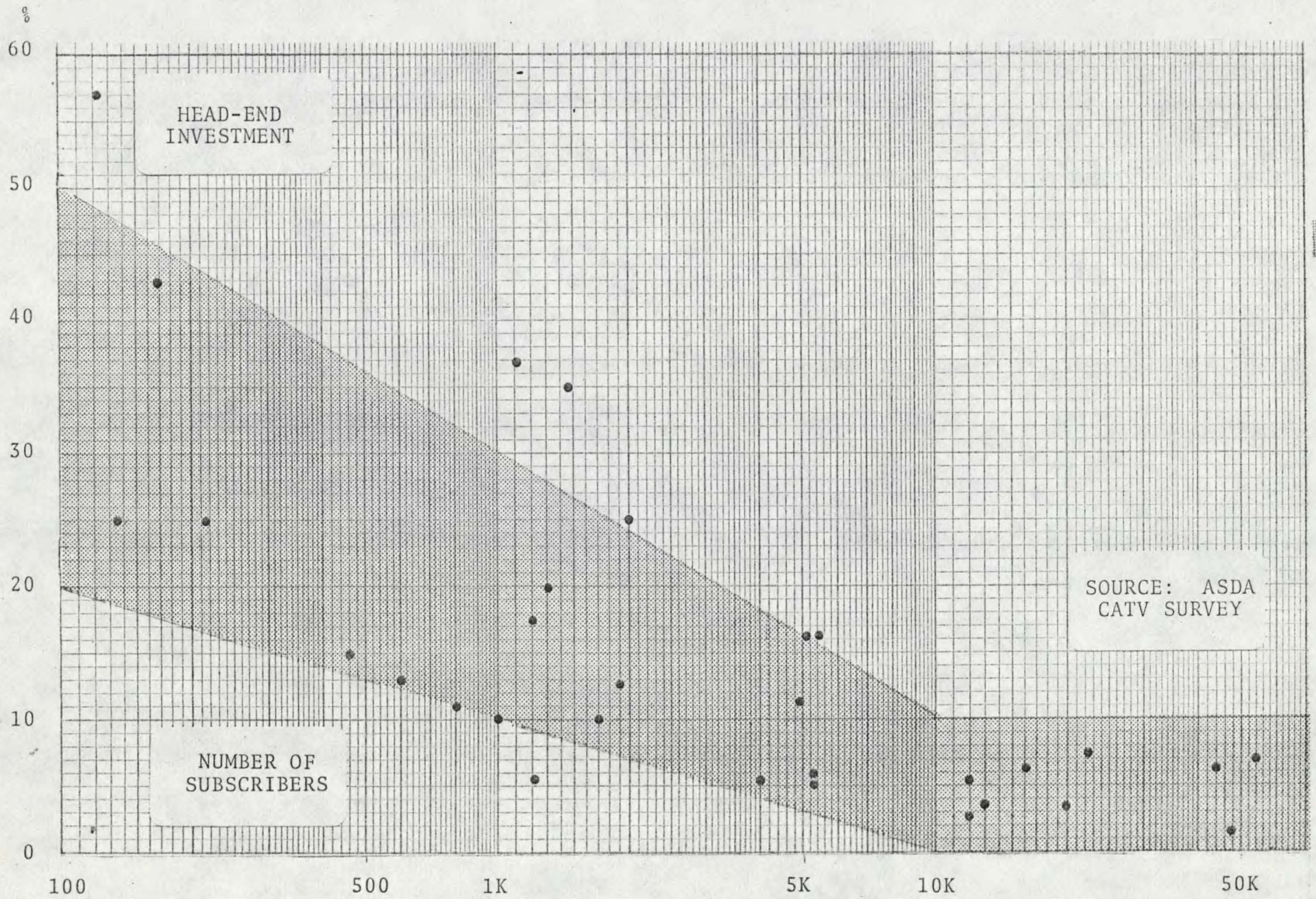
1.22



INVESTMENT — HEAD-END

1.23




%
60
50
40
30
20
10
0
HEAD-END INVESTMENT
NUMBER OF SUBSCRIBERS
SOURCE: ASDA CATV SURVEY
100
500
1K
5K
10K
50K

We had earlier considered signal reception conditions by two methods:

- o Summary Statistical Analysis.
- o CATV Systems Survey.

These questions have in fact been asked in the CATV survey.

Replies represent, of course, the CATV operators' summary evaluation of the situation.

In addition, a number of the CATV operators have accepted the invitation, extended in the survey, to offer their comments on the broader issues involved. (See Section 8 of Volume 2).

Given for British Columbia and Ontario only, for the other provinces the data base is insufficient for meaningful statistical analysis.

The following questions arise in connection with any steps to improve reception conditions for remote TV signals:

- o What is existing signal quality?
- o What alternatives exist for effecting improvement?
- • Would such improvement increase the number of subscribers?
- • Would subscribers be willing to pay additional fees for such improved service?
- o What is the economic feasibility of such improvement?
- o Specifically, is a microwave system needed and could its cost be met from the CATV operators' own resources?
- • How much pressure do subscribers apply on the CATV operator to effect improvement of service?

Replies to the above questions (•) indicate, in general, that: F 1.27

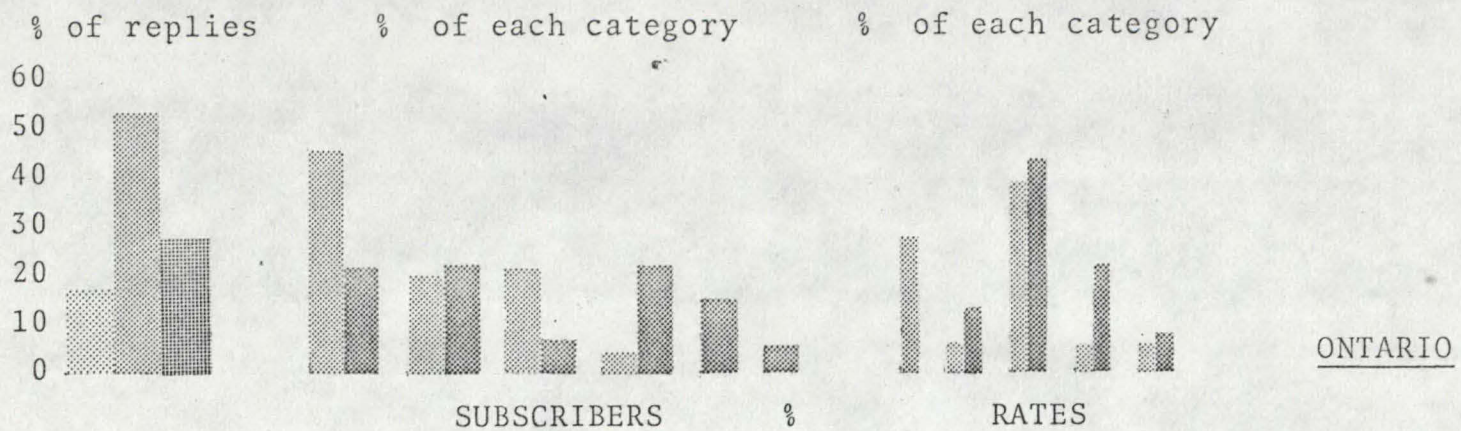
- o Pressure to improve quality is not very heavy.
- o CATV operators expect little or

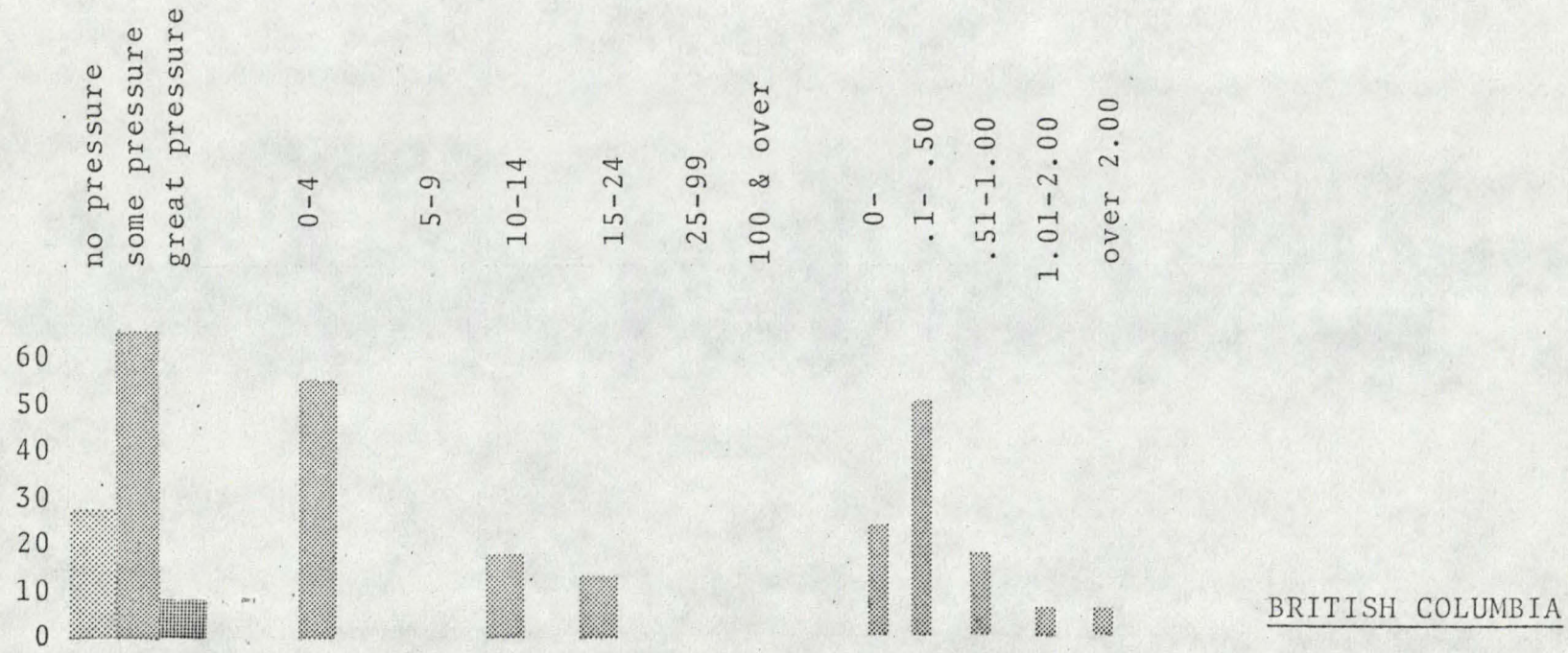
The comments of Mr. R.V. Mielen, while perhaps not typical of replies received, are nevertheless of considerable relevance and interest. (Section 8.10, Volume 2).

no increase in the numbers of subscribers or

- In the monthly fee they would be willing to pay for improved signal quality.

Nevertheless there appears widespread concern and interest on the part of CATV operators to improve the quality of service.


% of replies
% of each category
% of each category
60
50
40
30
20
10
0
SUBSCRIBERS %
RATES
ONTARIO


no pressure
some pressure
great pressure
0-4
5-9
10-14
15-24
25-99
100 & over
0-
.1- .50
.51-1.00
1.01-2.00
over 2.00
60
50
40
30
20
10
0
BRITISH COLUMBIA

This statistic applies to viewers and excludes non-viewers. The variation between regions and age groups is relatively slight.

Some salient data on viewing patterns are presented: T 1.29

- o Average TV viewing per weekday is in excess of 3½ hours.
- o The U.S. program content is under 20%.

The average numbers of channels carried by CATV systems are given in table 1.15

British Columbia	US 3.1, Cdn 2.3
Ontario	US 3.4, Cdn 5.4
Quebec	US 1.3, Cdn 4.1

The percentage of U.S. programs viewed is highest in provinces where CATV enjoys the greatest penetration (B.C. 42%, Ont. 35%).. The extent to which CATV systems contribute to raising the proportion of U.S. programs viewed is not explicitly stated. T 1.29

The low percentage of U.S. programs viewed in Quebec is attributable to language considerations.

In quite a number of comments received from CATV operators in Quebec (in response to the survey) greater emphasis was placed on receiving distant (French) Canadian stations rather than U.S. stations.

It is doubtful that improvement of quality of signals already received off-air will materially affect viewing patterns.

Broader social implications are discussed in connection with future trends in CATV.

It seems most likely that providing U.S. signals via microwave to CATV system that so far do not carry U.S. stations will substantially increase the viewing content of U.S. programs.

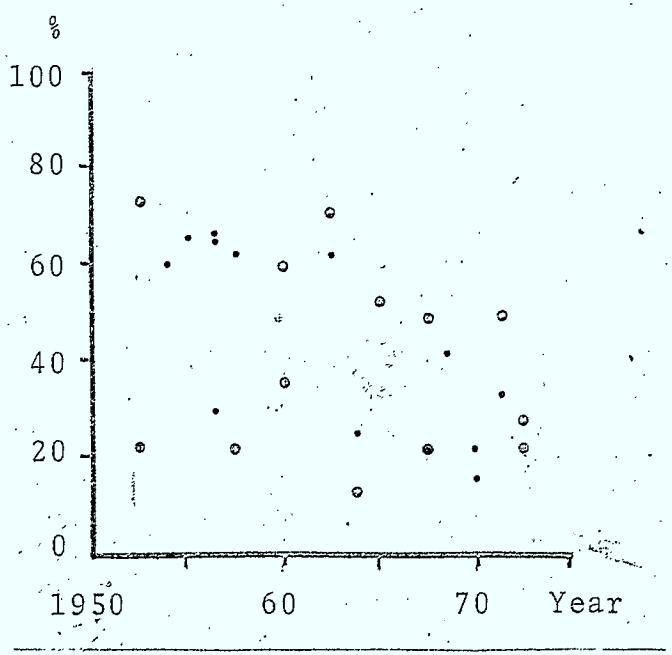
VIEWING PATTERNS - OVERVIEW

Coverage	CANADA # x1000	CANADA %	B.C. # x1000	B.C. %	ONT. # x1000	ONT. %	QUE. # x1000	QUE. %	OTHER # x1000	OTHER %
CBC English Coverage	15,143.6	73	1,865.2	89	6,490.2	86	1,985.1	34	4,803.1	90
CTV English Coverage	11,413.1	55	1,315.0	63	4,924.7	66	1,799.6	31	3,373.8	63
CBC French Coverage	5,093.8	24			237.8	3	4,657.1	79	198.6	4
Indep. French Coverage	3,841.8	18			80.6	1	3,761.2	64		0
Viewing by Network										
U.S. Stations (K-hrs)	85.0	18	18.5	42	54.8	35	6.4	4	5.3	5
Canadian Stations (K-hrs)	376.5	82	25.1	58	101.6	65	137.3	96	112.5	95
CBC English		33								
CTV English		20								
Indep. English		3								
CBC French		14								
Indep. French		12								
Daily Hours of Viewing										
All Viewers (avg. weekday)	3.6									
Adult Men "	3.4		3.3		3.1		3.6			
Adult Women "	4.3		3.9		4.0		4.9			
Teenagers "	3.2									
Children "	3.2									

Source ASDA/BBM

Scatter Plot

Penetration versus years in operation.



• metropolitan
• urban

Source: ASDA/BBM

It is suggested by other studies that maximum penetration of CATV systems is 75-80% for the range of services offered by CATV systems today and at a monthly fee of $5.

This would seem in keeping with the scatter plot shown on this page, based on 1970 figures (BBM) for penetration in major urban and metropolitan areas.

The scatter plot shows little correlation between years of operation and penetration, this points to the importance of factors such as type and quality of services offered in determining penetration.

The referenced studies further suggest that penetration of CATV systems would drop sharply for increases in monthly fee significantly above $5.
These findings seem corroborated by the CATV operators' own evaluation of market elasticity with respect to improved reception conditions.

ONE-WAY SERVICES

Programs

Local TV
Imported TV
Community TV
Educational TV
Movies, Sports
Public Information
Special Interest
FM Radio

Services

Time, weather,
Continuous news

o eg. community affairs

o eg. education, sports events

Expansion of existing services may be expected in several directions.

- o Improvement of quality.
- o Larger choice of program sources.
- o Development of locally originated programs.
- o Inter-city connection (microwave or satellite).

Improvement in quality refers both to the distribution systems (new DOC standards) and to the reception system. The latter may be obtained by:

- o Improvement of existing off-air pick-up systems.
- o Addition of microwave systems, as discussed in the next section.
- o Inter-connection of two or more urban systems.

Locally originated programs are of two general types

- o Those of local interest within the CATV system.
- o Those of wider interest for which system interconnection seems desirable.

TWO-WAY SERVICES

One-Way Return

- o Utility metering
- o Alarm

Viewer Response

- o Opinion polling
- o Voting

Viewer Initiation

- o Program selection
  - Entertainment
  - Education
  - Information categories
- o System access
  - Catalogue shopping
  - Classified ads
  - Stock market
  - Travel information
- o Fully inter-active
  - Computer services
  - CAI
  - Banking
  - Visual information
  - Travel reservation

Beyond the extension of existing services, as previously discussed, CATV systems have a vital role to play in the introduction of inter-active visual services.

The establishment of these facilities will, in the view of many authorities, usher in a new era in communications, whose consequences and social implications can at this time only barely be grasped.

These new services rely on the provision of a return path from subscriber to CATV distribution centre which, at least in the initial stages of this development, will serve primarily as a response or control device.

It will be noted that a large proportion of these services is of an essentially local character and viable only in an urban environment.

Capacity

The minimum capacity here of interest is one TV channel; several TV channels may be combined.

Frequency

Specific frequency bands are assigned according to service and ownership.

Modulation

- o FDM (frequency division)
- o PCM (pulse code modulation)

Performance

- o Long haul (continental)
- o Medium haul (inter-city)
- o Short haul (approximate range 150 miles).

Ownership

- o Common carrier
- o Private commercial
- o Manufacturers (experimental).

Microwave systems may be categorized with reference to a number of technical or functional criteria.

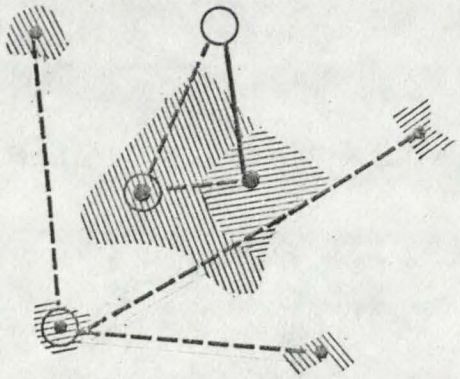
- o Information capacity.
- o Frequency.
- o Modulation type.
- o Performance quality.
- o Ownership.

For the specific application to CATV systems, three basic functional types of microwave systems are considered

- o Intra-city.
- o Head-end extension.
- o Inter-city.

Satellite systems are outside the scope of the present study.

Type 1
Intra-City



Function

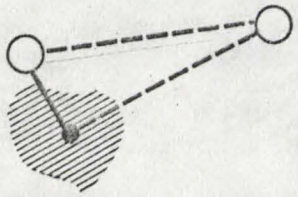
Serves to interconnect

- o Systems within metropolitan areas.
- o Suburban or satellite communities.

Problems

Frequency congestion.

Type 2
Head-End Extension



Function

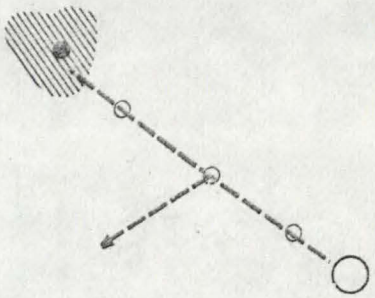
Head-end site location is trade-off between suitability for off-the-air signal pick-up and cost of cable run to city.

Provision of microwave link may allow choice of more suitable head-end location.

Problems

In urban areas: Frequency congestion.
Microwave propagation conditions.

Type 3
Long Haul (Inter-City)



Function

To carry TV signal from remote origin (eg. off-the-air pick-up) to point of distribution over several links of a microwave system.

Problems

System cost
Frequency congestion.

NOTATION

◯ Head-end
● Distribution point
——Cable
---Microwave
o Repeater station

Method

For the purpose of this analysis microwave installations are considered in three categories:

- o Single hop systems/serving primarily to allow head-end relocation.
- o Two hop systems/serving also for remoting the head-end installation (or connecting to a main trunk).
- o Extensive systems/more than two hops required to convey a signal from a remote pick-up point to the system.

  Such a medium to long-haul system could serve as a trunk to which a number of small systems could be connected.

Establishment of Need

There are several ways to estimate potential demand for microwave installations to serve existing CATV systems:

- o Analysis of signal sources and reception conditions.
- o Subjective evaluations in response to CATV survey.
- o Extrapolation from existing installations and actual applications for new ones.

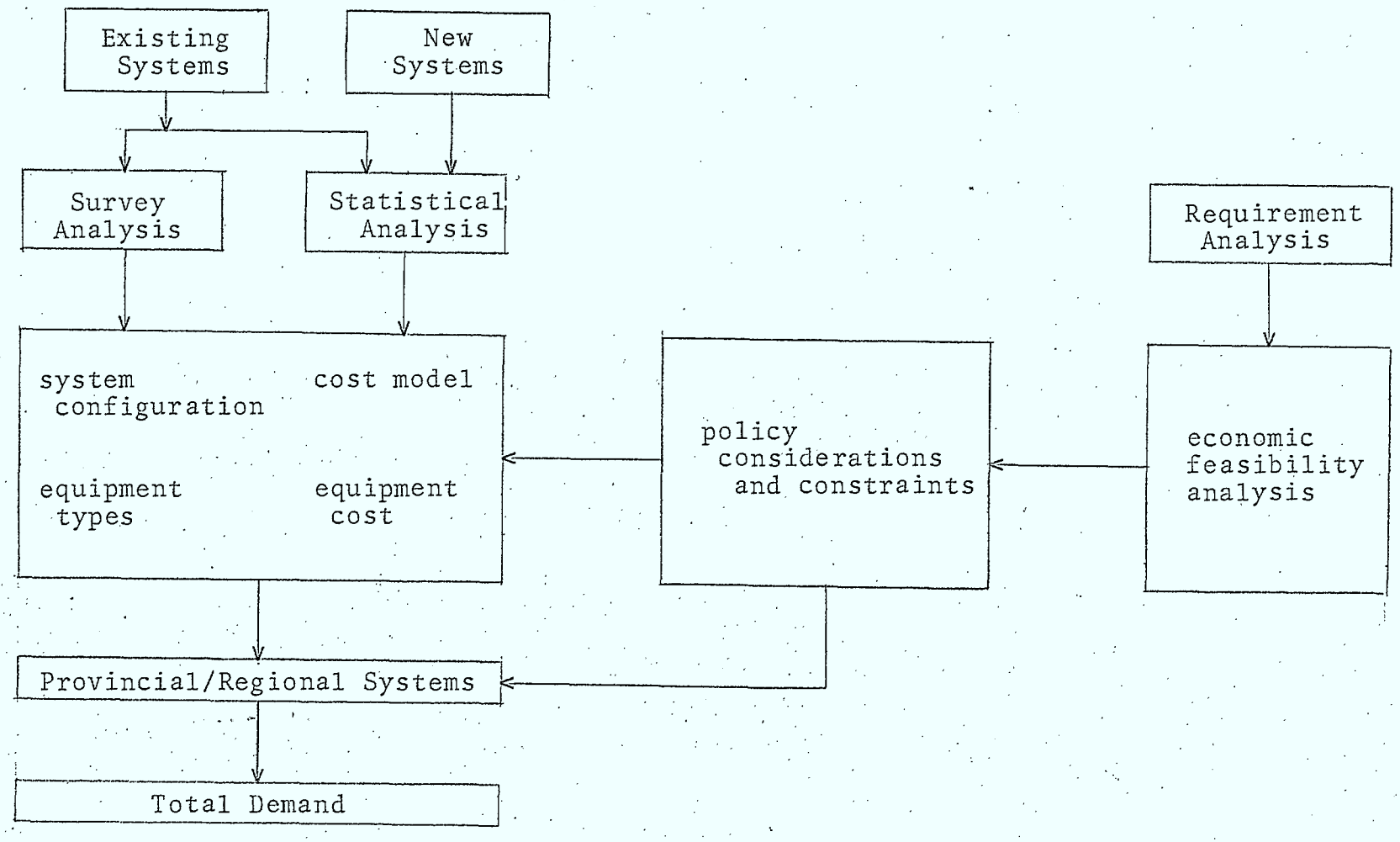
The need for new systems is extrapolated from present coverage of major population centres.

Examination of Constraints

Economic and other constraints are examined on the basis of

- o System cost alternatives.
- o Subjective evaluation in response to CATV survey.

Methods used for estimating demand for microwave systems for CATV services are here outlined.



These matrices relate range of TV signal sources (in the U.S.) to specific CATV systems of stated sizes.

These appear on the tables as operants on single hop, two-hop and multi-hop systems.

These factors, different for each size of system and each microwave system A-C, appear also on the tables.

Economic factors are developed on the basis of cost models relating

- o Resources to system size and increment.
- o Equipment cost comparison.

The shaded portion shows combinations of system size and source distance which give rise to a potential demand for a microwave system.

From the matrices presented in Volume 2, a single matrix has been prepared. T 2.06

Need is estimated on the basis of requirement factors assigned to each range (Type D). T 2.09 T 2.10 T 2.11

Economic factors are applied for systems of three different cost levels (Types A, B, C).

These are intended to correspond roughly to these alternatives:

A CARS type system

B Conventional microwave F 2.08

C Common carrier system. F 2.08

The requirement matrices anticipate, to a degree, economic factors. T 2.06

- o The TV channel matrix shows all channels received from U.S. sources.
- o The systems matrix shows systems in terms of the TV channel from the most distant source received.

MICROWAVE SYSTEM

POTENTIAL DEMAND
(U.S. STATIONS)

SYSTEMS

D \ S	●	•	·	●	•	·	●	•	·	●	•	·	●	•	·	S / D
●	11	8	11	5	12	12	6	7	7	5	5	2	27	32	32	●
•	3	4	7	33	13	5	6	17	17	0	1	2	42	35	31	•
·	1	1	0	4	2	0	0	2	7	0	0	2	5	5	9	·

BRITISH COLUMBIA	ONTARIO	QUEBEC	OTHER PROVINCES	CANADA

TV CHANNELS

D \ S	●	•	·	●	•	·	●	•	·	●	•	·	●	•	·	S / D
●	17	20	16	8	28	17	7	7	8	10	7	3	42	62	44	●
•	27	30	30	101	53	14	16	28	27	3	3	4	147	114	75	•
·	22	4	3	65	19	3	6	20	15	0	0	3	93	43	24	·

NOTATION: Systems (S)
- ● > 5000 Subscribers
- • 1000-5000 Subscribers
- · < 1000 Subscribers

Distance (D)
- ● Beyond off-air pick-up
- • Off-air pick-up zone
- · Proximity to transmitter

Microwave potential

SIMPLIFIED COST MODEL

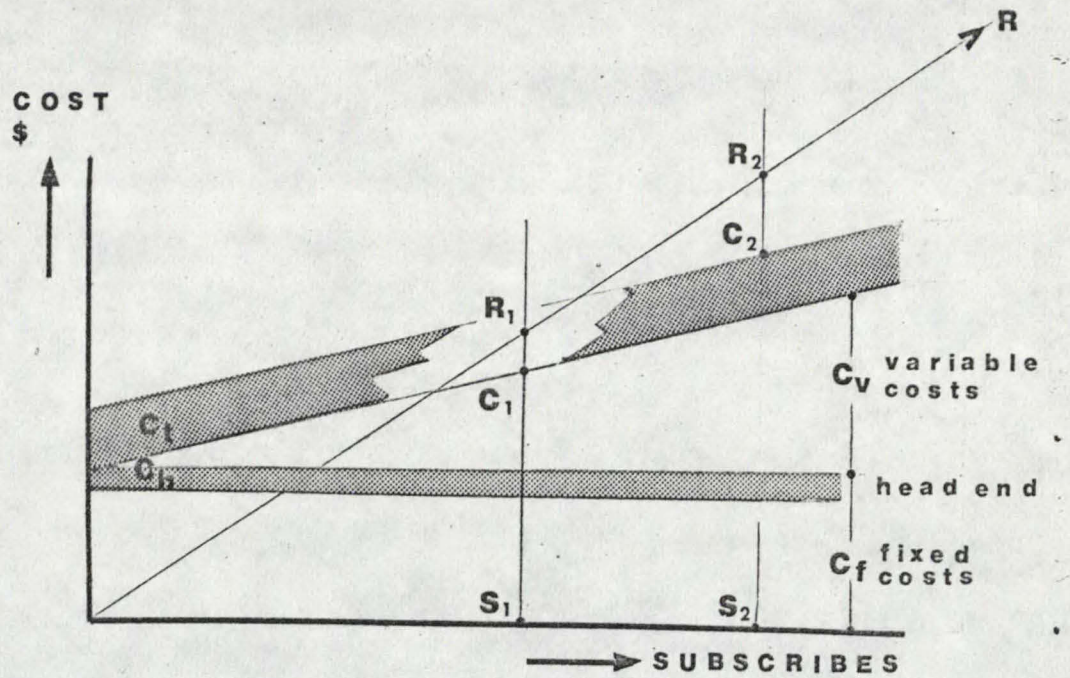
OBJECT

To establish criterion for profitability of microwave transmission facility, on the basis of:

- o increased number of subscribers
- o increased subscription cost.

ASSUMPTIONS

- o Existing head-end retained
- o Variable costs vary linearly with number of subscribers.



CRITERION FOR PROFITABILITY

$$R_2/C_2 > R_1/C_1$$

$$r_2.S_2/(c_f + c_t + c.S_2) > r_1.S_1/(c_f + cS1)$$

$$c_t < \frac{r_2 S_2}{r_1 S_1}(c_f + cS_1) - (c_f + cS_2)$$

if $r_1 = r_2$ $\quad c_t < c_f(S_2 - S_1)/S_1$

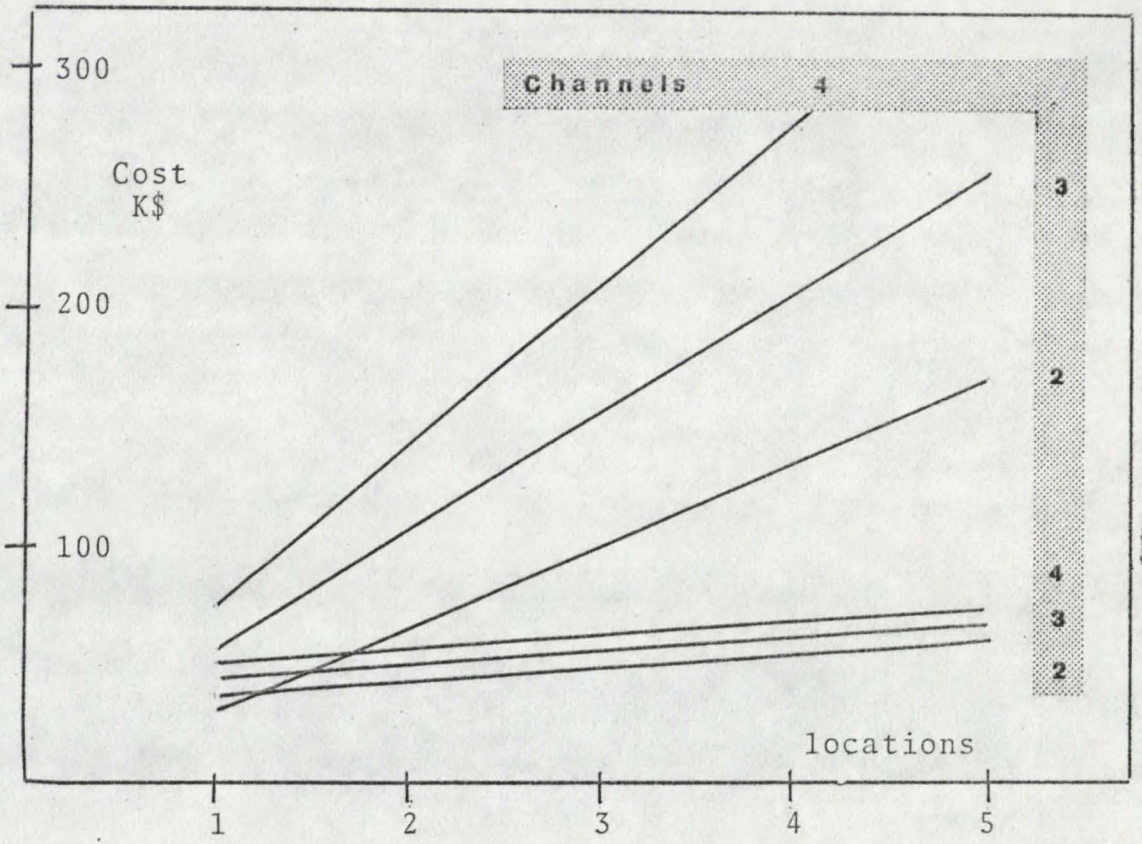
if $S_1 = S_2$ $\quad c_t < (r_2/r_1 - 1).(c_f + cS)$

where: c...unit variable cost
r_1...old unit revenue
r_2...new unit revenue

Other symbols may be identified from the diagrams.

The chart shows cost comparison between a typical CARS-type system and conventional microwave system.

Costs for basic electronic equipment only are shown.



Low incremental costs render this type of system particularly suitable for the inclusion of additional small CATV systems within an area already covered.

Of particular significance for the CARS-type system are the low incremental costs for augmentation of:

- o TV channels.
- o Locations.

MICROWAVE SYSTEMS

ESTIMATE OF POTENTIAL DEMAND

CANADA

1	SYSTEMS ANALYSIS	A $	A	A	B $	B	B	C * $	C	C	System Type Cost/link CATV system size	
BIAS	LONG RANGE FACTOR										FACTOR	MEDIUM RANGE
	Extensive 0.8	.50	.00	0.0	.75	.25	0.0	.75	.25	0.0	0.1	Extensive
	2-link 0.2	.75	.25	0.0	1.0	.50	.25	1.0	.75	.50	0.25	2-link
	1-link 0.0	1.0	.50	.25	1.0	.75	.50	1.0	1.0	.75	0.65	1-link
	Requirement Factors	Economic Factors									Requirement Factors	

2		RECEPTION RANGE CATV SIZE CATV SYSTEMS	Long 27	Long 32	Long 32	Medium 42	Medium 35	Medium 31	ESTIMATED DEMAND Systems	Links	Total	
SYSTEM TYPE	A	Extensive 3-link	10.8	-	-	2.1	-	-	12.9	38.7		A
		Remote H-E 2-link	4.1	1.6	-	7.9	2.2	-	15.8	31.6	114	
		Near H-E 1-link	-	-	-	27.3	11.4	5.1	43.8	43.8		
	B	Extensive 3-link	16.2	6.4	-	3.2	.9	-	26.7	80.1		B
		Remote H-E 2-link	5.4	3.2	1.6	10.5	4.4	2.0	27.1	54.2	189	
		Near H-E 1-link	-	-	-	27.3	17.1	10.1	54.5	54.5		
	C	Extensive 3-link	16.2	6.4	-	3.2	.9	-	26.7	80.1		C
		Remote H-E 2-link	5.4	4.8	3.2	10.5	6.6	3.9	34.4	68.8	214	
		Near H-E 1-link	-	-	-	27.3	22.8	15.2	65.3	65.3		
	D **	Extensive 3-link	21.6	25.6	25.6	4.2	3.5	3.1	83.6	250.8		D
		Remote H-E 2-link	5.4	6.4	6.4	10.5	8.8	7.8	45.3	90.6	412	
		Near H-E 1-link	-	-	-	27.3	22.8	20.2	70.3	70.3		**

* For extensive systems apply B

** No economic constraints

MICROWAVE SYSTEMS

ESTIMATE OF POTENTIAL DEMAND

BRITISH COLUMBIA

1	SYSTEMS ANALYSIS	A $ ●	A ○	A •	B $ ●	B ○	B •	C * $ ●	C ○	C •	System Type Cost/link CATV system size	
BIAS	LONG RANGE FACTOR										FACTOR	MEDIUM RANGE
	Extensive 0.8	.50	.00	0.0	.75	.25	0.0	.75	.25	0.0	0.1	Extensive
	2-link 0.2	.75	.25	0.0	1.0	.50	.25	1.0	.75	.50	0.25	2-link
	1-link 0.0	1.0	.50	.25	1.0	.75	.50	1.0	1.0	.75	0.65	1-link
	Requirement Factors	Economic Factors									Requirement Factors	

2		RECEPTION RANGE CATV SIZE CATV SYSTEMS	Long ● 11	Long ○ 8	Long • 11	Medium ● 3	Medium ○ 4	Medium • 7	ESTIMATED DEMAND Systems	Links	Total	
SYSTEM TYPE	A	Extensive 3-link	4.4	-	-	.2	-	-	4.6	13.8	24	A
		Remote H-E 2-link	1.7	.4	-	.6	.3	-	3.0	6.0		
		Near H-E 1-link	-	-	-	2.0	1.3	1.2	4.5	4.5		
	B	Extensive 3-link	6.6	1.6	-	.2	.1	-	8.5	25.5	42	B
		Remote H-E 2-link	2.2	.8	.6	.8	.5	.4	5.3	10.6		
		Near H-E 1-link	-	-	-	2.0	2.0	2.3	6.3	6.3		
	C	Extensive 3-link	6.6	1.6	-	.2	.1	-	8.5	25.5	48	C
		Remote H-E 2-link	2.2	1.2	1.1	.8	.8	.9	7.0	14.0		
		Near H-E 1-link	-	-	-	2.0	2.6	3.5	8.1	8.1		
	D **	Extensive 3-link	8.8	6.4	8.8	.3	.4	.7	25.4	76.2	105	D **
		Remote H-E 2-link	2.2	1.6	2.2	.8	1.0	1.8	9.6	19.2		
		Near H-E 1-link	-	-	-	2.0	2.6	4.6	9.2	9.2		

* For extensive systems apply B

** No economic constraints

MICROWAVE SYSTEMS

ESTIMATE OF POTENTIAL DEMAND

ONTARIO

1	SYSTEMS ANALYSIS		A $ ●	A ○	A •	B $ ●	B ○	B •	C * $ ●	C ○	C •	System Type Cost/link CATV system size	
BIAS	LONG RANGE FACTOR											FACTOR MEDIUM RANGE	
	Extensive	0.8	.50	.00	0.0	.75	.25	0.0	.75	.25	0.0	0.1	Extensive
	2-link	0.2	.75	.25	0.0	1.0	.50	.25	1.0	.75	.50	0.25	2-link
	1-link	0.0	1.0	.50	.25	1.0	.75	.50	1.0	1.0	.75	0.65	1-link
	Requirement Factors		Economic Factors									Requirement Factors	

2		RECEPTION RANGE CATV SIZE CATV SYSTEMS		Long ● 5	Long ○ 12	Long • 12	Medium ● 33	Medium ○ 13	Medium • 5	ESTIMATED DEMAND Systems	Links	Total	
SYSTEM TYPE	A	Extensive	3-link	2.0	-	-	1.7	-	-	3.7	11.1	55	A
		Remote H-E	2-link	.8	.6	-	6.2	.8	-	8.4	16.8		
		Near H-E	1-link	-	-	-	21.5	4.3	.8	26.6	26.6		
	B	Extensive	3-link	3.0	2.4	-	2.5	.3	-	8.2	24.6	80	B
		Remote H-E	2-link	1.0	1.2	.6	8.3	1.7	.3	13.1	26.2		
		Near H-E	1-link	-	-	-	21.5	6.4	1.7	29.6	29.6		
	C	Extensive	3-link	3.0	2.4	-	2.5	.3	-	8.2	24.6	88	C
		Remote H-E	2-link	1.0	1.8	1.2	8.3	2.5	.7	15.5	31		
		Near H-E	1-link	-	-	-	21.5	8.5	2.5	32.5	32.5		
	D	Extensive	3-link	4.0	9.6	9.6	3.3	1.3	.5	28.3	84.9	156	D
		Remote H-E	2-link	1.0	2.4	2.4	8.3	3.3	1.3	18.7	37.4		
	**	Near H-E	1-link	-	-	-	21.5	8.5	3.3	33.3	33.3		**

* For extensive systems apply B

** No economic constraints

MICROWAVE SYSTEMS

ESTIMATE OF POTENTIAL DEMAND

QUEBEC

1	SYSTEMS ANALYSIS		A $ ●	A ○	A •	B $ ●	B ○	B •	C * $ ●	C ○	C •	System Type Cost/link CATV system size	
BIAS	LONG RANGE FACTOR											FACTOR MEDIUM RANGE	
	Extensive	0.8	.50	.00	0.0	.75	.25	0.0	.75	.25	0.0	0.1	Extensive
	2-link	0.2	.75	.25	0.0	1.0	.50	.25	1.0	.75	.50	0.25	2-link
	1-link	0.0	1.0	.50	.25	1.0	.75	.50	1.0	1.0	.75	0.65	1-link
	Requirement Factors		Economic Factors									Requirement Factors	

2		RECEPTION RANGE CATV SIZE CATV SYSTEMS		Long ● 6	Long ○ 7	Long • 7	Medium ● 6	Medium ○ 17	Medium • 17	ESTIMATED DEMAND Systems	Links	Total	
SYSTEM TYPE	A	Extensive	3-link	2.4	-	-	.3	-	-	2.7	8.1	27	A
		Remote H-E	2-link	.9	.4	-	1.1	1.1	-	3.5	7.0		
		Near H-E	1-link	-	-	-	3.9	5.6	2.8	12.3	12.3		
	B	Extensive	3-link	3.6	1.4	-	.4	.4	-	5.8	17.4	49	B
		Remote H-E	2-link	1.2	.7	.4	1.5	2.2	1.1	7.1	14.2		
		Near H-E	1-link	-	-	-	3.9	8.3	5.6	17.8	17.8		
	C	Extensive	3-link	3.6	1.4	-	.4	.4	-	5.8	17.4	61	C
		Remote H-E	2-link	1.2	1.1	.7	1.5	3.2	2.2	9.9	19.8		
		Near H-E	1-link	-	-	-	3.9	11.1	8.3	23.2	23.3		
	D **	Extensive	3-link	4.8	5.6	5.6	.6	1.7	1.7	20.0	60.0	114	D **
		Remote H-E	2-link	1.2	1.4	1.4	1.5	4.3	4.3	14.1	28.2		
		Near H-E	1-link	-	-	-	3.9	11.1	11.1	26.1	26.1		

* For extensive systems apply B

** No economic constraints

It is interesting to note the correlation between subscribers' pressure for system improvement and the reception quality of U.S. signal (F 2.14).

The CATV operators' ability and preparations to meet the cost of microwave links from their own resources is also indicated.

The pro-rated extrapolation based on these factors may give somewhat inflated estimates, if the lack of response from operators is indicative of lack of interest in microwave systems.

The potential demand for microwave systems is estimated from replies received in response to the CATV survey.

This demand is shown separately for

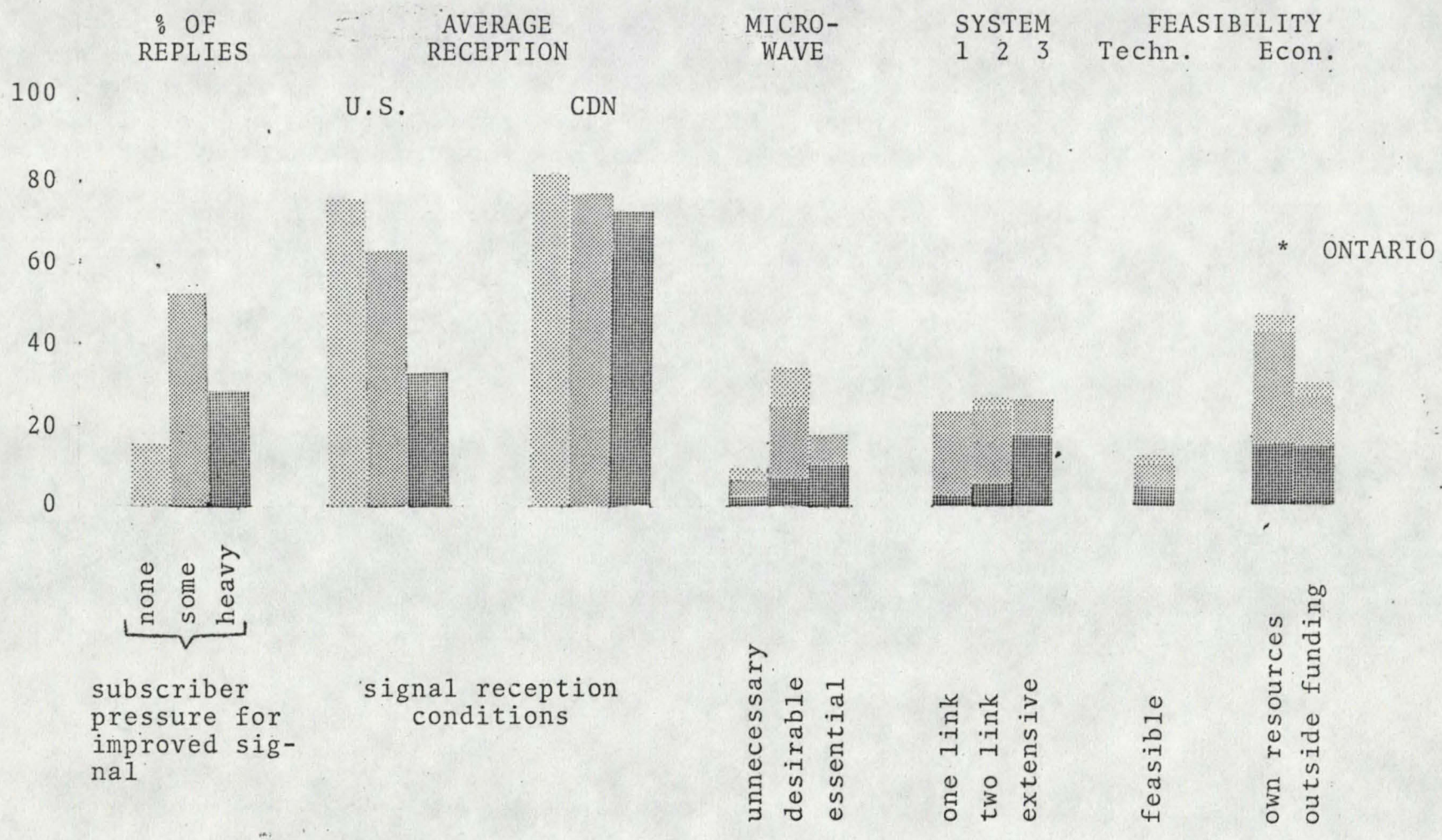
- large systems
- medium systems T 2.15
- small systems.

Factors are applied to account for CATV systems from whom no replies have been received.

System Size	Factor B.C.	Factor Ont.	
●	1.6	1.5	
•	1.5	1.6	T 2.15
·	2.0	1.8	

CATV SURVEY

MICROWAVE SYSTEM



* Replies to 31 Jan. 73

Province	British Columbia						Ontario					
System Length	1 link		2 link		System		1 link		2 link		System	
Economic Feasibility	EF	EU	EF	EU	EF	EU	EF	EU	EF	EU	EF	EU
CATV System Size												
> 5000	2	0	-	-	4	2	11	1	5	1	3	3
1000-5000	5	1	-	1	2	1	5	1	5	1	1	7
< 1000	-	1	-	2	1	2	-	-	-	2	-	1
Total	7	2	0	3	7	5	16	2	10	4	4	11
* Weighted Total	10.7	3.5	-	5.0	11.4	8.7	24.5	3.1	15.5	6.7	6.1	17.5
Links	10.7	3.5	0	10.0	34.2	26.1	24.5	3.1	31.0	13.4	18.3	52.5
Requirement (EF &EU)	14.2		10.0		60.3		27.6		44.4		70.8	

Total Links

Own resources	45		46	
Other resources	40		69	
Total	85	BRITISH COLUMBIA	115	ONTARIO

Notation refers to CATV operators' declared ability to self-finance a system.

EF economically feasible

EU economically unfeasible

* for weighting factors see page 2.13

Data are based on CATV survey.

Tables showing population centres and existing CATV systems serving them are presented for each province or region in Section 6 of Volume 2.

These factors are assigned on the basis of the overall spread of population centres in the region considered.

Not considered are systems for population centres of less than 2,500 inhabitants.

Some of these may become economically feasible if located near a trunk serving the general area.

Somewhat reduced figures are used for the summary of potential demand.

Such analysis would have to take into consideration the topography of each region and also the range of approved microwave systems.

The need for microwave systems is estimated on the basis of population centres in excess of 2,500 inhabitants not yet served by CATV systems. T 2.17

Factors summarily estimating the number of microwave links involved are also shown.

The economic feasibility of these systems is difficult to establish; the majority of systems are not economically viable as commercial enterprises and would need to rely on subsidies for their implementation.

For the above reasons the results of this summary analysis are suspected to be high. T 2.17

A more rigorous analysis, relating the geographical locations of the as yet unserviced population centres with existing CATV systems, is indicated.

PROVINCE	POPULATION CENTRES					
Pop'n	2,500	5,000	25,000	Total	Factor	Links
B.C.	8	5	1	14	3	42
Alta.	25	8	0	33	3	99
Sask.	11	5	3	19	3	57
Man.	8	9	6	23	3	69
Ont.	34	31	5	70	2	140
Que.	58	66	17	141	2	282
N.B.	8	5	1	14	2	28
P.E.I.	1	3	0	4	1	4
N.S.	10	10	1	21	2	42
Nfld.	15	9	2	26	2	52
Total	178	151	36	365		815
CATV Size	•	o	●	all		
Subscribers		1,000	5,000			

Source data are received-signal matrices given in Volume 2.

Source data are CATV systems summaries in Volume 2.
Source data appear are given in Volume 2.

This technique tends to offset various trends for which explicit data are not available:

- o Assumes high economic feasibility for small systems, ignores interconnect potential.
- o Ignores new population centres under 2500 but assumes geographic distribution patterns similar to those for existing systems.
- o Assumes that any lack of interest in U.S. signal sources (eg. Quebec) is offset by a corresponding interest in remote Canadian signal sources.

The demand summary takes into consideration: T 2.19

- o Microwave systems to replace off-air pick-up, particularly of U.S. stations. T 2.09 T 2.12
- o For existing CATV stations not at present carrying U.S. stations. T 5.12 T 5.15
- o For population centres in excess of 2500 inhabitants not at present served by CATV systems. T 2.15

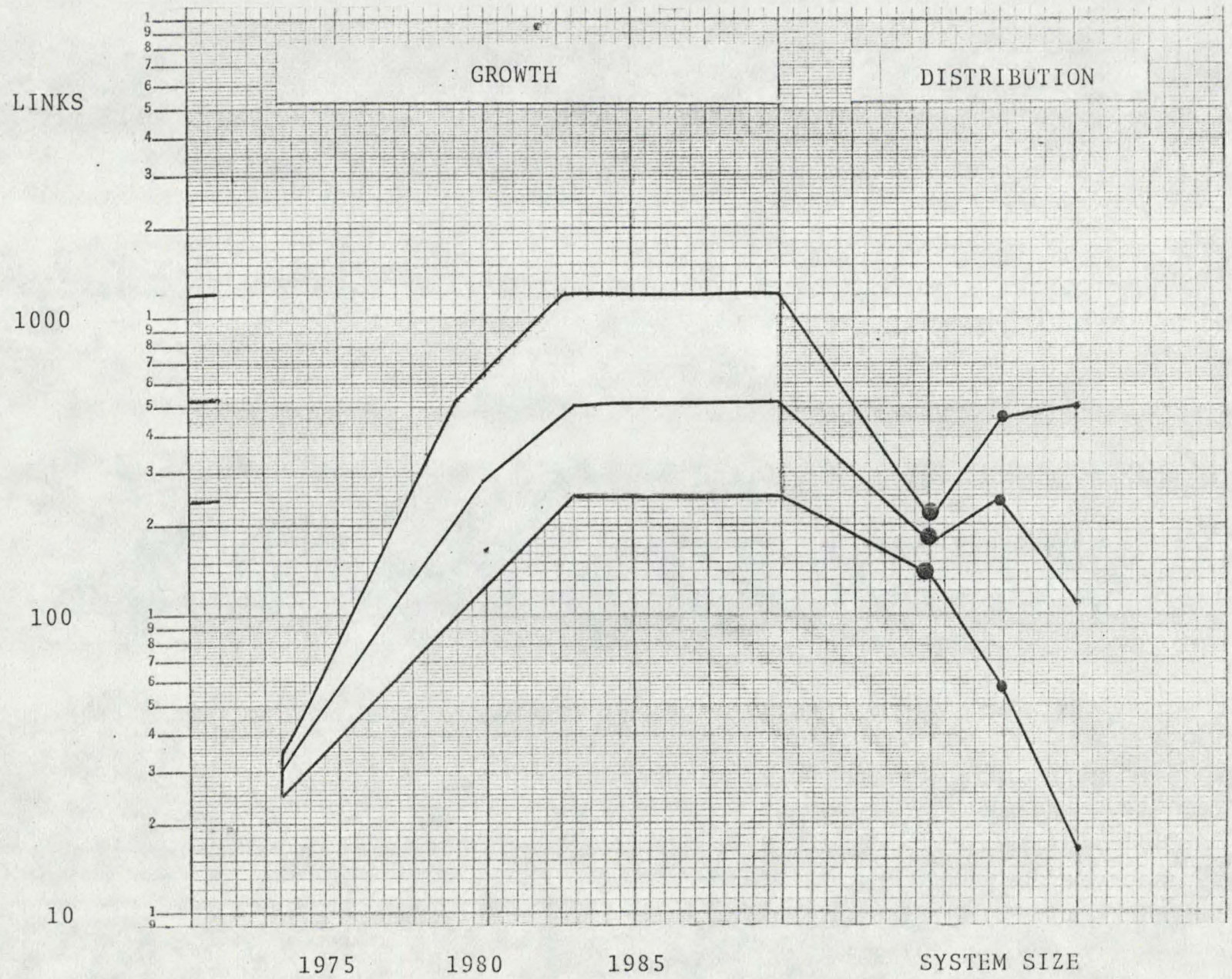
The basic extrapolation technique used consists of:

- o On the basis of assigned requirement and economic feasibility factors determine demand for major regions. T 2.09 T 2.12
- o Apply ratios derived from this analysis, for each system size group and cost level, (detail not shown) to arrive at extrapolated values.

The results are tabulated and plotted. T 2.19
Growth rates typical for TV/CATV have been used. T 2.20

Type System	Item	Other	Que.	Ont.	B.C.	CANADA	
Existing Systems	Number	21	69	87	47	224	
Reception	Requirement	37	114	156	105	412	1.84
Improvement	Maximum	17	61	88	48	214	.96
(U.S. Channels)	Minimum	8	27	55	24	114	.51
Existing Systems	Number	13	48	6	5	72	
New Services	Requirement	23	72	13	12	120	1.67
(No U.S.	Maximum	7	36	4	2	49	.68
channels now)	Minimum	1	9	1	0	11	.15
New Systems	Number	140	141	70	14	365	
(Based on popu-	Requirement	240	231	148	31	650	1.78
lation centres	Maximum	77	119	47	10	253	.69
statistics)	Minimum	15	52	16	2	85	.23
All Systems	Number	174	258	163	66	661	
	Requirement	301	417	317	147	1182	1.79
	Maximum	102	215	139	60	516	.78
	Minimum	23	89	72	26	210	.32
							AVG.

N.B. Averages are figures in last column (CANADA) divided by corresponding numbers of systems.


GROWTH
DISTRIBUTION
LINKS
1000
100
10
1975
1980
1985
SYSTEM SIZE

Intra-city microwave systems are, in general, well within the economic means of CATV operators.

Head-end extensions involving a single microwave link may be considered within the economic means of most medium size and all large size systems.

Subsidized systems could be of various forms, such as:

- o Satellite earth stations (these have already been introduced in the far north).
- o Inducement, by suitable means, for consortia to include small or remote systems.
- o Somewhat reduced standards, at appreciable cost savings, might be acceptable to CATV systems and their subscribers without undue hardships.

CATV systems have flourished under this combination of circumstances:

- o Sufficiently large population centre.
- o Proximity to U.S. signal sources.

In substantial areas of the country these conditions do not

To introduce CATV to these regions one or more of the following alternatives seem necessary:

- o CATV consortia.
- o Provincial system.
- o Other forms of subsidies.

Consortia, which are primarily based on economic considerations,

- o Tend to exclude small or remote systems (actual or potential).
- o Must rely on economically viable microwave systems.

Provincial systems tend to:

- o Include small or remote systems.
- o Favour trunk systems of high standards of quality and reliability.

Each of these component systems has its own characteristics of performance and reliability.

The signal delivered to the individual subscriber is a function of:

- o Program origination.
- o Reception at head-end.
- o Cable or microwave feed system.
- o Distribution system.

Overall system performance can be no better than that of the worst component system.

Total system performance is, of course, a function of the characteristics of each individual system.

Under economic constraints, the choice may well be between a system of less-than-perfect quality or no system at all.

Costs tend to rise steeply with system performance above a minimum acceptable level.

The distinction between these two aspects may at times be blurred, as in the case of propagation conditions between signal source and head-end.

Performance may be considered functionally in terms of:

- o Average signal quality.
- o Reliability of maintaining this quality level.

The application of performance standards should take these factors into full consideration.

Proper system design involves the optimum balance between these considerations, on a given economic base.

SIGNAL IMPAIRMENT

1. Linear Distortion

Low freq.	frame streak
IF	line streak or smear
High freq.	line ringing

2. Non-Linear Distortion

Sync. signal	mis-synchronization
Amplitude	blurred contours
Diff'l gain	colour distortion

3. Noise

Random	"snow"
Periodic	wavy vertical contour
Impulse	random streaks

4. Echo

Video	ghost image
FM	line ringing.

The most pronounced effect in off-air pick-up is noise under adverse propagation conditions.

MICROWAVE TRANSMISSION

Signal impairment may be caused by any portion of the transmission medium.

- o Propagation (off-air pick-up).
- o Microwave Transmission.
- o Distribution System.

The signal to noise ratio, including all sources of noise and distortion, is a measure of quality:

Subjective evaluations are given below:

Picture Quality Rating

S/N	Rating
	flawless signal
40 db	
	some snow noticeable
35 db	
	acceptable, but flaws visible
30 db	
	snow objectionable
25 db	
	unacceptable.

The extent of local program facilities is considered in the analysis of CATV systems (T 5.12-T 5.15).

DOC documents BP 23 and BP 24 apply.

Substantial improvements of performance can often be achieved merely by head-end modifications.

It makes little sense to provide the ultimate in performance and reliability to carry signals which are degraded by propagation conditions.

The extent to which this can be done effectively depends on the results of careful functional, technical and economic analysis.

Program Origination

This is outside the control of the CATV system, except for locally originated programs.

Distribution System

This must be designed to carry local signals without appreciable degradation.

Head-End

Great care is required in site selection and in the design for optimization of remote signal.

Microwave System

- Where a microwave system serves effectively as an extension of the head-end, its performance and reliability should be matched to the best signal(s) to be carried.

  Further improvement may involve a costly multi-hop microwave system beyond the economic reach of the CATV system.

  The reliability requirement is further reduced if any existing head-end is retained as a standby facility.

Reasons for strigency are:

- o Multi-hop systems are in general required.
- o Trunk lines feeding several systems may be involved.
- o The microwave system is likely to be the sole available carrier of remote signals.

Intra-city systems are not specifically considered in this report.

To what extent this can be done effectively depends on individual circumstances, such as:

- o Reception characteristics of separate head-ends.
- o Distances between head-ends.

- o For inter-city applications performance criteria are more stringent.

  For such systems applicable performance and reliability standards could be fully evoked.

- o Intra-city systems are likely to be single hop systems over moderate distances.

  Requisite performance standards under these circumstances are, in general, not difficult to satisfy.

  Intra-city systems could be used as links of a diversity system interconnecting separate metropolitan CATV systems having their own existing head-end installations.

Frequencies of primary interest lie in the 2, 4 and 6-8 ghz bands.

Suitable equipments for the CARS band (community antenna relay service) exist.

It appears that no immediate large scale use for digital transmissions is contemplated.

While theoretical studies at CRC and elsewhere allow prediction of signal attenuation in terms of atmospheric conditions, the correlation with meteorological factors in specific regions is still under investigation.

The economic viability of digital transmission in the 12 ghz band, in relation to emerging alternate techniques, is in some doubt.

The frequency bands below 10 ghz are becoming very congested, particularly in metropolitan and urban areas.

In the U.S. the frequency band of 12 ghz is allocated for CATV type of service.

In Canada the 14 ghz band is proposed for CATV microwave services.

At either of these frequency bands atmospheric absorption effects set severe limitations both to maximum link distance and total system length.

This effect is more severe at the higher frequency (14 ghz) but quite pronounced at the lower frequency (12 ghz).

Some doubt exists that Canadian or U.S. manufacturers will convert to 14 ghz unless this band is the only one permitted for CATV systems.
An even longer delay before actual systems can be installed and commissioned. This may place microwave systems beyond the economic reach of a proportion of small CATV operators.

Canada enjoys a lead in the CATV field; with the emergence of CATV systems abroad, a considerable potential for export exists.
This applies also to situations where, due to special topographical conditions, unusually long line-of-sight paths exist. Under such circumstances, a multi-link system at 14 ghz (or 12 ghz) may be required to replace what could be a single hop system.

Exclusive assignment of the 14 ghz band for CATV microwave use is likely to have these consequences:

- A minimum delay of one year until suitable equipments can be produced and approved.
- Substantial increase in the cost of such equipment over available 12 ghz equipment.
- The cost would be further increased by the need for shorter hop distances for equivalent performance.
- Canadian manufacturers producing such equipment may encounter limitations of foreign markets without further conversion expense.
- For long-haul or medium-haul microwave systems in areas where little frequency congestion exists, frequencies below 10 ghz appear more suitable.

Ownership

In the view of CATV operators, as reiterated in comments in response to this survey, the cost of systems offered by common carriers is substantially higher than the cost of a private system they could install and maintain themselves, often by a factor of 2 or more.

One of the factors contributing to the higher cost of common carrier supplied systems appears to be performance quality and reliability in excess of limits set by economic considerations.

In a number of situations alternatives exist for lack of full protection on microwave channels (eg. retention of head-end installations as standby facility).

The need for system optimization, as a trade-off between cost and quality, has already been stated.

This could very well mean a mixture between common carrier and private microwave systems within a single comprehensive plan, providing for interconnection and allowing for eventual system expansion.

The effect of system cost on the number of economically viable CATV systems is illustrated in Section 2.

In the following pages are shown, in conceptual outline, communication system configurations to serve the CATV cable systems in the various regions.

These system outlines are intended as a guide to possible trends of new microwave developments, in relation to existing systems. They are not intended as definitive, or even tentative, designs of such communication systems.

A more detailed examination of each province or region is considered beyond the scope of this study.

Notation

The general configuration of new microwave systems, based on concepts and findings of this report is indicated (_____).

These systems may follow existing routes; to what extent existing systems along these routes may be used or augmented is left in abeyance.

INDEX

Province	Text	Map
British Columbia	3.10	3.11
Alberta	3.12	3.13
Saskatchewan	3.14	3.15
Manitoba	3.14	3.15
Ontario	3.16	3.17 & 3.18
Quebec	3.19	3.20
New Brunswick	3.21	3.22
Prince Edward Island	3.21	3.22
Nova Scotia	3.21	3.22
Newfoundland	3.21	3.22

Signal reception is reported satisfactory in both these areas.

From a technical point of view, the receiving facilities for the Alberta system at Salmo could be shared.

The B.C. Regional Microwave Committee of CCTA (see their comments Section 8, Volume 2) is developing the basic concept for a microwave network.

It favours the consortium principle and private ownership of the microwave system to be developed.

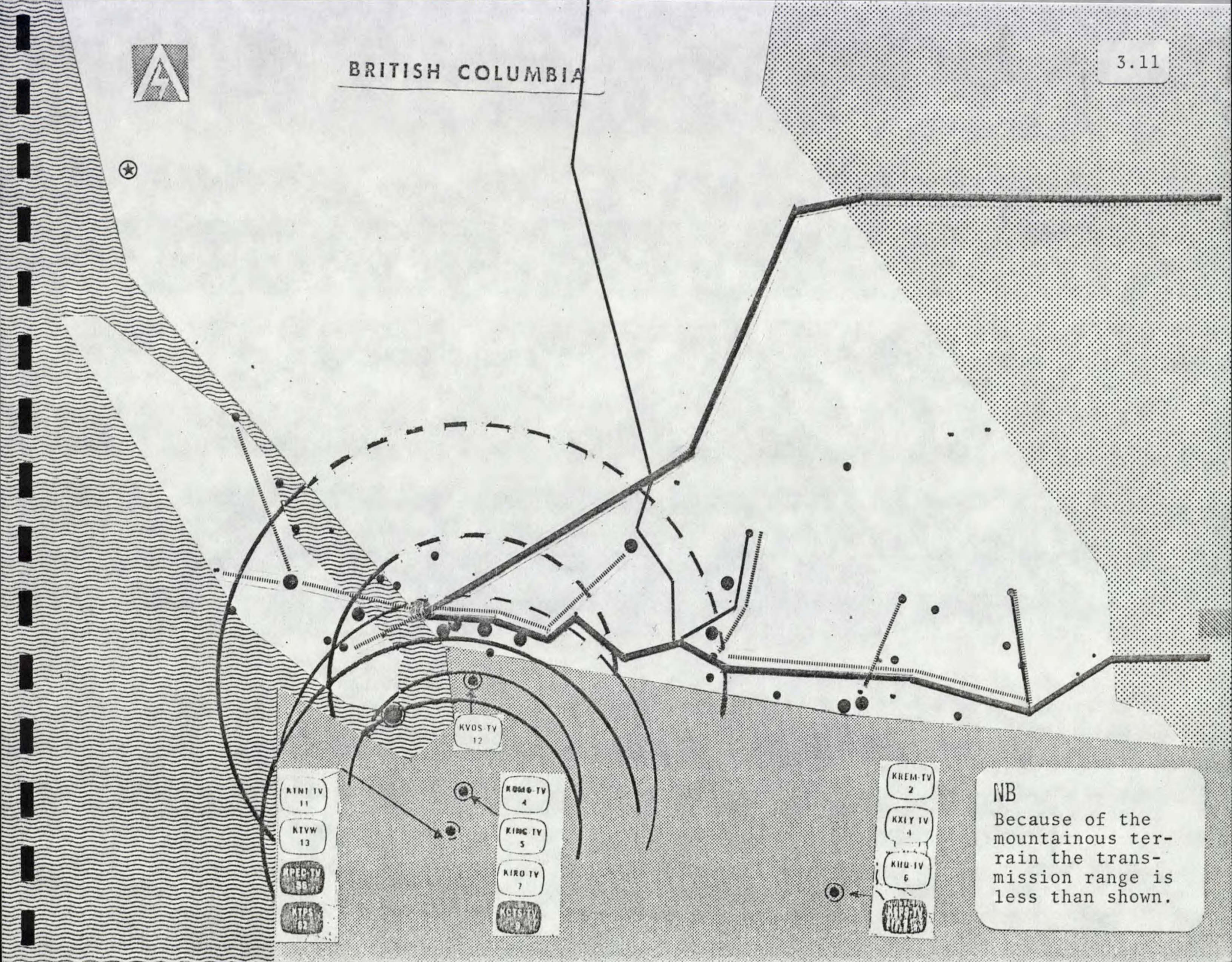
There are two principal favourable pick-up areas for U.S. signal

- o Vancouver-Victoria region (Bellingham, Seattle).
- o Salmo (Spokane).

The topography in the Vancouver-Victoria region seems particularly favourable for an economic microwave distribution network. To take full advantage of potential link distances, a frequency below 10 ghz would be desirable.

Major microwave routes already exist, both E-W and N-S in the Okanagan and Kootenay areas.

BRITISH COLUMBIA



NB
Because of the mountainous terrain the transmission range is less than shown.

The cities to be interconnected are:

City	Phase/Months		Rate Group
Calgary	1	12	5
Camrose	4	21	1
Drumheller	3	18	1
Edmonton	2	15	5
Grande Prairie	3	18	1
Lethbridge	1	12	3
Lloydminster	4	21	1
Medicine Hat	3	18	2
Red Deer	2	15	2
Wetaskiwin	2	15	1

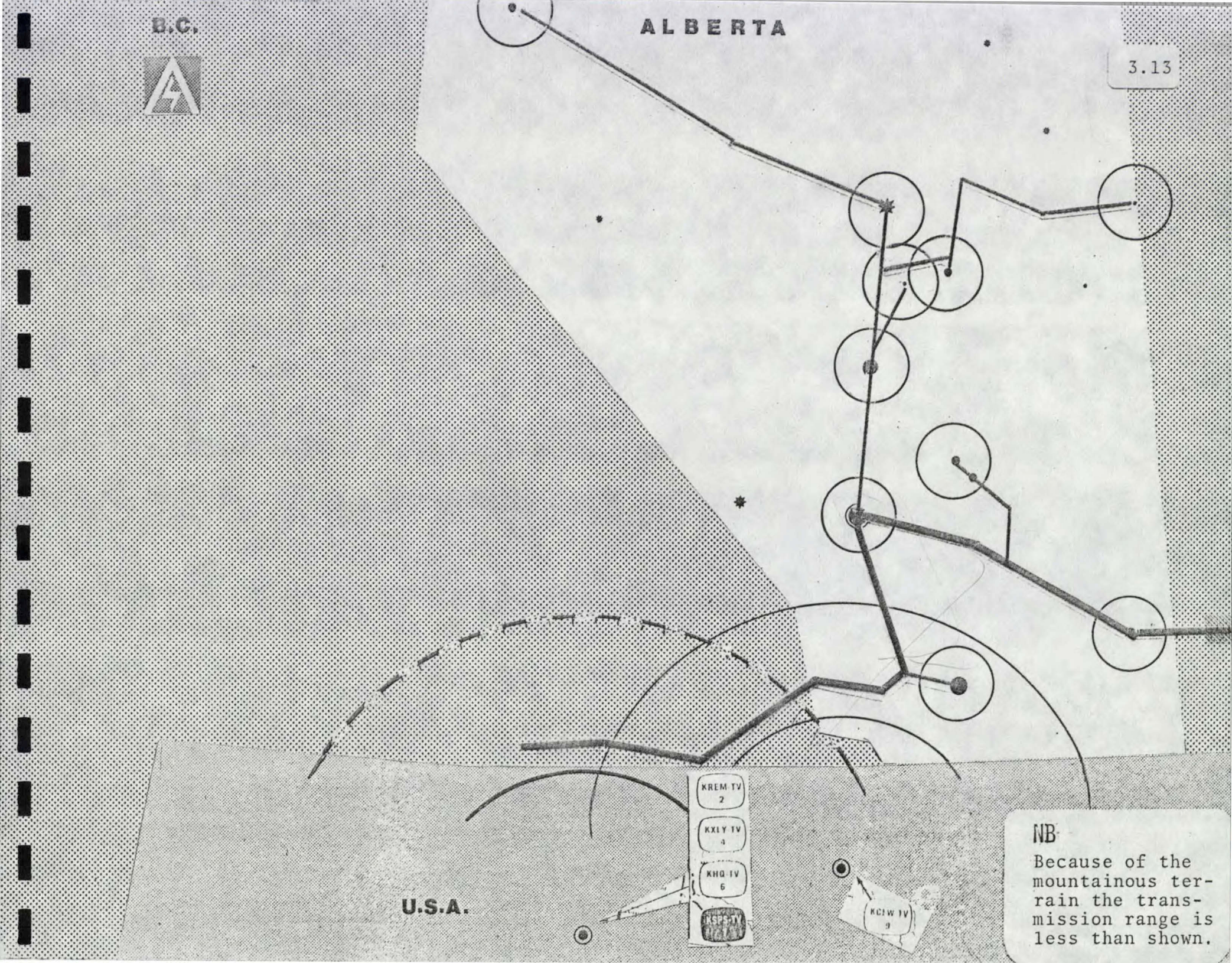
Rate Group	Monthly	Subscribers
1	1.00	
		1,000
2	.90	
		2,000
3	.80	
		10,000
4	.70	
		25,000
5	.60	
		50,000
6	.50	
		100,000
7	.40	

Minimum monthly charge per system $500.

The system configuration here outlined describes the ten city plan, developed by Alberta Government Telephones.

The plan provides for two unprotected TV channels, derived from a head-end located in Salmo, B.C., to be distributed to the ten cities shown. Implementation phase/months and rate group are also indicated.

The rate structure for connection, as tentatively defined, is also tabulated.


B.C.
ALBERTA
3.13
U.S.A.
KREM TV 2
KXLY TV 4
KHQ TV 6
KSPS-TV
KCTW TV 9
NB
Because of the mountainous terrain the transmission range is less than shown.

SASKATCHEWAN

Pick-up areas for signals from U.S. stations (all networks) exist in the eastern part of the Province.

From these regions communication arteries to the major population centres exist.

The flat terrain leaves little choice for alternate routing.

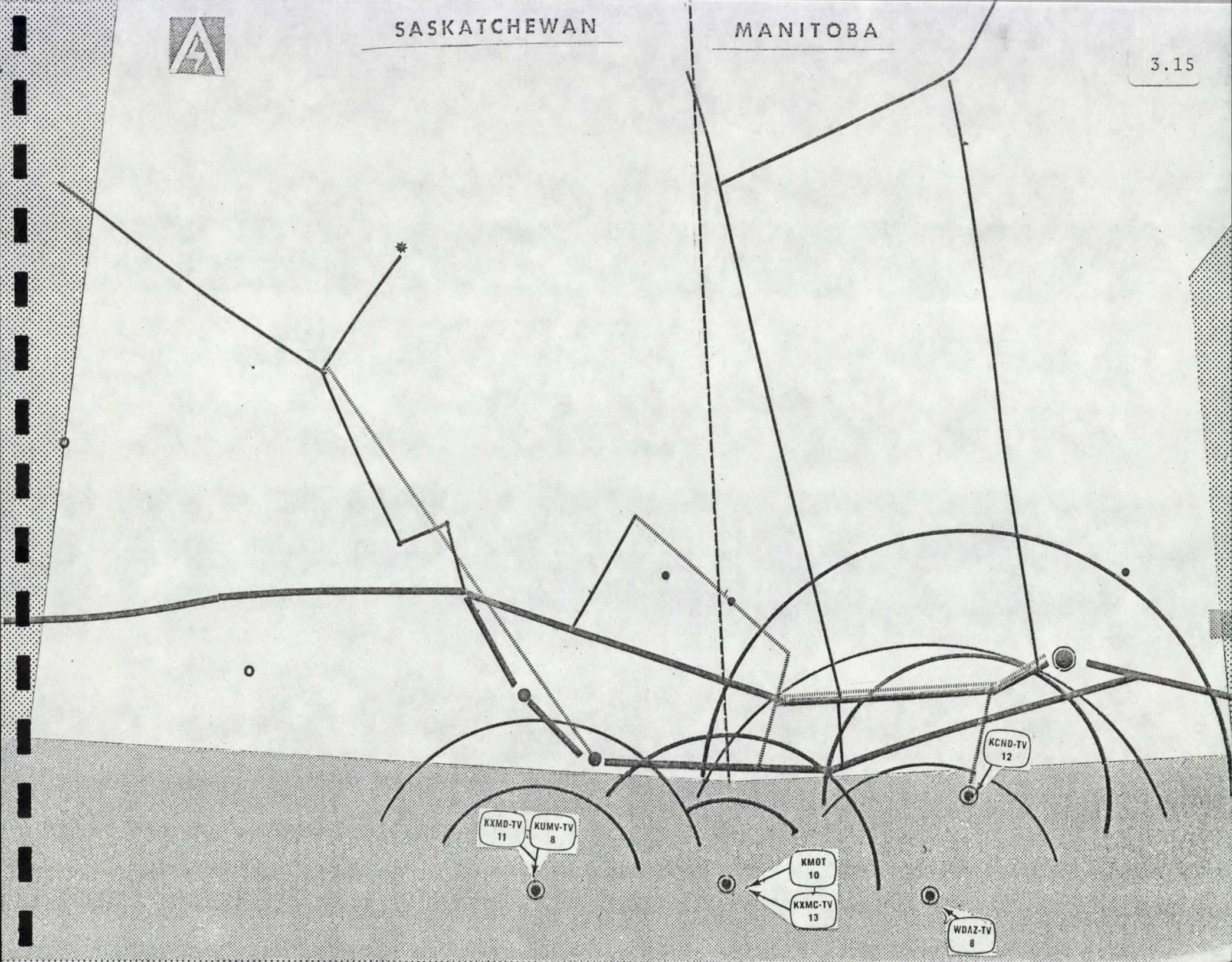
MANITOBA

A favourable pick-up area for signals from U.S. stations exists.

From this region communication arteries exist to major population centres.

The flat terrain leaves little choice for alternate routing.

From a technical standpoint, this could serve the western portion of Ontario.


SASKATCHEWAN
MANITOBA
KXMD-TV 11
KUMV-TV 8
KMOT 10
KXMC-TV 13
KCND-TV 12
WDAZ-TV 8

In areas close to U.S. station sources the adequacy of existing reception conditions may obviate the need for microwave interconnections.

The Niagara - Toronto area seems the most likely region, because of density of population centres, where inter-city microwave for special events and local programming may find application.

The western most region could, from a technical point of view, derive its signals via Manitoba.

The Northland region, though transversed by communication arteries, would seem economically the most difficult area to interconnect via microwave.

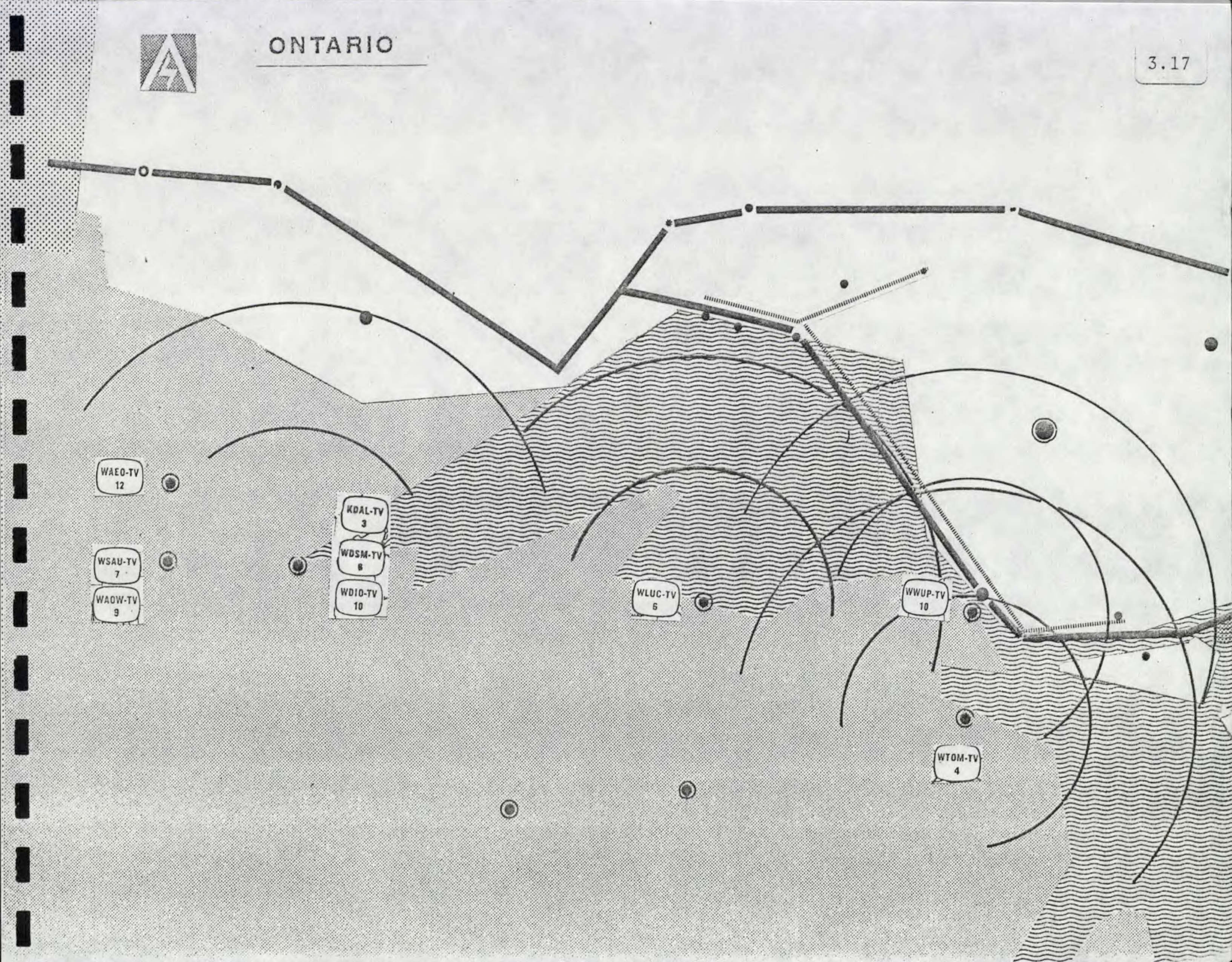
Several distinct distribution regions need to be considered:

- Kenora - Fort Frances - Dryden.
- Port Arthur - Sault Ste. Marie.
- Niagara Peninsula - Toronto.
- Northland (Sudbury - North Bay).
- Trenton - Cornwall - Ottawa.

Favourable pick-up areas for TV signals from U.S. sources are:

- Sault Ste. Marie.
- Niagara Peninsula.
- Toronto - Oshawa.
- Kingston - Cornwall.

ONTARIO


WAEO-TV
12
WSAU-TV
7
WAOW-TV
9
KDAL-TV
3
WDSM-TV
6
WDIO-TV
10
WLUC-TV
6
WWUP-TV
10
WTOM-TV
4

ONTARIO
WWNY-TV 7
WSYR-TV 3
WHEN-TV 5
WNYS-TV 9
WCNY-TV 24
WROC-TV 8
WHP-TV 21
WOKR 13
WGR-TV 2
WBEN-TV 4
WKBW-TV 7
WNED-TV 17
WJET-TV 24
WICU-TV 12
WSEE 35
WTLV 33
WKYC-TV 3
WEWS 5
WJW-TV 8
WNEM-TV 5
WJRT-TV 12
CKLW-TV 9
WKBD-TV 50
WXYZ 38
WJBK-TV 2
WWJ-TV 4
WXYZ-TV 7
WNEM-TV 5
WKNX-TV 25

This point has been stressed in a number of comments received from CATV operators in the course of the survey.

Specifically by extension of systems serving Cornwall and Ottawa.
For systems on the South Shore direct reception may in many instances be adequate.
No large systems are located in this area.
Reception is reported good, with very limited investment.

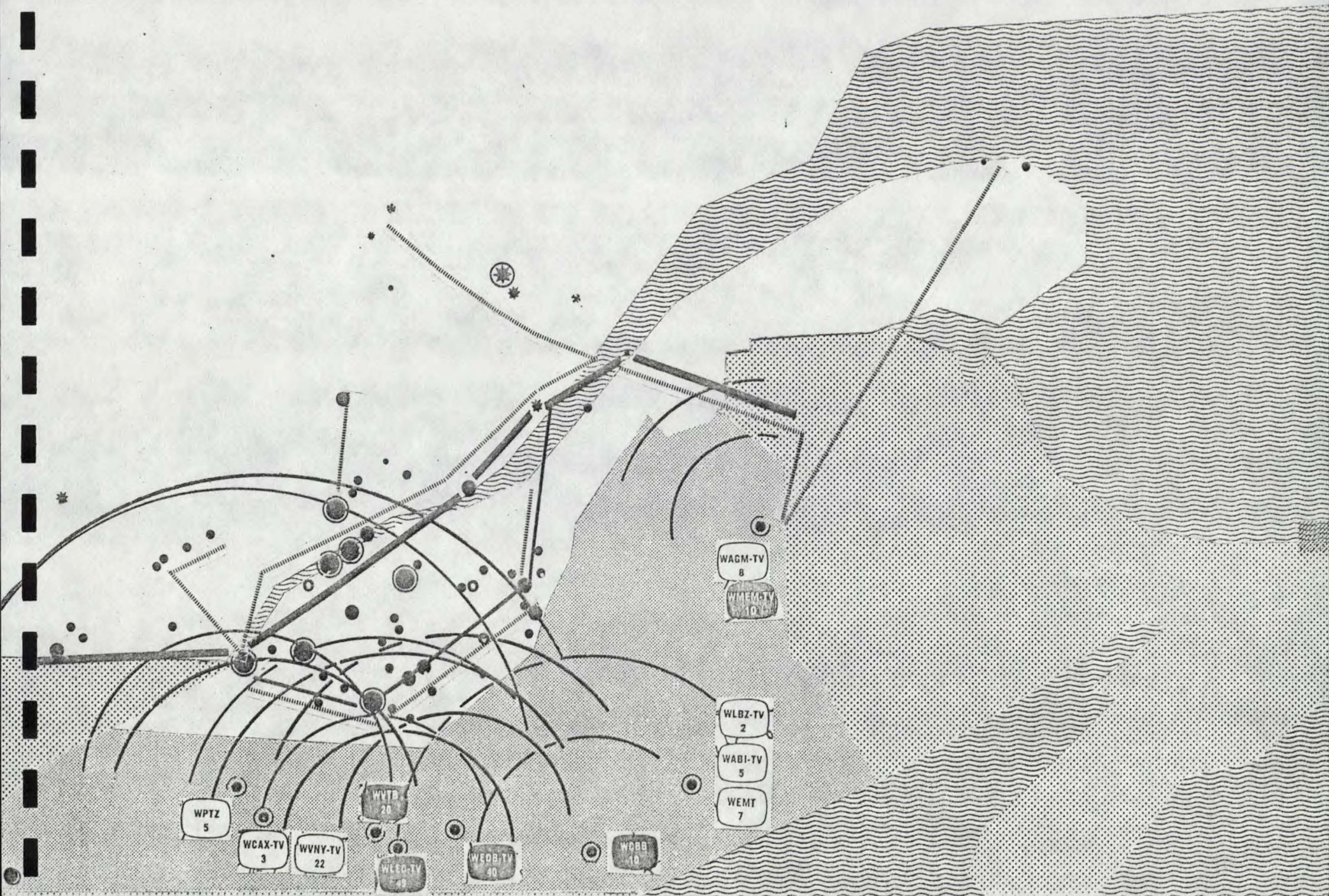
The adequacy of direct reception would need to be considered, particularly in view of the emphasis placed on French TV signal sources.

In this Province, for reasons of language, the provision of remote signals from Canadian sources is an important factor.

There are three main regions for favourable pick-up of U.S. signals.

- West of Montreal
  Via Ontario systems.
- Montreal - Rivière du Loup
  Reception areas in the regions of Sherbrooke and Rivière du Loup.
- Gaspe
  Via New Brunswick systems.
- A fourth possible area centres around Mont Tremblant.

A design for a microwave system would seek to combine and co-ordinate the requirements for remote signals from Canadian and U.S. sources.


WAGM-TV
8
WLBZ-TV
2
WABI-TV
5
WEMT
7
WPTZ
5
WCAX-TV
3
WVNY-TV
22
WVTB
20
WCEO-TV
49
WEQB-TV
40
WQBB
10

NEW BRUNSWICK

This province contains favourable pick-up areas for TV signals from U.S. stations.

Fredericton and Campbellton are served by existing private microwave systems.

These pick-up areas and microwave systems could be integrated with feed systems in the adjacent provinces.

PRINCE EDWARD ISLAND

CATV systems could be served by extension of microwave systems serving New Brunswick and Nova Scotia.

NOVA SCOTIA

The Halifax/Dartmouth area is connected via microwave to pick-up point for U.S. signals in New Brunswick.

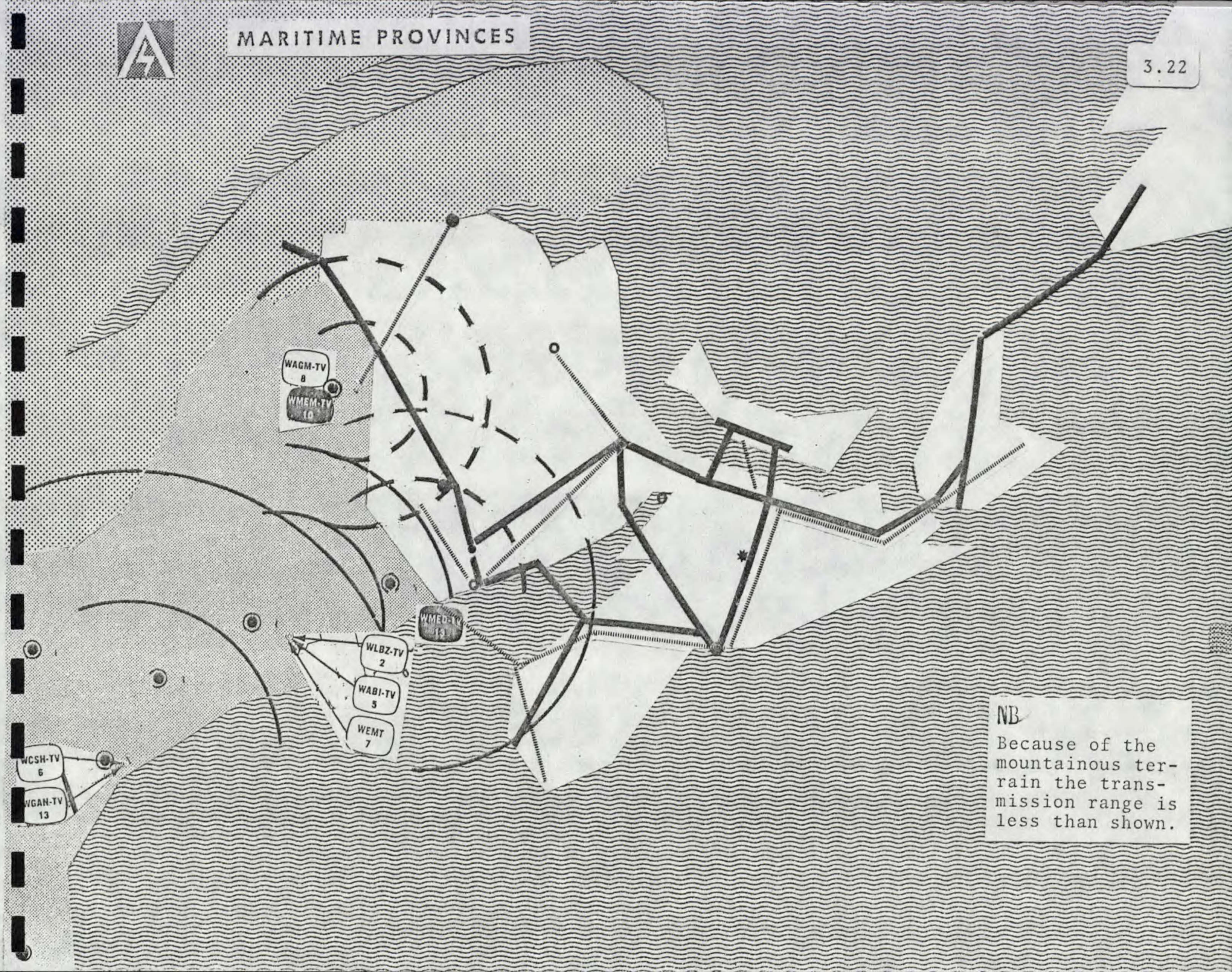
One of the interesting features of these CATV systems is their rapid growth and potential two-way capacity.

An alternative pick-up point to serve the southern portion of Nova Scotia may be considered.

NEWFOUNDLAND

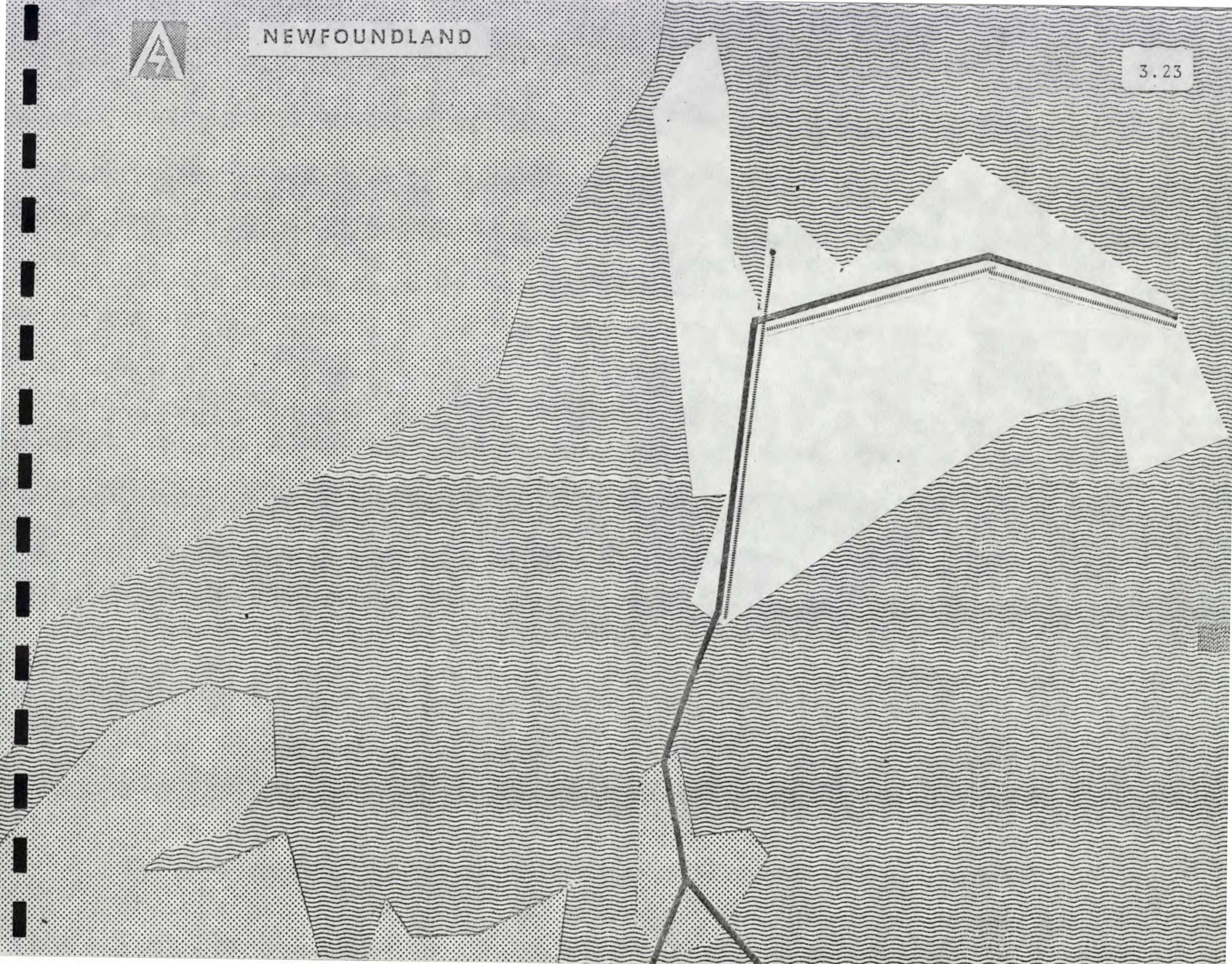
The introduction of remote signals would be economically contingent on the extension of the Nova Scotia microwave system to the Sydney area; the existing communication route would seem appropriate for the further extension of these signals.

MARITIME PROVINCES



NB

Because of the mountainous terrain the transmission range is less than shown.


NEWFOUNDLAND
3.23

CATV systems are considered in Section 1, with supportive data in Volume 2.

Microwave systems are considered in Section 2.

As new issues will undoubtedly arise, the importance of issues currently of major concern will inevitably be affected.

The difficulty arises chiefly from:

- o Largely unpredictable degree of acceptance of new systems.
- o Emergence of new facilities, services and equipment.

It seems particularly important that the role of cable systems be defined and co-ordinated with that of other systems involved in these developments

This report concerns itself with existing CATV systems in Canada and with the improvement and extension of available services in the near future, particularly by means of supportive microwave systems.

It is important to view these developments in the context of rapidly evolving new concepts in communications.

The technical, economic and social implications of these changes are as yet difficult to define with clarity or precision.

Cable systems may be expected to play a major role in these new developments.

This corresponds to average values of links per CATV system

Existing	New	Total
1.80	1.78	1.79
0.89	0.69	0.78
0.42	0.23	0.32

Growth rates of the order experienced with TV/CATV systems are shown.

The upper limit should be regarded as an asymptotic value.

Any such constraint is assumed to be reflected in increased equipment cost.

It will be noted that the effect both of subsidies and of constraint becomes more pronounced for smaller CATV systems.

The potential demand for microwave systems, in terms of individual links, is shown in Figure 2.20 for:

- o No economic constraint.
- o Low cost (CARS type) systems.
- o Conventional microwave.

The centre line may be taken as representative of demand.

Any subsidies (eg. Provincial Systems) would tend to raise demand towards the upper limit.

Any constraint on availability or choice of system or equipment would tend to lower demand towards the bottom limit.

The distribution of this demand, in terms of CATV system size, is indicated:

- ● > 5000 subscribers
- • 1000-5000 subscribers.
- · < 1000 subscribers.

CONCLUSIONS

Measures which would be directly or indirectly reflected in raising the level of demand:

- o Formation of consortia of CATV operators.
- o Subsidies or other inducements to encourage and permit the inclusion of smaller CATV systems in such consortia.
- o Provision of trunk facilities, particularly to remote areas, as part of a government-sponsored or subsidized program.
- o Public pressure for new services.
- o Subscriber pressure for improved existing services.
- o Maximum flexibility, within the established framework, regarding the choice of frequency most suitable for a given transmission requirement.

CONSTRAINTS

Constraints which would be reflected in increased system costs and/or reduce the level of demand:

- o Performance standards above ecomomically feasible levels, particularly for small CATV systems.
- o Signal protection levels above those appropriate to CATV system size.
- o Restriction of CARS type microwave distribution equipment (small incremental cost for additional channels carried or locations served).
- o Time delay and cost in producing or converting such equipment for a new frequency band.
- o Restriction of the number of signals carried.

This has been borne out by findings of the CATV survey:

- o Large proportion of U.S. programs
- o Subscriber pressure for improved signals correlates with quality of U.S. program reception.

In the Province of Quebec, for reasons of language, there is greater emphasis on remote Canadian TV stations.

Particularly in regions of reasonable direct reception, extension of head-end to a more favourable location is a viable alternative.

The most likely effect is a shift in viewing patterns of U.S. and Canadian programs; this effect, though more extensive, is not likely to be greater than already experienced in some regions.

Interactive TV is likely to have the most profound social implications.

The main function of inter-city CATV microwave systems remains the conveyance of U.S. programs for distribution.

In view of the wide coverage by existing TV networks, and the essential similarity of programs within the networks, there appears less demand for this type of service.

The concept of an extensive trunk-fed microwave feeder network for CATV systems is not necessarily valid for all regions.

The social implications of providing additional remote TV channels, or improving the the quality of existing ones, do not appear appreciable.

The full social impact of the vast potential of cable systems appears to lie in the introduction of new types of services, initially in urban areas.

BIBLIOGRAPHY

1) Future Developments in Telecommunications	James Martin	Prentice Hall	1971
2) Branching Out - Volumes I & II	CCCT	DOC	1972
3) Moloch or Aquarius?	G.B. Thompson	Bell-Northern	Feb/70
4) On Human Communications	C. Cherry	MIT Press	1966
5) Planning Community Information Utilities	H. Sackman et al	AFIPS Press	1972
6) The Wired Scientific City	B.A. Bowen et al	DOC	Nov/71
7) Seminar on the Wired City Telecommission - Study 6(d)		DOC	1971
8) The Wired City Telecommission - Study 8(d)		DOC	1971
9) Communication System Engineering Handbook	D.H. Hamsher	McGraw-Hill	1967
10) Canadian Broadcasting Policy Statement on CATV		CRTC	Jul/71
11) Annual Report 1971-'72		CRTC	1972
12) Broadcasting Undertakings in Canada	Maps	CRTC	1972
13) Television Factbook 1971-'72		Television Digest	1971
14) Radio and Television Data		BBM	1971
15) On the Cable	Sloan Commission	McGraw-Hill	1971
16) Urban Cable Systems	W.F. Mason	Mitre Corp.	May/72
17) Prospects for Cable in the 100 Largest Television Markets	R.E. Parks	Bell Journal of Eco.	1972
18) Interactive Television	K.J. Stetten et al	Mitre Corp.	Dec/72
19) Cable Television 1971		Statistics Canada	Dec/72
20) Cable Television Systems in Canada		CRTC	1972
21) CATV System Engineering	W.A. Rheinfelder	TAB Books	1967

BIBLIOGRAPHY (CONT'D)

22) Microwave Communication	S. Yonezawa	Prentice Hall	1970
23) The Physics of Microwave Propagation	D.C. Livingston	Prentice Hall	1970
24) Tropospheric Radiowave Propagation Beyond the Horizon	F. du Castel	Pergamon Press	1966
25) Ultra-High Frequency Propagation	H.R. Reed et al	Chapman & Hall	1966
26) VHF Radiowave Propagation in the Troposphere	W.G. Burrows	Intertext	1968
27) A Comparison of Precipitation Attenuation & Radar Backscatter Along Earth - Space Paths	K.S. McCormick	IEEE - Ant. & Pro.	Nov/72
28) Precipitation Attenuation at 15.3 GHz	J.I. Strickland	DOC	Sep/72
29) Use of the Frequency Spectrum Above 11.7 GHz in Canada		Tel. Assoc. of Canada	Apr/69
30) Delphi: The Bell Canada Experience		Bell Canada	1972

QUEEN P 91 .C655 M549 1973 v
ASDA Limited
Microwave systems for CATV

MICROWAVE SYSTEMS FOR CATV

CACC / CCAC
84943

P
91
C655
M549
1973
v.1

DATE DUE
DATE DE RETOUR

LOWE-MARTIN No. 1137