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Philip A. Lapp Limited

DEPARTMENT OF COMMUNICATIONS

COMMUNICATIONS RESEARCH CENTRE

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TASK REPORT NUMBER TWO OF A STUDY AND REVIEW OF TECHNICAL ASPECTS OF SCRAMBLED TV SERVICES BY DIRECT BROADCAST SATELLITE PHASE II "TECHNOLOGY BASE STUDY"

CARRIED OUT FOR THE
COMMUNICATIONS RESEARCH CENTRE
OF THE
DEPARTMENT OF COMMUNICATIONS
UNDER DSS CONTRACT NUMBER
OST82-00251

by

March 1983
~~July, 1982~~

Work Carried out by: K.E. Hancock
Dr. J.N. Barry

Approved by: ....
K.E. Hancock
Vice-President
Telecommunications

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TASK REPORT NUMBER TWO
"TECHNOLOGY BASE"
OF A STUDY AND REVIEW OF TECHNICAL ASPECTS
OF SCRAMBLED TV SERVICES BY DIRECT BROADCAST SATELLITE
PHASE II

1. BACKGROUND

The technology of DBS scrambling systems is changing rapidly. As an example, some conclusions drawn during the initial study were obsolete after only a few months owing to the growing interest in scrambling DBS signals, particularly in the United States. It is therefore necessary to remain abreast of new developments in this area so that their impact can be assessed and their potential application to Canadian systems evaluated.

2. OBJECTIVE

The objective of this phase of the study is to gain information to update current knowledge of DBS scrambling. Areas to be studied include the following:

- development in combined video/audio scrambling
- degree of scrambling hardware required
- security of scrambling techniques and hardware
- application of LSI
- cost of descramblers relative to users terminals
- system implementation
- new techniques.

3. APPROACH

The approach taken to fulfill this objective was to monitor technical literature, attend trade shows, conferences and similar presentations, and to contact industry representatives on these matters during the whole of the 1982/83 fiscal year. The information gained was analysed and monthly reports written on the progress of DBS scrambling technology. These monthly reports form in sequence Sections 4 to 14 of this report.

4. APRIL 1982 REPORT

Decision CRTC 82-240 of 18 March, 1982, approving the applications of six organizations for Canadian Pay-TV licenses gave rise to a very considerable activity in the area of DBS applications and scrambling during the month of April.

This report is in three parts. The first covers a meeting with Mr. Nicholas Hamilton-Piercy, Vice President of Engineering and Operations for Rogers Cablesystems Incorporated, on the plans of his company for implementing scrambling for their Canadian Pay-TV services. The second covers discussions with senior officials of Telesat Canada regarding Telesat's plans for the use of ANIK B and C in the DBS mode for the carriage of Pay Television and other signals. The final part reviews information gained at a combined CCTA/CTRI/OCTA two day Pay Television seminar dealing with the cable television industry's plans for scrambling Pay Television signals, and for their general distribution and marketing.

It should be noted that the specific plans on the sequence of implementation of various levels of scrambling security by Rogers Cablesystems Incorporated, was given on the understanding that CRC should treat this information as CONFIDENTIAL, and it is presented here strictly on that basis.

4.1 Rogers Cablesystems' Scrambling Plans

Rogers Cablesystems Incorporated plan to use a new Zenith scrambling system for all of their Canadian cable systems carrying Pay TV. The current thinking is that scrambled signals received from ANIK satellites will be descrambled, and rescrambled at the head end with an ever increasing level of complexity.

From the beginning, the encoder, decoder and associated computer software will be capable of the maximum level of security to be described below. However, the philosophy is to commence Pay-TV distribution with simple sync suppression security. At an appropriate time, when it is felt that there is significant theft of signals in one form or another, a higher form of security would be implemented thus making ineffective all illegal descrambling devises previously used. This concept would be applied at a number of levels making it extremely expensive for persistant illegal viewers. By this "step-by-step" form of security it is expected to greatly discourage theft of services.

The first stage of scrambling would be sync suppression using a fixed RF offset. This would be followed by random RF offset sync suppression. The next level would be full frame video inversion, again this would be replaced by a random sequence, full frame video inversion with the keying information contained, as with the non-random frame inversion, in line 21. The next stage would be to use a vertical interval line other than line 21, followed by encryption of the digital flagging information. Finally, if necessary, a sound squelching system can be added.

The system has full mechanical security with much of the information being contained in the LSI crystal structure and with the LSI itself being encapsulated. Precautions are taken to prevent electronic scanning of the program.

The scrambling system is addressable with the capability of 1,000,000 addresses, and is also capable of switching up to 20 programming tiers.

The current cost of this system, which will be delivered to Rogers in approximately 6 months time, is $75 Canadian per descrambler. The encoder cost is approximately $25,000.

It should be noted that during the period that these plans were devised, it was the understanding of the industry that at least one Pay-TV licensee, First Choice Canadian Communications Corporation, would not scramble his signal on the satellite. It is now likely that all Pay-TV licensees will scramble their signals, and will all use ANIK C in the interim DBS mode. (see Sections 4.2 and 4.3 below)

These changes in plans may well lead Rogers and other cable companies to consider the possibility of using the satellite scrambling system "end-to-end" providing such a system is compatible with low cost decoders.

4.2 Current Telesat Plans

Although not directly part of DBS scrambling, the activities of Telesat, particularly those concerned with the applications of the ANIK C series of satellites, are of considerable interest to this study. As detailed in the Phase I report of this work (1), the ANIK C series of satellites operating in the 14/12 GHz range, is capable of use as an interim DBS. Indeed the hybrid 6/4GHz-14/12GHz ANIK B is also capable of interim DBS use, this application being restricted to its 14/12GHz transponders.

To appreciate the impact of recent Telesat and Pay TV activities upon the progress of DBS scrambling in Canada, it is perhaps appropriate at this time to provide some background detail on Telesat's recent marketing activities.

At the moment Telesat operates the ANIK B hybrid satellite mentioned above, together with two 6/4 GHz ANIK A satellites, the A2 and the A3. The ANIK B satellite in its 6/4 GHz mode carries, at this time, voice traffic together with the House of Commons video channel, several CANCOM video channels, CBC video traffic and occasional use CTV video traffic. In the 14/12 GHz mode, it is currently structured to operate 6 transponders, one of which carries La SETTE with the other 5 carrying experimental DBS video traffic for TV Ontario and a number of other entities. All of this 14/12 GHz traffic, with the exception of La SETTE, is operating in an experimental DBS mode.

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(1) The Final Report of a Study of the Technical and Economic Consequences of Scrambled TV Services Offered by Direct Broadcast Satellite

Over the next three years Telesat plans to launch the following satellite:

	Launch Date		In-Service Date	
ANIK D1 - 6/4 GHz	August,	1982	October,	1982
ANIK D2* - 6/4 GHz	December,	1985	January,	1986
ANIK C3 - 14/12 GHz	November,	1982	January,	1983
ANIK C2 - 14/12 GHz	April,	1983	June,	1983
ANIK C1* - 14/12 GHz	April,	1984	June,	1984

* These launches might be interchanged, with the decision to be made by December, 1983.

One the 17th February, 1982, Telesat Canada filed with the CRTC a proposed tariff for the provision of 10 RF channels in the 12/14 GHz band to GTE Satellite Corporation (G-Sat) of the United States to provide Pay TV service in a interim DBS mode to G-Sat customers in the United States. To optimize this service, it was proposed that ANIK C3, the first ANIK C to be launched, would have a 0.5 degree southerly tilt. This tilt would reduce service to Canadian customers, particularly those in the North and East. To help alleviate the impact of this, Telesat is currently proposing to move ANIK B in November/December of 1982, so that it will be co-located with ANIK A3 at 109° West. At the same time some 6/4 GHz traffic will be moved from ANIK B to ANIK A3 and certain 6/4 GHz transponders turned off to permit the full transponder capacity of the 14/12 GHz transponders of ANIK B to be used. This will give a total of 8 video channels on ANIK B. It should be noted however that the "footprint" of B3 is less suitable to video distribution in Canada, particularly in Atlantic Canada, than is the footprint of the ANIC C series. (See Appendix A) In addition, ANIK B has a limited lifetime left to it. With these ANIK B modifications, the total 12/14 GHz space segment capacity in television channels for the next 6 years is shown below.

	JAN-JUNE 1983	JAN 1983- JUNE 1984	JUNE-DEC 1984	1985	1986	1987	1988
ANIK B	8	8					
ANIK C3	32	32	32	32	32	32	30
ANIK C2		32	32	32	32	32	30
ANIK C1	___	___	32	32	32	32	32
TOTAL	40	72	96	96	96	96	92

NOTE: CAPACITY IN RF CHANNELS CAPABLE OF CARRYING ONE TELEVISION SIGNAL. (27 MHz BANDWIDTH)

The matter of the leasing of interim DBS channels to the United States prior to launch of ANIK C3, caused considerable consternation among both the newly licensed Pay TV operators, and Atlantic TV, a Halifax Broadcasting Company licensed to distribute via satellite. A number of comments were filed with the CRTC and are currently being considered. Telesat then took the initiative and then held a meeting of all interested parties. This meeting, the key results of which are given below, was organized and attended by the following senior Telesat personnel:

- Mr. Eldon Thompson: President
- Mr. Mac Lester: Vice-President, Business Development
- Mr. Peter Norman: Director, Satellite Services
- Mr. Brian Alson: Manager, Broadcast Services.

The meeting revealed that in addition to the 10 full-power 54MHz channels proposed for lease to GSAT commencing February 1, 1982, on ANIK C3, four further full-power 54MHz channels were the subject of an agreement signed with OAK Satellite Inc. for use commencing March 30, 1982. Thus 28 TV channels on the interim ANIK C satellites were to be leased to the U.S. The traffic assignments planned by Telesat for interim DBS and message traffic on ANIK B (14/12), ANIK C3 and ANIK C2, to meet these U.S. requirements and the known Canadian traffic are shown below:

14/12 GHz

PROPOSED TRAFFIC ASSIGNMENT

JANUARY - JUNE 1983

ANIK B				ANIK C3 (Southerly Tilt)			
W		E		W		E	
KNOWLEDGE	- 1	TV ONTARIO	- 1	MESSAGE	- 5	MESSAGE	- 7
ACCESS	- 1	SETTE	- 1	U.S.	- 6	U.S.	- 6
CBC	- 1	NTV	- 1	OCCANSIONAL TV	- 1	OCCASIONAL TV	- 1
BCTV	- (1)	ATV	- 1	LAMB	- 1	LAMB	- 1
(Possible)		STAR	- 1	ALBERTA PAY	- 1	ONTARIO PAY	- 1
TOTAL	3(4)		5		14		16

Note: In Nov/Dec, 1982 ANIK B will be co-located with ANIK A3 on 109W. When ANIK C1 is launched this will be located at 109°W and ANIK B moved.

14/12 GHz

PROPOSED TRAFFIC ASSIGNMENT

JUNE 1983 - JUNE 1984

ANIK C3				ANIK C2 (Zero Tilt)			
W		E		W		E	
U.S	- 14	U.S.	- 14	MESSAGE	- 9	MESSAGE	- 9
MESSAGE	- 2	MESSAGE	- 2	KNOWLEDGE	- 1	TVO	- 1
				ACCESS	- 1	SETTE	- 1
				CBC	- 1	NTV	- 1
				ALBERTA PAY	- 1	ATV	- 1
				LAMB	- 1	LAMB	- 1
				OCCASIONAL TV	- 1	STAR	- 1
						ONTARIO PAY	- 1
TOTAL	16		16		15		16

Note: TVRO's previously receiving ANIK B will require repointing.

14/12 GHz

TRAFFIC ASSIGNMENT

JUNE 1984 AND BEYOND

ANIK C2

KNOWLEDGE	- 1	TVO	- 1
ACCESS	- 1	SETTE	- 1
CBC	- 1	NTV	- 1
ALBERTA PAY	- 1	ATV	- 1
LAMB	- 1	LAMB	- 1
OCCASIONAL TV	- 2	STAR	- 1
		ONTARIO PAY	- 1
		OCCASIONAL TV	- 2
TOTAL 7		9	

These traffic assignments were not acceptable to the Pay-TV licensees or to Atlantic TV. After very considerable discussion, Telesat agreed to reopen negotiations with GSAT and OAK with a view to putting all U.S. traffic on ANIK C2 to be operational in June, 1983, provided that the Pay television licensees and Atlantic Canada gave firm letters of content to Telesat for commencement of service by February 1, 1983.

At the time of writing (April 26, 1982) there is every indication that the Canadian companies are likely to do this. This would mean that ANIK C3, the first ANIK C to be launched, would carry all Canadian video traffic in an interim DBS mode with zero tilt, together with some message traffic. The ANIK C2 would then carry all the U.S. traffic and 2 video equivalent channels of message traffic with a half degree southerly tilt.

Official "Planning EIRP Contrours" issued by Telesat for ANIK C with Nominal, 0.25° North and 0.5° South curves, plus detailed patterns for 0° tilt and 0.5° Southerly tilt, plus ANIK B 12 GHz transmit patterns are given as Appendix A to this report.

4.3 Inputs Gained at the CCTA/CTRI/OCTA Pay Television Seminar

The information in this section was gained mainly at a Pay-TV workshop held by the CCTA/CTRI/OCTA in Toronto on the 19th and 20th of April, 1982.

The workshop was split into two main parts, the first dealing with Pay-TV scrambling methods and costs, mainly for redistribution via cablesystems, but was also of interest to DBS. The second day was taken up with presentations by the three Pay-TV licensees that will be operating in Ontario namely; First Choice Canadian, the national station; Super Channel, the Ontario regional station; and LAMB, the national cultural station. While these presentations dealt with many aspects of the licensees plans, their statellite disribution and scrambling plans were discussed in some detail.

Of the six pay television licensees, one, the multi-national channel, plans to distribute its services via video tape. The remaining five will distribute by satellite. All six pay-TV services will initially be distributed solely by cable television. However the door is left open for reception in the direct broadcast mode, and for redistribution by MATV Systems and by terrestrial re-broadcast.

The multiplicity of Pay-TV licensees (up to three in any one region), and the desire of cable television companies to market all available in a given area, effectively eliminates simple negative or positive traps as the economic scrambling option on cable television systems. The adoption of scrambled multi-pay security systems significantly increases the cost of delivering and scrambling Pay-TV service and, in the opinion of the writer, is likely to lead to an evolutionary trend toward a single scrambling system for both the space segment and the cable distribution segment.

The CCTA is of the opinion that it would benefit the cable television industry if all Pay-TV services were on a single satellite. Thus at its April 14th meeting, the CCTA Board of Directors adopted the following resolution:

> "The Canadian Cable Television Association recommends that all groups concerned with a satellite distribution of television signals strive to have these signals carried on one ANIK C satellite. Existing services such as the distribution of the House of Commons and of the CANCOM signals should have the option to continue on a single 4 GHz satellite."

One of the matters discussed early in the workshop was pirate/pay percentages, in other words the fraction of non-paying viewers that might be expected on cable television systems with various types of security systems as the Pay television system develops. A matrix developed by CTRI is given as Figure 4.1.

FIGURE 4.1

CTRI DEVELOPED ILLEGAL PAY VIEW PERCENTAGES

CABLE TV SECURITY METHOD	PIRATE/PAY PERCENTAGES YEAR END 1	2	3	4	5
NEGATIVE TRAPS	2%	4%	6%	8%	10%
ADDRESSABLE TAPS	3%	6%	9%	12%	15%
POSITIVE TRAPS	5%	10%	15%	20%	25%
RF SCRAMBLING	3%	6%	9%	12%	15%
BB SCRAMBLING	1%	1%	2%	2%	3%

There was some discussion as to the precise validity of these figures, but it was generally agreed that the ratios between the various types of scrambling systems were valid. It is of interest to note that base-band scrambling, which includes the line manipulation and audio-only systems recommended in the previous phase of this study, give acceptable and indeed the lowest pirate/pay percentages. During the workshop it was stated that there had been incidents in the United States where pseudo-distributers would canvas a complete sub-division in an area, purporting to be legal distributers, and "sell" Pay-TV service on a yearly basis, providing the unsuspecting subscriber with and illegal descrambler. Having obtained large amounts of money in a short period of time the illegal entrepreneur would then move his operation to a distant city, leaving the viewer under the impression that they had legally subscribed to the service. Such illegal activities must be expected on Canadian DBS systems, and security services should take such potential activities into account.

In-so-much that the majority of the initial users of a Canadian DBS system will be cable television licensees distributing Pay television, it is perhaps appropriate to provide information on the size and distribution of the Canadian cable television industry.

The latest statistics (2) show 414 operating cable systems in Canada serving some 4,755,055 households. In addition it can be estimated that a further 10% "bulk" subscribers are served. A break down of basic subscribers against system size is shown in Figure 4.2.

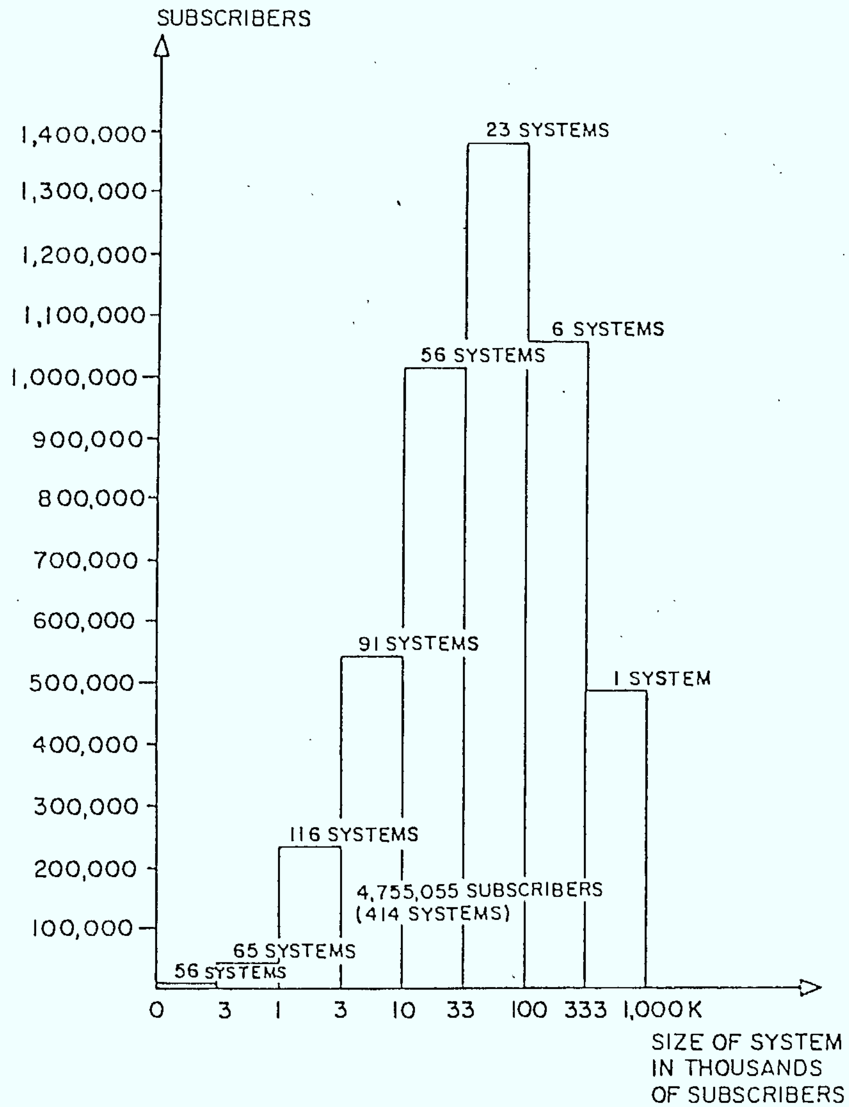
SYSTEMS SIZE	ENTRIES	BASIC SUBSCRIBERS	MEAN
1 to 333	56	8,141	145
334 to 1,000	65	40,487	623
1,001 to 3,333	116	232,780	2,007
3,334 to 10,000	91	538,116	5,913
10,001 to 33,333	56	1,013,256	18,094
33,334 to 100,000	23	1,382,664	60,116
100,001 to 333,333	6	1,051,611	175,269
over 333,333	1	488,000	488,000
	414	4,755,055	11,486

FIGURE 4.2 CANADIAN CATV SYSTEMS BY SIZE

(2) Matthew's CATV list for June, 1981.

A further breakdown in Gantt chart form is given in Figure 4.3 below.

FIGURE 4.3



CANADIAN CATV SYSTEMS BY SIZE JUNE 1981

(Source: Matthews' CATV Volume 10 Number 2)

Since the final report of Phase 1 (1), there has been considerable activity both in Canada and the United States on scrambling design, development and production, applicable to both DBS systems and cable television systems. A summary of these activities, gained both at the Pay-TV workshop and elsewhere is given below.

Zenith Radio Corporation has announced a cable version of SSAVI (suppressed sync & video inversion system). This now represents the emergence of a form of pseudo-random scrambling in the cable TV & DBS domain. Previously such techniques were available off-the-shelf only for over-the-air STV (subscription television) systems. Electrohome of Kitchener has re-staffed its Pay-TV scrambler design team and is engaged in the development of its own pseudo-random sync suppression/inversion system. The Jerrold Division of General Instruments has also announced development of a pseudo-random scrambler, and Oak Industries has proceeded as planned with a frontier-package version of ORION, their satellite-link, pseudo-random system. Tocom Inc. of Dallas, Texas, is reported to be developing a pseudo-random version of the baseband periodic inversion system presently used in the Tocom 55 Plus scrambler.

Magnavox is reported to have temporarily suspended production of the MAGNA 58 converter/descrambler while undergoing a change of management. Video scrambling within this system was to have been based on the process of continuous line inversion.

Interdiscom Systems Limited (ISL) of Winnipeg has successfully conducted favourable experiments using a novel kind of scrambling that inverts selected segments of consecutive lines. It is claimed that the new technique affords a more effective picture scrambling than more conventional whole line inversion techniques.

Microcom of Toronto has unveiled its STARS Line of non-addressable, but manually tierable, RF sync suppression add-on descramblers. The manufacturers offer a support program to buy back all of the discarded plug-in integrated circuit chips used to preset the descramblers for a given tiering structure. Reprogramming service is also included for a modest extra charge.

By the fourth quarter of 1982, Digital Video Systems of Willowdale, Ontario, expects to be in production of an addressable baseband cable converter/descrambler unit featuring a process of video digitization. The scrambled signal would remain in the analog NTSC format so that the system would appear to be similar in concept to Class-5 satellite scrambling systems being developed by Westinghouse and Microtime. Details of the Digital Video Systems scrambling system remain proprietary.

Tabulated below is an initial list of Canadian, and some U.S., Pay-TV security equipment sources, featuring equipment that while perhaps designed for cable television or other systems could be considered for DBS systems.

DIGITAL VIDEO SYSTEMS INC. 716 Gordon Baker Road Willowdale, Ontario M2I 3B4 John Lowry: (416) 499-4826 Chairman & Chief Executive Officer	Manufacturer: Addressable baseband descrambler units using digitization techniques. Production expected to begin by 4th quarter 1982.
ELECTROHOME ELECTRONICS DIVISION 809 Wellington Street North Kitchener, Ontario Alan Lodberg (519) 744-7111	Manufacturer: RF sync suppression scrambling equipment plus baseband addressable scrambling equipment. Both systems in final development stage. RF system designed to be upwards compatible with baseband system.
INTERDISCOM SYSTEM LIMITED Winnipeg, Manitoba	Developer: Line Dicing Scrambling System
JERROLD DIVISION General Instruments of Canada Ltd. 87 Wingold Avenue Toronto, Ontario M6B 1P8 John B. Aarts: (416) 789-7831 Business Development Manager	Manufacturer: RF sync suppression scrambling systems addressable & non-addressable STARPACK product line.
LEITCH VIDEO LIMITED 705 Progress Avenue Scarborough, Ontario G.B. Newhook: (416) 438-5060 Sales Manager	Manufacturer: Audio/Video Digital Scrambling System

MAGNAVOX CATV SYSTEMS INC.
133 West Seneca Street
Manlius, New York 13104
U.S.A.

Manufacturer:
Tierable scrambling systems.

J.G. (Jay) Staiger: (315) 682-9105
Manager Systems Design

MICROCOM SYSTEMS LTD.
225 Nugget Avenue, Unit #18
Agincourt, Ontario
M1S 3L2

Manufacturer:
Non-addressable, tierable,
RF sync suppression
scrambling systems
"STARS" product line.

Brian DeChamplain: (416) 292-6640

MICRO-SAT COMMUNICATIONS LTD.
975 Brock Road South
Pickering, Ontario
L1W 3A4

Mark Beggs: (416) 839-5182
President

Distributor for:
GTE SYLVANIA
Pathmaker product line
RF sync suppression
scrambling system
addressable & non-
addressable.

SATCOM INCORPORATED
1756/E Junction Avenue
San Jose, California 95112
U.S.A.

Manufacturer and Development:
Audio only and Line Inversion
scrambling systems.

Dr. Bernard Jacobs: (408) 286-6000
President

SCIENTIFIC-ATLANTA (CANADA) LTD.
1640 Bonhill Road, Unit #6
Mississauga, Ontario
L5T 1C8

John Fazackerly: (416) 677-6555

Distributor for:
Sceintific Atlanta
Series 8500
Addressable RF sync
suppression scrambling
system.

TOCOM (CANADA) INC.
102 Bloor Street West, #702
Toronto, Ontario
M5S 1M8
(416) 968-2700

Distrubutor for:
TOCOM 55 PLUS
baseband
addressable
baseband systems.

WHITE RADIO LIMITED
4445 Harvester Road
Burlington, Ontario
L7L 4X1

D.W. (Dave) Martin: (416) 632-6894
President

Distributor for:
OAK INDUSTRIES
RF sync suppression
scrambling systems
addressable & non-
addressable.

ZENITH RADIO CORPORATION INC.
1000 Milwaukee Avenue
Grandview, Illinois 60025
U.S.A.

Jim Faust: (312) 391-8338
Director of Marketing

Manufacaturer:
Baseband addressable scrambling systems in stand-alone and integrated (converter/descrambler) configurations.

In the second portion of the workshop the three Pay television licensees that will distribute in Ontario made individual presentations. The following information relating either directly or indirectly to DBS scrambling was gained.

First Choice Canadian Communications Limited

Represented by:

Mr. Don McPherson - President
Mr. Peter Legault - VP External Affairs
Mr. Peter Grant - Council

Mr. McPherson informed the attendees that First Choice Canadian planned a Pay-TV package consisting mainly of movies, and "made-for-pay" programming, with very little sports or soft-core pornography.

First Choice Canadian did not plan to scramble its services initially, but would wait until HBO had started their scrambling program around the end of 1982, and make a descision on the success or otherwise of this scrambling. On the other hand, they felt that the cable companies should pay considerable attention to security with an expeditious and inexpensive system. Their recommendation for Ontario Cable TV operators was to install two negative traps for First Choice-English and Super Channel, and two positive traps for LAMB and First Choice-French.

First Choice Canadian originally planned to use ANIK D1 as its distribution method but is now looking closely at ANIK C3 with Pay-TV operation commencing in mid January, so that all Pay-TV systems could be on one satellite.

They did not plan to launch nation-wide at one time, but would probably initiate their system in Ontario co-insident with the Super Channel. They saw two definite "market windows" spreading from January, 1983 to May, 1983, and if this was not feasible from August to November, 1983.

During the question period, cable operators showed very considerable concern that First Choice Canadian was trying to define the cable television operators scrambling hardware whilst not planning to scramble its own service. Mr. Jack Davis, the Chairman of CCTA, made a statement that CCTA based its plan on the use of one satellite and one common scrambling method for all Pay-TV services. It was pointed out that at least six months lead time would be required by cable TV systems to provide Pay-TV security regardless of type.

Super Channel (Ontario Independent Pay-TV Limited)

Represented by:

Mr. Steve Harris - President
Ms Tina Cordina - Financial Vice President
Mr. John Slan - Chairman

Mr. Harris informed the meeting that Ontario Independent Pay-TV Limited had decided to do business under the name of "Super Channel". Their product would consist of movies, variety and sports. Some of the sports would be on a separate channel on an occasional basis pay-per-view system.

Super Channel plans to distribute via the ANIK C interim DBS (preferrably ANIK C3) starting if possible in mid January, 1983. They will scramble their service from the begining and provide all cable systems with the headend descrambler. In reply to a question as to whether Super Channel would sell their wares only to cable systems, Mr. Harris replied that this was their current plan, but this could change in the future with the sales to direct-to-home, STV or MATV, as the distribution method was not limited by the license.

LAMB (C Channel - Lively Arts Market Builders)

Represented by:

Mr. Ed Cowan - President
Mr. Sam Freeman - Vice President

LAMB plans to distribute in English only, with programming broken down into 40% movies; 40% lively arts; and 20% children's programming. The latter would be broadcast between 6 and 7.30 p.m. Programming in general would run between 6 p.m. to midnight daily, and 6 p.m. to 1 a.m. weekends.

LAMB would be scrambled from the beginning with a scrambling device consistent with cable TV requirements. While they saw cable companies as being their prime customer, they were also looking at the direct-to-home market, the CANCOM market and possibly STV.

LAMB plan to commence using ANIK C3 on February 1, 1983, if this can be arranged with Telesat. Scrambling is planned from the beginning, as are stereo audio transmissions.

In addition to the three presentations mentioned above, the following general pieces of information relating to DBS scrambling were gained at the Pay-TV workshop.

CANCOM is planning to distribute Pay television in addition to its normal programming, and is expanding this normal programming to include DBS, CBS, ABC and NBC. In addition, it is planning to "unbundle" its programs so that cable TV customers could select the programs of their choice.

Mr. Ross Dryden of Kingston Cablenet TV, stated that he had heard of rumours that the Department of Communications was planning to enforce a single coded scrambling system of cable TV operators and that he was very concerned about this. I assured him that, to my knowledge, there were no plans for mandatory enforcement of any type of scambling system.

Satcom, the San Jose, U.S., designer of audio-only scrambling, is currently promoting its one metre 12GHz TVRO's in Canada at a landed price of $1,200 Canadian complete (dish, LNA and receiver) in quantities of 250.

It was announced on April 24, 1982, that agreement had been reached in principle for France to provide New Brunswick with approximately 8 hours-a-day of French TV programming, to be distributed via satellite and cable TV. No details of the satellite distribution system was given.

Providing Pay-TV licensees and the broadcasters were successful in getting all of their programming on a single ANIK C satellite, CCTA plan to discuss with CBC the possibility of moving the House of Commons programming to ANIK C interim DBS.

<u>Canadian Satellite Communications Ltd.</u> (CANCOM) started <u>scrambling its video</u> signals on March 20, beginning with CHCH Hamilton and CITY Edmonton.

At the moment, the CANCOM signals are being scrambled on a progressive basis, for random periods. Viewers have been advised of this procedure through an on-air message crawl.

CANCOM's $12 million Oak Industries scrambling system is the first scrambled satellite-delivered television system to be put into operation. Home Box Office (HBO) in the U.S. plans to scramble its service later this year or early in 1983, and other U.S. Pay-TV services have indicated they will follow suit.

CANCOM currently has over 306 licensees, of which 50 are now operating. The cost of the descrambling device is included in the $4 monthly fee paid to CANCOM by each of the licensees subscribers.

5. MAY 1982 REPORT

The annual convention of the National Cable Television Association (NCTA) took place in Las Vegas between 2nd May and the 5th May. Attendance at this convention (the traditional launch venue of new products and services in the fields of satellites, scrambling and Pay TV for the cable television industry) was the major method of information gathering in May.

The NCTA Convention Exhibition was characterized by a large number of new scrambler/descrambler and addressable converter offerings. It should be noted that Pay-TV in the United States, although almost wholly redistributed by satellite to cable TV headends is currently only scrambled in the cable TV distribution system. This means that the majority of scrambling systems are devised for cable systems and are not necessarily suitable for DBS use. In particular, many companies were offering security systems based on negative or positive traps, and others on unsophistocated RF sync suppression systems.

Some of the latter were obviously designed with low cost rather than a high degree of restoration or security in mind. Although, due to the large number of offerings, considerable time was spent checking these products to ascertain their suitability for DBS scrambling systems, those considered unsuitable will not be identified or described in this report. It is perhaps sufficient to state that the market in the United States is being flooded with inexpensive low-quality scrambling and descrambling products which are completely unsuitable for DBS use, and indeed in many cases could not be recommended for cable TV distribution due to their low level of security and poor restoration of the signal.

However, a number of products were identified as being of possible use for DBS scrambling systems, and these fall into two groups. The first group contains either new models or additional information gained on systems already identified either in previous reports or in the previous chapter of this report. In the second group are a number of new products produced by reputable organizations that are likely to be of interest as DBS scramblers. Generally speaking these are still under development or not in full production, and technical information was generally meagre. These are identifed with such information as was available, and will be followed up in subsquent reports.

5.1 The OAK Orion Series of Scrambling Systems

The OAK Orion Satellite Security System uses the pseudo-random line inversion and horizontal sync pulse relocation system combined with a digitized audio carrier. The current Orion-C System is designed specifically for headends and the decoder costs over $3,000. This was the system described in the Phase 1 Report and is currently being used by CANCOM for scrambling its Anik A services. CANCOM's scrambling system went into full-time commercial use this month, superceding the experimental use that has been in operation since March.

At the NCTA Exhibition the Orion-1 decoder was on display. This decoder is fully compatible with the Orion-C security system, and is intended for subscriber use rather than headend use. It has been repackaged and partially redesigned to give single channel operation only. It does, however, use the same decoder boards as the Orion-C unit, slightly modified so that they are not plug-in replaceable. The new version also uses a smaller power supply and common "phono" jacks in place of the XLR audio connectors used in the Orion-C. The input is at video level and the unit is designed for connection to the baseband video output of the satellite receiver. The terrestrial distribution system used by CANCOM and showing the Orion-C decoder used for cable TV distribution, and the Orion-I individual decoder used for direct-to-home use is shown in Figure 5.1

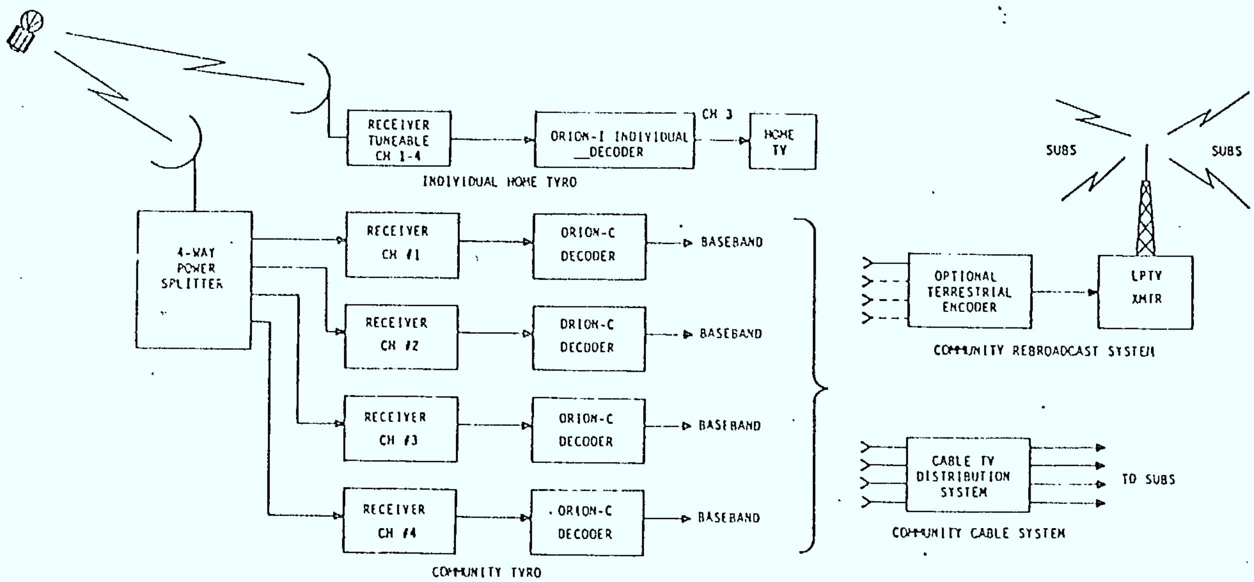


Figure 5.1. TERRESTRIAL DISTRIBUTION SYSTEM - CANCOM

Systems specifications with an Orion-C encoder/Orion-I decoder are shown in Figure 5.2.

In discussions with OAK engineers it was learned that the Orion-I system will soon be replaced by the Orion Frontier system. Once more this is completely compatible with both the I and the C systems; however, it will make use of a VLSI chip currently being developed in Holland. This would reduce costs down to the order of $100 Canadian, and it is expected to be on the market early in 1983. As such it will compete with the SATCOM audio-only system which is likely to be released at approximately the same time.

FIGURE 5.2

ORION-C ENCODER/ORION-I DECODER SYSTEM SPECIFICATIONS

Addressing/Control Information	Digital data contained within VBI
Addressing Rate	1000 decoders per minute
Addresses Available	2,000,000 maximum
Compatibility	Preserves Teletext, VITS, VIRS, Source ID and captioning
Operational Sequence	A. Pre-authorize all subscribers B. Send decryption data
Program Tiers Available	49 maximum
Video Performance	
Input/Output Level	1 volt peak-to-peak into 75 ohms unbalanced
Frequency Response	30 Hz to 4.5 MHz ±0.3 dB
Encryption Modes	Analog based on random scene changes; six other highly dynamic computer controlled modes available for maximum security in teleconferencing and non broadcast applications
Audio Performance	
Input/Output Level	0 dBm nominal into 600 ohms balanced
Frequency Response	50 Hz to 10 kHz ±0.5 dB, 12 kHz -3 dB
Encryption Modes	Digitized/encrypted using time-varying key, 12 bits to 8 bits companded
Power Requirements	90-130 VAC, 60 Hz
Operating Temperature	0°C to 50°C
Dimensions	4-1/2" H, 18-1/2" W, 8-3/8" D
Input/Output Connectors	
Video	BNC
Audio	Miniature Phono (Switchcraft Part No. 142A)
VHF	Type F Female

Notes: The satellite receiver video output signal-to-noise ratio is recommended to be 50 dB or better (C/N 12 dB or better).

The transmission paths between the pre-encoder and post-encoder, and between the post-encoder and decoder must not employ clamping circuits.

5.2 SATCOM Audio-Only Descrambler

The progress of the SATCOM audio-only descrambler was discussed with senior engineers from that company.

Apparently development is progressing as planned, and as discussed in the Task Report 1 of this study. There have been no significant changes in specifications or planned cost and it is still expected that the first sample from the preproduction run will be available for trial by November 1982 with full production commencing early in 1983.

5.3 Zenith Z-TAC System

This system which was discussed in the April Report as being the product selected by Rogers Cablesystems Incorporated for its Canadian systems, was on display and is being heavily promoted. This system which employs both sync pulse offset and video frame inversion in various combinations is described in reasonable detail and shown in Appendix B.

Canadian cost of this device in very large quantities is in the order of $75.

5.4 Tocom 55 Plus

Although Tocom has expanded on its baseband periodic inversion system to provide an addressable terminal (Model 5504A) and a home information terminal (Model 5510A) the latter having teletext data channels and on-screen text and graphic facilities together with a two-way interactive option, there is as yet no sign of the expected pseudo-random version of this system. The 5504A and the 5510A are both fully compatible with the other 55 Plus products of Tocom and uses the identical baseband encoded periodic inversion scrambling system.

5.5 Digital Video Systems Baseband Encryption System

Digital Video Systems provided advanced information on its DPS401 Encryption System designed for DBS use.

Although discussions were held with Digital's engineers, they were perhaps understandably reluctant to give significant information prior to the release of this product which is expected in the fall of this year.

It can be said however that the DPS401 Encrypter provides digital encryption of both the video and audio signals. The baseband system provides inband multiplexing of digital audio, data and video in a single standard 4.5 MHz NTSC channel. The software control provides up to 4 billion individual user or terminal addresses with up to 65 thousand control conditions or tiers per address. Inband addressing of up to 500,000 subscribers per minute is specified.

Individual TV channels are processed at the origination point, with varying codes for audio, video and data. Address and contol words are multiplexed in the digital audio and data streams via a high speed buffer memory which is updated by a local host computer. Baseband dual channel audio is carried within the video envelope eliminating the need for a separate audio carrier, and apparently resulting in improved transmission characteristics. Although no specifications are given, reduced intermodulation, harmonics and triple-beat distortion are claimed. As the encryption/decryption process is totally digital, a very high quality of restored signal is claimed. Block diagrams for single channel and triple channel terminals are shown in Figures 5.3 and 5.4 repectively.

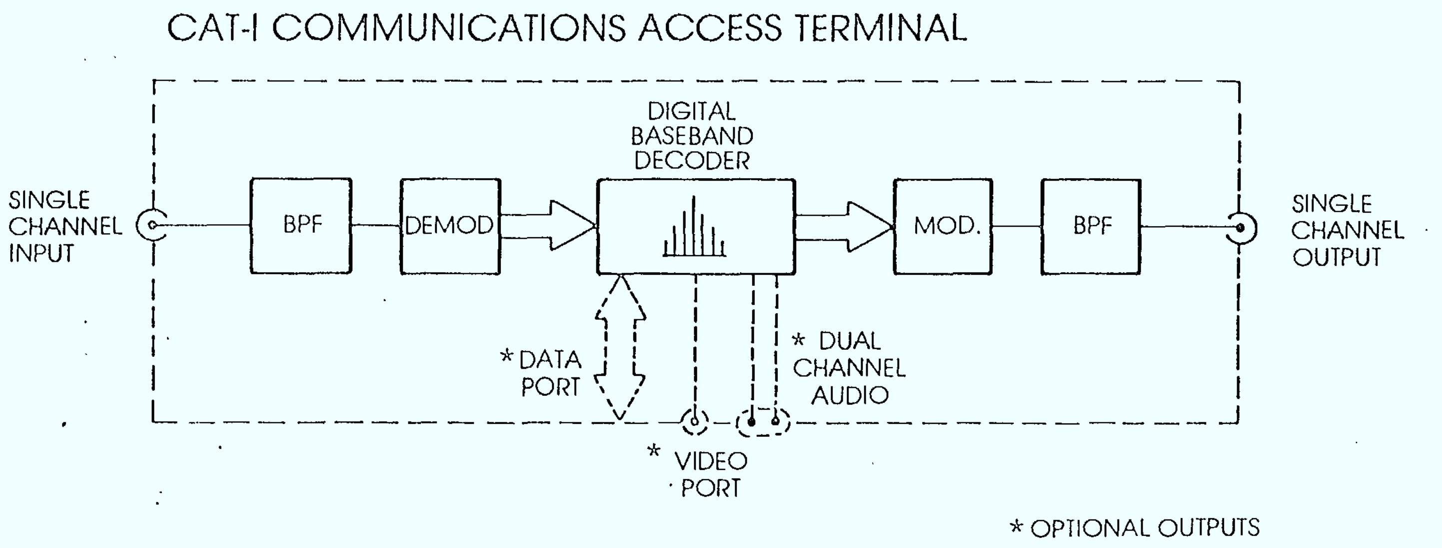


FIGURE 5.3

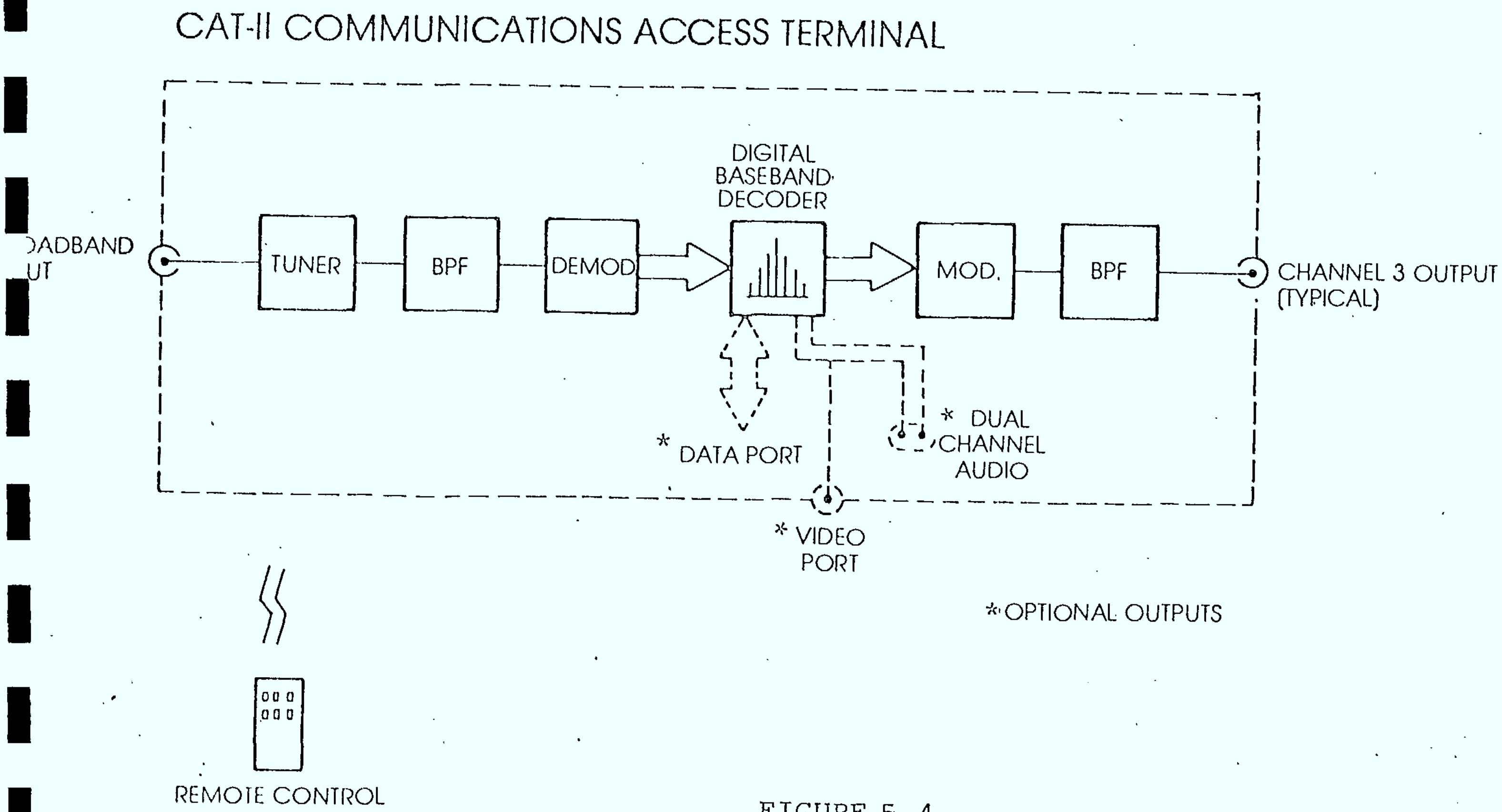


FIGURE 5.4

Although information is at this time limited, it appears that the DPS-401 does have potential for DBS scrambling and this product will be followed up in later reports.

5.6 Scientific Atlanta Model 8500 Set Top Terminal

A "smart" set top converter and descrambler, the Model 8500 is one of the better devices offered at the NCTA Convention. Using the switched sync suppression with offset timing it cannot be said to have extremely high security. It is however, capable of transmitting, within the vertical interval refresh signals to reset an internal clock. If this coded signal is not received the terminal automatically shuts itself down. The Model 8500 features a changeable PROM so that authorization instructions can be completely modified and will function only with those terminals with the new PROM.

Although designed for cable TV use, this system is capable of operation as a DBS scrambling system.

5.7 Matsushita Sprucer Converter

This system appears somewhat similar to the Zenith descrambler. A demonstration model was on show and a somewhat upgraded "Sprucer II" production model is planned within two months.

The scrambling and descrambling system is described by Matsushita as follows, "Using a unique random scrambling technique, level shifts both vertical and horizontal synchronous signals and random turnover of video signal polarity for every field, providing outstanding pay security without degrading picture quality. In the "refresh command" mode through a data channel especially assigned by Matsushita, Sprucer acknowledges 4 bit data providing 16 combination turnover timings to be stored in the addressable unit. If the descrambling code and parental discretion code of any program of the desired channel matched the memorized codes, Sprucer remodulates the synchronous signal, which is amplitude modulated with the audio carrier and starts turnover of the polarity of every field".

It should be noted however that a separate 73 MHz downstream address data carrier is required to operate this system. An additional narrow band transponder carrier would therefore be required for DBS use.

6. JUNE 1982 REPORT

This month's new information on DBS scrambling techniques has been gained mainly from the Canadian Cable Television Association (CCTA) convention held in Toronto during the first week in June, and from inputs obtained from ongoing contacts with manufacturers.

6.1 Subscriber Terminal Evolution in Rogers Cablesystems Incorporated (RCI) Systems

In a paper by Mr. George Green of RCI, the development of subscriber terminal (converter/decoder) equipment used by Canada's largest cable TV company is described.

As this has, in part, significant implications for DBS systems, and infact implíments paragraph 4.1 of this report, relevant excerpts from Mr. Green's paper are quoted here under:

"The results of a series of studies and cost analyses indicated a perference towards an addressable, dual input, 57 channels per cable, baseband converter descrambler with a wireless infra red (IR) keypad. The baseband converter was preferred because of the secure encoding technique which used pseudo random DC sync offset and active video inversion. The baseband option also provided access to the vertical blanking interval (VBI) for simple text recovery schemes, and allowed direct video access to future television sets which would improve the received picture quality. The baseband unit also had the advantage of providing remote audio volume control. The addressability enhanced the security, reduced the service costs on pay churn and provided the first step toward effectively controlling pay-per-event programming.

In addition, the results of our studies indicated that significant system improvements could be achieved by using a low noise converter terminal and by modifying and encoding technique to reduce the carrier levels on a large number of channels. (i.e. a lower level of distribution for the same carrier-to-noise ratio and a reduction in third order distortions could be achieved respectively).

...the manufacturers of consumer products were introducing television sets with video inputs and cable ready tuning systems. In U.S. systems this had provided some contentious issues where cable systems are encoding large number of channels, and subscribers innocently assume that their newly purchased cable ready television will receive and decode all of the channels distributed by the cable operator. It is important, therefore, that the cable industry understand and address this problem with the manufacturers in order to develop common interface standards to minimize these and future areas of contention.

Figure 6.1 illustrates the current status of the subscriber terminal products. Figure 6.2 illustrates typical Noise Figure (NF) comparisons for the converter categories currently available and shows the potential NF improvement when using a single mixer tuner.

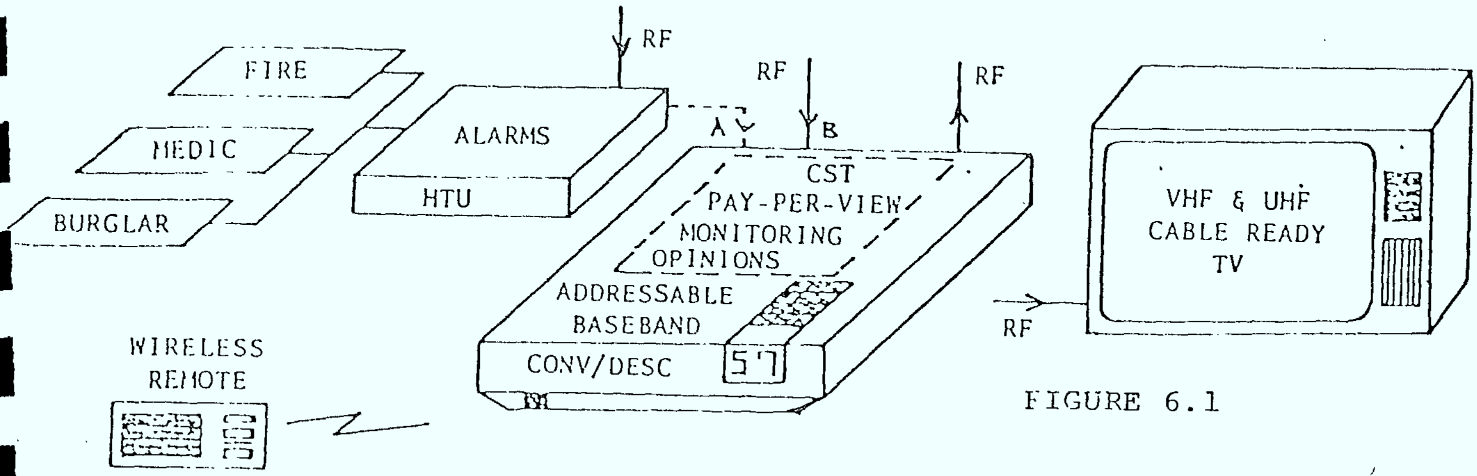


FIGURE 6.1

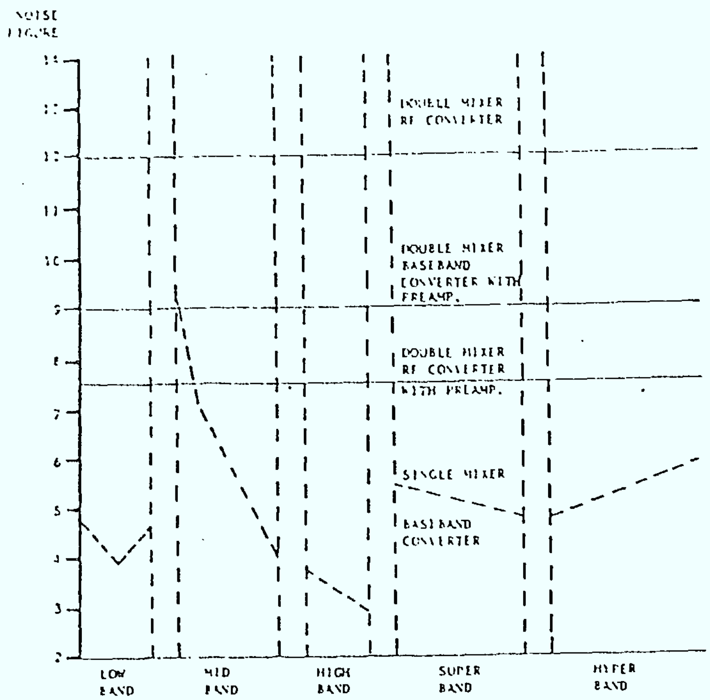


FIGURE 6.2

TYPICAL NOISE FIGURE CHARACTERISTICS

FUTURE DEVELOPMENTS

New developments in consumer products are already promoting component television concepts,... These components are further complemented with the home VCR and video disk which will interface to the converter terminal and the television set via an audio/video switcher. This switcher, recently introduced to the consumer market, allows the selection and routing of the required programming material (software) into the television or VCR at some specific or pre-set time. The source of the material may be off-air, a video disk, or from the cable system via the converter terminal.

The current indication from manufacturers is that this switching and distribution will be done at baseband which reinforces the choice for a baseband converter terminal. Interest from premium programmers and broadcasters is accelerating the adoption of transmission standards in North America for stereo audio for television. This could have significant impact on both the terminal device and the transmission path through the cable system to ensure the transportation and transparency for this new service.

In addition to the familiar television programming components, other potential new services opportunities are evolving with the increased consumer demand for home computers, video games and, to a lesser extent, information services. To cater to these new emerging services, it is anticipated that a separate "out of band" universal high speed (4 Mbs) data channel will be used to download software providing tiered data services to the home. This data channel will not replace but will complement the existing "in band" pay addressing and tiering information signals and alarm and monitoring signals in the 5 MHz to 13 MHz band. Figure 6.3 illustrates the anticipated components and indicates that little change is required in our present converter terminal configuration. Since the converter terminal is already at baseband and most of the new components are external, the additional baseband audio and video ports will provide the necessary communication links. The two possible additions internal to the converter are, a VBI text character generator chip set and a stereo audio decoder. An additional port will provide access to the 4 Mbs via a data extractor in the converter terminal.

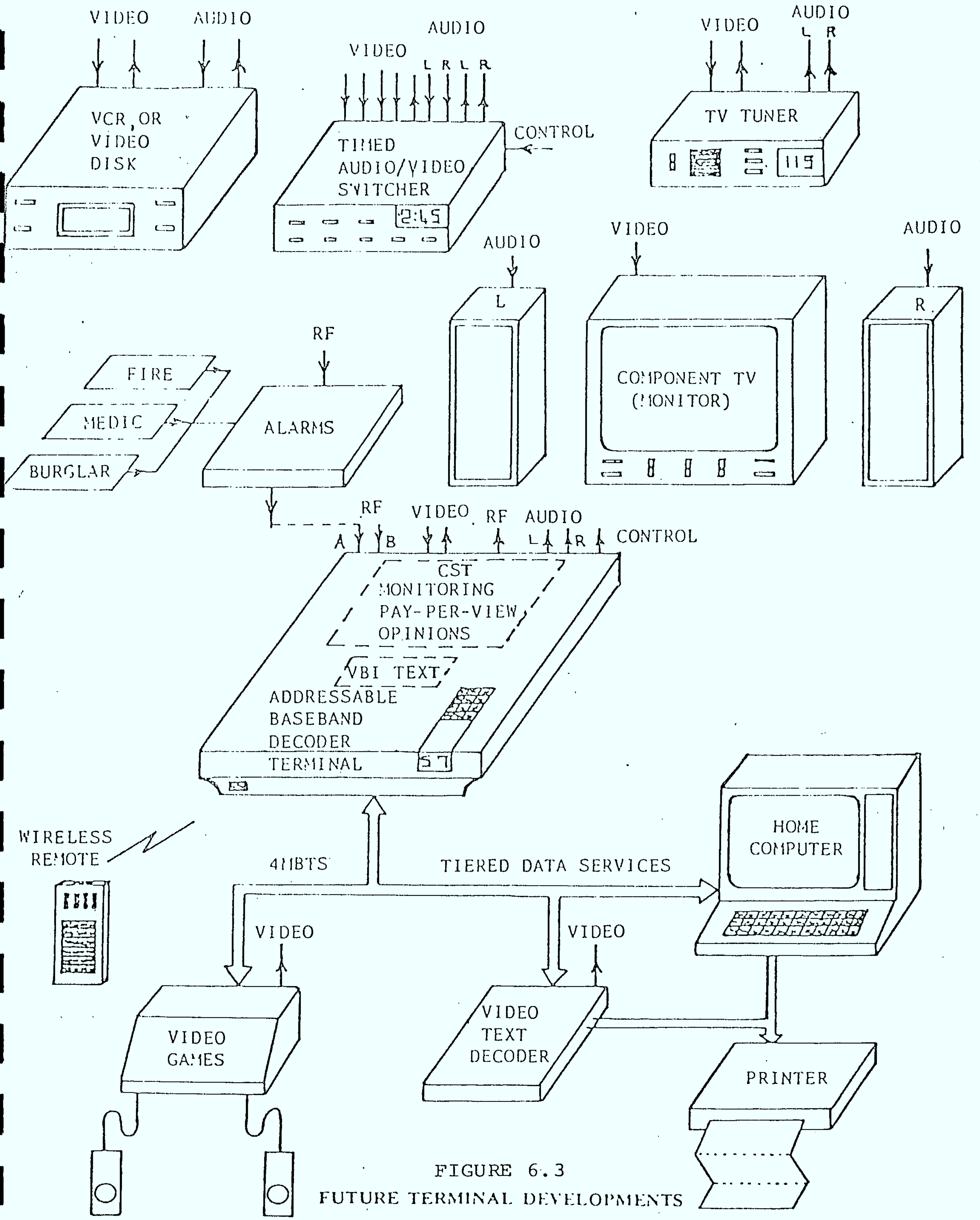


FIGURE 6.3
FUTURE TERMINAL DEVELOPMENTS

Another output port may also provide a communication link to the converter wireless remote keypad to control some of the external component features, such as the text decoder and the audio video switcher. The alarm monitoring, interactive and pay-per-view services will still be provided in this new terminal as previously described. This new terminal can be considered as an extension of the cable plant which provides remote controlled switched access to a variety of new services that will be available in the near future.

A simplified block diagram of this proposed new terminal device is illustrated in Figure 6.4. The device is an addressable baseband decoder using "in band" timing and control in the VBI. The encoding assumed is pseudo random DC sync offset and active video inversion.

The unit will provide dual cable input options with bandwidths of at least 5 MHz to 450 MHz. The RF signals are received and translated to a 45.75 MHz IF by a single conversion low noise tuner. The tuner output feeds the IF module via a surface wave filter which eliminates the adjacent channels and simplifies the IF alignment for the manufacturer. The audio and video signals are detected and fed to the decoder board which decodes them, if authorized. The baseband signals from the decoder board are fed into a VHF modulator, channel 2, 3 or 4, whose output is connected to the television RF input.

The timing and control information for the decoder is contained in a data format in the VBI and is recovered in a custom LSI which controls the decoding sequence. The use of "in band" control is preferred because it is a proven technology, reliable, and requires little intelligence in the same data acquisition circuit, a simple low cost VBI text service can be accommodated for captioning.

The separate "out of band" universal high speed data channel is recovered via a fixed tuned data extractor to download software for video games, video text and home computers.

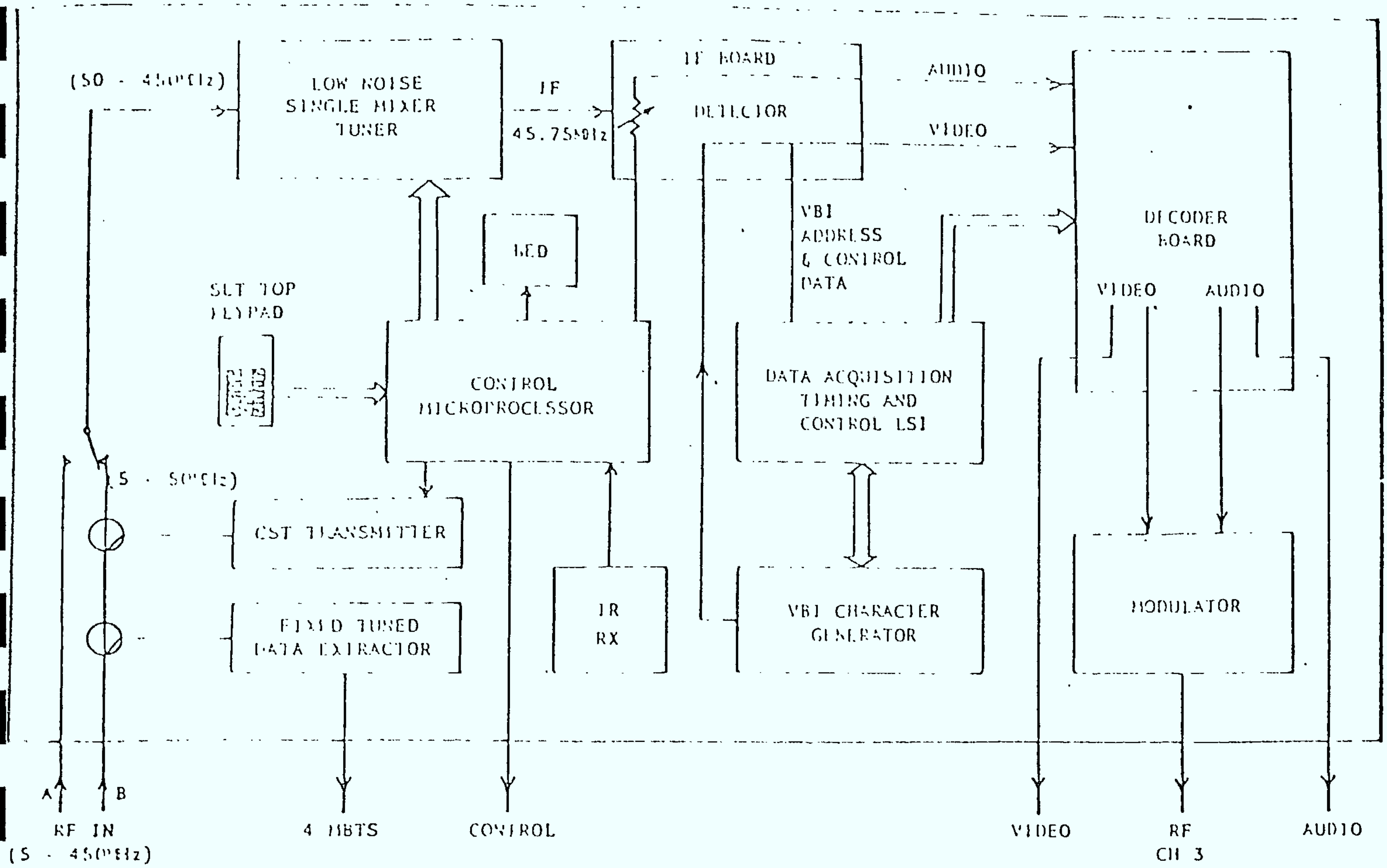


FIGURE 6.4 — PROPOSED SUBSCRIBER TERMINAL CONFIGURATION

The control microprocessor interfaces with the set top and remote keypads, the channel indicator, the audio volume control and processes the tuning information. It also contains the intelligence for communicating via a serial data link to the CST module, or externally to the HTU if alarms are to be provided. The CST or external HTU contains the FSK transmitter which communicates the opinion polling, channel monitoring, status monitoring and pay-per-view ordering information upstream to the cable system headend. The control microprocessor may also be used to provide remote control of other external components via the wireless remote keypad.

Baseband audio and video signals are also available to interface directly with baseband input televisions. As the number of televisions with video inputs increases, the need for the VHF modulator unit decreases and will ultimately be removed, which will reduce the terminal cost and improve the picture quality for the customer."

6.2 The Orion System. The Satellite Signal Control and Piracy Solution

A paper and presentation by O.J. Hanas et al of Oak Communications Inc. provided additional information to that given in section 5.1 of this report on the Orion series of scramblers. Excerpts from the paper containing this additional information are given below.

> "Of the 40,000 TVRO's which will be in place in 1982 in Canada and U.S., less than one-third will be owned by CATV and other commercial operators. The remaining 70% will be used by individuals, and other unauthorized persons who are using the signals without payment.
>
> ...The legal recourse is available through policing, enforcement and litigation; the technical solution is through encoding, encryption, scrambling, addressability and tiering. It is the technical solution which will be described in this paper.
>
> The basic elements of the technical solution, of course, are scrambling and encryption...
>
> Addressability - means computer control of individual decoders and groups of decoders. Also, it means business control through computerized authorization, tracking, installations and billing.
>
> Tiering means program control by interest groups or categories and time-share multiplexing of programs...Canadian Satellite Communications Inc....are using the ORION System described in detail below (Figure 6.5).

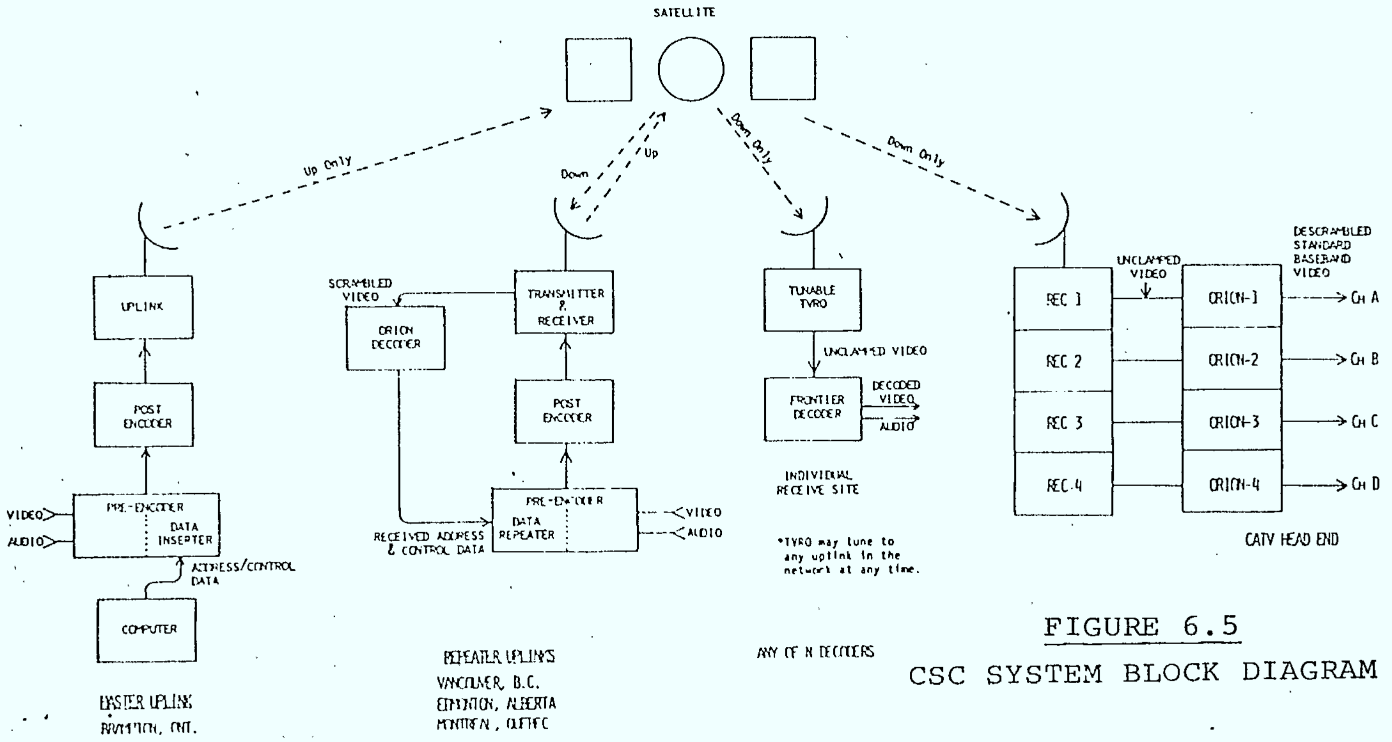


FIGURE 6.5

CSC SYSTEM BLOCK DIAGRAM

The ORION system...provides for scrambling the video, digitizing and encoding the audio, at the uplink control center and decoding the same parameters at the downlink sites. The system is fully addressable allowing for computer controlled delivery of information or programs to individual or groups of decoders. Each decoder in the system carries a unique code and address that must be matched with a digital message transmitted from the control center.

The principle behind the TV signal encryption system is based on the fact that... Within the decoder, a circuit extracts a hidden and encrypted digital message and uses it to restore the normal patterns to the scrambled signal, restoring the original video. Before this circuit can be activated, the decoder must recognize its unique address and decoding data. Since the digital messages are time varied in a pseudo-random fashion, decryption of the signal is essentially impossible in real time by a non-authorized decoder.

The digitized broadcast-quality audio signal consists of two bytes sampled at a 31 KHz rate. To improve sound quality, the audio is compressed from 12 to 8 bits per sample. The 8 bit signal is encrypted and inserted in the video signal. <u>The original audio subcarrier in the satellite channel is unused and available for other applications.</u> (emphasis added)

The principal features of the ORION system are:

- Time varying video scrambling
- Digitized and encrypted audio
- Computerized control of entire system through addressability and tiering
- Standard interface at baseband, compatible with existing standard earth station equipment.
- Multi-tier program control within the secure channel.
- Meets or exceeds Cancom satellite signal security system specifications, and EIA RS250B specifications.

...the Cancom satellite signal scrambling system
...consists of the following subsystems:

A. Master control center equipment
B. Uplink earth station equipment
C. Receiving sites equipment
D. Repeater control equipment

...photographs of the actual encryption and decoding equipment...are:

Figure 6.6: ORION Encryuption Equipment

Figure 6.7: ORION-C Decoder for Community sites

Figure 6.8: ORION-I Decoder for Individual sites

Figure 6.9: Frontier Decoder for end-user individual sites and homes

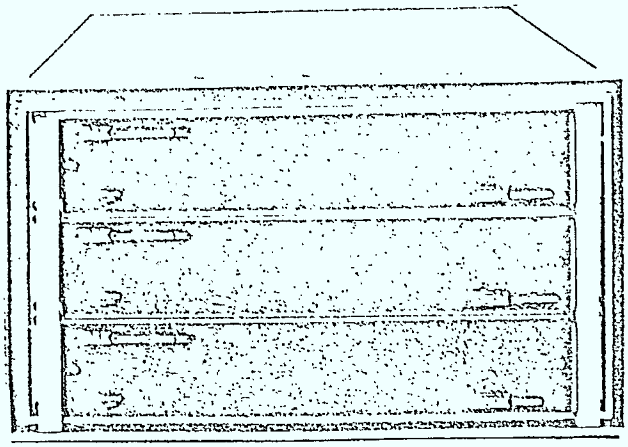


FIGURE 6.6 ORION Encryption Equipment

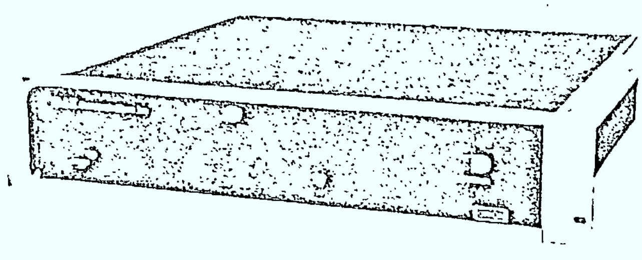


FIGURE 6.7 ORION-C Decoder for Community Sites

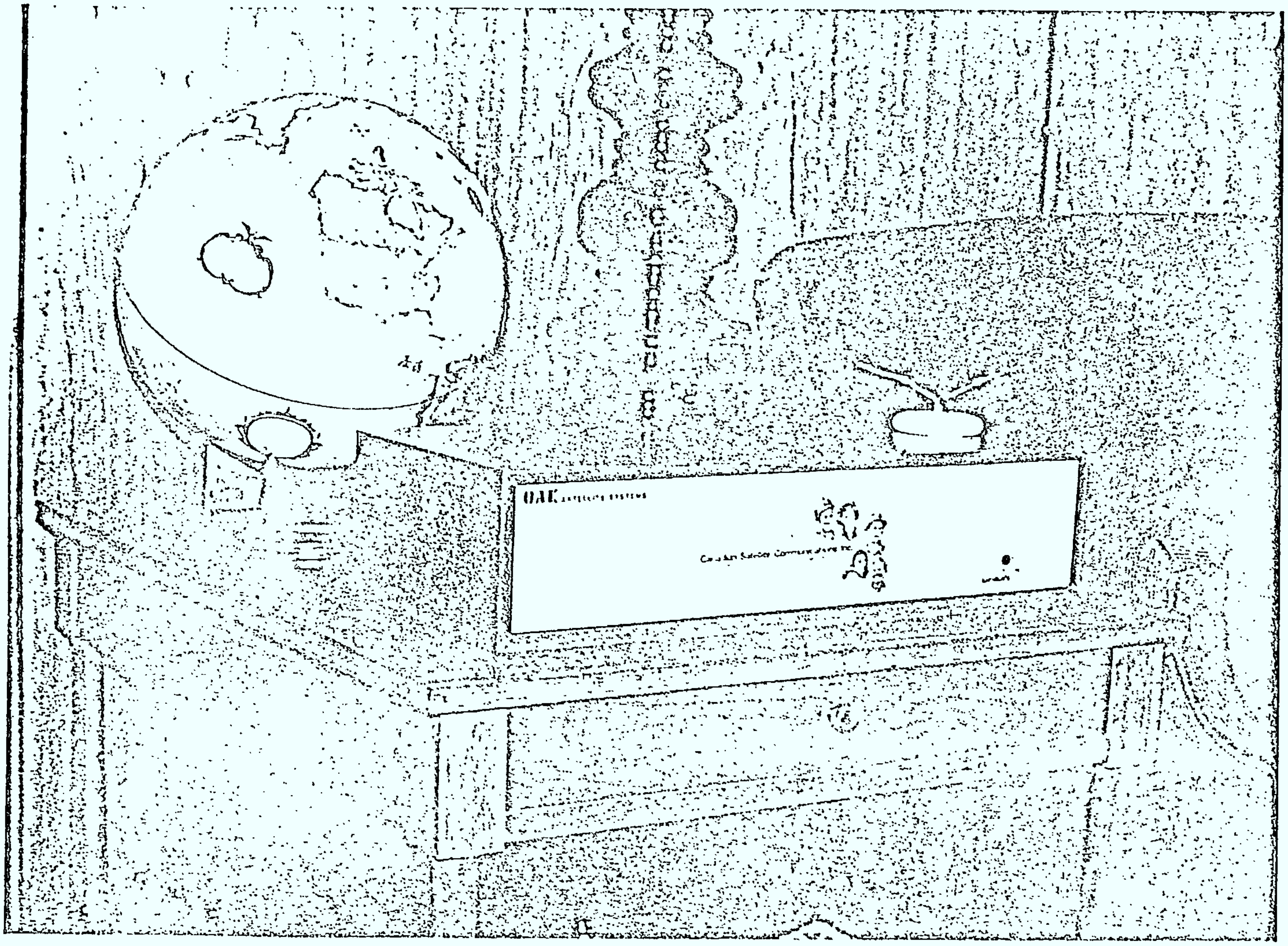


FIGURE 6.8 ORION-I Decoder for Individual Sites

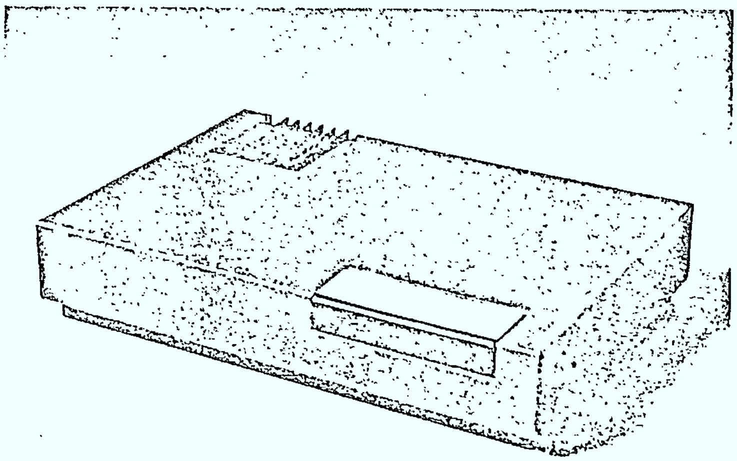


FIGURE 6.9 Frontier Decoder for End-User, Indivudual sites and homes

At the Control Center, the video is scrambled, the baseband audio is digitized and encrypted (using an advanced technique similar to that used by banks for electronic funds transfers) and the addressing information is formatted.

At the uplink earth station in Brampton, Ont., the address channel, the encrypted audio and the scrambled video are combined, modulated and transmitted to the satellite. There are other similar uplinks at Vancouver, B.C., Edmonton, Alberta, and Montreal, Quebec. These uplinks are repeaters which do not have computers of their own. The control information for the entire system is contained in the data stream originating at the Brampton control center and reinserted in the signals at the other uplinks. Thus, every decoder in the system is controlled from that one central computer. (emphasis added)

RECEIVE SITES

As shown in Figure 6.3, two types of receive sites will exist in the Cancom system:

a. CATV sites which will decode each channel separately using the "community" decoders (Figure 6.7), and

b. Individual sites which will decode any channel which the tunable receiver feeds into the I-decoder (Figure 6.8) or into the Frontier decoder (Figure 6.9).

Note: The I-decoder is totally equivalent in broadcast level performance to the ORION-C decoders but is packaged for individual site use. The ORION Frontier decoder has been designed for direct-to-home application to serve the end user at high performance and low cost...

Standard satellite TVRO receivers are used for converting the satellite transponded F . signal to baseband video signal. (Unclamped video signal must be provided to the ORION decoders.)..."

6.3 Sylvania Pathmaker Model 5301 Scrambler and Model 4023 In-Band Descrambler

New product information received from Sylvania describes a straightforward sync supression system, and is described here for the sake of completeness. It is not however considered to be a suitable system for DBS scrambling:

> The Model 5301 Scrambler is standard 19" rack mountable, head-end unit used to distort the video of any TV channel. It accomplishes this scrambling by suppressing a composite of the channel's synchronization pulses so that they are buried in the video brightness information where the TV receiver synchronization circuits cannot distinguish them. This creates diagonal lines and video tearing, making the resulting scrambled picture difficult and frustrating to watch.
>
> Reinstatement of the video for pay TV applications is accomplished in the optional descrambling circuitry of the subscriber's converter. The converter amplifies the received RF in the vicinity of the synchronization pulses, thus recovering the original video signal.
>
> One of the most valuable features of the Scrambler is that it uses the audio carrier frequency of a channel instead of additional bandwidth to convey its timing information.
>
> A modulator with separate audio and video IF outputs is required to provide the inputs to the Model 5301. The audio carrier frequency of the channel is used instead of additional bandwidth, to convey timing and tiering information. Tiering can be internally generated or fed from a remote source, and is used for compatibility with other manufacturer's equipment. Additional pulses are also generated by a Pulse Insert Assembly for proper operation of certain manufacturers' converters in the standby mode. Timing and tiering flag adjustments are provided through front panel hex switches along with compensation of head-end and descrambler delays. The front panel also includes a "giveaway" switch for sales promotion purposes.

All necessary circuitry to perform the scrambling function, as well as necessary DC powering circuitry, is contained within a three-inch high standard rack-mountable chassis. Since one Model 5301 is required to scramble one standard channel, two, three, four or more scramblers may be stacked in a standard rack without occupying much room in the head-end.

MODEL 4023 IN-BAND DESCRAMBLER

As are all the other options, the Model 4023 is designed to be easily incorporated to the converter. The descrambler module snaps onto the up-down tuner inside the set-top-unit and plugs in using connectors. No. soldering is required. Channel authorization is accomplished by programming the descrambler's control module using the Model 5302 Programmer. The control module circuit card plugs into the side of the descrambler for ease of installation and removal. Potting of critical circuitry prevents theft of unauthorized pay channels. In addition to being capable of descrambling any channel to which the converter is tuned, the Model 4023 Descrambler is compatible with some of the other sync. suppression scrambling methods and therefore can be used in conjunction with other manufacturer's scramblers.

Specifications

MODEL 4023 DESCRAMBLER:

Input/Output Frequency Range	Channel 2, 3 or 4
Impedance	75 ohms
Return Loss	15dB
Input Level Sensitivity	
Picture Carrier Level	22 dBmV Max.
Sound Carrier Level	-17 dBmV to 9 dBmV
Insertion Loss	
Descramble	Sync: 0dB typical Video: -6dB typical
Standard	0dB typical
Powering	105-130 VAC, 60 Hz

MODEL 5301 SCRAMBLER:

IF Input-Output Impedance	75 Ohms Unbalanced
IF Input Levels	35 dBmV Nominal
IF Output Levels	Transparent
Tagging Levels	12B
Horizontal Sync. Suppression	6 dB
Vertical Sync. Output	3V Min.
AC Power Requirements	115 VAC, 60Hz, 16W. Max.
Weight (Approximate)	10 lbs., 8 oz.
Dimensions	17" X 17" X 3" (front panel: 19" X 3½")
Mounting	Standard 19" Rack

6.4 Jerrold Starbase

Information was received from Jerrold on its new product "Starbase". This is an add-on descrambler for Jerrold's SSE 200 AN pseudo-random scrambling system. (see section 4.3 above). Starbase fits under the Jerrold Starcom line of converters and interfaces with many other converters on the market, eliminating the need for a new converter/descrambler in cable systems.

6.5 Interdiscom Systems Limited (ISL)

It was announced in the "Globe and Mail" of July 3, 1982 that ISL of Winnipeg has given notice to its employees and is within days of going out of business. No information is available on the fate of the experimental scrambling system described on page 12 of this report, and it is assumed that it will die with the company.

7. JULY 1982 REPORT

This month, Mr. Richard Treece of CANCOM was interviewed to obtain comments on CANCOM's experience with the OAK Orion-C System.

Further information on the current status of DBS scrambling techniques was obtained from ongoing contacts with manufacturers and from routine literature study.

7.1 The Experience of Canadian Satellite Communications Ltd. (CANCOM) with the OAK Orion-C Scrambling System

CANCOM commenced scrambling its video signals on an experimental basis on the 25th March 1982, and in May 1982 started scrambling all video signals on a routine basis using an OAK Orion-C Scrambling System. It was felt that it would be useful to gain the comments of CANCOM on their experience to date, in-so-much that as far as is known this is the only operational satellite video scrambling system in Canada, and probably in North America. The information given below should be read in conjunction with that on the OAK Orion Systems given in Sections 5.1 and 6.2 of this Report.

CANCOM has found the system to be extremely versatile. It can be controlled and manipulated from a central source at which is located the scrambling control computer at the Brantford, Ontario up-link. Alternatively, the computer can be accessed by the remote terminal at Ottawa. Brantford is the location of the uplink for station CHCH, Hamilton, The computer controls the scrambling and the tiering at all the other uplinks by transmitting the information on the scrambled signal from Brantford. This signal is monitored with TVRO's at the other uplink sites where the scrambling directions for the local uplink are interpreted and executed, thus permitting each uplink to have a unique set of customers. CANCOM presently operates with about 15 tiers in their system which are principally adjusted for the time zones across Canada. CANCOM also provides program substitution in the case of broadcasts originating on local stations that could possibly be picked up at CANCOM receive sites. This is to avoid the cost of program substitution to the customers. This feature is easily accomplished through the central computer.

The system is thus adapted to a great variety of system needs and requirements.

With experience a number of operational points have arisen, some positive and some negative and these are summarized below:

- By virtue of the remote access to the computer, the system is easy to manage, right through from authorization to de-authorization.

- Low cost TVRO's using 10 foot, and in some cases 12 foot diameter antennas cause difficulty with the descrambler because of insufficient carrier-to-noise or post detection signal-to-noise ratios.

- Some TVRO's are being manufactured with IF bandwidths in the order of 25 MHz whereas commercial practice is to have IF bandwidths at least 30 MHz wide. The CANCOM decoders can be seriously effected in their operation if the transmission channel of the coded signal reduces the bandwidth of the baseband below 4.5 MHz.

- CANCOM has had some problems with clients with low cost TVRO's and they are attempting to have their clients replace marginally performing TVRO's with a TVRO that meets the following "standard".
  IF bandwidth 30 MHz minimum; receive system G/t ratio-20.2 minimum; carrier-to-noise ratio-8dB minimum.

- Experience so far with the OAK Orion system indicates that TVRO's that are presenting a good quality picture are compatible with the decoder.

- Because of the production of the synchronization pulses in a composite video wave form, no video manipulation can be inserted in a scrambled channel. In other words the signal once scrambled must be carried with good fidelity to the decoder.

- CANCOM receives all of their television signals directly off air, and they have not encountered problems with encoding of signals in the presence of moderate interference or less than ideal signal quality. It is apparent, therefore, that the scrambler can handle a reasonable degredation in the input, but once scrambled the signal must be tranmsmitted faithfully until it is undecoded.

- CANCOM have not observed any noticeable deterioration between a signal that has passed through the scrambling descrambling system and a signal that is received directly.

7.2 U.S. Satellite Video System Scrambling Plans

To date the large number of American organizations using communications satellites for the distribution of Pay Television and other video services have not scrambled their services. A number of organizations do however have plans to scramble their satellite video services and it was felt that it would be useful to summarize these plans as they are known to date. The following information was obtained mainly from the June issue of "Electronics and Communications".

- Home Box Office - the Pay-TV service of Time Inc. - will electronically scramble the satellite signal it transmits to its 3,300 affiliates starting in late 1982 or early 1983. HBO is the largest Pay-TV network in the US with 8.5 million individual subscribers. The network figures that signal piracy may already be costing it as much as $3.2 million a year in revenue losses.

- Comsat's Satellite Television Corporation is planning to introduce a scrambled DBS Pay-TV service on the 12.2-12.7 GHz band in 1985/6.

- OAK Industries Inc., has leased four transponder channels on Canada's Anik-C satellite for scrambled Pay-TV programming to US subscribers beginning in mid-1983.

7.3 Leitch Video Limited Digital Television Scrambler/Descrambler

Other than a brief mention in Section 4.3 of this Report (April 1982 Report), the Leitch DTS/DTB-2000N Digital Descrambling System has not been mentioned. The reason for this was that the system was demonstrated to CRC on the March 23, 1982, and an evaluation made by both Leitch (DIGI-TEL), and CRC staff.

Further information on a demonstration and a test made with Warner Amex of Long Island, New York on April 16, 1982, using the SATCOM IV Satellite have been received. It is felt appropriate therefore to describe the system as a whole and to include as Appendices C and D the test results of the CRC and Warner Amex demonstrations respectively.

The DTS/DTD-2000N System uses digital techniques to provide audio/video signal security in satellite transmission links.

The signals are digitally encoded, using a random time-varying algorithm. Audio is imbedded in the video.

Full audio/video bandwidths are maintained. The Descrambler video output conforms to EIA RS170A specifications.

The Descramblers are individually addressable for complete control from the origination center.

Sync presence throughout the system allows sync tip clamping. Complete scrambling takes place at the point of origin, not at the uplink site.

Forward coding techniques ensure high immunity to noise and drop-outs in the transmission path.

The Scrambler inputs consist of a composite NTSC video signal, an audio signal and Descrambler control information. The Descramblers can be turned on and off, individually by means of this control information. Each Scrambler only contro's the Descramblers associated with its own transmission link. The Scrambler output consists of a single baseband, analog video signal containing scrambled video, scrambled audio and descrambling control signals.

Video Scrambling

The DTS-2000N Scrambler contains an analog/digital converter which is used to sample the incoming video signal at a four times subcarrier rate (14.3 MHz). A video processor with 384k bytes of high speed memory is configured to manipulate the video data.

Video scrambling is achieved by dividing a field of video into distinct segments. The system intermixes the information in each segment by using a time-varying random generator. A different random pattern is used for each segment per field. In addition, the segments are randomly intermixed within themselves. This process provides more than 10^{139} different possible fields, given one field at the Scrambler input.

Sync, burst, audio data and descrambling information are inserted into the data stream possible to feed the signal through sync tip clamping amplifiers.

The data stream is fed to a digital/analog converter. This is followed by a folded noise filter. The signal is then buffered through a 75 ohm video amplifier. The information resulting from this scrambling method still fits into the standard baseband video bandwidth. Video lines 10 to 21 are not scrambled in order to allow the passage of VITS, VIRS or Station ID.

Audio Scrambling

The incoming audio signal is sampled with a 44 kHz clock. The Scrambler has an 8-bit µ-law (12 bit) A/D converter, thus reducing the bits from 12 to 8, while still maintaining the 12-bit dynamic range.

The 8 bits are added to the digital data stream and are scrambled, using a process similar to that used for video. A block coding technique provides error concealment of the audio data.

Audio/Video Descrambling

The scrambled, analog video signal (including audio data) is received by the DTD-2000N Descrambler and converted to a digital format. The control information transmitted with the video signal is separated and decoded. The decoded data enables a digital controller to allow a video processor to reconstruct the video signal to its orginal format.

All digital information received by the Descrambler is eliminated at its output. The video signal, with new sync the burst inserted, conforms to the EIA Standard RS170A and maintains zero SCH at all times.

The block-coded audio data is extracted from the video signal and decoded. Audio is resorted to an analog waveform via a µ-law D/A converter. The signal to noise ratio of the filtered and amplified audio signal is independent of the transmission link, provided the video p-p S/N ratio is better than 35 dB.

Since the audio and video signals share the same processing paths, there is no audio to video delay in system. Specifications of the system are given in Figure 7.1 below.

FIGURE 7.1

SPECIFICATIONS

VIDEO SIGNAL

Scrambler Input

Impedance .... 75 Ohm, terminated
Signal level .... 1 Vpp nominal, adj. ±6 dB comp. video, negative sync
Return loss .... >46 dB to 5 MHz (power on/off)
Connector .... BNC, female

Descrambler Input

Impedance .... 75 Ohm, terminated
Type .... Automatic Gain Control (AGC)
Level .... 1 Vpp nominal, ±3 dB

Descrambler Output

Impedance .... Unbalanced, source terminated into 75 Ohm
Signal level .... 1 Vpp nominal, comp. video, negative sync
Return loss .... >46 dB to 5 MHz (power on)
Gain .... internally adjustable ±3 dB
DC offset .... 0 V at blanking level
Connector .... BNC, female

Electrical Characteristics

System gain .... unity
Frequency response ... ±0.2 dB DC to 4.5 MHz
Residual diff. gain (3.58 MHz) .... <3%, 10% - 90% APL, 1 Vpp comp. video and 40 IRE units subcarrier modulation
Residual diff. phase (3.58 MHz) .... <2°, 10% - 90% APL, 1 Vpp comp. video and 40 IRE units subcarrier modulation
Line time waveform distortion .... 1% or better
Short time waveform distortion .... 2T: 1% or better
Field time waveform distortion .... 1% or better
Chrom./Lum. gain inequality .... 1% or better
Chrom./Lum. delay inequality .... ±10 ns
Chrom. non-linear gain distortion .... 20 IRE level = 1% or better
40 IRE level = 1% or better
80 IRE level = 2% or better
Chrom. non-linear phase distortion .... 2° or better
Chrom./Lum. intermodulation .... 1% or better
S/N ratio (weighted) .. >54 dB measured at nominal video input (pp signal to rms noise)
Sync jitter .... ±2 ns or less
H and V blanking ..... meets EIA RS170A specifications

AUDIO SIGNAL

Scrambler Input

Impedance .... 600 Ohm, terminated (balanced)
Signal level .... 0 dBm, nominal
Clipping input level ... +12 dBm

Descrambler Output

Impedance .... 600 Ohm, source terminated (balanced)
Signal level .... 0 dBm, nominal
Clipping output level .. +12 dBm

Electrical Characteristics

System gain .... unity
Frequency response ... 30 Hz to 18 kHz ±0.8 dB
Third harmonic distortion .... 1% or better; measured at 1 kHz and referenced to 12 dB above nominal input level
IM distortion .... 1% or better; referenced to 12 dB above nominal input level with 1:1 ratio
Total harmonic distortion .... 1.4% or better; measured at 1 kHz and referenced to 12 dB above nominal input level
S/N ratio (weighted) .. 70 dB or better; referenced to 12 dB above nominal input level

POWER REQUIREMENTS

Scrambler/Descrambler

Voltage .... 115 VAC ±10%
Frequency .... 50/60 Hz
Scrambler power consumption .... 130 VA max.
Descrambler power consumption .... 75 VA max.

Temperature Range

Operating .... 0° - +55°C

MECHANICAL

Scrambler

Height .... 88 mm (3.5 inches)
Width .... 483 mm (19 inches)
Depth from mounting surface .... 430 mm (17 inches)

Descrambler

Height .... 44 mm (1.75 inches)
Width .... 483 mm (19 inches)
Depth from mounting surface .... 406 mm (16 inches)

Specifications and designs are subject to change without notice. Specifications apply to scrambling and straight through modes of operation; scrambler output connected directly to descrambler input.

* * *

8. AUGUST 1982 REPORT

During August there has been considerable activity among Canada's Pay TV licensees to finalize agreements with cable television companies for distribution, and to set retail prices for this service. Although this is not directly concerned with scrambling, these activities, which are reported below, will permit the finalization of both satellite and cable distribution scrambling systems for use in Canada. In addition, further information is given on the operation of the OAK ORION scrambling system by Canadian Communications Satellite Limited (CANCOM), supplementing that given in last month's, and several previous reports. Also given this month is additional information on DBS and related scrambling systems obtained from the literature and from ongoing contacts with suppliers.

8.1 Activities of Canadian Pay TV Licensees

During this month, Canada's largest cable TV system, Rogers Cablesystems Inc., has signed agreements with Alberta Independent Pay TV and Ontario Independent Pay TV to provide the Super Channel regional Pay TV service to Rogers subsidiaries in Alberta and Ontario respectively. The agreement sets a retail price of $14.95 per month for the Super Channel service.

Super Channel will be commencing transmission on February 1, 1983 for both its Alberta and Ontario services. It will use Anik C regional beams in an essentially DBS configuration and while its major distribution will be via cable TV systems, it is not restricted to such distribution, and it is expected that there will be some direct-to-home and radio rebroadcast distribution in the future.

Super Channel will be scrambled but at this time has not released any information on the type of scrambling system to be used.

As mentioned in Section 4 of this report, Rogers Cable Systems Inc. plan to use the Zenith Z-TAC scrambling system in their cable distribution networks.

Rogers Cable system has also signed an agreement with C Channel, the national cultural Pay TV licensee, for cable distribution rights throughout the country. In this case the monthly retail price has been set at a maximum of $15.25 for the first year. Once more, although C Channel plans to scramble its services from

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Ottawa Cablevision Limited and Skyline Cablevision Limited, both of Ottawa, have also signed agreements with Super Channel and C Channel for similar retail rates.

There is considerable activity throughout the country over Pay TV agreements and licenses, both for the distribution of the various Pay TV services by cable and by radio rebroadcast systems. All five major Pay TV licensees plan to commence service on February 1, 1983 using the Anik CIII satellite. There have been some instances of competing applications to provide services in the same area, by cable TV and by over-the-air distribution. These have notably been in the Maritimes area and the CRTC have hearings scheduled on these applications for September 29, 1982 in Halifax, and for October 1, 1982 in Saint John's, Newfoundland. Again there is currently no information available on the type of scrambling system proposed by the "Off Air" Pay TV distributers.

8.2 Additional Experience of Canadian Satellite Communications Ltd. (CANCOM) with the OAK ORION-C Scrambling System

Further to the information given in 7.1 of this Report on the operation of the ORION-C scrambling system by CANCOM, the following information has been received during the past month.

There are seven scrambling modes of the ORION-C system as follows:

- video inversion;
- double video inversion (non invert);
- line by line scrambling;
- field by field scrambling;
- line by line inverted;
- field by field inverted;
- computer controlled random sequencing of the above six modes.

The base computer issues control signals to all decoders every few minutes or less depending on the number of the decoders, advising them of the current mode of scrambling. The decoders can instantaneously switch to the particular scrambling mode currently being transmitted.

All address, tier control and scramble control information is sent in the vertical blanking interval (VBI). The horizontal synchronization pulses are removed and digital audio substituted. Proper decoding is dependent upon full bandwidth, relatively noise-free reception of the vertical blanking intervals. Once the digital information is properly received, decoding is very robust. Information on the coding mode and coding mode changes are "sent ahead" during the vertical blanking interval.

The computer can command any slave uplink to remove scrambling, or, more correctly not to re-scramble since descrambling occurs automatically at all slave uplinks. If the computer control link fails anywhere along the link, the uplinking slave, if it is generating its own programming, will continue to scramble in the last mode. All decoder addressing and control subscribers will operate on memory until central computer control is re-established. A problem with this memory mode failure is the inability of the computer to authorize a subscriber of a particular program that begins during the memory mode period. Home Box Office have selected a "Fail to Clear" configuration if central control is lost. In this system decoders default to a clear signal if the control signal is lost. HBO's philosophy is not to penalize the cable operators subscribers if the HBO system develops a fault in the scrambling operation.

In the OAK ORION C system the programming through a slave uplink can be uniquely "Tier Tagged". It is a "1 to 49" labelling system that authorizes subscribers to decode matching tiers. A subscriber can be authorized for any number of individual tiers. Because of the system read out tier authorization method, subscribers can however inadvertantly decode some programs for which they are unauthorized. Precise information on this mechanism is not currently available.

Current CANCOM decoders cost $1,500 each. The new "I" decoders designed for home use currently cost about $900 Canadian with this figure dropping to a few hundred dollars with a sufficiently large order.

8.3 Additional Information Gathered From Current Literature

It is now estimated that in the United States there are approximately 25,000 privately owned TVROs in operation, and with the coming use of the 17/12 GHz band, this figure is expected to increase nearly 10 fold by the end of 1985. By this date there will thus be approximately 50 private terminals in the United States for every cable TV TVRO. This, combined with the fact that recent special events delivered by cable on a pay-per-view-per-program basis have been able to charge up to $15 per subscriber per event will produce extraordinary pressure on US Pay TV organizations to implement high security encryption type scrambling on their services.

ALCOA-NEC Communications Corp, the first joint effort by a Japanese and US company to serve the direct broadcast satellite (DBS) home receiver market, will have a complete $350 U.S. system ready in 1983. Later systems will retail for $250 U.S.

ANCC was formed May 12 after eight months of negotiations. Low-noise converters (LNCs) and set-top tuners made by NEC in Japan will be mated with antennas and mounting hardware made by ALCOA at an existing facility in Sidney, OH. Final assembly and testing will be conducted at the Sidney facility.

The $350 U.S. system will serve the "early-entry" market for DBS, which will receive downlink signals from the low-power transponders aboard the Anik-CII and CIII satellites. These systems will require larger antennas (1 to 1.8 m in diameter) and more sensitive receiver front ends than the systems that will be used to receive US satellite transmissions. The company's later systems, expected to cost $25,00, will use antennas of approximately 0.75-m diameter, although a 0.6-m offset feedhorn configuration may prove to be superior. The offset-feed types provide higher gain, and can be oriented more vertically to avoid moisture collection encountered in northern climates.

9. SEPTEMBER AND OCTOBER 1982 REPORT

9.1 Canadian Pay TV Licencees Decide Against Scrambling

The main activity during this two month period has once more been among Canada's Pay TV licencees. The plan to commence service by the 1st of February 1983 is now a firm committment on the part of all major Pay TV licencees. However, in a change of approach no Pay TV licencees are currently planning to scramble their service for at least one year, leaving the scrambling to the cable television operators.

There are a number of reasons for this. Perhaps the first is the comparatively high cost of scrambling systems that would give a significant protection, bearing in mind that cable companies are unlikely to "pirate" the signal as they require formal permission from the CRTC to distribute the service. In discussions with certain Pay TV licencees, the statement has been made that it is unlikely that a significant number of 12GHz TVRO's will be purchased by domestic users, or by "pirate distributors" at least in the near future. The problems of trying to do many things at once to "get on the air" in the very short time period prior to the 1st of February also has had an impact upon the scrambling decision.

9.2 Canadian Pay TV Satellite Segment Plans

At the time of writing (the end of October 1982) no agreements for transponders have yet been signed between the Pay Television licencees and Telesat. However, detailed discussions and negotiations have taken place, and the following Pay TV allocations on Anik C3, (due for launch on the 11th of December,) are considered likely:

LIKELY INITIAL ANIK C3 TRAFFIC ASSIGNMENT

WEST BEAMS		EAST BEAMS	
Message (1)	5	Message (1)	7
Occasional Use TV (2)	1	Occasional Use TV (2)	1
C-Channel (3)	1	C-Channel (3)	1
First Choice Canadian (3)	1	First Choice Canadian (3)	2
Super Channel-Alberta (4)	1	Super Channel-Ontario (4)	1
		La Sette (4)	1
		ATV (4)	1
		Star (5)	1
TOTAL	9		15
POTENTIAL	16		16

ADDITIONAL POSSIBLE USERS

EAST BEAMS	
NTV (4)	1
French Pay TV (5)	1

It should be noted that as the result of discussions between Canada, the United States and Mexico, the orbital position of Anik C3 has been changed from 112½°W to 117½°W. The EIRP contours for this new orbital position, for half beam, quarter beam and two channel use of quarter beam are shown in Appendix E.

(1) ------- Point to Point
(2) ------- Point to Point or Interim DBS as Required
(3) ------- Pay TV; Interim DBS; ½ Canada Beam
(4) ------- Broadcast; Interim DBS; ¼ Canada Beam
(5) ------- Pay TV; Interim DBS; ¼ Canada Beam

9.3 Canadian Pay TV Affiliate Agreements

Although agreements are yet to be signed between the Pay TV licencees and Telesat, a large number of agreements have been signed between the Pay TV licencees and Cable TV licencees for the distribution of Pay TV. Figure 9.1 shows the Pay TV affiliation agreements signed as of the 29th of October 1982.

FIGURE 9.1

Pay TV Affiliation Agreements: A Regional Overview

SUBS BY AGREEMENT	STAR CHANNEL	FIRST CHOICE	C CHANNEL	SUPER CHANNEL ONTARIO	SUPER CHANNEL ALBERTA	WORLD VIEW	REGIONAL TOTALS
ATLANTIC	198,000	133,835	227,000	-	-	-	558,835
QUEBEC	-	-	-	-	-	-	-
ONTARIO	-	906,368	1,715,000	868,000	-	-	2,917,876
ALBERTA	-	216,881	-	-	170,946	-	672,881
MID WEST	-	-	456,000	-	-	-	170,946
BC/YUKON	-	616,341	664,000	-	-	444,000	1,724,341
TOTAL	198,000	1,873,425	3,062,000	868,000	170,946	444,000	-
TOTAL SYSTEMS SIGNED	25	?	69	17	3	6	

By courtesy of CCTA

Discussions with cable television operators shows great diversity in their plans for scrambling Pay TV. A number of systems are planning to use addressable scrambling systems, others non-addressable systems by Oak, Zenith, Jerrold and others, and some of the smaller systems are considering negative traps.

The delay in the scrambling of the signals transmitted by the Pay TV licencees via Anik C3, together with initial comparatively low cost scrambling approaches of the cable TV distributors, will perhaps give the opportunity for discussion and coordination by the Department with these organizations to advise as to the optimum overall scrambling systems most appropriate to "end-to-end" distribution system use thus eliminating double degradation of the scrambled signal.

10. NOVEMBER 1982 REPORT

10.1 Cable TV Scrambling

As mentioned in last months report, the scrambling of Pay TV services will be provided by the cable television distributors, for at least the first year of operation.

Most cable companies see scrambling as a major capital expense and there is considerable caution in their current approaches. This is enhanced by the feeling that the scrambling systems currently on the market represent an interim stage of development. As a consequence, although Pay TV service is to commence on February 1, 1983, there is still a great deal of uncertainty by most of the major cable TV companies regarding scrambling systems selection.

Discussion with Roger Poirier, Vice-President, Engineering, CCTA, regarding the current scrambling plans of the major cable television companies resulted in the following tentative information:

- Rogers Cable Systems Inc. - Zenith addressable scramblers
- McLean Hunter Cable TV Limited - Jerrold or Zenith
- Quality Cable Television Limited - Positive traps
- Telecable Videogron Limitee - Undecided
- Cable Casting - Oak or Philips
- Cable TV Limitee - Undecided
- Telecable Laurentien Inc. - Probably Zenith

10.2 Pay TV via DBS for Remote Areas

When Pay TV becomes available via satellite, North Star Home Theatre hopes to supply TVROs to an estimated 100,000 potential subscribers to the Superchannel service in Ontario and Alberta, and negotiations are underway with other Pay TV licencees.

The company will be marketing 1.8 m 12 GHz dishes with descrambling units for $1,500, although this price could decrease if large quantities were purchased. The units will be addressable and will require a common descrambling unit with different codes for each channel. (The 12 GHz dishes will be unable to pick up existing American satellite signals.)

10.3 CANCOM: Oak/Orion

CANCOM re-instituted its Oak/Orion scrambling of its signals in mid-November, having overcome the addressing and slave uplink control problems previously affecting the system.

The current descrambled image was assessed to be 3 to 3.5 on the CCIR 5 point impairment scale. The major impairments were noise and the slowly varying intensity of several horizontal lines caused by the scrambling mechanism and by a less than optimum receiver.

11. DECEMBER 1982 REPORT

From the 29th of November to the 2nd of December Globecom '82 was attended in Miami, Florida. This annual global telecommunications conference organized by the IEEE is a major event covering new developments in the field. The complete program is attached as Appendix F.

As there were typically eight sessions running concurrently, attendance at the sessions was selected to have maximum relevancy for direct broadcast satellites, and in particular to scrambling and encryption techniques.

The Conference included a technical exhibition and this was also attended.

Given below are summaries of the papers most relevant to DBS signal scrambling or encryption requirements.

The 1,383 page Conference Record is held on file in the Library of PHILIP A. LAPP LIMITED.

11.1 Session A.6: Modern Techniques for Computer/Communications Security

Paper A.6.1: Overview of Communications Security and Vulnerabilities (J. Michael Nye, Marketing Consultants International Inc.)

The first announcement at this session was that Mr. Nye was unable to present his paper due to illness. As the paper is of specific interest to this study, a summary of the printed paper is given.

The paper reviewed the overall problem of communications security with emphasis on the problems of voice security of telephone messages. As however, many points of philosophy in this field are applicable to the security of DBS video signals, it is useful to compare the conclusions drawn by this paper with those drawn by the authors in the initial report on DBS scrambling.[1]

In relation to the security of voice messages over communication satellites, Mr. Nye makes the following statements: " ... interception of the uplink requires either hovering in an aircraft somewhere in the beam path or positioning a receiving antenna on the ground within the lobes near the transmitter. The former is impractical and the latter is risky, relative to detection. An intercepter is unlikely to attempt either because of the particular vulnerability of downlinks. A communications satellite transmits a signal specifically intended to be received at many points by many different receivers over a broad area, past thousands of square miles ...."

"Unauthorized listeners, appropriately equipped, can point a satellite receiving antenna at the satellite and receive the downlink anywhere within the footprint. Detection of the intercepter is extremely unlikely and almost impossible. An investment of less than $10,000 in equipment would be necessary for the interception and its operation would require the expertise of a highly trained technician."

In a table indicating interception risks the following information is given for a communications satellite: interception method - passive electronic interception; detection probility - unlikely; approximate cost-$8,000; level of expertise - electronic technician skills with knowledge of telephone systems and/or computer sciences background.

Mr. Nye continues "communications security for voice and data messages requires utilization of a variety of technologies -- usually voice scrambler systems offer short term protection wherein the length of time that a message could be considered protected, i.e. measured in minutes and hours. However with digital encrypted messages, length of protection (security is measured in terms of man-years of effort to decipher).

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1. The final report of a study of the technical and economic consequences of scrambled TV services offered by Direct Broadcast Satellite., Philip A. Lapp Ltd., Feb., 1982.

In data communications applications...security principals are identical to those employed in digital voice systems..."

Basic levels of protection are usually defined as tactical or strategic.

- Tactical protection is used to restrict the information from an observer or listener for a period of time measured in minutes or days. A variety of simple techniques are available that provide this level of protection at reasonable cost.

- Strategic security involves a situation in which the eavesdropper would require a long period of time to decode the message before the receipt of useful information. Strategic security is used to protect information from interceptors who have sufficient resources to decipher messages in periods of time measured in months and years.

Mr. Nye completed his presentation with a list of companies producing voice analogue scrambling and digital encryption devices.

Paper A.6.2: An Analogue Scrambler of Speech Based on Sequential Permutations in Time and Frequency (R.V. Cox; N.S. Jayant and B.J. McDermott: Acoustics Research Department, Bell Laboratories.)

This presentation described a method of analogue speech scrambling by segmenting speech to 10 to 30 ms segments and permutating these segments in both time and frequency. The system was tested for residual intelligibility.

Despite sophiticated filtering and delay lines, residual digit intelligibility remained fairly high in the order of 35 to 40 percent.

It must be emphasized that the work described was purely of a research nature and apparently, to date, has not been developed into a production system. Despite statements by the authors in the conference record that simulation results have been extremely encouraging and indictate that the system is feasible and robust, the verbal presentation and subsequent questioning indicated that this analogue voice scrambling approach is unlikely to be developed further.

Paper A.6.4: A Highly Secure Cryptographic Algorithm for High Speed Transmission
(G.Y. Desmedt, J. Vandewalle, R.J.M. Govaerts - Esat Electrical Engineering Department, Belgium.

This paper discussed an improved classic algorithm for data encryption. The alogrithm gives a higher security than the "public key" alogrithms in use, and is easy to implement in digital circuits and permits high speed transmission. However it is not suitable for a public key version and hence is unlikely to find applications in encryption of DBS signals.

11.2 Session B.6: Image Processing in Communications

Paper B.6.1: Digital Broadcast TV at 45 Mb/s
(R.C. Brainard and A.N. Netravali: Bell Telephone Laboratories)

This presentation again dealt with experimental laboratory work which had not proceeded to overall system test.

A coding system for transmission of NTSC TV signals over a digital channel of only 45 Mbit/s with full broadcast quality was described. Predictive coding was used for the composite signal sampled at 4 times the colour carrier with 9-bit samples. Adaptive prediction and variable word length coding were used to minimize the data to be transmitted. Only the active part of the system had been built and tested and it was found that the predicter was very scene dependent. It should be noted that the coder only was built with no decoder or transmission path tests being carried out. However the analogue to digital coder gave a CCIR quality grade estimated at 4.5 where the scenes gave no problems with the predicter. The comparators can be easily overloaded, and in the overload mode the quality grade dropped to the order of 3.5. When prediction errors were encountered due to rapid motion of the scene, vertical edge distortion was encountered, dropping the quality grade to 2 or 3. The system is insensitive to the direction of motion.

Questioning brought out the fact that the work was still very much in the research stage and that considerable work remained to be done. No simulation or modelling had been carried out of the effect of transmission path errors, and one thing I pointed out that it was very likely that there would be significant propagation path problems as the decoder was based upon pre-propagation history only.

In summary, although this work is interesting from a theoretical aspect, it appears that reliable distribution of digital broadcast TV at comparatively narrow bandwidths is still a long way off.

B.6.2: Predictive Coding of the Component Colour TV Signal (C.E. Li, Rochwell International, and R.K. Rao, University of Texas).

This presentation was another which showed trends in bandwidth compression by predictive digital encoding techniques of the video signals. Again it outlined research work on the encoder rather than testing or an evaluation of a full operational signal.

Unfortunately, the presentation was very difficult to understand due to the heavy accent of the speaker and the fact that the slides were difficult to read and no video tape of the results was presented.

However, the work described involved digital demodulation of the composite signal sampled at three times the colour sub-carrier and the implementation of compression alogrithms on the subsampled component signal and then digital reconstruction of the processed NTSC colour signal. Indications were given that a bit rate in the order of 40 Mbits is required for a colour TV signal. The authors stated that they felt that considerable further research was required on subjective quantizers and adaptive predicters.

Again this work indicates trends rather than a system that could be operational in the relatively near future.

B.6.3: Transmission of Two NTSC Colour Television Signals Over a Single Satellite Transponder Via Time-Frequency Multiplexing (R.L. Schmidt, B.G. Haskell - Bell Laboratories)

A TFM method of transmitting two TV signals over a single satellite transponder was stated to give significant improvement over existing methods. It was stated that the complexity of the hardware was similar to TDM systems but that picture quality approaches so-called network quality. No back-off of the satellite transponder is required as in FDM systems.

In essence, the two video sources are synchronized, and alternate fields transmitted. However, the difference signals only of sequential fields of the same video source are sent in the second field of that signal. Predictive coding techniques are then employed to make the differential signal as small as possible on the average. Compounding reduces the noise in low variation areas, i.e. where it is most visible.

Very reasonable results were given for this approach and these were backed up by detailed subjective testing. In the discussion period it was asked why the field differential rather than the line differential was used. The response was that the field differential required a smaller bandwidth. In answer to another question it was stated that compounding gave an 11 db improvement in signal-to-noise ratio; in addition it was felt that further bandwidth reduction could only be obtained by the reduction of quality. The tested degradation in weighted signal-to-noise ratio between a satellite transmission path carrying a single TV channel against that carrying two TV channels using the time-frequency multiplexing described was 59 db for the single channel to 55 db for the two channels.

This approach appears to be near the operational stage and to have a number of advantages over current systems for transmitting two TV channels over a signal Comstar D2 transponder.

11.3 Session C.5: Rural Applications of Satellite Communications

This session was attended as it was considered to be significant to direct broadcast satellite applications to rural areas. Although the session was mainly dedicated to telephone traffic, a number of aspects are relevant to DBS use. In particular, it was felt that ground station requirements for narrow band voice terminals could be applicable to SCPC operation for the carriage of radio signals "piggy back" on a DBS video channel.

Paper C.5.5: An Earth Station Design for Rural Telecommunications (G.F. Tustison - Communication by Satellite Inc.)

The presentation described three metre 6/4 GHz transmit/ receive ground stations designed for inexpensive rural telecommunication implementation. SCPC transmission techniques were used. The ground station requirements paralleled those required for TVROs and receive only satellite earth sations. An integrated common equipment approach was used to reduce system complexity and a block down converter approach was used similar to current TVRO trends. This approach permitted frequency agility to take place at lower more stable frequencies.

Quite detailed design figures are given in the conference record; however, suffice to say that a LNA with a noise temperature of $100^{o}K$ maximum was used with a 30 db gain and an instantaneous bandwidth of 800 MHz in the 4 GHz receive band.

Many of the approaches used are applicable to low cost DBS ground station design.

11.4 Session D.5: Broadcasting Satellite Systems

Paper D.5.1: National Service Requirement, Planning Methods and System Parameters for the 1983 Broadcasting/Satellite Planning Conference (E.E. Reinhart - Satellite Television Corportation)

This paper outlined the U.S. postion for RARC-83. In addition to full details of the total DBS service requirements for Region 2 (North and South America), service area requirements submitted to the IFRB in September 1982 were presented.

Of particular interest was the fact that the U.S. East coast service area overlaps all the maritime provinces, part of Quebec and part of Ontario. Also identified were the differences of Canada's position and the U.S. position regarding co-channel protection ratios with Canada's position for most impairment grades being considerably more stringent than the U.S. position. Another major difference is Canada's requirement for a 50 MHz wide allotment for each of its six service areas in the orbital arc 75° to 170° West, whereas the state U.S. postion is for 700 MHz allotments in each of four service areas in the orbit arc 99° to 170° West. Canada favours a flexible channel assignment planning method, whereas the U.S. favours a block frequency allotment method. These differences between the Canadian and U.S. position combined with somewhat different approaches to minimum satellite spacing, gives rise to considerable uncertainty in DBS design parameters.

D.5.2: Satellite Broadcasting in the 12 GHz Band - WARC-77 Frequency Plan and European Projects (D. Sauvet-Goichon, Telediffusion de France)

This paper outlined the so called "Geneva Plan" which defined frequency assignments for the 11.7 to 12.5 GHz band in Region 1 (Europe including U.S.S.R. and Africa).

EIRPs of 63 dBW are planned and considerable use of these high powered DBS systems is foreseen for France, Germany and the United Kingdom.

D.5.3: Digital Techniques in Broadcasting - Current Studies and Prospects in Europe (H. Mertens - European Broadcasting Union)

In Europe the 12 GHz DBS will commence operations in 1985, meeting in general the Geneva plan characteristics. As such, it is possible to add to the analogue video signal a 2 Mbit digital bit stream which may be used for a wide range of sound and data services. Although considerable consideration was given to digital vision, the wide bandwidth required for high quality could not be accommodated in the Geneva frequency plans, and in any case home receivers would be too expensive at this time. For this reason, extended PAL (or SECAM) approaches are being looked at.

However, it is felt that digital sound is quite feasible with a multiplex digital sound or data system which is both efficient and flexible. Both continuous and packet digital multiplexing is being considered; however, no decision has been made as yet. Packet digital multiplexing has already been demonstrated and is receiving close consideration. In this system the digital signal is multiplexed via a subcarrier in the blanking interval.

D.5.4: Proposed U.S. Broadcasting - Satellite Systems (J.F. Clark - RCA Corporation)

In this most interesting presentation Mr. Clark stated that the biggest problem facing direct broadcast satellites in the United States was one of standardization. Eight systems had been proposed varying between three to thirty video channels.

In June 1982 the FCC adopted rules for the licensing of DBS systems, conditional on the outcome of WARC-83. The approach taken was one of deregulation. In September the FCC granted the first construction license to Satellite Television Corporation to construct one satellite to serve the Eastern service area and one ground spare satellite an orbital slot and frequencies for its three transponders will be assigned after RARC-83. On November 5th additional construction permits were issued by FCC. These included one for CBS using a scrambled high definition TV which would be downward compatible to a standard NTSC signal. Public broadcasting was permitted to construct two satellites, each with three advertiser supported channels. Video satellite systems had been granted permission to construct one east and one west satellite each with a scrambled channel. An additional group were planning for common carrier one-way services using six channels and eight stop beams.

The FCC RARC-83 Advisory Committee is putting forward a postion for an EIRP of 57 plus or minus one DBW per standard channel. This would be the equivalent of 60 DBW per double channel for HDTV. During the question period it was stated that there had been no support for a 47 DBW EIRP interim DBS of the ANIK C type. An offset feed antenna, showing a significant improvement over the current Canadian proposals, and thus permitting a two degree satellite spacing, was being investigated by the FCC.

Although eight construction permits have been issued, STC is currently the only company to place an order for its satellites.

In further discussion it was stated that the ANIK C interim service was not considered to be a viable DBS service as the U.S. proposal was based on 1 to 2 metre dishes and it was foreseen that the ANIK C would require 3 metre minimum dishes. Again during discussion STC stated that they were going to scramble but declined to elaborate upon their scrambling plans.

In discussions regarding rain models it was stated that a modified CCIR Method One was used for tropical regions. This led to somewhat higher attenuation figures and therefore permitted an uplink power of 1,000 watts rather than 500 watts. It was stated that the biggest problem seen at RARC-83 was in getting ITU to make technical rather than political decisions. In answer to a further question it was stated that some 5 million subscribers were required to support each U.S. system. In response to a question on how many of the eight proposed systems were likely to survive, the speakers opinion was only two or three. The point was made that FCC had given construction permits to all applicants meeting its deadline. In response to the writer's question to Mr. Reinhart of Satellite Television Corporation as to whether or not STC had made the decision between digital or analogue scrambling, the answer was given that they hadn't but were currently looking very hard at digital video encrption. It was suggested that Mr. David Durand of STC be contacted.

11.5 An Update on Pay TV Scrambling Plans from Rogers Cablevision Incorporated

In the last part of December an interview was held with Mr. Hamilton-Piercy, Vice President Engineering of Rogers Cablesystems Incorporated and the following information gained.

Z-Tac Zenith stand alone descramblers are currently being produced in Etobicoke, for Rogers's 1st of February Pay TV start-up date. Canadian production was a condition of the Rogers/Zenith contract. Current production is approximately 2,000 per day. Rogers has installed on the Zenith production line a military type sequential level quality assurance testing system. Currently (21st of December) approximately 30,000 units have been manufactured. By February it was expected that combined descramblers/converters would be coming from the Canadian production lines.

Rogers' current contract with Zenith calls for a total order of 100,000 descrambler units of all types. The purchase order has however a rotating clause and a 1983 total purchase of some 250,000 units is expected.

Rogers' pre-orders with Pay Television, many with a one year committment, have exceeded all projections. Many customers are taking all three Pay TV services at a reduced price of $44 per month.

The Z-Tac system is tiered and addressable; there are three levels of addressing priority, using various programs on an Intel computer. The main program used for general addressing housekeeping carries out a sequential poll at the rate of 10,000 subscribers per minute.

The second program is a priority over-ride for installation, testing and maintenance, and for future pay-per-program systems. This program cuts into the sequential poll and normally reacts within 15 seconds. The final program comes into operation if there should be a pay-per-program bottleneck immediately prior to the commencement of a program. If this should happen, the computer goes into a non-scramble mode for all customers of that tier until the computer "catches up".

It should be noted that all Pay Television software is tied directly into the billing system. This approach is considered mandatory.

The main reason for the selection of the Z-Tac system by Rogers Cablesystems was that:

- it allows for the addition of any type of new discretionary programming service as required;
- it can address either tiers or time slots;
- it permits a gradual build-up of security level;
- it gives direct audio and separate video outputs for the likely new generation of component television sets. i.e. it can connect directly into a monitor;
- the addressing is carried out on lines 10 to 13. Low speed teletext (500K/bits) can be carried out on each channel without an additional decoder, and can be used to operate a character generator;
- it has the capability for either stereo audio or encoded audio, has capability of being used with satellite transmission, FM on cable, or microwave trunks.

It should be noted that baseband encoding reduces the sync reference very significantly. Therefore a sync gate regenerator is required for each drop-off in a microwave system or at each ground station;

A text chip is available for the Z-Tac decoder at a cost of approximately of $30 in large quantitites if included in the television set, or for approximately $50 in a stand-alone configuration. The current price of the Z-Tac descrambler is in the order of $80 Canadian and $190 for the decoder/converter.

Rogers is concentrating on the stand-alone Z-Tac as their systems have a high converter penetration.

There has been considerable publicity of the so-called "cable ready" television set problem where many cable-ready TV sets have been sold using advertising that gives the purchaser the impression that Pay TV can be received without any additional equipment. The last three million Zenith cable-ready TV sets produced have the capability of "plugging in" the Zenith decoder to a internal socket thus overcoming this problem. All 1983 Zenith TV sets will have this internal socket and converters will be shipped separately to their distributers.

The drawings of this cable-ready interface are also being made available to Jerrold, OAK, Hamlin and other descrambler manufacturers for possible use in their sets, thus creating a "de-facto" standard. Rogers Cablesystems and the CCTA are acting as catalysts for this approach and as liaison between the cable TV companies, the TV manufacturers and the scrambler manufacturers.

Rogers plans to carry out field trials of about 100 cable-ready TV sets with the Zenith descrambler interface and descrambler already inside the set in Vancouver and Toronto as soon as Pay TV starts on the 1st of February.

Mr. Hamilton-Piercy also stated that he felt that the Hamlin descrambler was of high quality, providing a good reconstituted signal that did not affect the sound carrier. This unit might be used in the Rogers systems in Leamington and Chatham. It was already in use in a number of Rogers systems in the United States.

11.6 Additional Relevant Information

Pay TV using the ANIK C3 satellite in a interim DBS mode commences in Canada on the 1st of February 1983. As such there is considerable market activity relating to DBS in one form or another which is tabulated below.

- Pre-sales of Pay TV generally appear to be very high. An example of this is the signing on of 577 Pay TV subscribers over a period of two weeks by Cablevision Medicine Hat, a comparatively small Prairie system.

- During this month the CRTC hearing on tiering was concluded. Mr. Michael Hind-Smith, CCTA President stated, "I am not worried by DBS except in circumstances where the cablesystems are not permitted to compete with it."

- The CRTC has licensed an additional French language Pay TV system, TCEC, to serve Quebec, Ontario and the Atlantic region commencing September, 1983.

12. JANUARY 1983 REPORT

12.1 Direct Broadcast System Incorporated

Two Vancouver area firms, Norsat International Inc., and International Phasor Telecom Inc., have joined forces in creating a new joint venture company, Direct Broadcast Systems Inc., to develop encryption equipment for Direct Broadcast Systems.

The new company will attempt to produce a de-facto industry standard for encrypted satellite signals and for scrambling systems for all segments of the market. It is perceived that these would be licensed to other North American TVRO equipment manufacturers.

In discussions with Mr. Rod Wheeler, President of Norsat International Inc., the following information was obtained:

- The new encryption system would not alter the horizontal or vertical synchronization, an approach considered mandatory in any practical system.
- It is planned that it will be a simple, reliable and undefeatable standard system.
- It would be low cost and the decryption unit would have only 12 ICs.
- There would be a single level of scrambling.
- It would be transparent to video signals.
- Classical military type encryption algorithms would be used.
- There will be facilities for the adding on of addressing at either the cable headend or at the uplink.
- It is planned that a public demonstration will be given in mid-January 1983. This would encompass both a terrestrial microwave link and a cable system.
- The algorithm is being patented. After this the system would be fully publicized and efforts made to get it accepted as a common standard.
- The address of Norsat International is:
  Unit 205
  19425 Langley Bypass
  Surrey, B.C.
  V3S 4N9

12.2 CTRI Surveys Pay TV Exhibition Methods

The Cable Telecommunications Research Institute (CTRI), through the facilities of Matthew and Partners Ltd., is conducting a survey of the method selected by cable TV companies to exhibit Pay TV. Arrangements are being made with CTRI to obtain the analysis of the results of this survey so that they may be given in future reports of this study.

The information provided by this national survey will be used by CTRI in planning new cable services that are well matched to existing plant.

12.3 Cable-Ready Sets and Descramblers

Further to the report concerning cable-ready TV sets being adapted to accommodate descramblers given in December's report, cable industry representatives and CCTA staff members met on the 7th of January with members of the Electrical and Electronic Manufacturers' Association of Canada to discuss the compatability of cable-ready TV with Pay Television descramblers. A special pamphlet is now being prepared for distribution to consumers explaining how cable-ready TV sets could be adapted to accommodate Pay TV descramblers.

The pamphlet is designed for cable TV licencees to use in responding to consumer enquiries. In addition, manufacturers belonging to EEMAC will distribute large quantities of the pamphlets to their dealers as well as distributing them at January/February manufacturers' shows.

12.4 HBO Now Scrambling

Information has been received that Home Box Office is now scrambling its U.S. Pay Television services distributed on 6/4 GHz satellites in the U.S. No further information is available at this time as to the details of the scrambling systems.

12.5 Pay TV Sales Exceed Expectations

In a release dated the 31st of January, Michael Hind-Smith, President of the Canadian Cable Television Association, stated that a spot check of CCTA members across Canada indicates that the early demand for Pay TV is running ahead of the capacity to install the necessary descrambling equipment. Reliable estimates of national Pay TV sales will be available at the end of February when cable companies are required to provide subscriber accounts to the Pay Television licencees.

Prelaunch Pay TV penetrations in Alberta have been as high as 29 percent in the smaller communities with hither-to limited entertainment resources.

Mr. Hind-Smith added that while Pay Television will be available on the 1st of February to subscribers in all major English language areas, cable affiliates in some communities will not be equipped to offer Pay TV until the Fall. In addition, the launch of services in Quebec may be delayed pending the results of hearings being conducted January 26th and 27th by La Ragie des Services Publics in that province.

12.6 Cable Regina Changes Scrambling System

Cable Regina recently informed television manufacturers and local TV retailers that they plan to change their Pay TV security system from the current positive trap approach to an addressable system later on this year. No reason was given.

13. FEBRUARY 1983 REPORT

13.1 HBO Encryption Contract

In last month's report, under sub-section 12.4 it was mentioned that Home Box Office was scrambling its U.S. pay television services. Information has now been received that Home Box Office awarded a contract for satellite encryption equipment to M/A-Com Linkibit, Inc. HBO will begin to provide decoders to their 4,400 affiliate cable companies by mid 1983. The system will be implemented in two phases, with HBO West affiliates receiving their decoders first. Then, after several months for installation and testing, HBO East affiliates will be begin to receive their decoders. The system will be addressable and will allow HBO to transmit its audio in stereo. Both audio and video will be scrambled at HBO's new satellite communications center in Hauppauge, New York.

13.2 Oak Media Satellite Scrambling

Oak Media announced that it will have the first U.S. fully scrambled national pay-TV satellite broadcast service. The service was scheduled to begin on February 28th, using the Oak Orion satellite scrambling system. The new service is a joint venture with Telstar Corporation using Comstar D-4 transponders. Both east and west coast feeds will be scrambled and uplinked from Salt Lake City. The programming is being marketed to subscription television services (STV), low power television systems (LPTV), cable television systems, satellite master antenna systems (SMATV) and multi-point distribution services (MDS).

13.3 European Satellite Scrambling System

Satellite Television PLC of London, England has awarded a contract to Oak Satellite Corporation for the Oak Orion Satellite Security System, following an initial order placed in December 1981. The contract has been extended for the scheduled delivery of Orion decoders to increase to approximately 50 per month by the present time. Satellite Television PLC has recently begun transmissions to Norway, Finland, Malta and Switzerland. The Orion Satellite Security System was implemented in support of national licensing requirements to ensure that the signal cannot be received by unauthorized viewers.

13.4 Digital Video Systems (DVS) Aquired by Scientific Atlanta

Digital Video Systems whose baseband encryption system is reviewed in section 5.5 (page 22) of this report have recently been acquired by Scientific Atlanta Limited of Atlanta, Georgia, U.S.A. Scientific Atlanta offícals stated that the "unique" digital scrambling system (specifically applicable to DBS) is important to their position as a leading supplier to the satellite, broadcast, and cable TV industries. DVS will operate as a wholly owned subsidiary of Scientific Atlanta with laboratory and manufacturing facilities in Toronto.

Industry opinion is that this take-over is likely to result in a comparatively low cost, high quality, digital scrambling system being available in the comparatively near future for DBS, Communications Satellites, Terrestrial Microwave and Cable TV Systems. Unfortunately, this will now be a U.S. rather than a Canadian product.

13.5 Viewstar Incorporated

Viewstar Incorporated of Scarborough Ontario is currently developing a new Canadian video scrambling system. This system which is a baseband, random line delay and sync stripping system, is aimed primarily at the cable TV market, with DBS as a future market. As such it requires no additional out of band signals and uses digital addressing in the VBI.

The system being developed will have a 16 tier capability and will poll 14,000 subscribers per minute with a total subscriber maximum of 1 million. The decoder will accept VHF channels 2, 3 and 4 as inputs and will output similar channels. The design target for carrier to noise is 25db. The equipment uses a 24 bit address code and fails to safe (on) memory mode upon losing external power. The scrambler has the capability of either removing, adding or leaving alone the synchronization. The chromoburst is not touched, and video inversion is not employed.

Target prices are $80 to $100 Canadian, and demonstration models and field trial units of this all Canadian product are expected by late May 1983 (CCTA Convention).

13.6 Preliminary Results of Pay TV Scrambling Systems

Distribution of Canadian Pay TV commenced on February 1st. At the time of writing (March 1st) preliminary information has been received from the cable television industry as to the performance of the various scrambling systems used. It should be emphasized that this information has been received on a random basis and is not the result of a definitive industry survey.

The main types of scrambling system being used by Canadian cable television systems to distribute Pay TV are, in approximate order of importance:

- Zenith Z-Tac
- Jerrold
- Hamlin
- Oak

In general there have been very few problems with Zenith or Hamlin systems. Some minor problems relating to video pass-bands have been encountered on the Oak system.

Significant problems were initially encountered on the Jerrold system by Telecable Videotron Cable TV Systems, and by Western Cablevision of British Columbia. It was found that on the Videotron Systems (who use Scientific Atlanta modulators), the Jerrold system did not descramble. On the Western Cablevision Limited systems, problems of compression of the audio sub-carrier permitted the descrambler to descramble (i.e. interfere with) non-scrambled signals.

In the case of Telecable Videotron the problem was overcome after intensive efforts by Jerrold engineers. In the Western Cablevision case, the cable television company cancelled the order and, it is understood, is currently delaying distribution of Pay TV until suitable replacements can be obtained. It should be emphasized that in many other systems the Jerrold scrambler/descramber has worked extremely well.

Perhaps the lesson to be learned from these experiences is that the scrambler/descrambler equipment cannot be specified in isolation from the overall distribution system. This problem is likely to be exacerbated in a DBS system where there is little or no control over the TVRO operating parameters.

14. MARCH 1983 REPORT

14.1 Pay TV Introduction

Detailed information on the scrambling equipment situation and penetration level at Pay TV start-up of February 1st is now available. This section will therefore be in two parts, the first covering the detailed subscriber situation at start-up and the second covering the scrambling equipment in use.

14.2 Pay TV: Subscriber Situation at Start Up

Initial success at launch among cable operators reflected the degree to which cable TV companies were organized and how agressively orders were sought, since pay is a service which has to be "sold". Where addressable systems were involved, equipment shortages tended to restrict cable operators' ability to fulfill orders. This was particularly true on the West Coast and in Maclean Hunter's Ontario systems. Equipment failures were not uncommon. Many operators did not accurately anticipate the high demand. Others experienced late delivery of the TVRO satellite dishes forcing them to delay start-up.

On February 9, 1983 the CRTC clarified its policy on FM stereo for pay television by indicating that the general ban on stereo would be maintained but that exceptions for certain musical programs requiring exceptional sound quality would be considered on a case-by-case basis.

Formal comments were invited on the subject by March 7, 1983 and industry observers believe it will be at least July, 1983 before a final policy decision on FM stereo will be forthcoming.

14.2.1 First Choice, National Service

With potential homes of approximately 4,000,000, First Choice had about 112,000 pay subscribers at February 1. It projects 500,000 subscribers by year end and 960,000 by the end of 1984. It expects to be in a positive cash position within eight months, and to break even by the end of the second year. Until the "Playboy" protests gained national news coverage, First Choice was lagging in many competitive markets such as Alberta and the Atlantic region. The ensuing publicity did much to gain a larger market share for the service, as well as dramatically increasing public awareness of pay television during the last two weeks before launch. The issue did embarrass the regulators however and may create future problems for all pay services.

14.2.2 Superchannel, Alberta

The number of pay television homes in all of Alberta at start-up were 48,414, or just over 10% of potential cable homes. It was reported that 1.5 pay services per pay customer were subscribed for on average for an estimated 73,000 to 74,000 pay subscriptions. Superchannel was reportedly in the lead by a small margin with an estimated subscriber base of 38,000 to 40,000. Equipment availability has not been a problem to operators. Some are using preprogrammed boxes and QCTV is using positive traps, however, Rogers' Calgary system is using Z-Tac addressable converters. Orders for pay televison were running well ahead of connections and continued strength is predicted. Many of the larger systems are reporting penetration rates in the 13% to 18% range.

14.2.3 SuperChannel, Ontario

It is estimated that the service obtained about 43,500 subscribers at start-up. Rogers reported that about 40% of its Ontario pay subscribers were taking this service. Superchannel is offering about 44 movies in the first month against 22 from First Choice. It would appear that it is opting to carry movies for a longer period but to have a lower repeat factor within the monthly programming line-up. The service also carries more sports events.

14.2.4 C Channel, National Service

Initial targets were achieved with 20,000 subscribers which has subsequently increased to 24,000 and is expected to reach 30,000 by February 15, 1983. The company estimates it needs about 200,000 subscribers to break even. Most of the sales to date were part of packages, single C Channel sales being relatively low. The definite alternative, special interest nature of the product suggested that by and large, exclusive C Channel customers would not be impulsive buyers. The company has designed a conservative well-placed advertising effort directed at the target group it has identified as its most likely customers. It did anticipate a gradual build-up. Now that the pre-launch and launch Pay-TV activities are over, C Channel customers should gradually start to build. Recent newspaper coverage on pay service programming has been highly complementary of C Channel's line-up.

14.2.5 Star Channel, Atlantic Region

High unemployment levels and the poor regional economic climate have apparently done little to dampen consumer enthusiasm for pay television. Of the potential 180,000 cable homes currently up and running with pay, cable systems are reporting penetration rates of between 10% and 15%. About half the cable homes in the Atlantic region will be using an addressable system, primarily with Jerrold equipment. Several cable operators have just received CRTC approval to market pay. The Halifax system will not begin until March 1st. Consequently, the potential pay market should expand to about 225,000 homes during the next month or two. It is estimated that Star Channel had a subscriber base of about 8,500 to 9,500 at start-up. The company estimates that it is leading its competitors, First Choice and C Channel, by a small margin. It is offering much the same package as Superchannel, but with additional regional programming offerings.

14.2.6 World View, British Columbia Multilingual Service

World View has about 7,000 subscribers and expects to reach 10,000 during the next few months, on a potential subscriber base of about 400,000 homes. The service is of special interest, however, its initial potential has been handicapped by the lack of sufficient descramblers on the West Coast. This situation is expected to rectify itself during the next few months as the initial rush for service modifies. It should be noted that World View does not use satellite distribution.

14.2.7 ESTIMATED PAY SUBSCRIBERS BY SERVICE AT START-UP, FEBRUARY 1, 1983*

	FIRST CHOICE	SUPER CHANNEL ALBERTA	SUPER CHANNEL ONTARIO	C CHANNEL	STAR CHANNEL	WORLD VIEW	TOTAL
Potential Cable Subs. in Licenced Area	4,817,696	446,371	1,948,005	4,818,696	270,863	813,164	13,114,795
No. of Affiliated Cable Subs	4,000,000	440,000	1,400,000	4,000,000	180,000	400,000	10,420,000
No. of Pay Subs. at Start-Up (Est.)	112,000	40,000	43,500	20,000	9,000	7,000	231,500
% of Affiliates	2.8%	9.1%	3.1%	0.5%	5.0%	1.85	2.2%

*Estimates compiled by McLeod Young Weir.

14.3 Pay TV Scrambling Equipment in Use Across Canada at Start-Up

For this section of this report we are indebted to Mr. Roger Poirier, Director of Engineering of CCTA, who made available to Philip A. Lapp Limited the draft of a paper entitled "Cable Pay-TV Across Canada," by Mr. Peter Parkinson of the Cable Telecommunications Research Institute. The following is extracted from that paper which will be presented at the CCTA Convention in Calgary in May, 1983. The complete paper will be published in the CCTA Technical Records available from that organization.

As of March 1st 1983, 90% of Canada's CATV companies were licensed pay exhibitors. Half of these operating companies then had scrambling or trapping hardware in place and were offering pay-TV service to 87% of Canada's basic cable service subscribers. Thus, one month after the launch, practically nine out of ten basic subscribers were being offered the new service.

With the exception of the Worldview service, the ANIK C satellite is used to deliver the pay-TV signals to most cable headends. Individual cable operators provide the necessary television receive only (TVRO) earth station antenna to capture the licensee's downlink transmissions in the 12 GHz band and to amplify, downconvert and demodulate the received video and audio signals.

Each licensee transmits clear unscrambled video signals to their affiliated cable exhibitors. Accompanying audio channels are also unscrambled although Superchannel has made provision to transmit its pay-TV audio using a proprietary modulation system to deter unauthorized direct access via pirate TVRO dishes. Superchannel, alone amongst the licensees, provides cable headends with special demodulators that are capable of deriving left and right stereo audio channels from suppressed carrier transmissions without the help of a reference pilot carrier. The other licensees on ANIK C use a similar Wegener modulation system. But, since they also transmit a conventional reference pilot carrier, no special audio demodulators are needed.

Scrambling of the ANIK-C pay-TV signals is ultimately intended by the licensees when a suitable technology can be found. One result of the individual decisions by licensees to postpone scrambling has been to keep the door open for a common addressable satellite scrambling system as advocated by Northstar Home Theatre Inc. of Toronto. Such a unified system would permit rooftop antenna delivery of pay-TV service to the 1.6 million Canadian households lying outside cable licensed areas. This approach involves the organizational problem of routing centralized addressing information east/west across Canada. It also requires development completion and production of a new generation of cost effective hard scrambling for both audio and video signals. Hard scrambling systems rely upon the encryption of restoration sequence information and represent a security level above that of the present generation of cable exhibition scrambling techniques. In the light of the new, less restricted, federal policy toward satellite antenna ownership, such scrambling systems have an important future role to play.

The basic types of scrambling system, i.e. negative trap, positive trap, RF scrambling and baseband scrambling, as a percentage of all cable companies across the country as of the 1st of February start-up data is shown in Figure 14.1.

The extreme right hand column shows that the majority (56%) of basic subscribers served by very large cable companies are being offered pay service by means of baseband scrambling systems. Baseband scrambling involves a combination of sync suppression and video inversion. In currently popular embodiments, it always includes addressability. This relatively secure method is also used to deliver pay signals to 32% of large company territory. Medium sized companies, on the other hand, use baseband scrambling for only 1.4% of their territory. No small company uses the addressable baseband method of exhibition.

RF (sync suppression) scrambling can be seen from the bar charts to be the more popular solution for large and medium sized companies and to be a close second choice even within small systems. Indeed, in terms of the overall basic subscriber population in Canada, RF scrambling is the number one choice. The diagram shown as Figure 14.2 illustrates its 37% adoption.

The universal popularity of RF scarmbling is due to several different factors. Perhaps most important it represents a well established technology for which reasonably priced equipment is available from a variety of manufacturers. The survey shows four equipment manufacturers supplying Canadian cable companies with RF scrambling equipment whereas baseband equipment is single-sourced. Furthermore, RF sync suppression systems are available in several configurations. Operators can choose between manual (programmable) tierable descramblers or remotely controlled addressable versions. The descramblers are available integrated with converters or sold separately as add-on units.

Despite the popularity of RF sync suppression scrambling, some reports of minor tuning difficulties have been received, especially within cable systems using offset superbands. The downwards offset of 1 MHz in this band is no longer recommended by the DOC as a means of reducing local oscillator interference. What appears to occur in such offset systems is that tunable converter output cannot always deliver sufficiently accurate channel 3 or channel 4 signals to the descramblers. This can affect reception of audio sub-carriers carrying restoration timing information.

LARGE CABLE SYSTEMS USING VARIOUS PAY-TV EXHIBITION TECHNOLOGIES.

(POSITION AT LAUNCH ON 1 FEB. 1983)

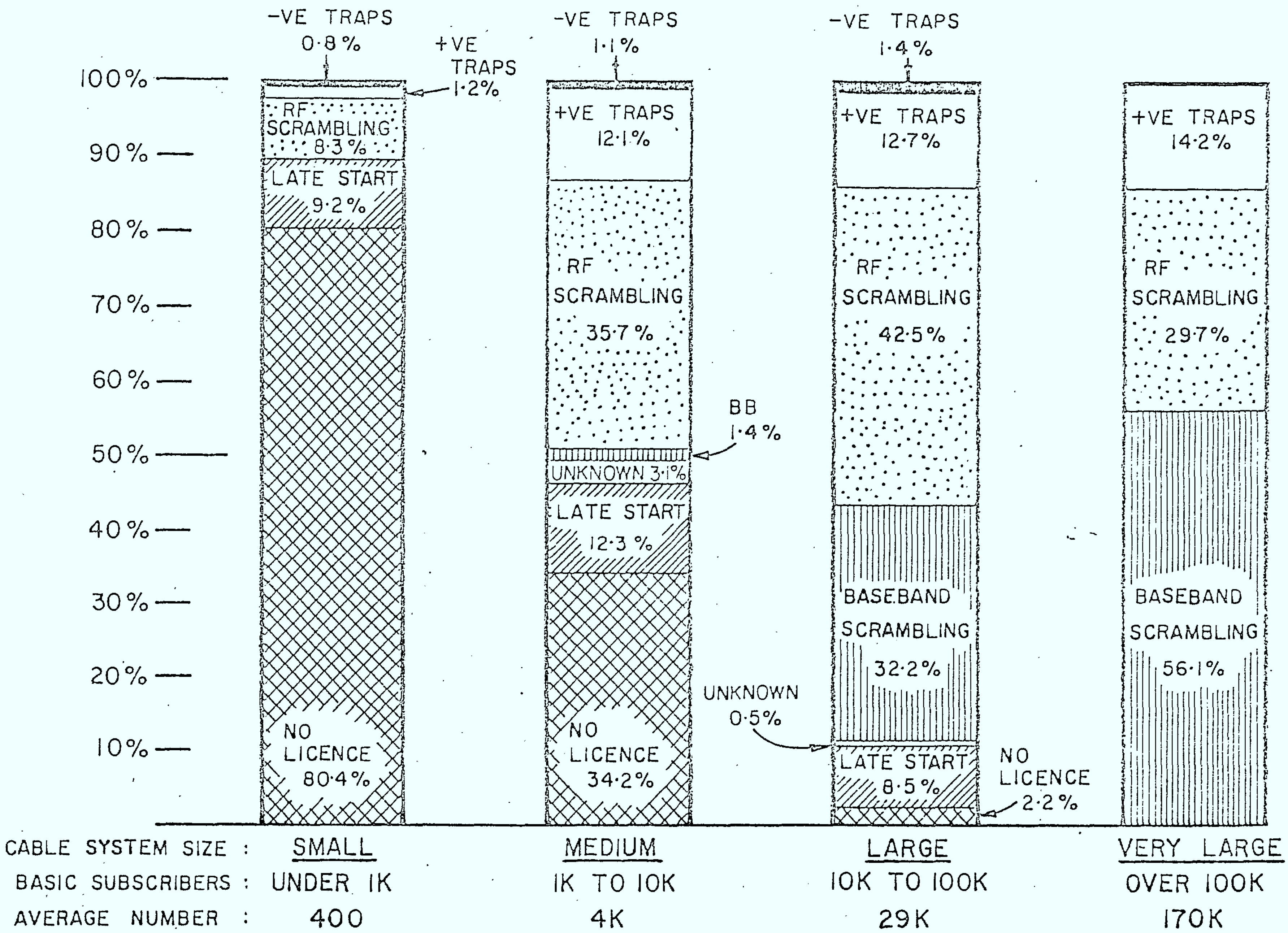
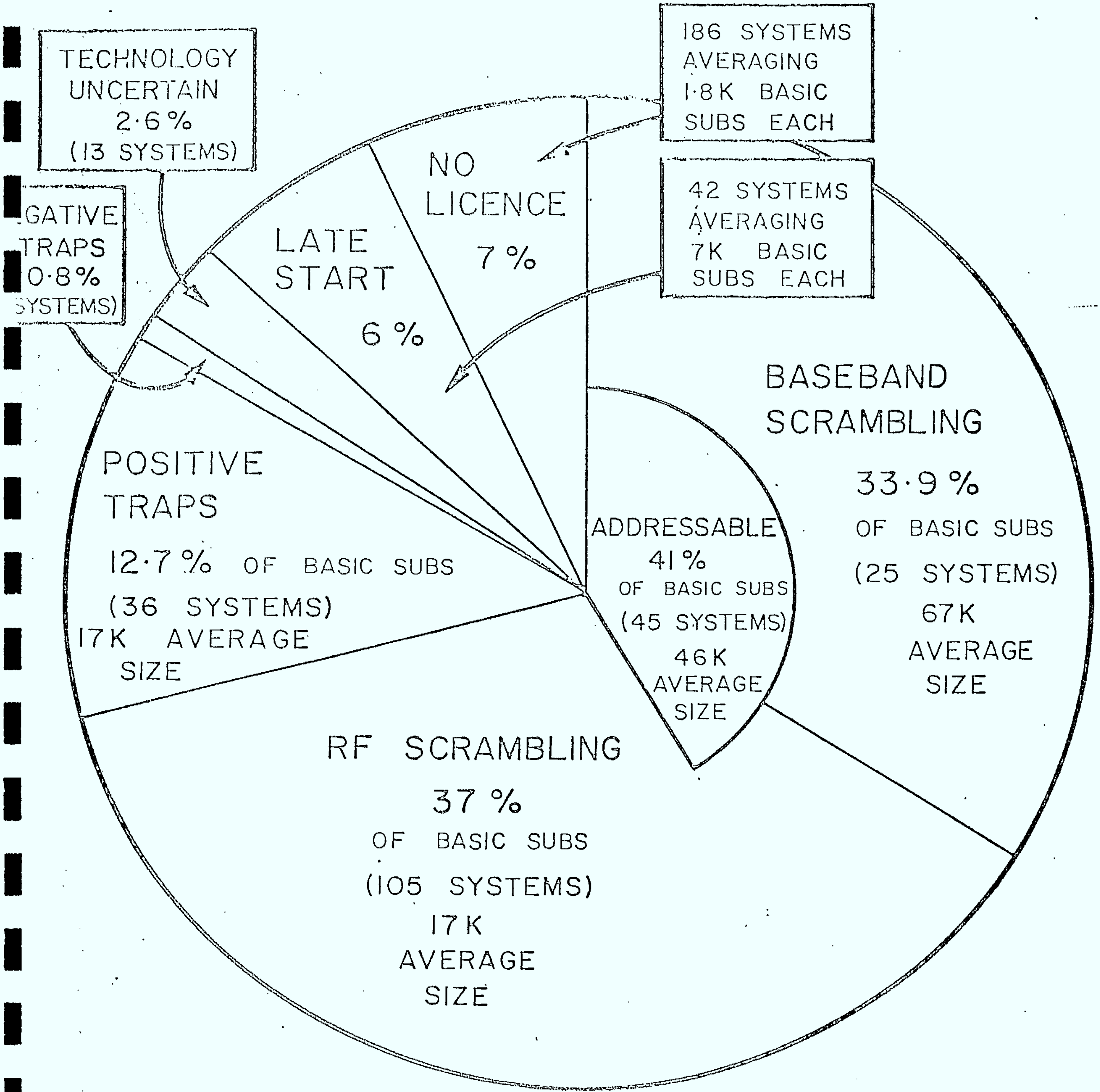


FIGURE 14.1

BASIC SUBSCRIBERS WITHIN CANADIAN CABLE SYSTEMS USING VARIOUS PAY-TV EXHIBITION TECHNOLOGIES



(POSITION AT FEBRUARY 1983 LAUNCH)

FIGURE 14.2

The four options mentioned: baseband and RF scrambling, positive and negative trapping, were the only techniques used in the Canadian pay-TV launch.

The addressable option for RF descramblers has been chosen by 17 systems out of 106, divided as follows by system size:

CABLE SYSTEM SIZE	RF (SYNC SUPPRESSION) NON-ADDRESSABLE systems	b. subs	SCRAMBLING ADDRESSABLE systems	b. subs
Small	6	4K	-	-
Medium	48	221K	8	51K
Large	33	831K	8	223K
Very Large	2	400K	1	106K
TOTAL	89	1,456K	17	380K

On the other hand, all of the baseband scrambling systems are addressable. An overall picture of the distribution of addressable facilities at the pay launch is as follows:

CABLE SYSTEM SIZE	NON-ADDRESSABLE systems	b. subs	ADDRESSABLE systems	b. subs
Small	8	6K	-	-
Medium	78	334K	11	66K
Large	44	1,270K	28	930K
Very Large	4	641K	6	1,061K
TOTAL	134	2,251K	45	2,057K

The significant commitment to addressable systems in Canada represents a large potential market for finely tiered service, including pay-per-event exhibition.

Because of the heavy pre-launch penetration of converter service in Canada, cable operators have favoured descramblers, both baseband and RF, which could be supplied as an add-on unit. This permits the basic subscriber to continue using an existing converter and avoids the expense of acquiring an additional (built-in) converter as part of a integrated converter/descrambler unit. This consideration is probably responsible for the lack of sales in Canada of several RF and baseband systems offered in the United States only as integrated converter/descrambler assemblies.

In an effort to reduce the cost of add-on descramblers, manufacturers have responded by pressing ahead with the development of descramblers which can be interfaced directly to both 'cable-ready' television sets and to component television systems. Specially designed barebones version descramblers can then be used with appropriately modified or speciallly designed television sets. The particular choice of interface signals and their levels determines the configurations of the descrambler.

The Zenith Radio Corporation has begun manufacturing television sets with external access to the receiver's detected baseband video and 4.5 MHz audio signals. This has been achieved by means of an 8-pin DIN socket which also permits direct baseband access to the picture tube and loud speaker input as well as to remote volume control and sound muting signals. The video interface signal level chosen by Zenith is 2.8 volts peak to peak with negative sync polarity and a sync tip reference to 4 VDC. The 4.5 MHz audio output is provided at greater than 15 mV RMS. The baseband audio input is at 1 volt RMS, depending upon volume level.

Although it is possible to design suitable descramblers to interface in this way for each of the RF sync suppression systems now used in Canada (Jerrold, Hamlin, Microcom & Oak), agreement on an interface standard will not be easy. Each manufacturer can be expected to prefer slightly different specifications. Systems using out-of-band addressing require additional connections between the add-on descrambler and the coaxial cable drop.

From the cable operator's perspective, a common video interface is highly desirable. Without such a standard it will be necessary to stock and install more than one type of barebones descrambler for a given scrambling system. A separate model will be required to accomodate different types of television receiver interface. On the other hand, given a single standard, future descrambler costs could be minimized and performance improved due to the reduced signal processing necessary.

Ongoing developments in descrambler technology could reduce exhibition costs while raising security levels and improving service quality. Extension of service via direct broadcast satellite to home delivery is technologically feasible given agreement on a common scrambling system. For the future, standardization issues promise to become increasingly important.

* * *

APPENDIX A

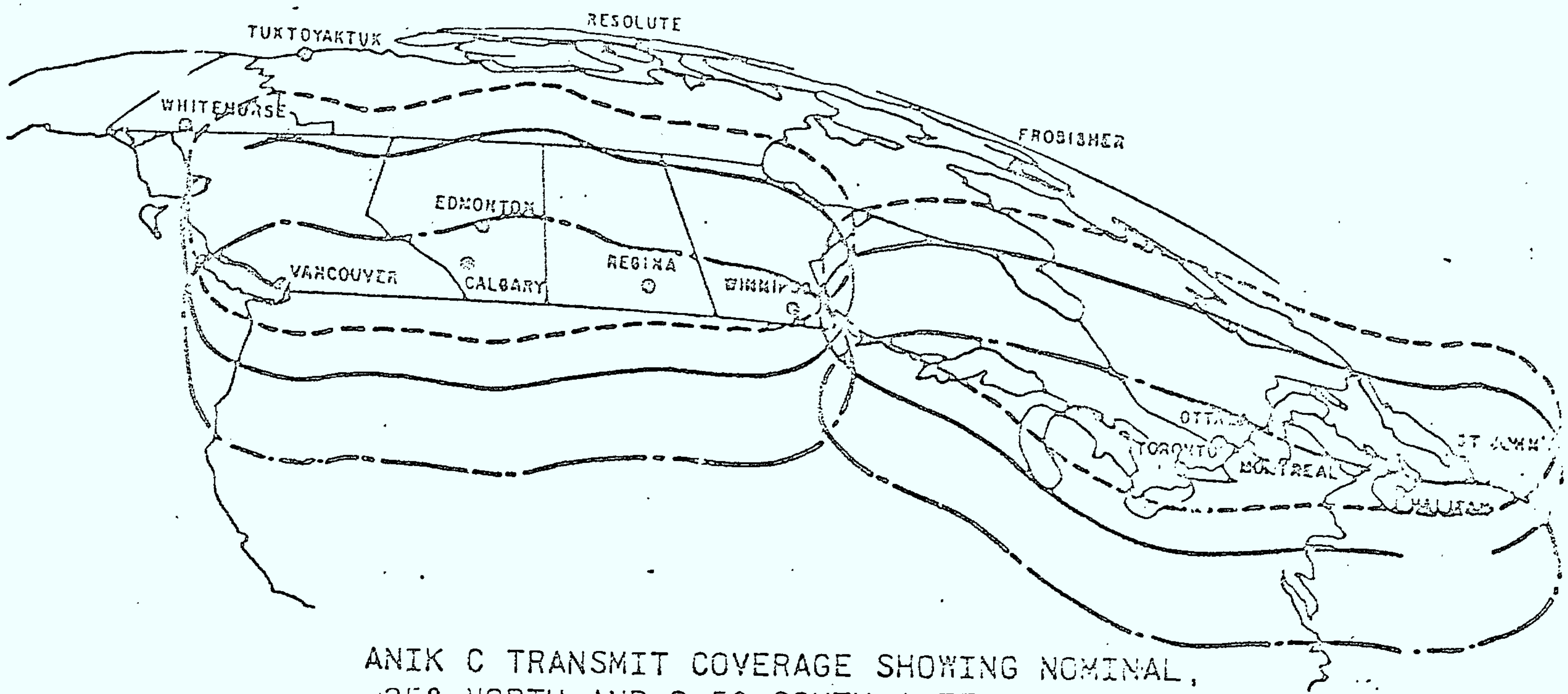
EIRP CONTOURS

EIRP CONTOURS

The following figures illustrate the typical Anik C coverage expected for each of the 1/4 and 1/2 Canada spot beams for nominal pointing (0° tilt), 0.5° Southern tilt and 0.25° Northern tilt. Anik B 14/12 GHz contours are also attached.

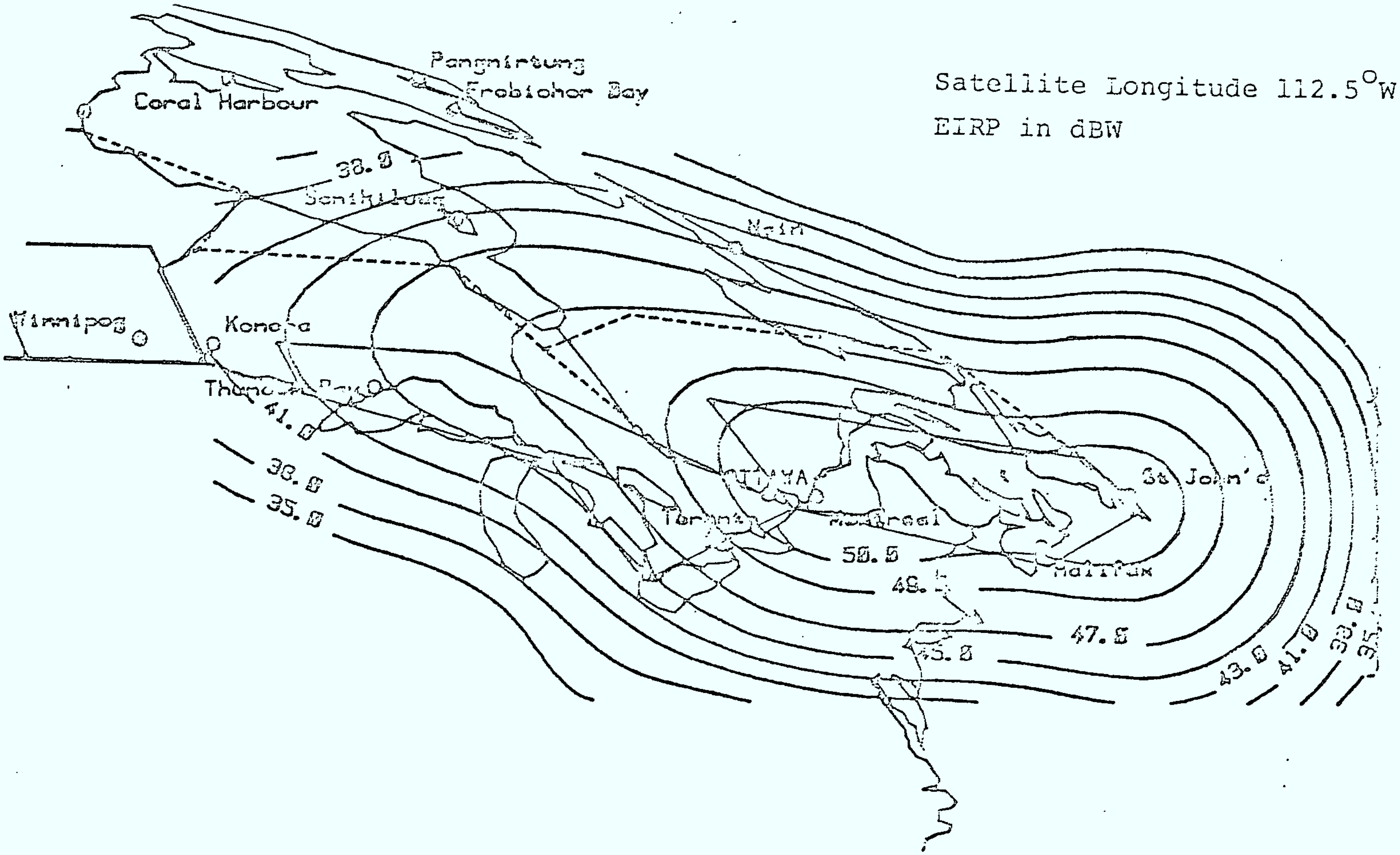
These contours are based on calculated data and are therefore suitable for planning purposes only. Actual coverage may vary due to the specific satellite orbital position, channel polarization, or channel assignment.

April 15, 1982



ANIK C TRANSMIT COVERAGE SHOWING NOMINAL,
.25° NORTH AND 0.5° SOUTH ANTENNA POINTING
(45 dBW EIRP CONTOUR)

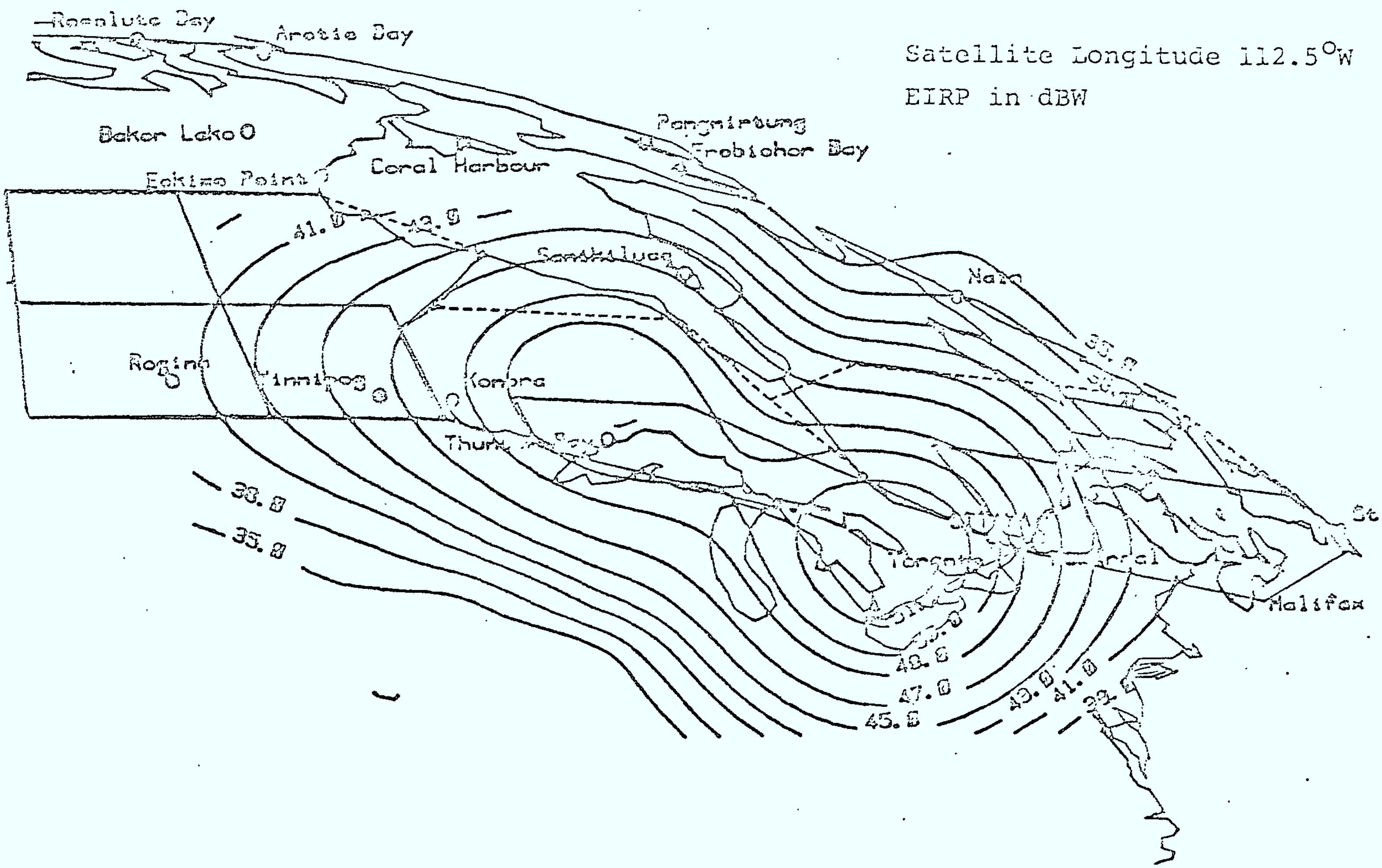
Télésat Canada



TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0° TILT

1/4 CANADA EAST (E) BEAM

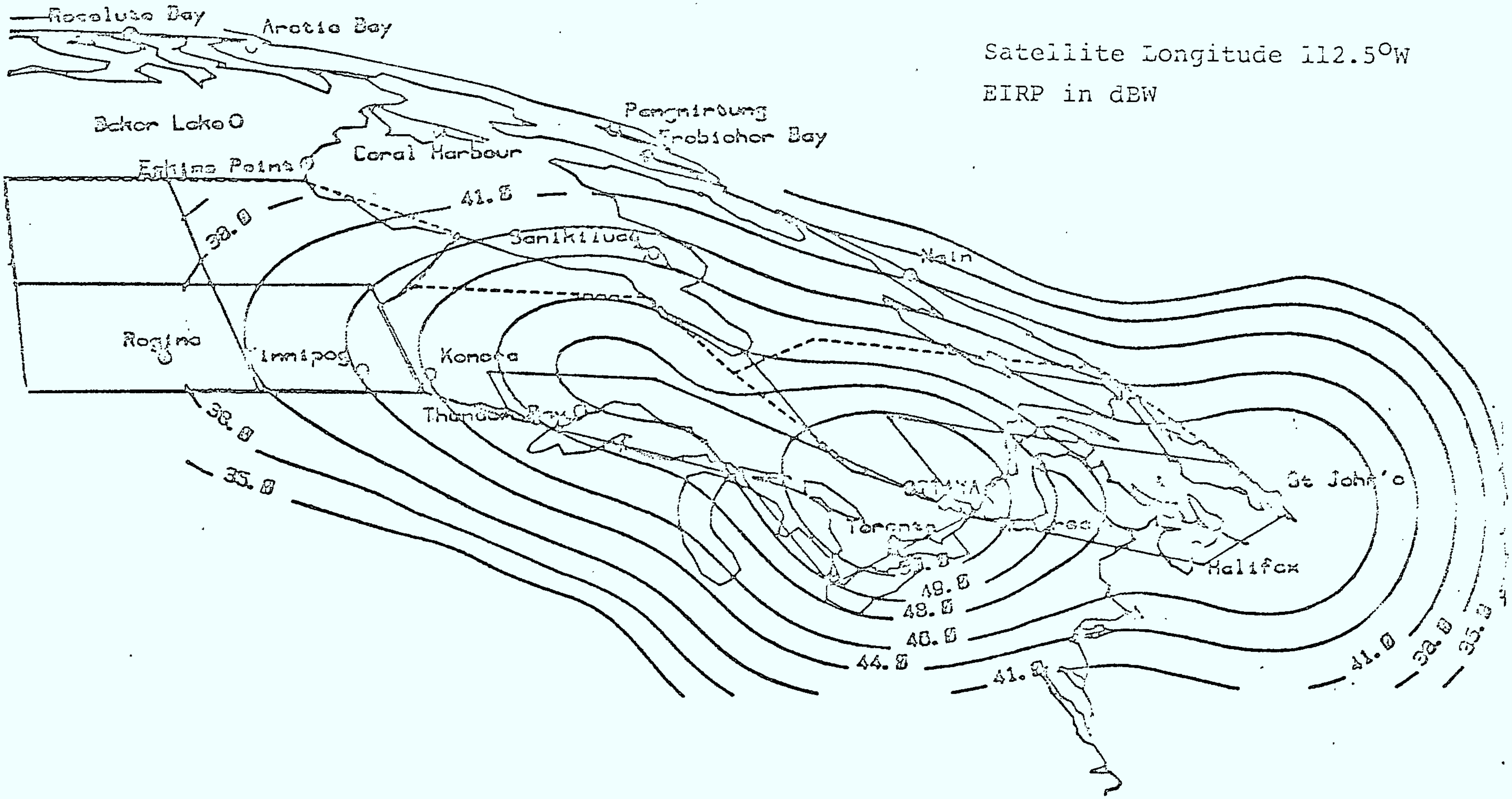
TC 154 B



TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0°TILT

1/4 CANADA EAST-CENTRAL (EC) BEAM

Telesat
Télésat Canada

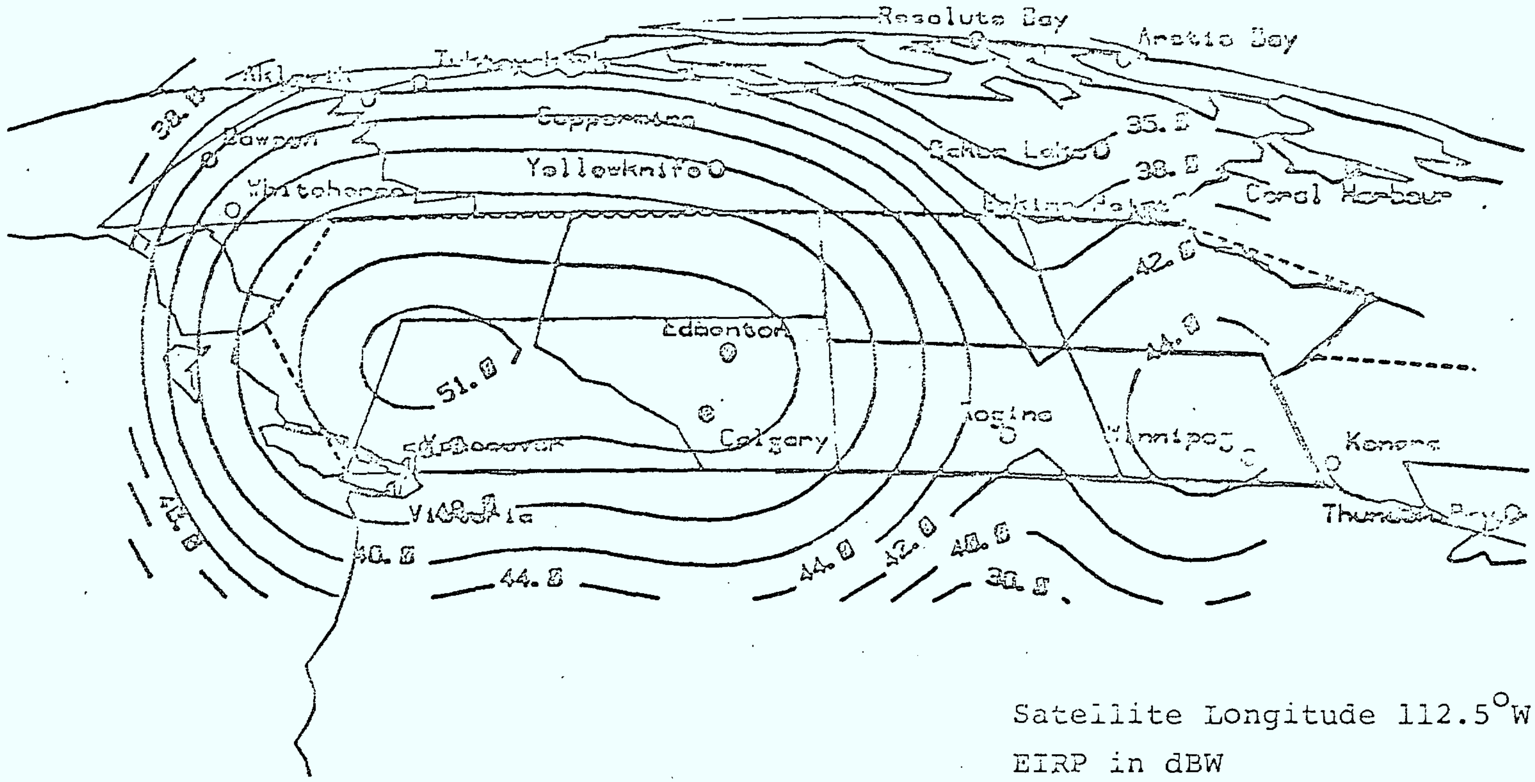


Satellite Longitude 112.5°W
EIRP in dBW

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0° TILT

1/2 CANADA COMBINED EAST/EAST-CENTRAL (E/EC) BEAM

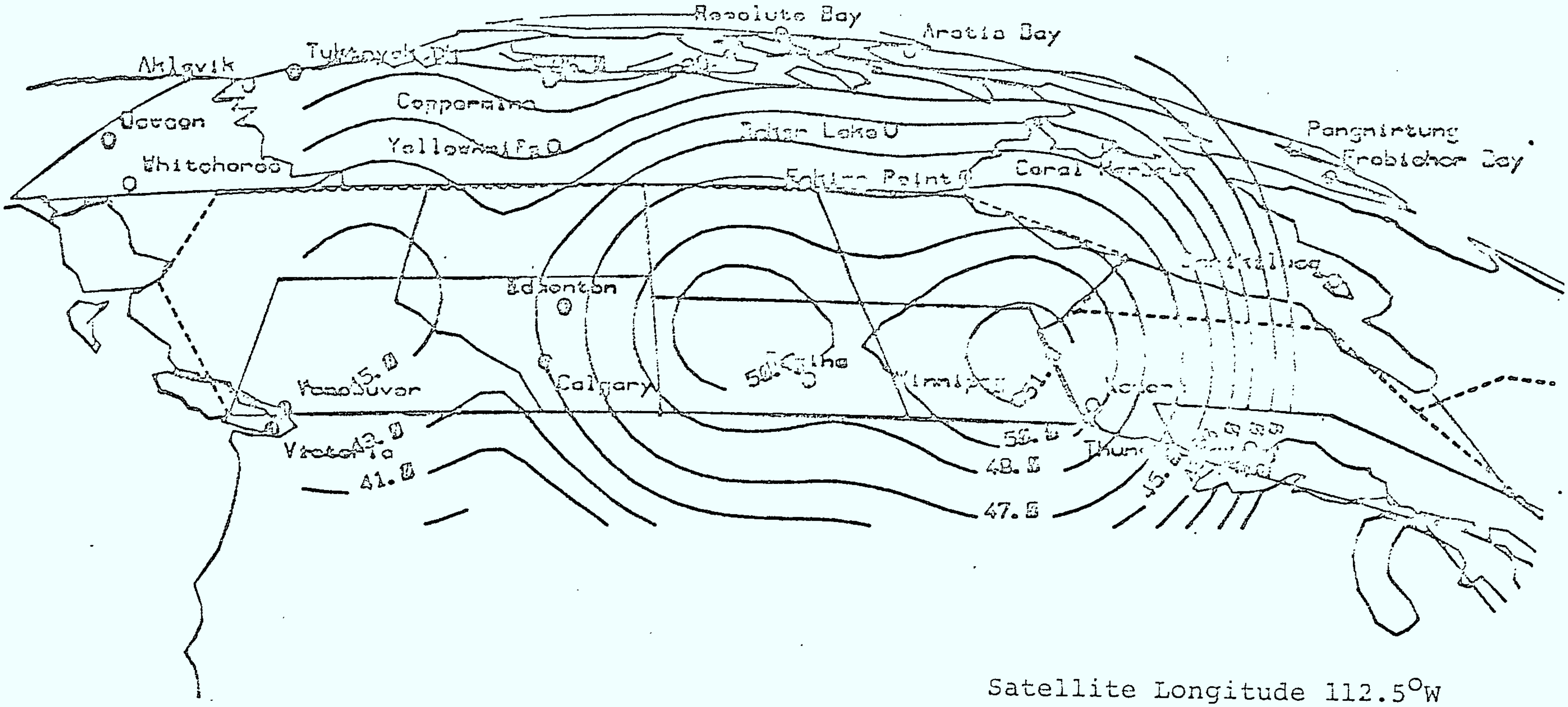
TC 1548



Satellite Longitude 112.5°W
EIRP in dBW

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0° TILT

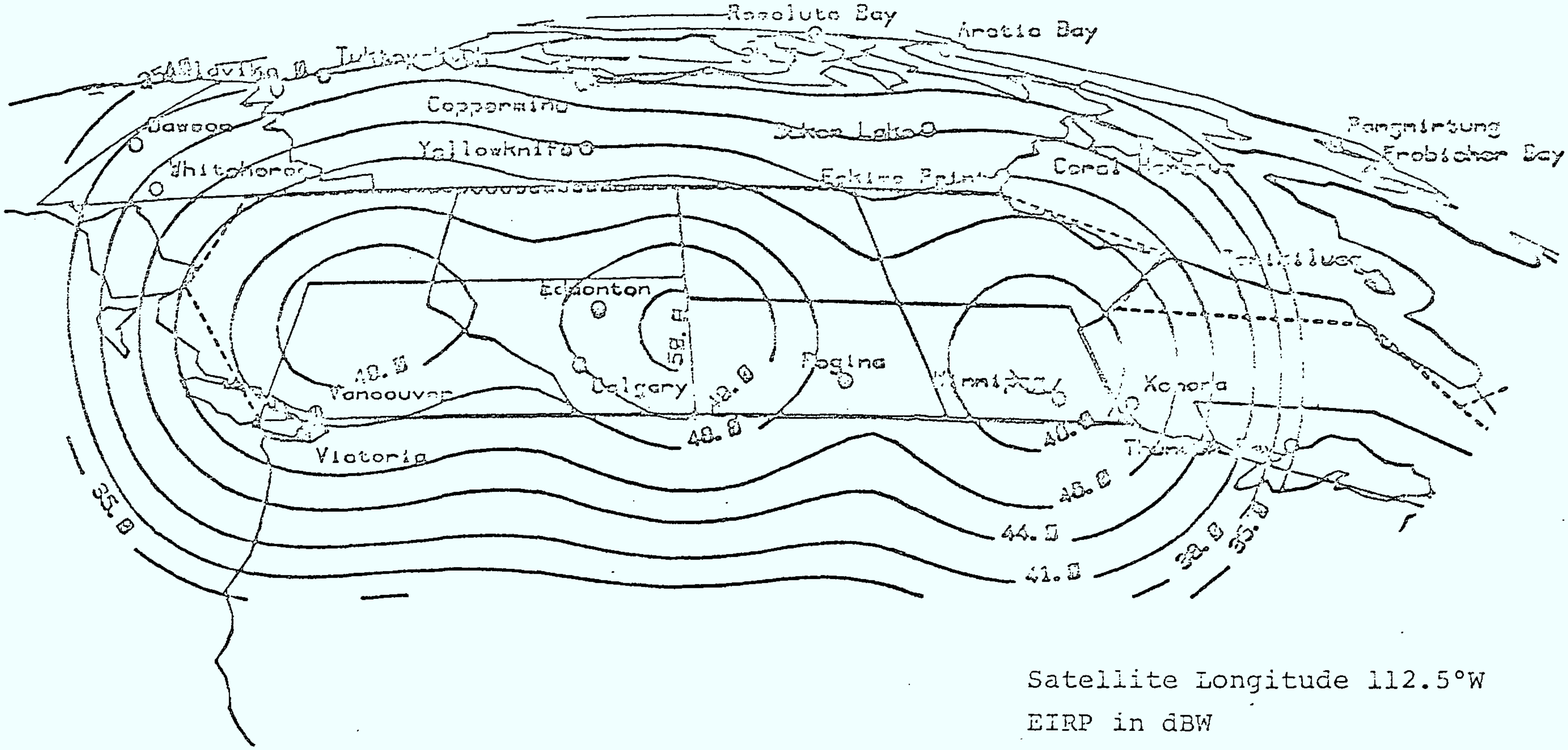
1/4 CANADA WEST (W) BEAM



Satellite Longitude 112.5°W
EIRP in dBW

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0° TILT
1/4 CANADA WEST-CENTRAL (WC) BEAM

TC 154 B



Satellite Longitude 112.5°W
EIRP in dBW

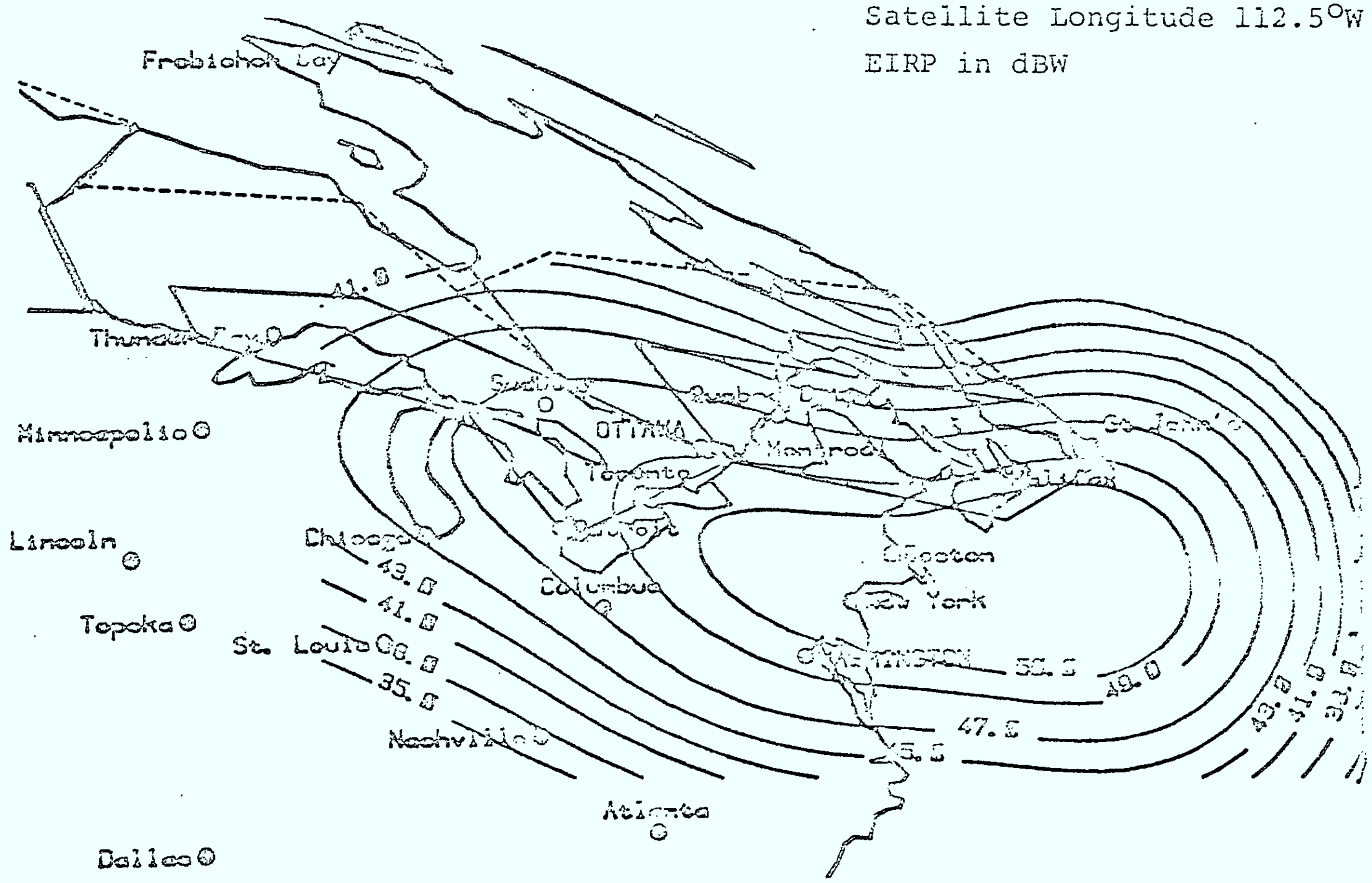
TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0° TILT
1/2 CANADA COMBINED WEST/WEST-CENTRAL (W/WC) BEAM

Telesat

Télésat Canada

Satellite Longitude 112.5°W

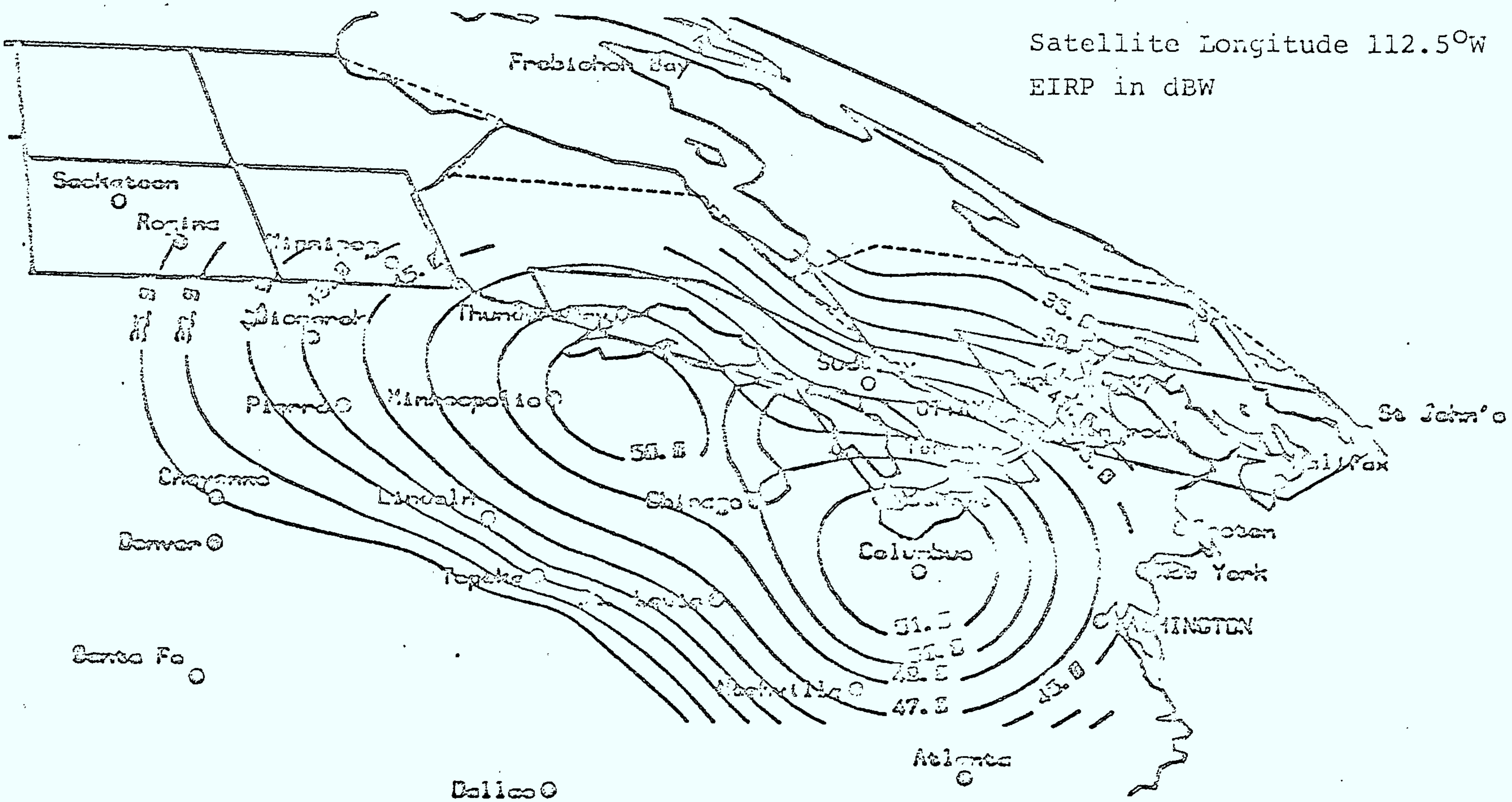
EIRP in dBW



TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.5°S TILT

1/4 CANADA EAST (E) BEAM

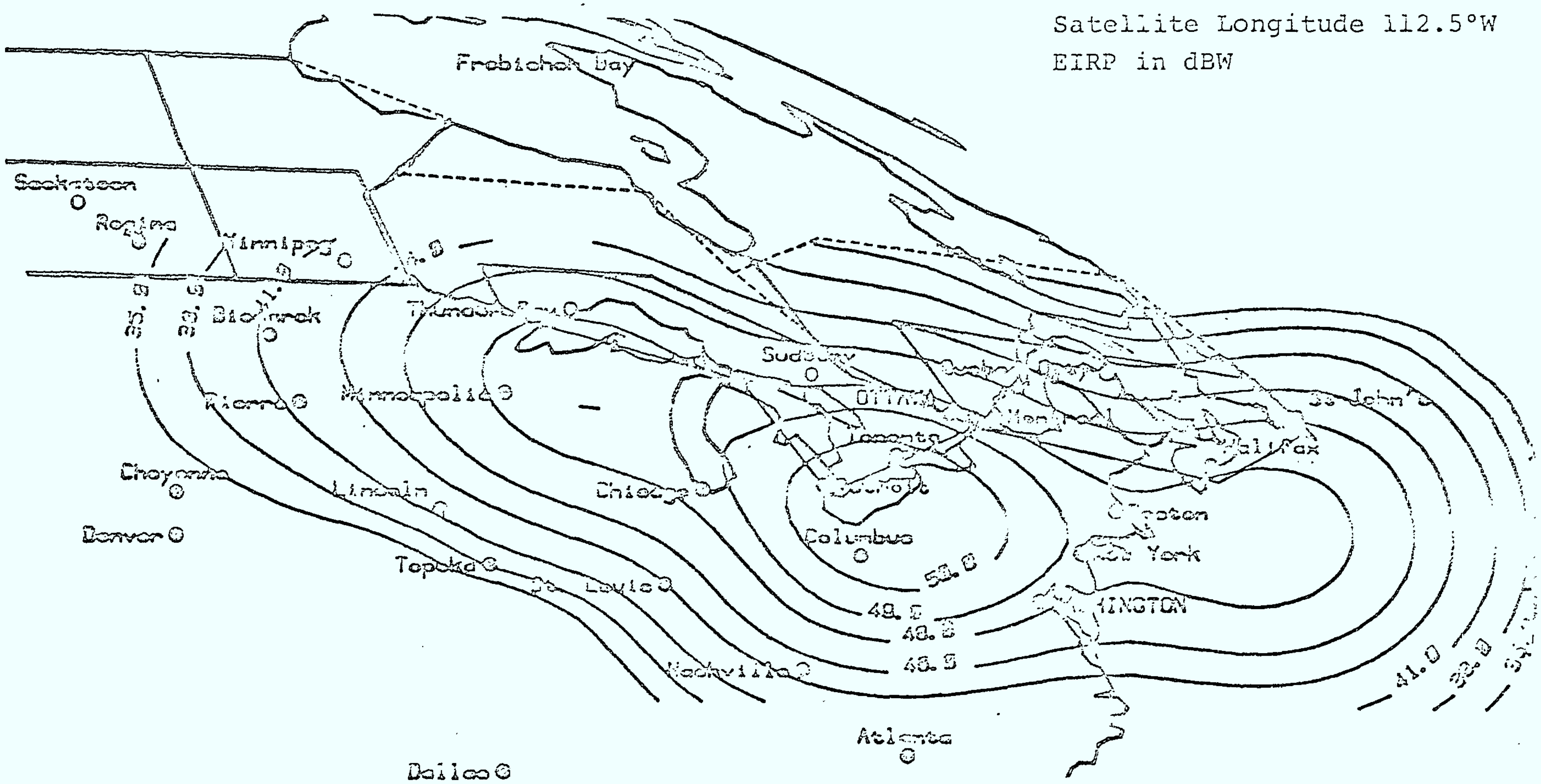
Telesat
Télésat Canada



TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.5°S TILT

1/4 CANADA EAST-CENTRAL (EC) BEAM

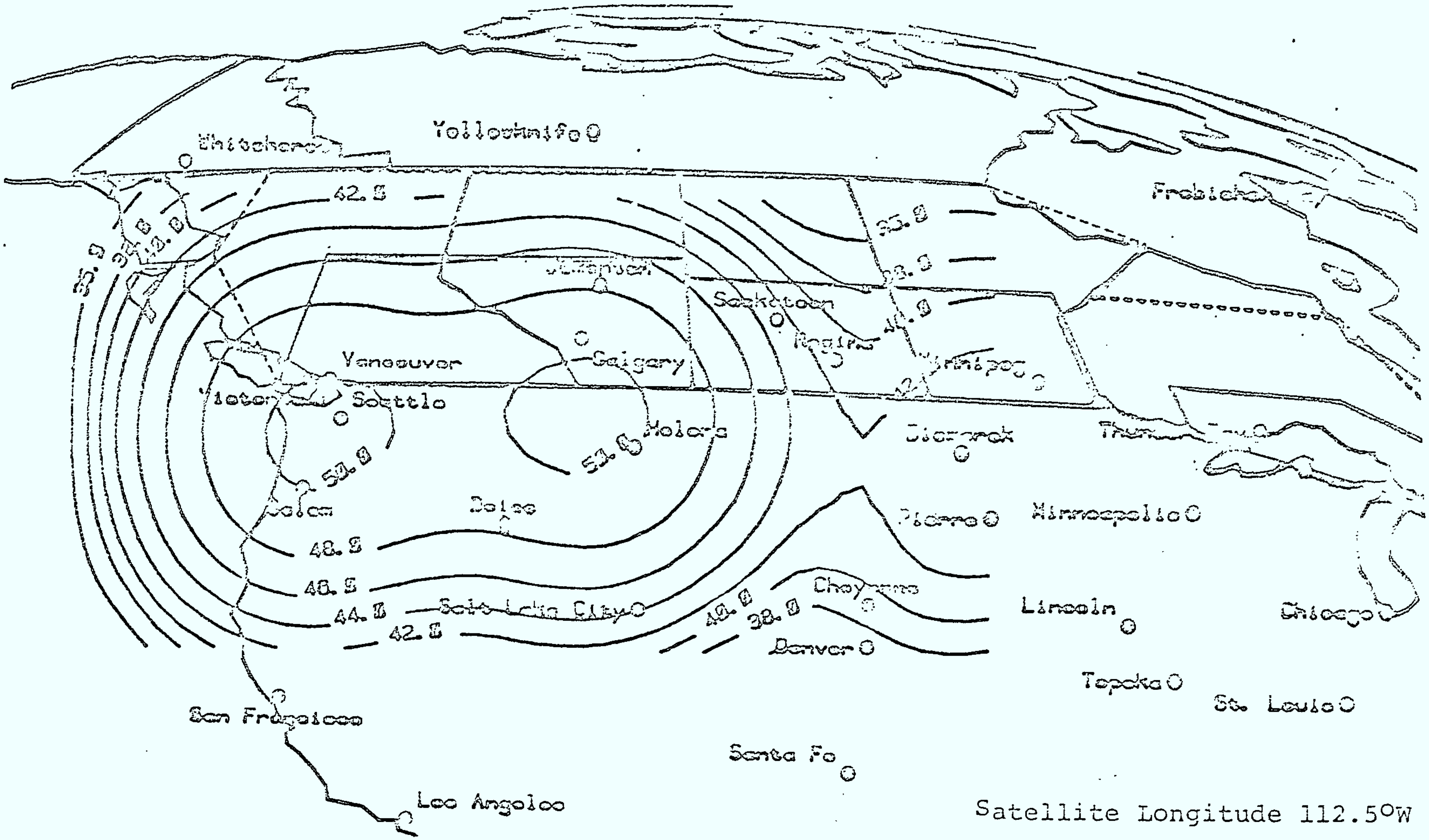
TC 154 B



TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.5°S TILT

1/2 CANADA COMBINED EAST/EAST-CENTRAL (E/EC) BEAM

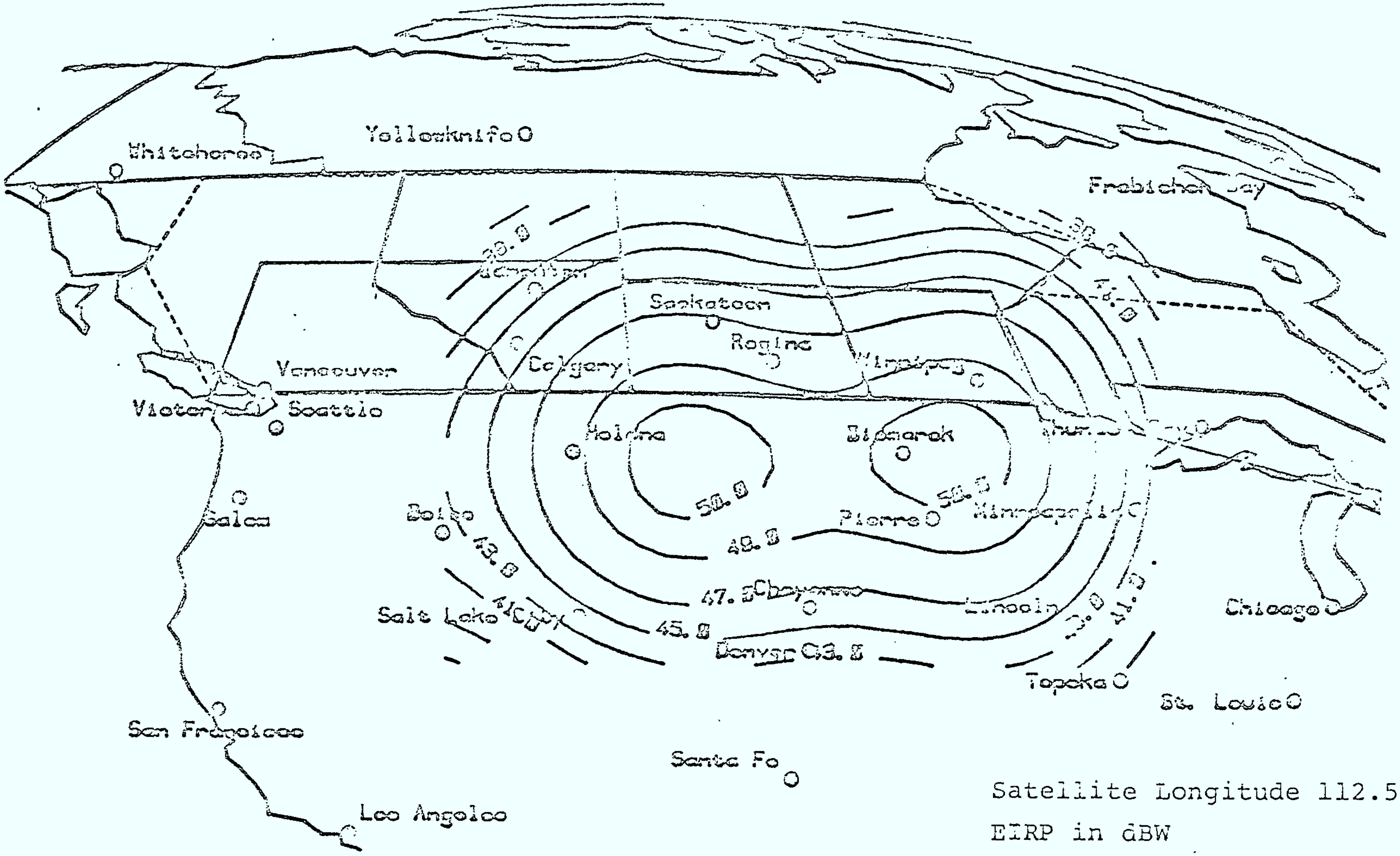
Télésat Canada



TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.5°S TILT

1/4 CANADA WEST (W) BEAM

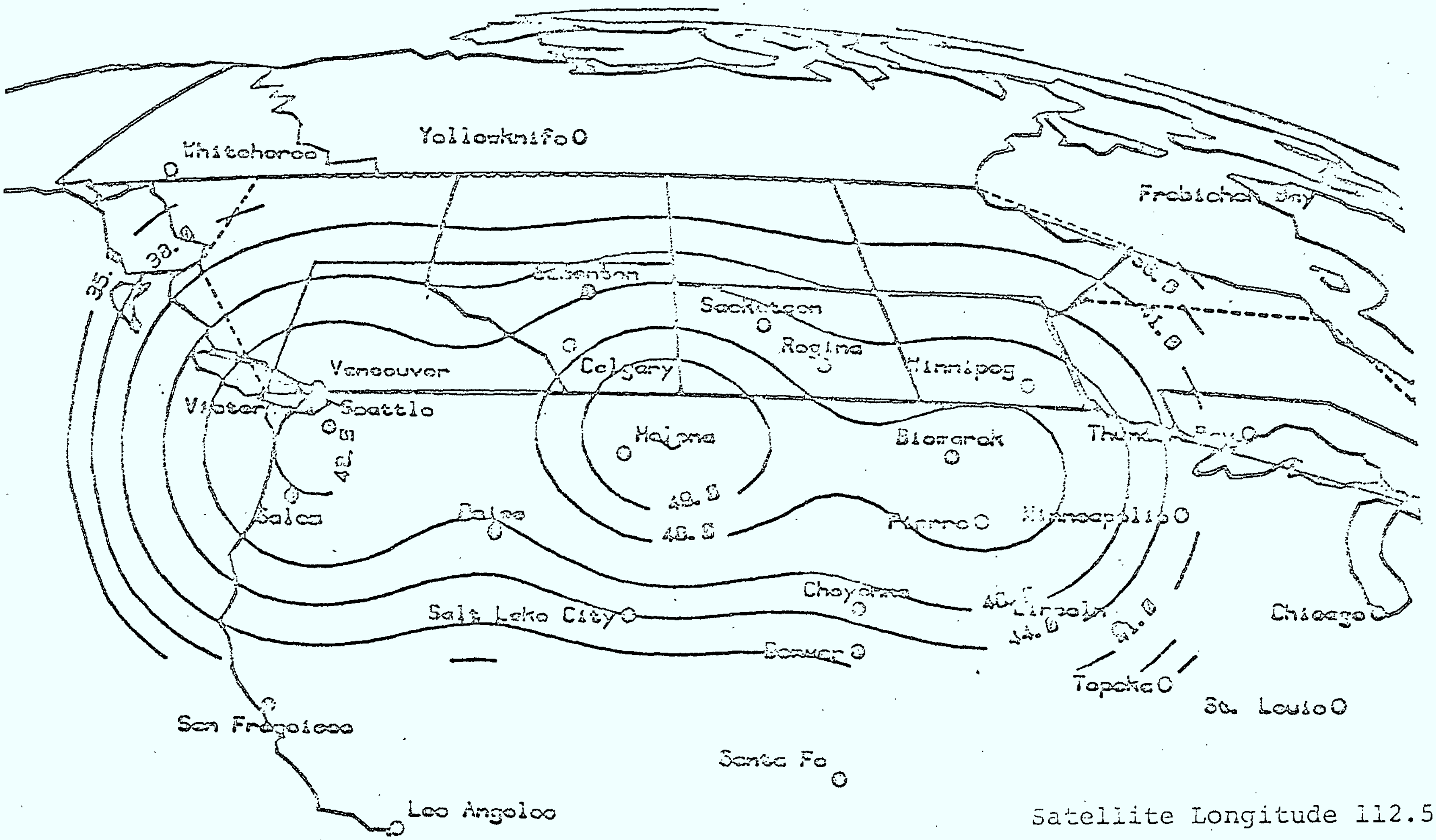
Télésat Canada



Satellite Longitude 112.5°W
EIRP in dBW

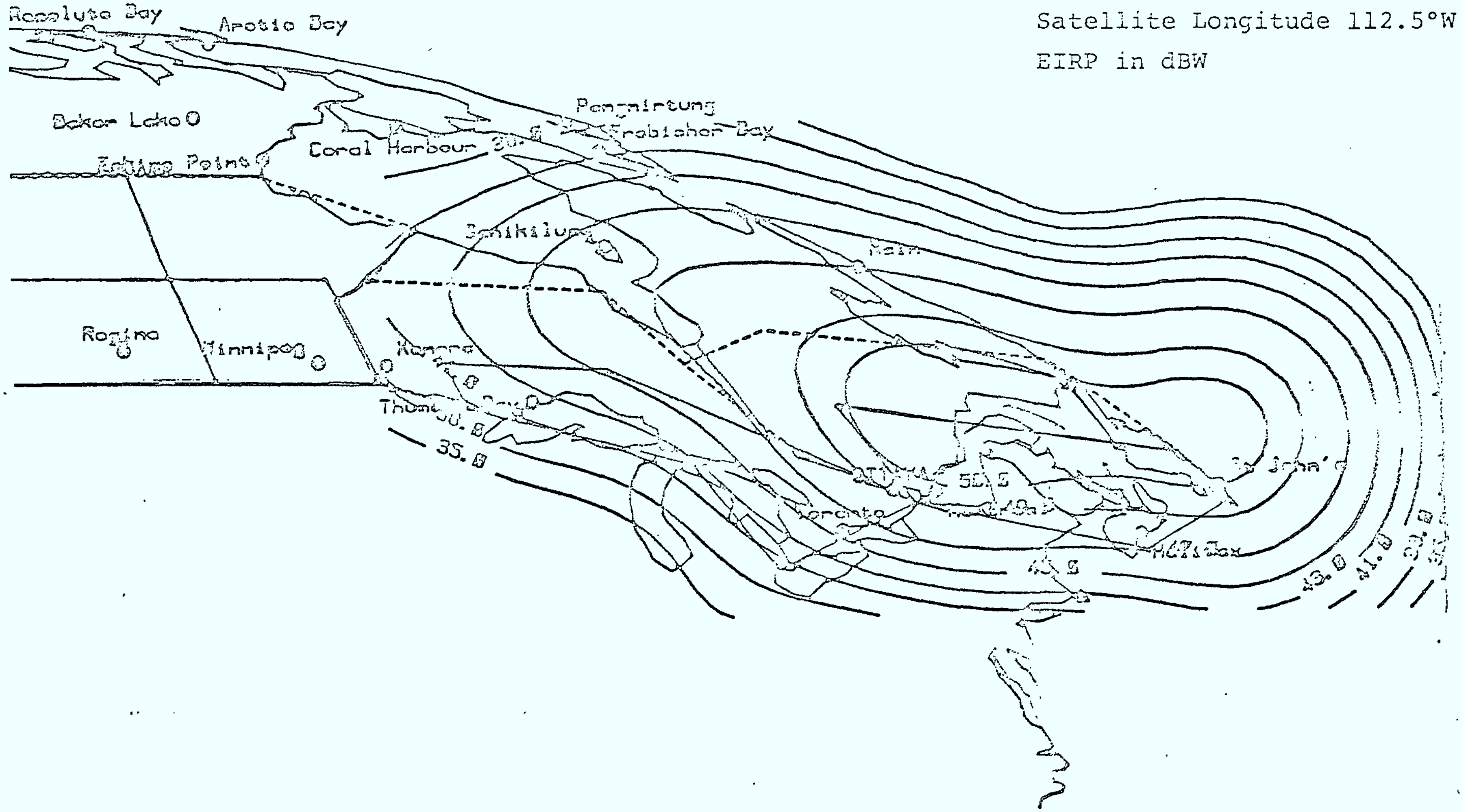
TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.5°S TILT

1/4 CANADA WEST-CENTRAL (WC) BEAM



Satellite Longitude 112.5°W
EIRP in dBW

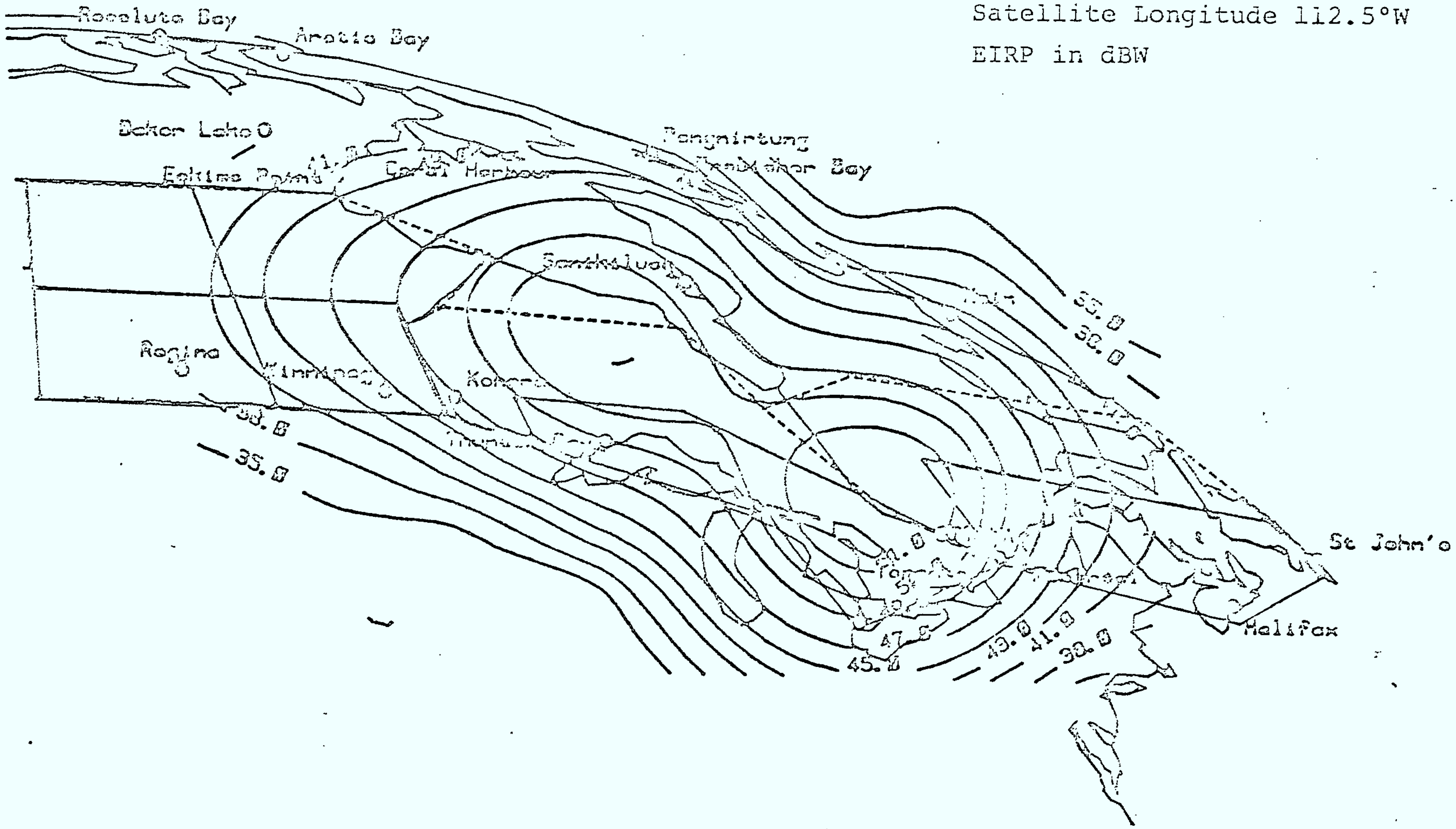
TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.5°S TILT
1/2 CANADA COMBINED WEST/WEST-CENTRAL (W/WC) BEAM



TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.25°N TILT

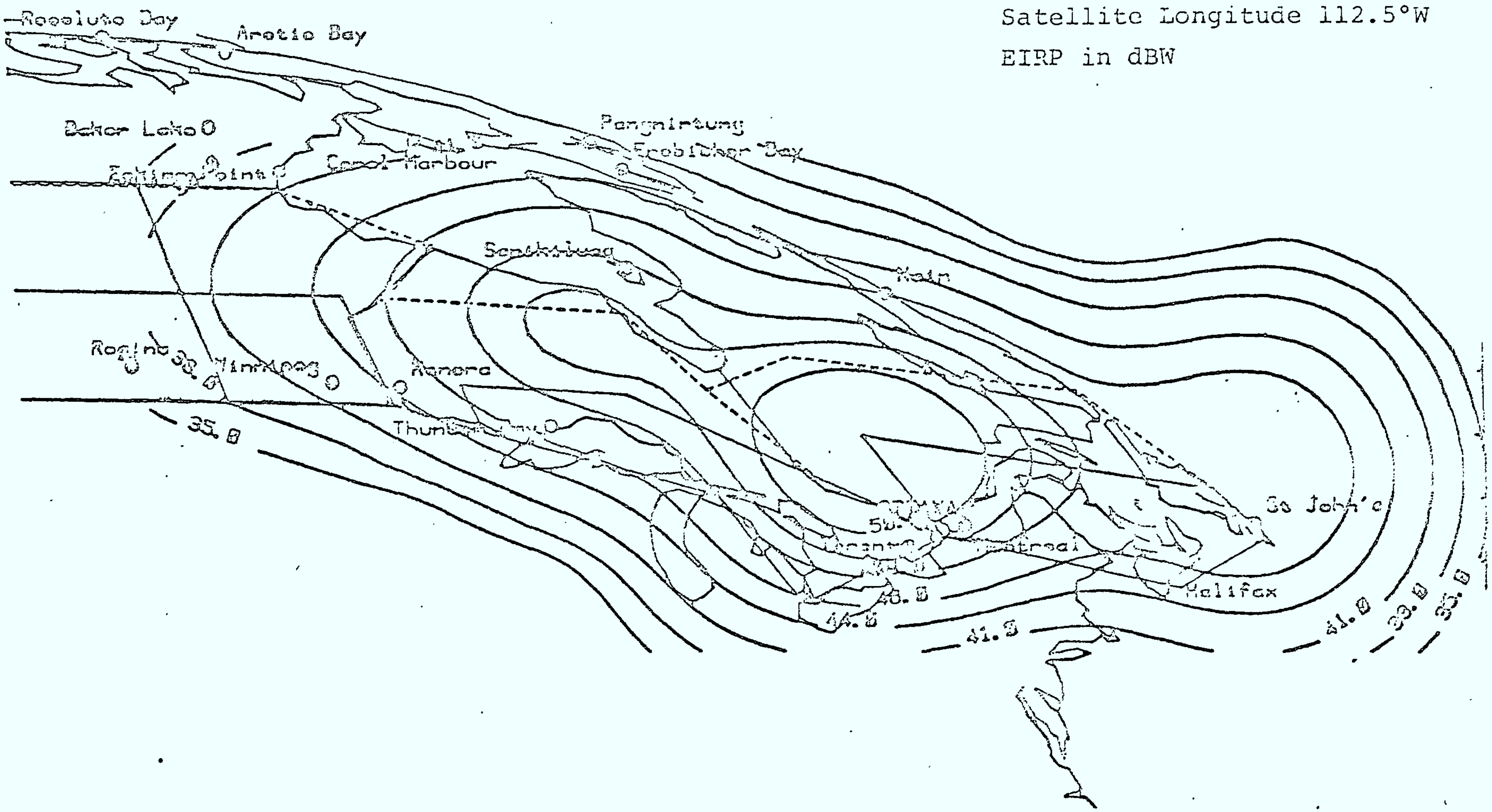
1/4 CANADA EAST (E) BEAM

Satellite Longitude 112.5°W
EIRP in dBW



TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.25°N TILT
1/4 CANADA EAST-CENTRAL (EC) BEAM

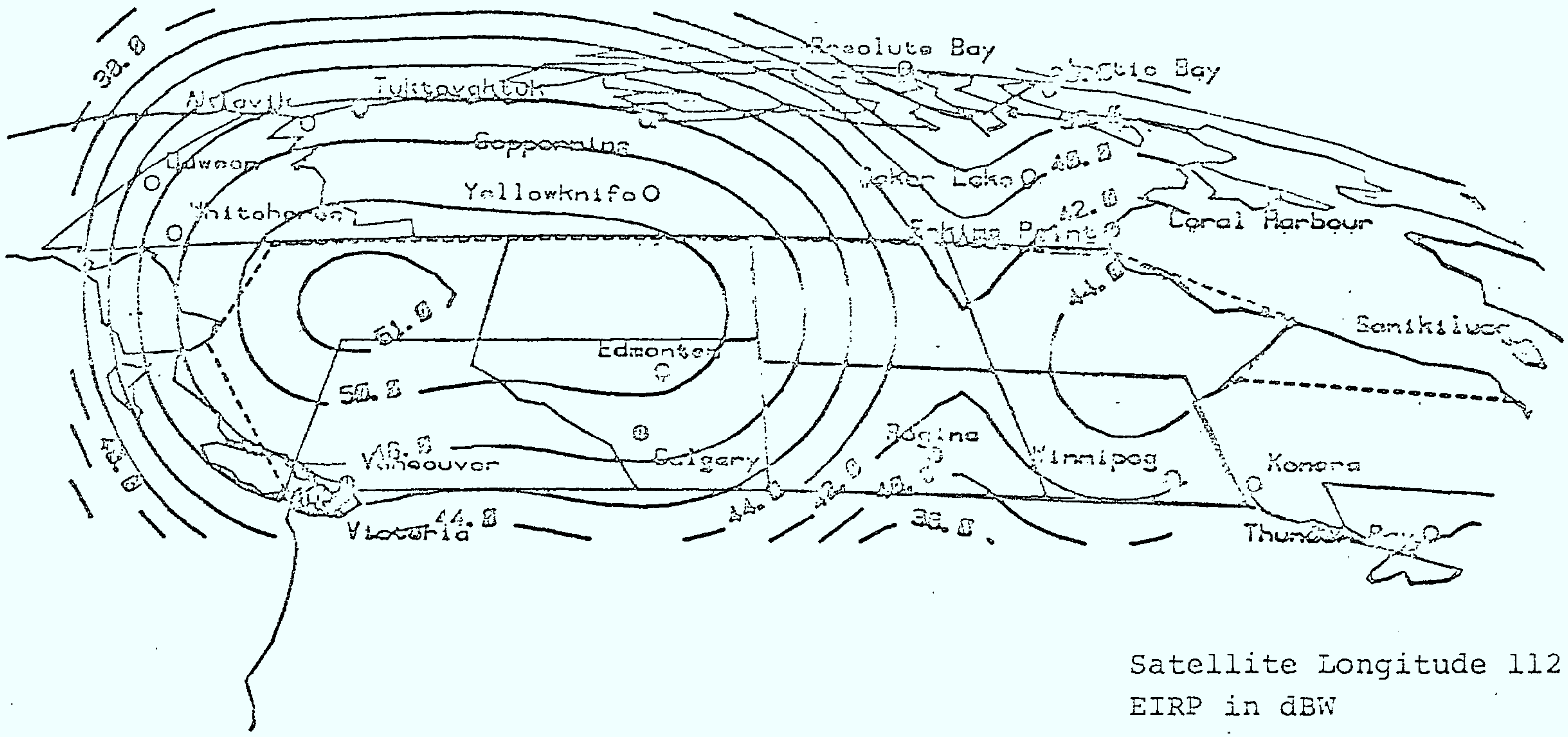
Télésat Canada



TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.25°N TILT

1/2 CANADA COMBINED EAST/EAST-CENTRAL (E/EC) BEAM

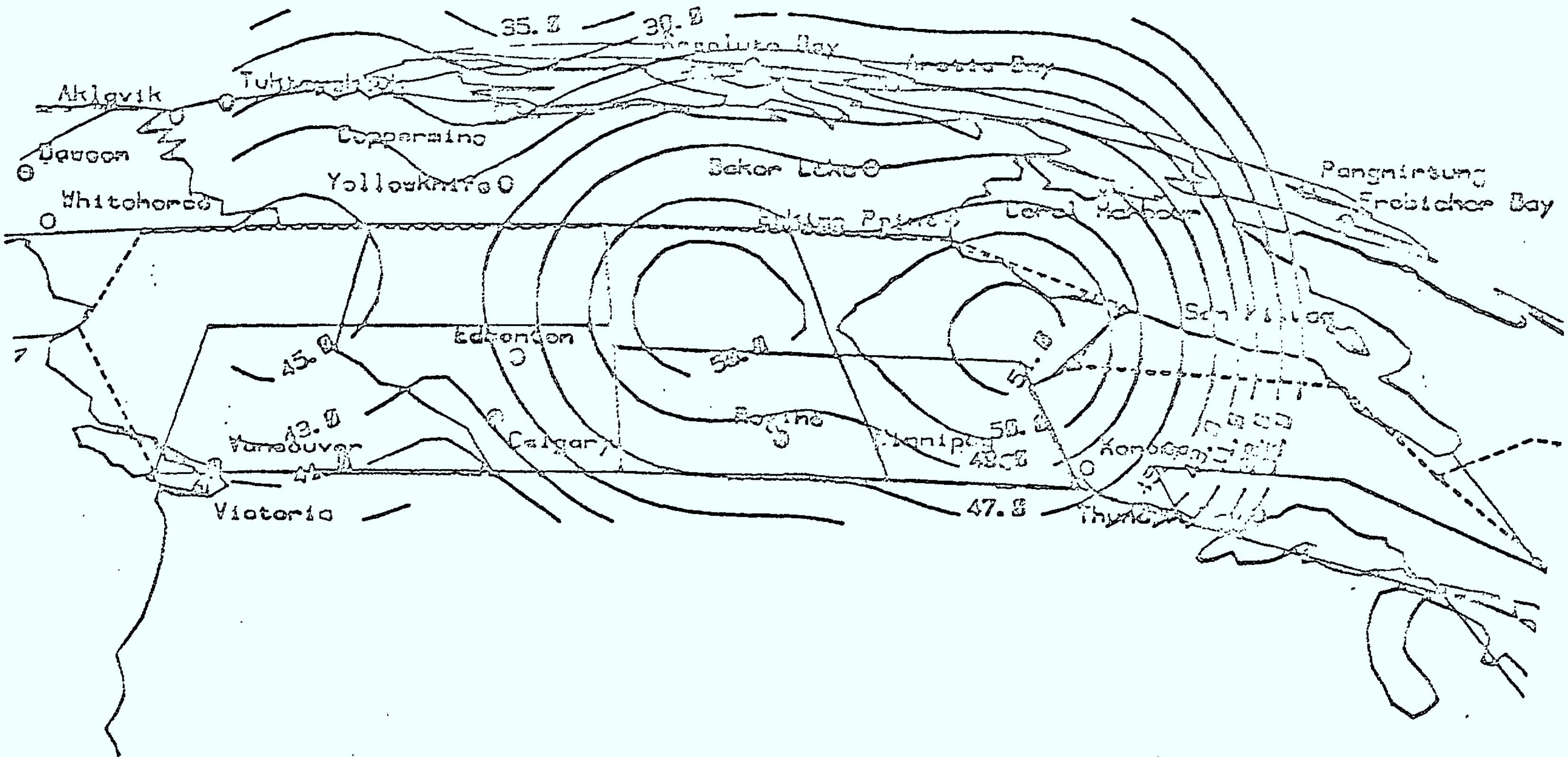
TC 154 B



Satellite Longitude 112.5°W
EIRP in dBW

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.25°N TILT

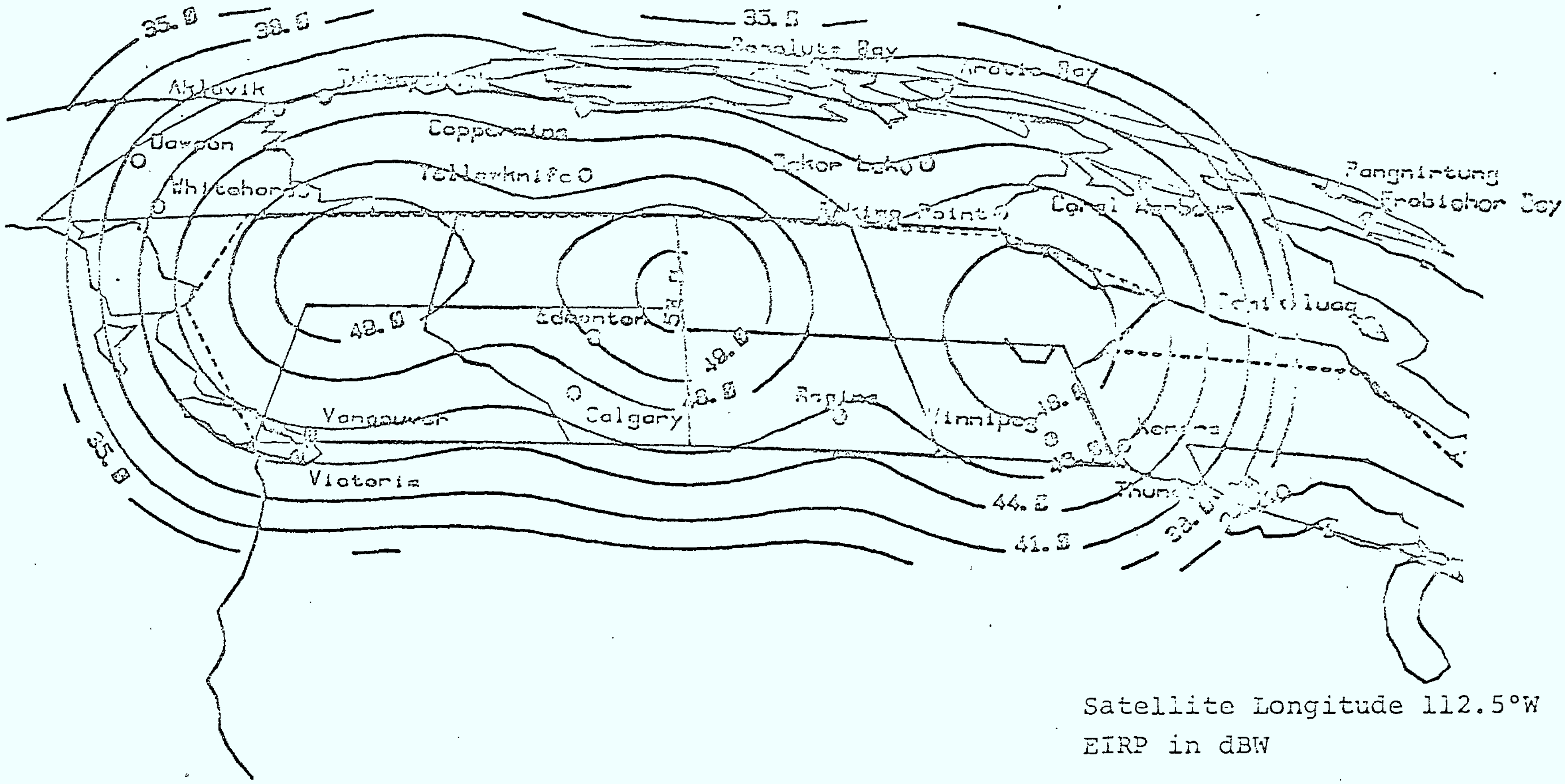
1/4 CANADA WEST (W) BEAM



Satellite Longitude 112.5°W
EIRP in dBW

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.25°N TILT

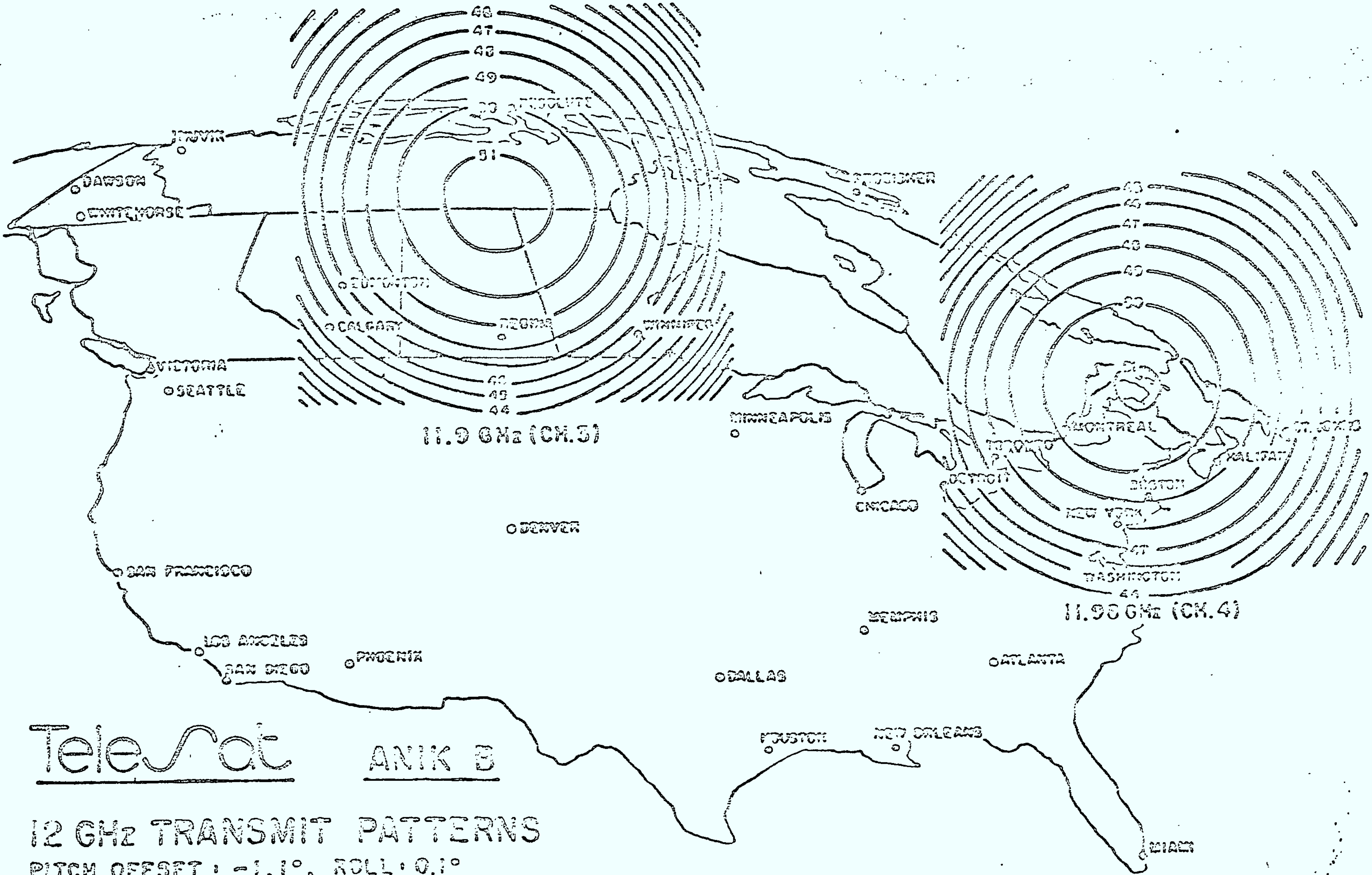
1/4 CANADA WEST-CENTRAL (WC) BEAM



Satellite Longitude 112.5°W
EIRP in dBW

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0.25°N TILT

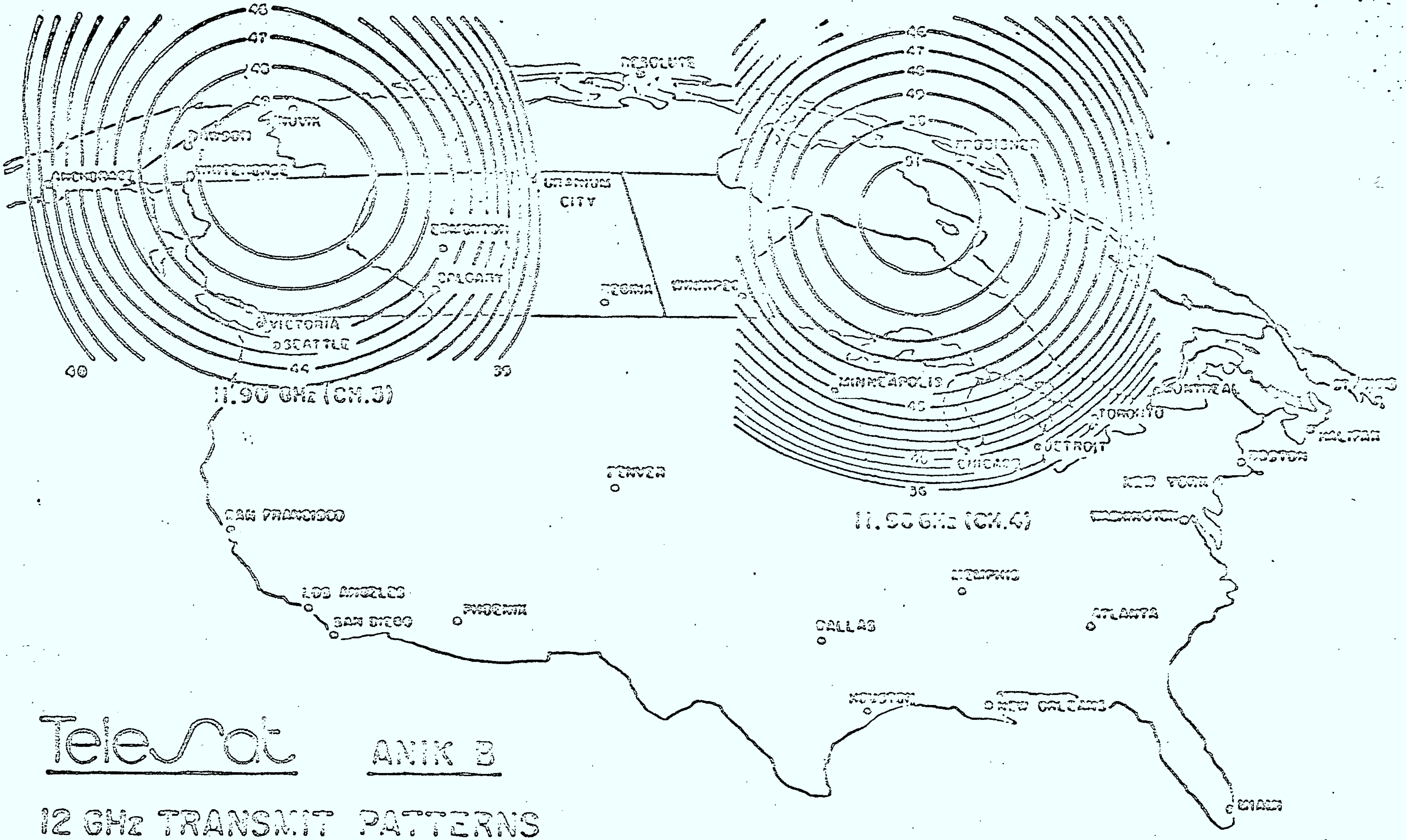
1/2 CANADA COMBINED WEST/WEST-CENTRAL (W/WC)BEAM



12 GHz TRANSMIT PATTERNS

PITCH OFFSET : -1.1°, ROLL : 0.1°
SUB SATELLITE POINT LONGITUDE : 109° W
BEST ESTIMATE OF EIRP (dBw)

EAST AND CENTRAL WEST BEAMS



Telesat ANIK B

12 GHz TRANSMIT PATTERNS

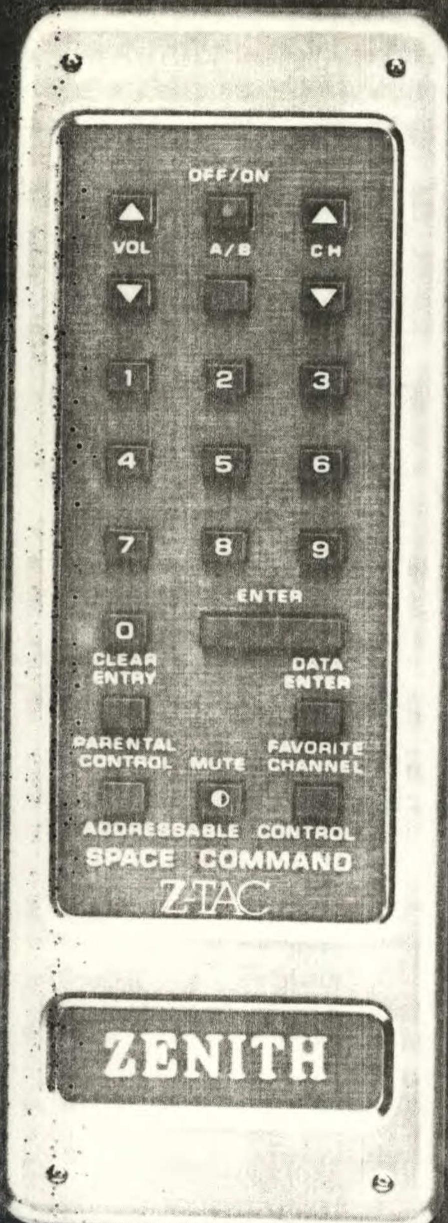
PITCH OFFSET : -1.1°, ROLL : 0.1°
SUB SATELLITE POINT LONGITUDE : 109°W
BEST ESTIMATE OF EIRP (dBw)

WEST AND CENTRAL EAST BEAMS

APPENDIX B

ZENITH Z-TAC SYSTEM

APPENDIX B



Z-TAC™

a securely scrambled, multi-tiered, fully-addressable, upgradeable converter system

ZENITH® | cable products

Channel Numbering Options for Dual Cable

Sequential numbering of the local cable channels is optional. Furthermore, the random channel numbering options allow any channel number to be assigned to any standard frequency; this permits familiar local channel numbers to be assigned even when the frequency must be changed.

Parental Control Options

The channel oriented parental control option allows a parent to select permissible channels for unsupervised viewing. Means are provided to protect the programmed channels against short-term power interruptions. The remaining channels are locked out. Lock options include a metallic key or keyboard password.

The program tag parental control option allows the cable operator to insert up to three VBI code tags which classify the program itself rather than one channel number. These tags may correspond to the movie ratings. The "G" rating needs no lockout. Three unique passwords are assigned to each home unit. Parents control access to the passwords.

In markets where the programming will only occasionally require parental control, the rapid addressing rate of Z-TAC permits phoned-in requests to be used to reconfigure the program authorization for periods of unsupervised viewing.

REDI-PLUG™

The Redi-Plug option is your gateway to current and future enhancements. Depending on the options ordered, the Redi-Plug enables Z-TAC to (a) interface with a monitor, (b) couple to a member of a family of two-way modules, or (c) connect to a text module. The monitor-ready feature allows Z-TAC to take advantage of the exciting new video monitors becoming available.

The two-way-ready option transmits remotely or locally originated key pad code to an optional Home Terminal Unit (HTU) which then modulates the signal for transmission up the cable. A family of HTU's permit a range of two-way services spanning the gamut from simple polling to sophisticated communications systems.

The Text-Ready option facilitates addition of a text module. The Z-TAC tuner, modulator and remote control circuits interface to the module via a connector on the back of Z-TAC.

NOTE: Options may require minimum order quantities or minimum lead times.

Z-TEXT™

Z-TEXT is a teletext module which interfaces with Z-TAC to provide a cost effective one-way text service. The user requests pages which are cyclically repeated. The decoder captures the page of interest.

Depending on decoder chip availability, signal formats could be chosen from (a) British Teletext, (b) Antiope, (c) Telidon, (d) the proposed North American Standard, or (e) other approaches.

Z-TEXT is a tiered, addressable system for VBI or full field application. In full field an entire channel is dedicated to text. The transmission rate is 500 pages per second with a page address range of 5,000 pages. Pages can be classified as belonging to groups of up to forty tiers.

The page format is either twenty or twenty-four rows of forty characters.

A discussion of the business opportunities in text service is available.

Z-ALERT™

The Z-ALERT option enables emergency alerting whenever Z-TAC is powered and tuned to a channel containing VBI data. The television receiver need not be on. The Z-ALERT option allows for several categories of alarms such as general alert, fire, medical, police, cable maintenance, city officials, snow removal, flood control, military, etc. The alarm consists of a sounder such as found on smoke alarms. The alarm is cancelled by a button on the Z-TAC unit or by an "all clear" signal from the head-end. The subscriber tunes his television set to a prescribed emergency channel to obtain advice. Alerts can be assigned to specific geographic locations.

TOTAL HEAD-END EQUIPMENT AVAILABLE

Head-end video processing plus data insertion equipment is available from Zenith as well as software and hardware for control of the channel scramblers. This system controller circulates a list of subscriber numbers and their authorizations. The system controller can be interfaced to a management and/or billing computer via a simple RS232C plug and protocol. Several choices already have been implemented. Optional audio processing equipment for audio scrambling is available.

Electrical Specifications

Electrical Requirements

Input Bandwidth—50 MHz to 440 MHz. **Input Levels**— −6 dBmV to 14 dBmV. **Input Impedance**—75 ohm. **Input Return Loss**—At least 6 dB. **Spurious Signals at the RF Input Terminal**—The level from the local oscillator or any signal of an undesired nature generated within this device and arriving at the input terminal shall not exceed: a) −50 dBmV from 5 MHz to 50 MHz. b) −26 dBmV from 50 MHz to 450 MHz. c) −10 dBmV from 450 MHz to 1000 MHz. **Output Return Loss**—At least 12 dB. **Output Signal Format**—Vertical interval blanked in output signal except for SSAVI signals, which will pass lines 14 thru 21. **Converter Selectivity at:**—Relative to Visual Carrier: a) Upper Adjacent Video Carrier—at least 15 dB down. b) Lower Adjacent Aural Carrier—at least 15 dB down. c) Lower Adjacent Color Carrier—at least 15 dB down. **Spurious Signals at the RF Output Terminal**—The level of any signal of an undesired or spurious nature, generated within this device and arriving at the output terminal, and falling within the pass band of the output channel, shall be at least 60 dB below the signal level of the output visual carrier. Spurious signals falling out of band will be no greater than: a) −20 dBmV for 5 MHz-50 MHz. b) −30 dBmV for 50 MHz-450 MHz. c) −20 dBmV for 450 MHz-1000 MHz. **Frequency Assignments**—HRC, IRC, standard, and standard with 1 MHz downward offset in superband (K to W). **Noise Figure**—9 dB maximum from 50 MHz to 440 MHz. **Output Amplitude Frequency Response Between +3.58 MHz and −0.75 MHz w.r.t. Visual Carrier**—Within +0.5 −2.0 dB on any channel. **Input Overloading Handling**—Withstand signals of +40 dBmV without component failure. **Automatic Frequency Tuning (AFT) Pull in Range**—±1.00 MHz. **Composite Triple Beat Ratio**—At least 55 dB down. See NOTE (1) below. **Cross Modulation**—At least 55 dB down. See NOTE (1) below. **Second and Third Order Beats**—At least 55 dB down. See NOTE (1) below. NOTE (1) For 60 channel CW carriers at 10 dBmV at the input. Test performed with AFT and AGC set to a fixed level to simulate a normal video signal input. **Differential Phase**—Within ±5 degrees @ 3.58 MHz. **Differential Gain**—Within ±5% @ 3.58 MHz. **Linearity**—At most 5% deviation from linear. **Memory Retention**—Provides at least 24 hours in the event of power loss. **Rechargeable Battery Lifetime**—At least 7 years. **Output Modulator**—a) Depth of modulation—Blanking 25% ±4%, White 90% −10% +0%. b) Output Visual Carrier Stability—Assigned frequency ±60 KHz. c) Video/Audio Carrier Difference—4.5 MHz ±5 KHz. d) Audio Carrier Level Relative to Visual Carrier— −13 dB to −17 dB relative to visual carrier. e) 920 KHz beat—At least 50 dB below visual carrier. f) Output Level—6 ±3 dBmV.

· Procedures for measurements referred to above will be made available upon request.

Specifications subject to change without notice.

ZENITH® | cable products

1000 Milwaukee Avenue, Glenview, Illinois 60025 (312) 391-8960 TELEX 25-4396 TWX: 910-233-2390

APPENDIX C

TEST RESULTS OF LEITCH

DTS-2000N/DTD-2000N

SYSTEM

USING ANIK B

SATELLITE

DIGI-TEL INC.
10 Dyas Road
Don Mills, Ontario, Canada

DTS-2000N
Digital Television Scrambler

DTD-2000N
Digital Television Descrambler

Performance Assessment on a Satellite Link

by

R. Kupnicki and S. Moote

Toronto, March 31, 1982.

Introduction

The following is a description of the performance evaluation of the 2000 System Scrambler - Descrambler over a satellite link with emphasis on noise sensitivity due to a degraded link.

The test was held at the Department of Communications test facilities in Ottawa, Ontario, Canada on March 23rd, 1982. Two descramblers were used to check the addressability and to generally monitor performance differences.

Satellite and Associated Equipment Characteristics

The equipment configuration used in the test is shown in Fig. 1.

Satellite type	Anik B
Frequency range	12 - 14 GHz
Channel	Channel 2 used
Maximum transponder power	20 Watts
Uplink dish	9 m
Downlink dishes	9 m
	1.8 m
	1.2 m

Equalizing distribution amplifiers were used on the uplink line and on the 9 m dish down link because the performance evaluation test equipment was located in a different building from the the one housing the uplink/downlink equipment.

The output from a video test signal generator and the video and audio signals of a program feed were used for the evaluation.

Tests

The lines to and from the transmitter building were equalized and a frequency response sweep performed before commencing the test. Due to a ground differential between the buildings, an attempt was made to minimize the hum. It was not possible to eliminate it completely, especially on the uplink line.

The equipment set-up shown in Fig. 1 was then normalized by setting the signal levels to unity.

9 m Dish Test (8.5 MHz Deviation)

All measurements were performed on a comparative basis i.e. link only and link with scrambler/descrambler. Parameters like video noise, tilt, frequency response and differential gain were recorded. The results are shown in Appendix A.

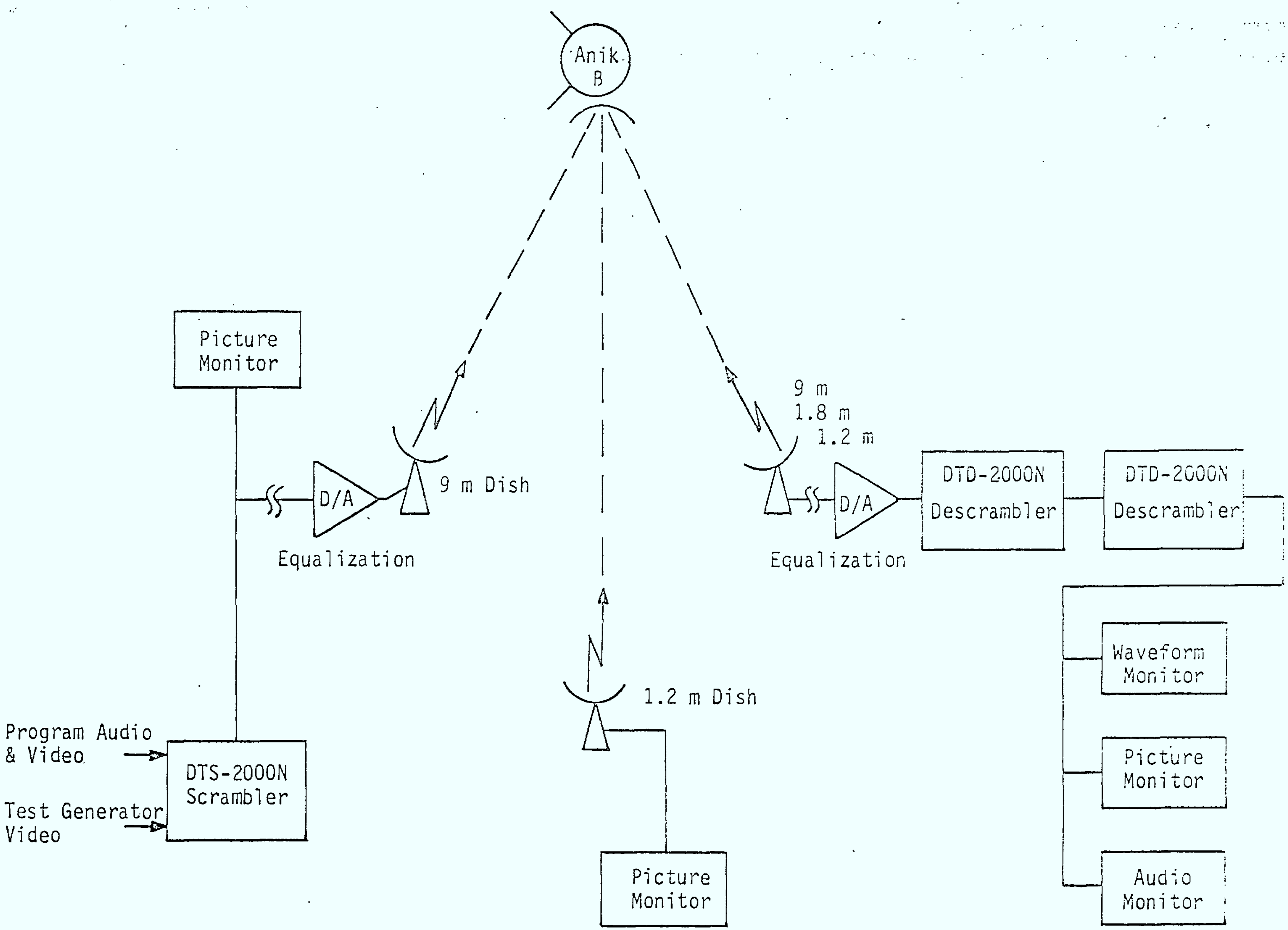


Fig. 1 - EQUIPMENT CONFIGURATION

Subjectively, hum was the only discernible degradation of the video signal.

Following this, the sensitivity of the descrambling process as a function of the carrier to noise ratio was evaluated. This was done by dropping the transmitter power.

The power was dropped by 12dB without causing any degradation in the descrambling of audio or video.

At this point it was suggested that the tests be repeated on a receiver with a smaller dish antenna.

1.8 m Dish

The test set-up was moved to a low cost "direct to home" terminal. The receiver was designed for 6 MHz deviation. Accordingly, the transmitter was switched from the previously used 8.5 MHz deviation. At full power, the received video contained 10 IRE units p-p noise (unweighted). The carrier to noise ratio was 14.9 dB.

The receiver had the following specifications:

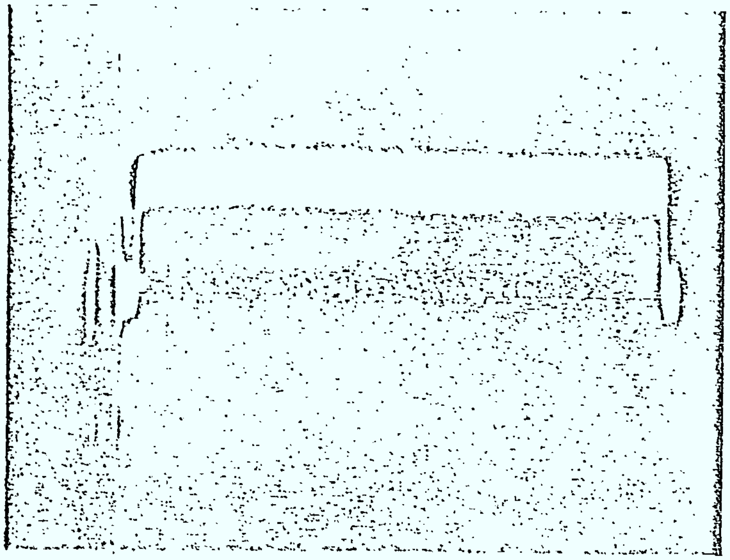
Differential Phase (10% - 90% APL)	8°
Differential Gain (10% - 90% APL)	15%
Chrominance to Luminance delay	150 ns
H Tilt	4 IRE units
V Tilt	15 IRE units
Sync pulse distortion	10 IRE units

As a first step it was necessary to establish the carrier to noise ratio at which the system was unable to descramble the video signal. The transmitter power was decreased in 1 dβ increments. The descrambler was losing vertical lock in the transition from 11 to 12 dB. This corresponds to a carrier to noise ratio of about 3.9 dB. The addressability was still functional and the system recovered after power shut-down.

The carrier to noise ratio at which audio noise became first noticeable occurred when the transmitter power was decreased from 4 to 5 dB. This corresponds to a C/N ratio of <10.9 dB. An analysis of this test result revealed that the severe pulse tilting was responsible for the audio failure at that point. The pulse tilting is shown in the Appendix. It is visible on sync and on the white bar of the multiburst signal.

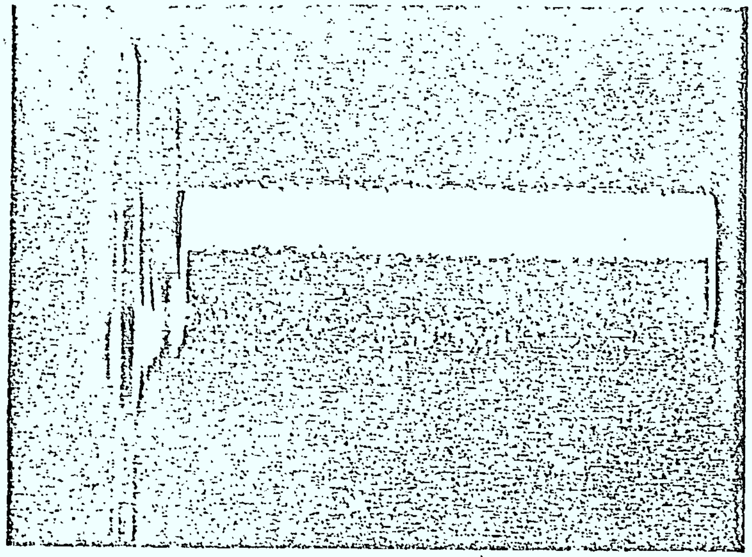
References:

Anik-B Program Delivery Pilot Project (CRC Report No. 1349) by I. Bischof, J.W.B. Day, R.W. Huck, W.T. Kerr, N.G. Davis.



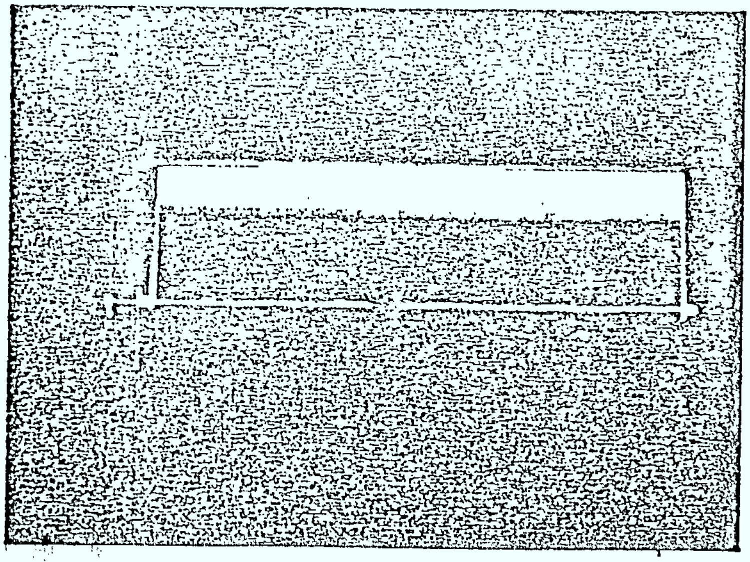
1.

Test generator black into link.
Received on 9 m dish.
H rate.
2 IRE units/div. (unweighted).



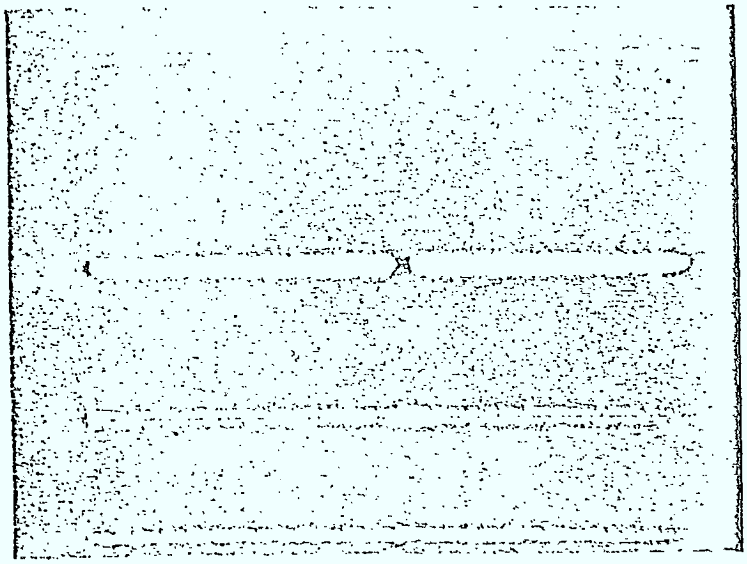
2.

Test generator black into link via scrambler.
Received on 9 m dish.
H rate.
2 IRE units/div. (unweighted).



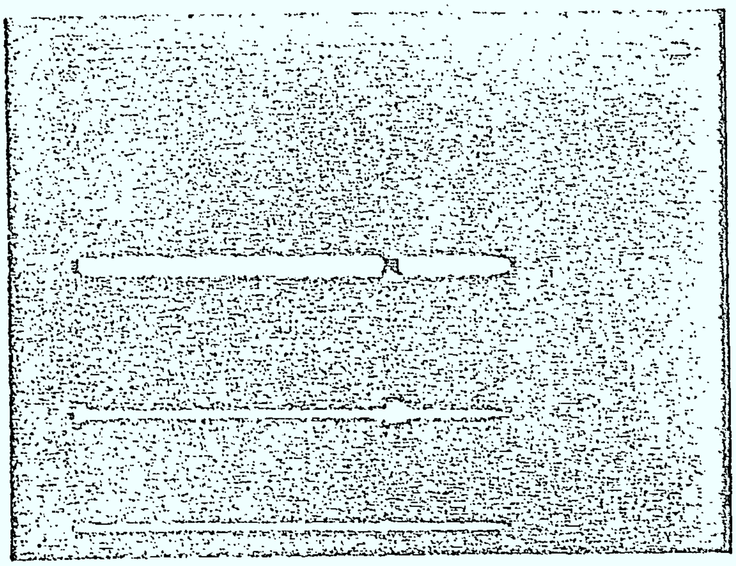
3.

Test generator black into link via scrambler.
Received on 9 m dish into descrambler.
H rate.
2 IRE units/div. (unweighted).
Note quantizing steps.



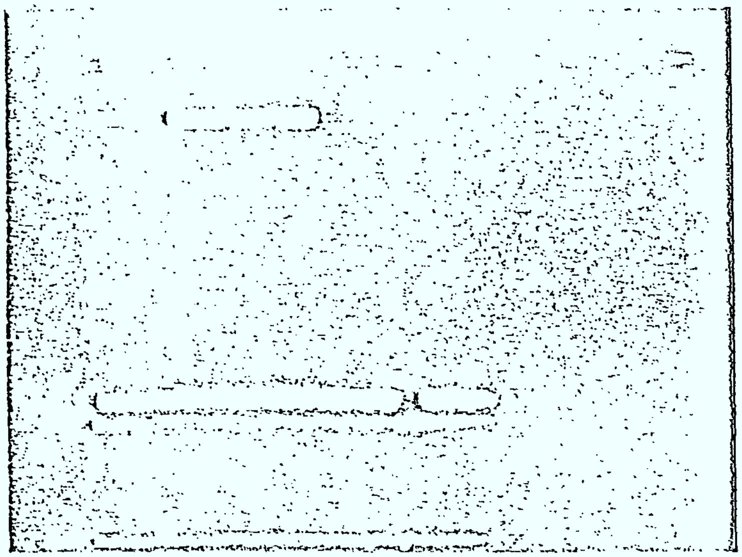
4.

Test generator gray into link.
Received on 9 m dish.
V rate.



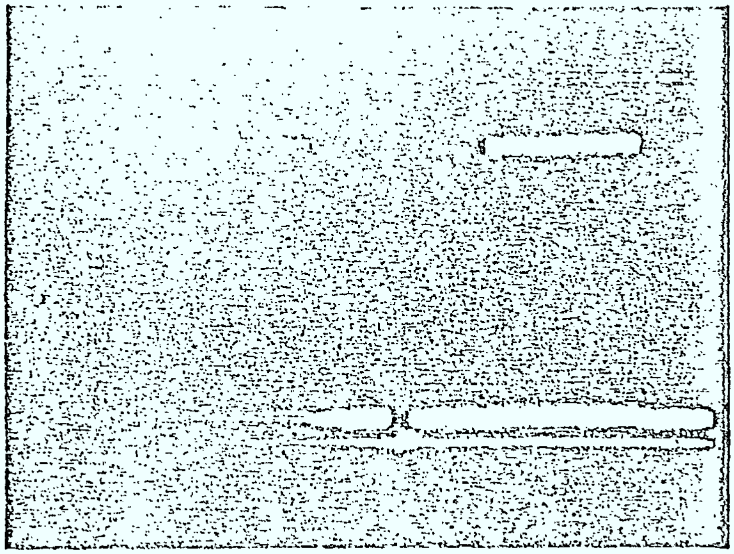
5.

Test generator gray into link via scrambler.
Received on 9 m dish into descrambler.
V rate.



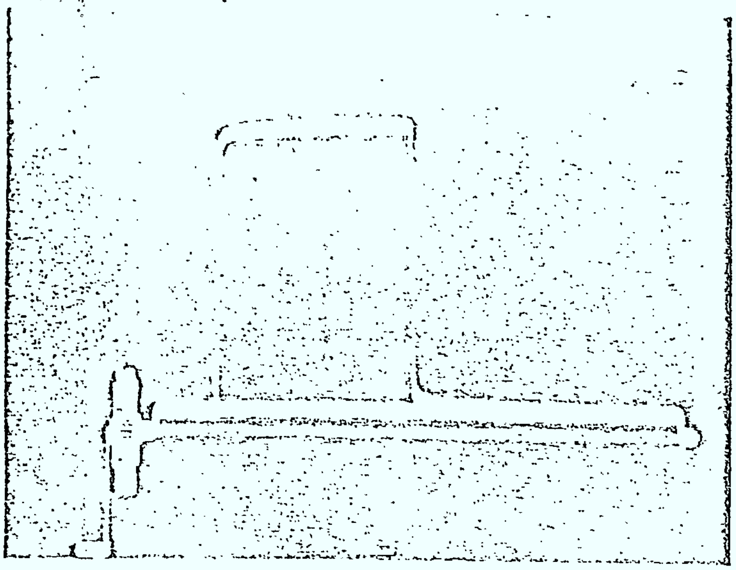
6.

Test generator window into link.
Received on 9 m dish.
V rate.



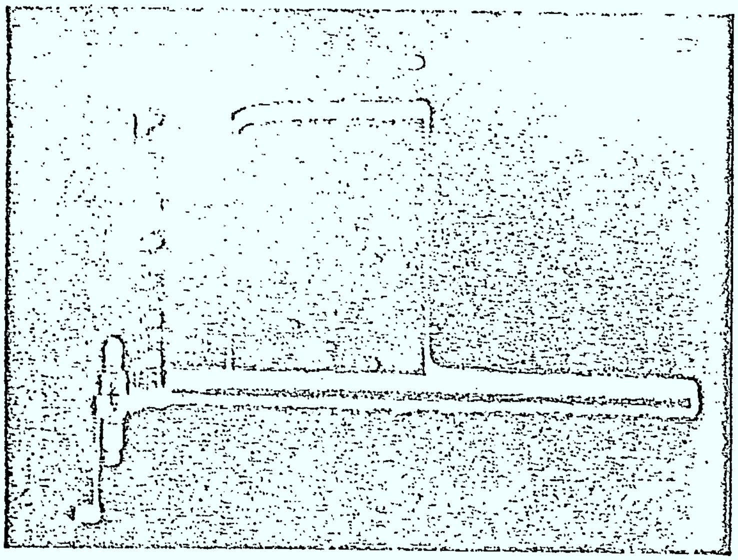
7.

Test generator window into link
via scrambler.
Received on 9 m dish into
descrambler.
V rate.



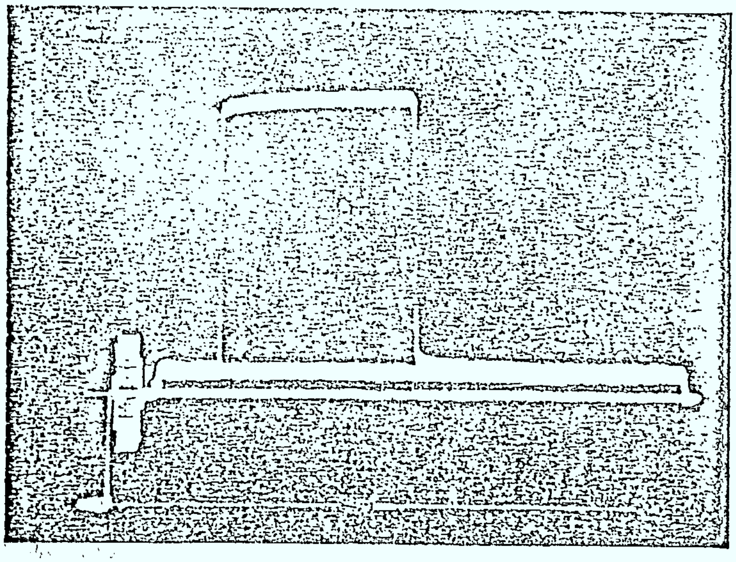
8.

Test generator window into link.
Received on 9 m dish.
H rate.



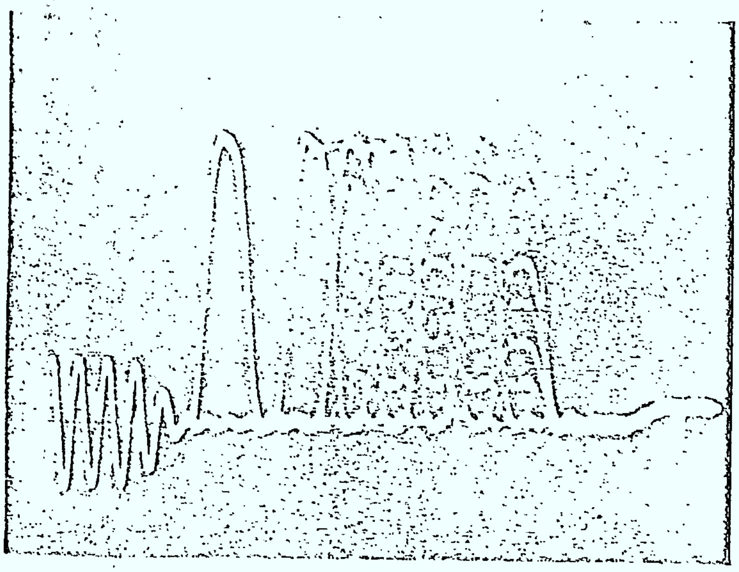
9.

Test generator window into link
via scrambler.
Received on 9 m dish.
H rate.



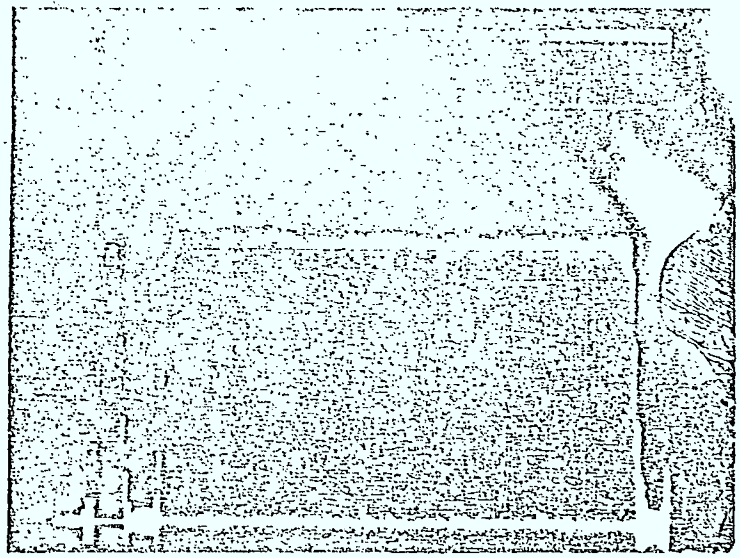
10.

Test generator window into link
via scrambler.
Received on 9 m dish into
descrambler.
H rate.



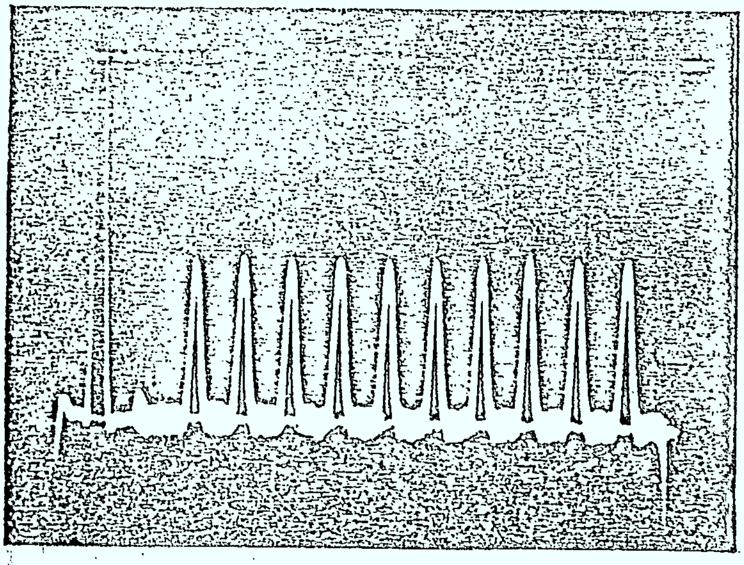
11.

Program feed into link via scrambler.
Received on 9 m dish.
H rate expanded.
Audio pulse amplitude modulation (PAM) data.



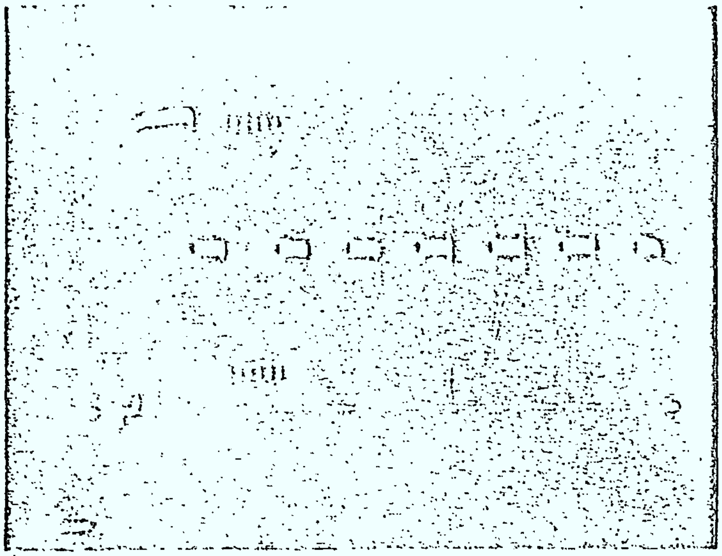
12.

Test generator modulated 10 step into link via scrambler.
Received on 9 m dish into descrambler.
H rate. 3.58 MHz bandpass filter. Differential gain setting on 1480.



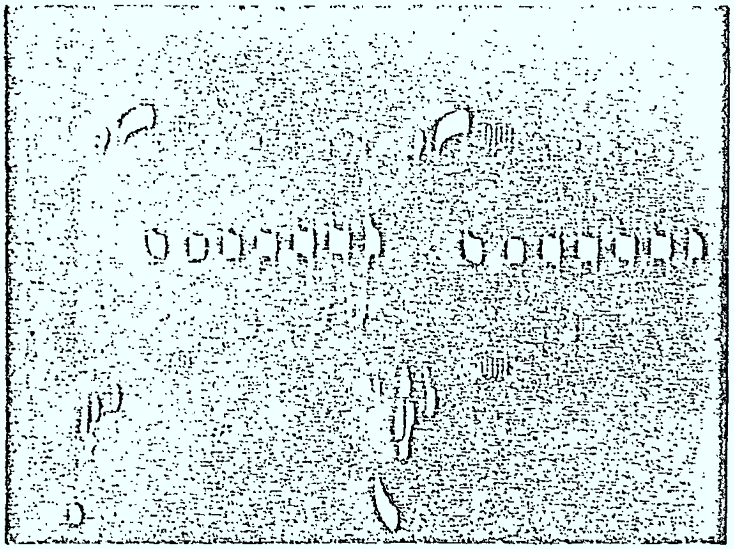
13.

Test generator 10 step into link via scrambler.
Received on 9 m dish into descrambler.
H rate.
Differential step setting on 1480.



14.

Test generator
100 IRE multiburst into link
via scrambler.
Received on 9 m dish into
descrambler.
H rate.



15.

Test generator
100 IRE multiburst into link
via scrambler.
Received on 1.8 m dish into
DBS receiver.
Note tilt on audio pulses.

APPENDIX D

TEST RESULTS OF LEITCH

DTS-2000N/DTD-2000N

SYSTEM

USING SATCOM IV

SATELLITE

APPENDIX D

a subsidiary of Leitch Video Ltd.

Digi-Tel Inc., 10 Dyas Road, Don Mills, Ontario, Canada M3B 1V5

DTS/DTD - 2000 TEST RESULTS

Satelite Test at Warner Amex
Long Island, New York   April 16, 1982

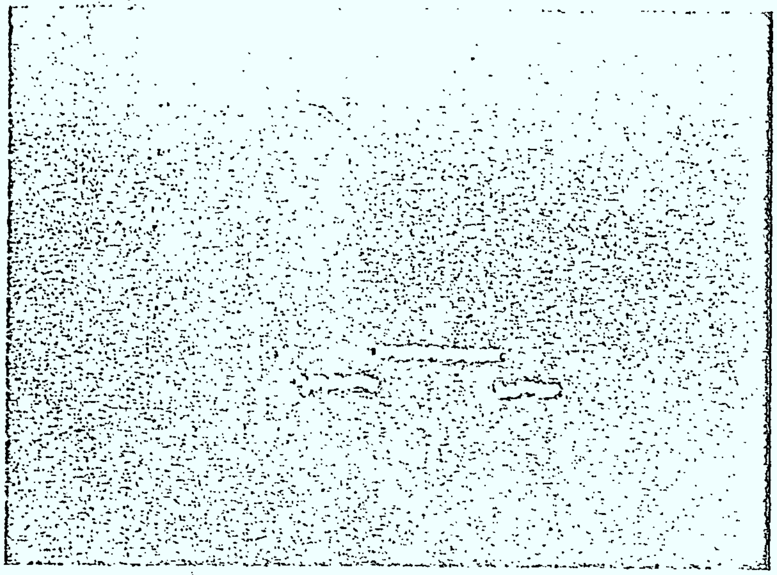
Using SATCOM IV, Transponder II

6145 MHZ	UP
3920 MHZ	DOWN

The 11m dish results in a 0.5^{o} beam width
The 7m dish results in a 0.7^{o} beam width

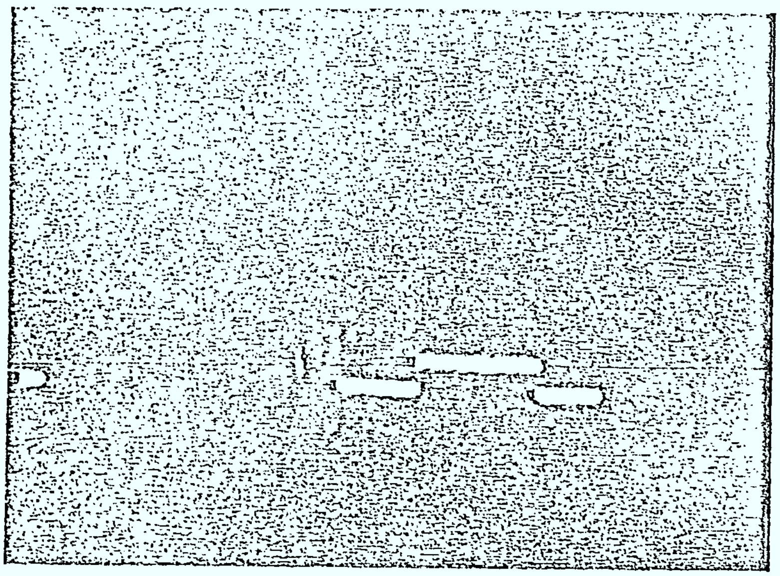
During the 7m dish tests, the receiver antenna was steered off beam until heavy pulse noise was seen and 5.75 dB c/n was measured.

Phone: (416) 445-9648   Telex: 06 986 241



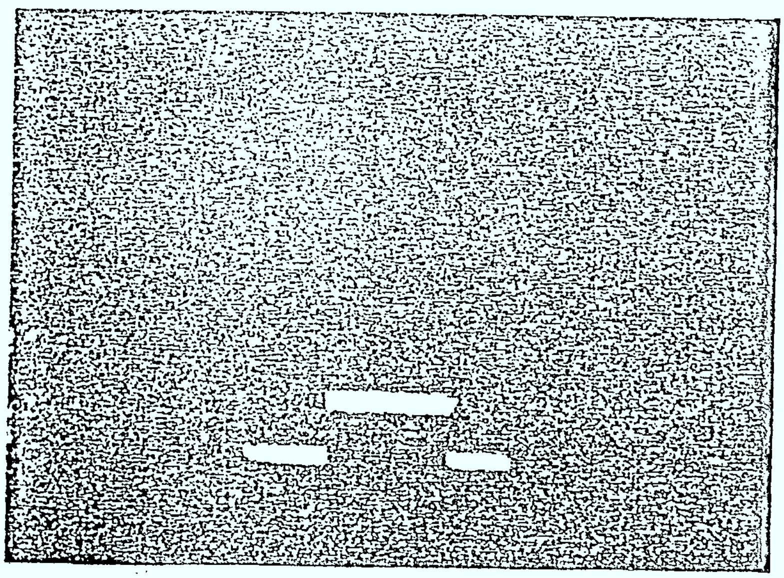
(1)

11m dish
16 dB c/n
Through Scrambler/Descrambler
.2V/div



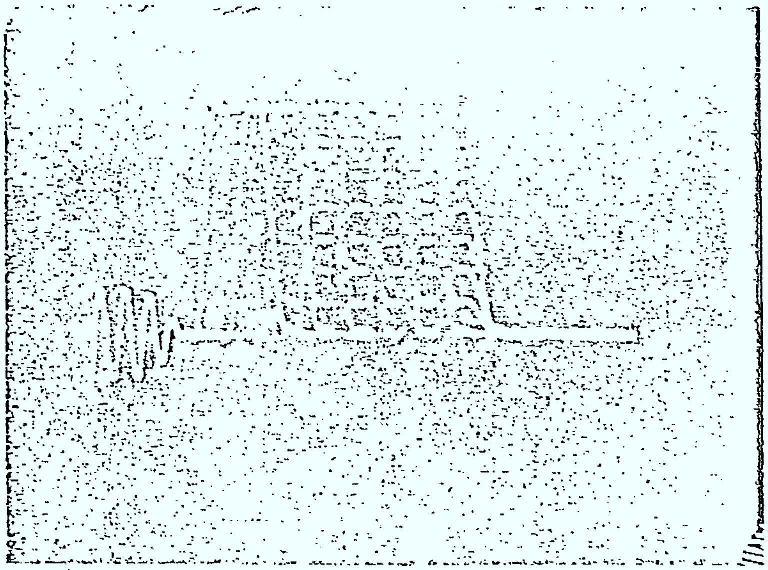
(2)

11m dish
16 dB c/n
Scrambler/Descrambler bypassed



(3)

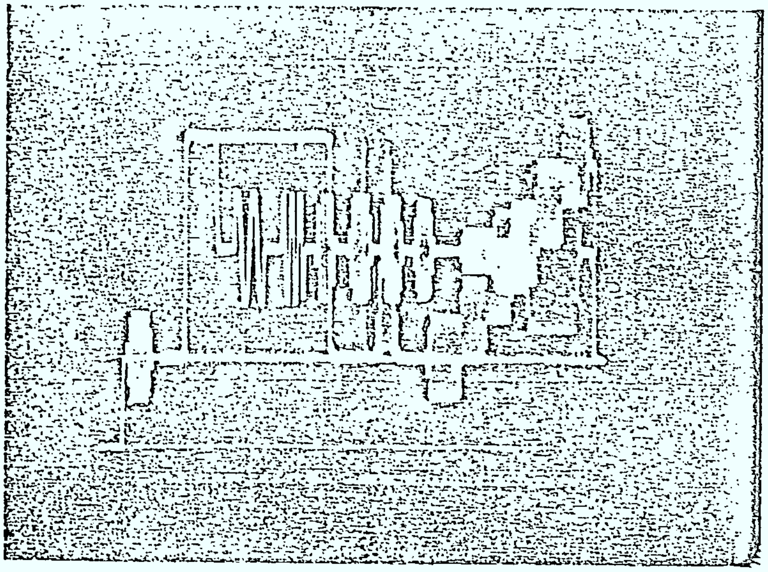
Same as (1)



(4)

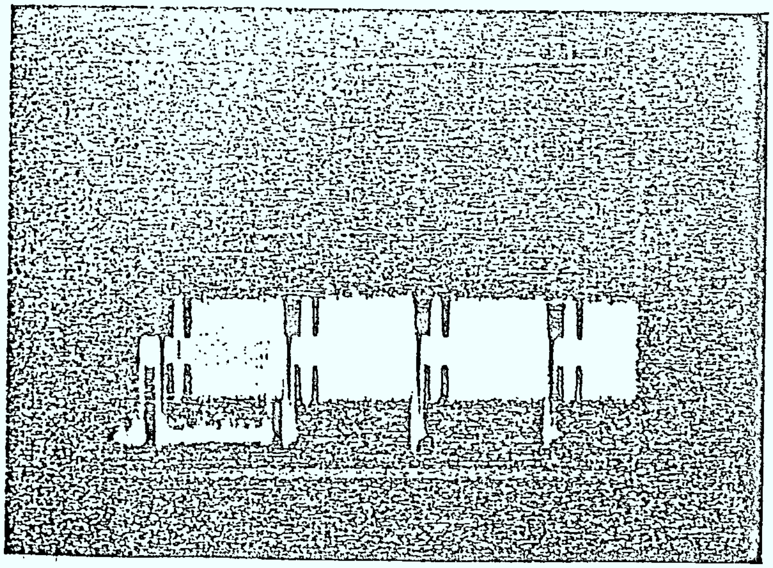
11m dish
1/2 power
Audio frm Scrambler

- On this test impulse noise just began to affect audio due to incorrect setting of audio position switches. The switches were corrected and audio passed with no degredation.



(5)

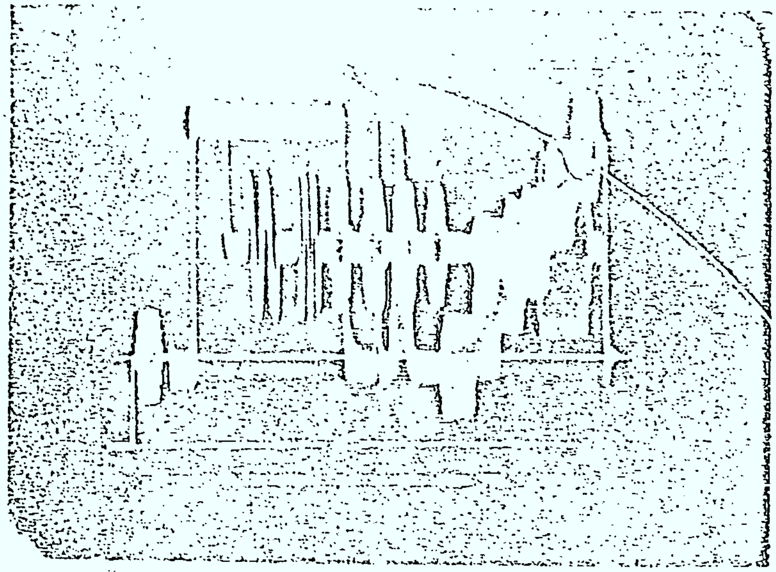
11m dish
1/2 power



(6)

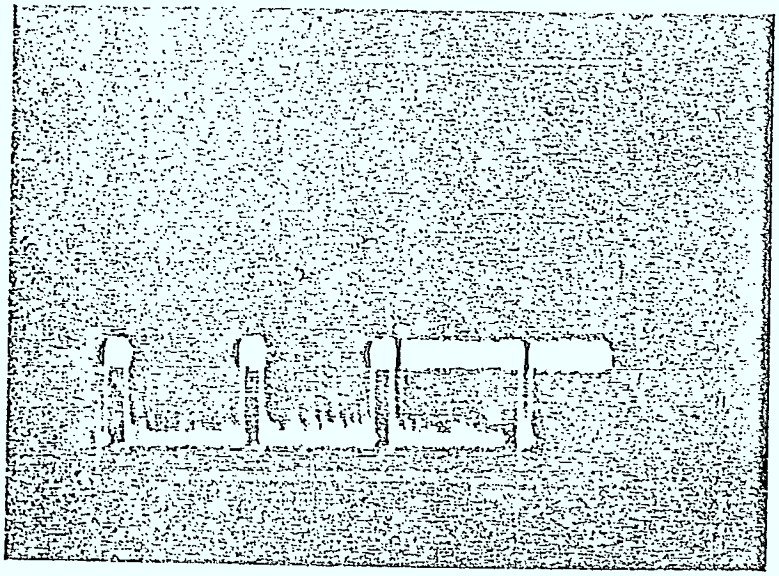
7m dish
5.75 dB c/n
Control Data from Scrambler

- Lost colour field ID
- Caused shift in H
- Vertical lost intermittently
- AGL and setup not stable



(7)

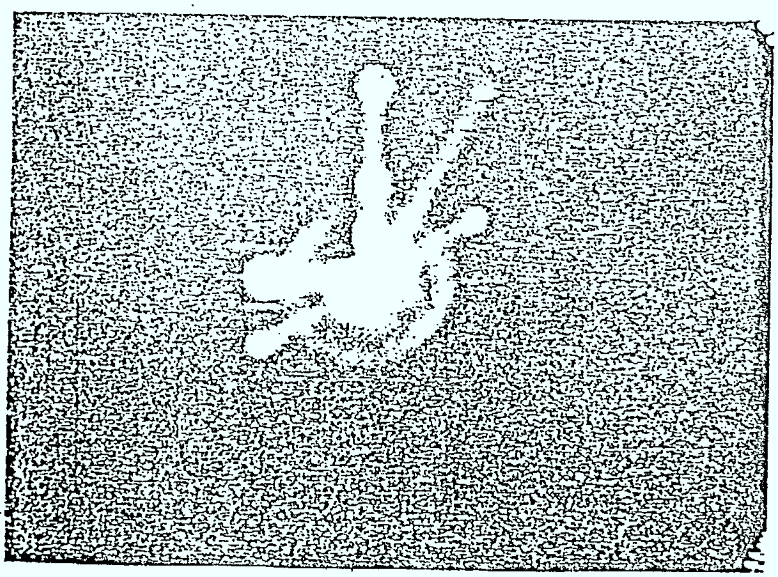
7m dish
5.75 dB c/n
Through Scrambler/Descrambler



(8)

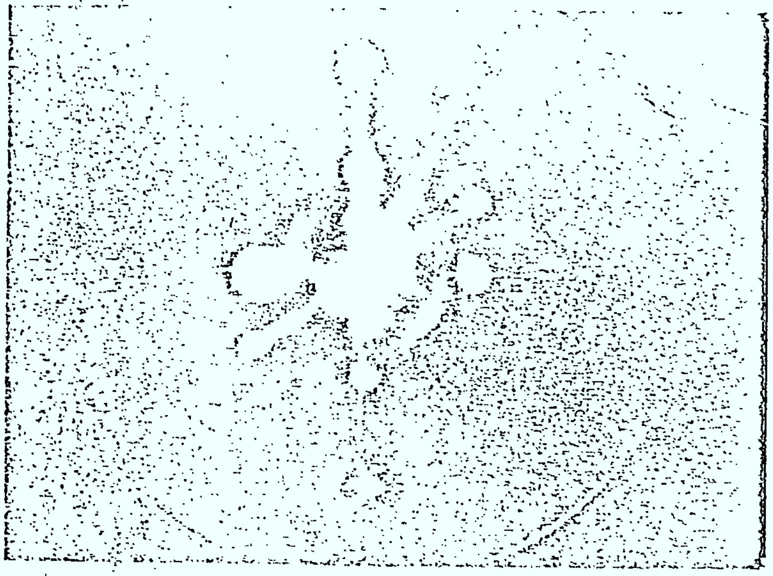
7m dish
5.75 dB c/n
Scrambler/Descrambler bypassed

- more than 50 units of spike noise with weighting curve.



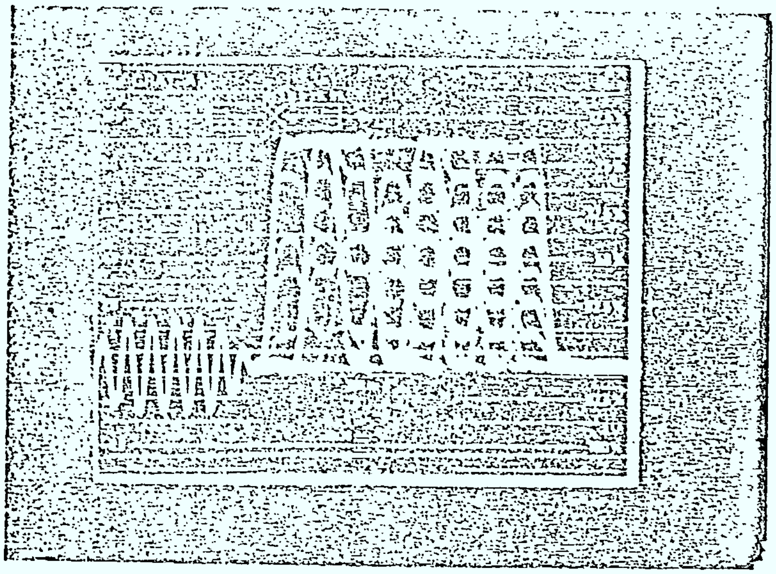
(9)

Same as (8)



(10)

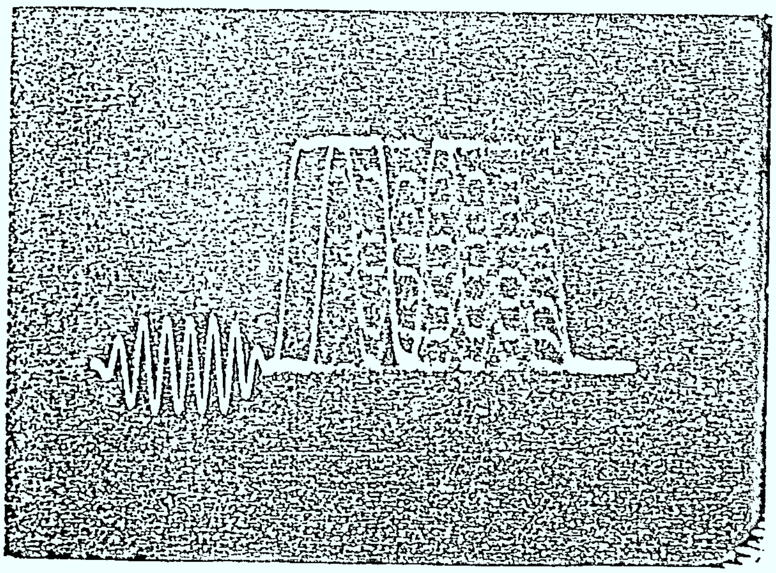
7m dish
5.75 dB c/n
Through Scrambler/Descrambler



(11)

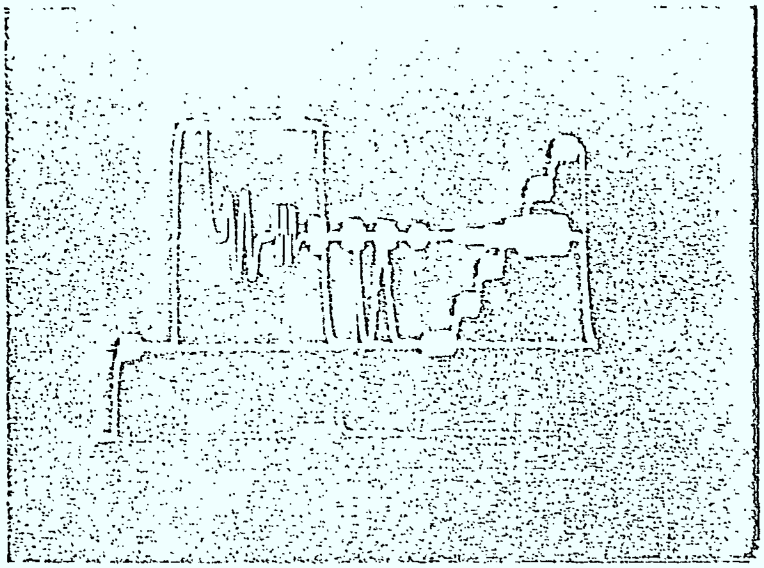
11m dish
1/3 power
41 dB s/n unweighted
50 dB s/n weighted

- audio from scrambler/descrambler just begins to fail.
- in normal subcarrier audio (230 KHZ deviation) clicking can be heard.



(12)

Same as (11)



(13)

11m dish
full power
through Scrambler/Descrambler

- To show weighting curve

APPENDIX E

ANIK C3 - 117½°W

EIRP CONTOURS

EIRP CONTOURS

The following figures illustrate the typical Anik C coverage expected for each of the 1/4 and 1/2 Canada spot beams for nominal pointing (0° tilt), for the proposed $117\frac{1}{2}^{\circ}$W oribital position.

These contours are based on calculated data and are therefore suitable for planning purposes only. Actual coverage may vary due to the actual satellite performance, channel polarization, or channel assignment.

29 October, 1982

Satellite Longitude 117.5^{o} W.
EIRP in dBW

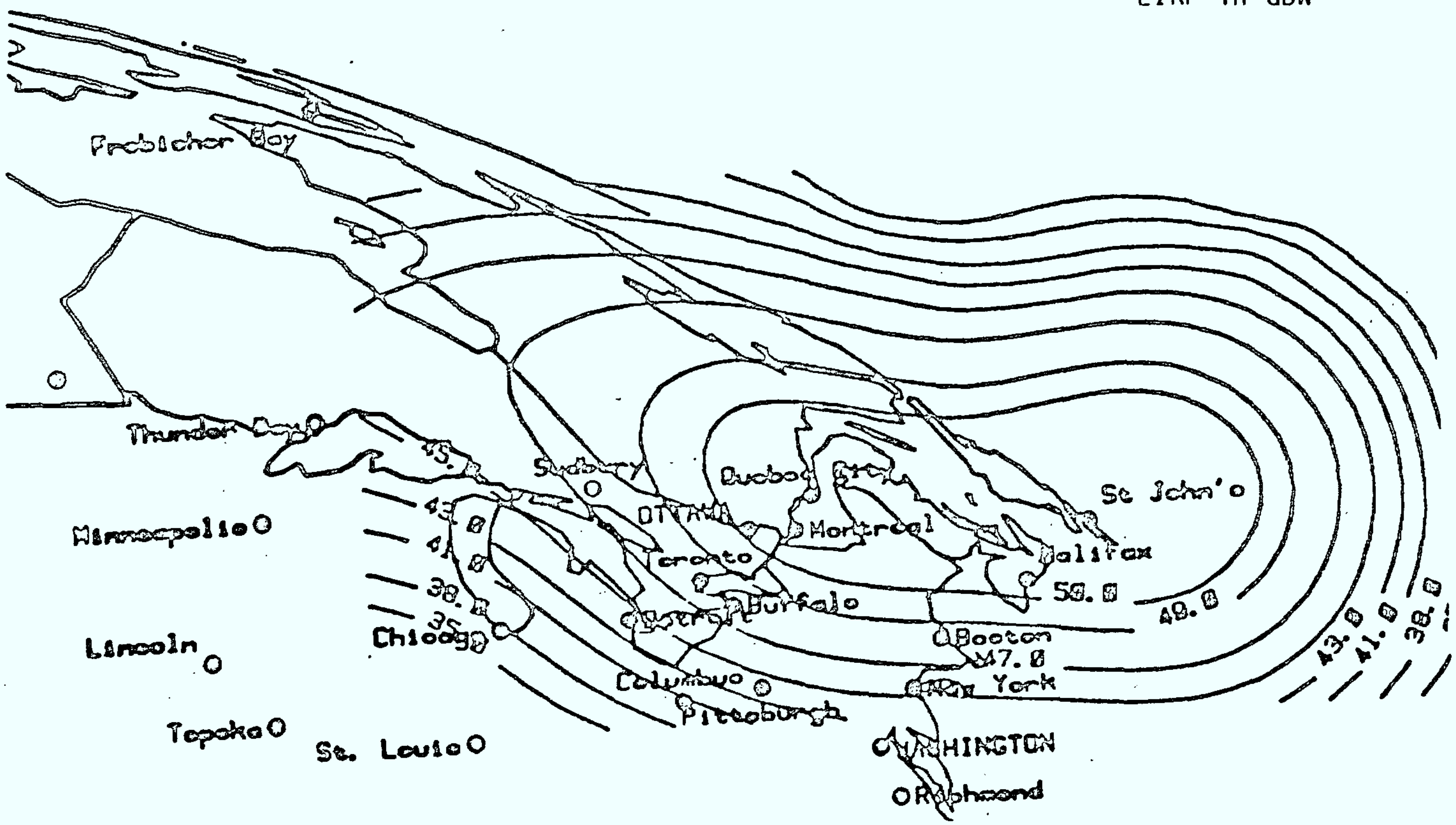


FIGURE 1

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0^{o} TILT

1/4 CANADA EAST (E) BEAM

Satellite Longitude 117.5° W.
EIRP in dBW

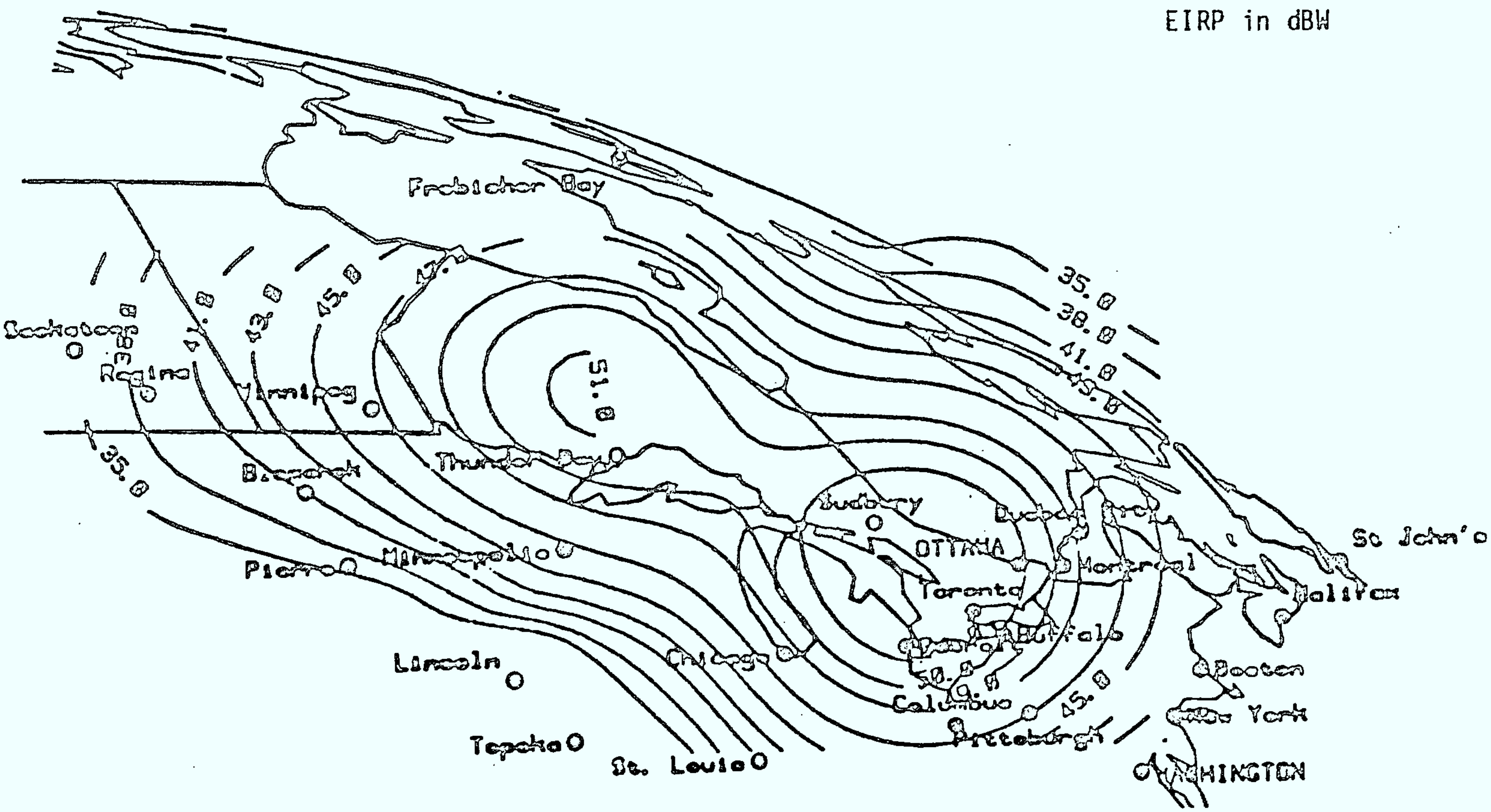


FIGURE 2

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0° TILT

1/4 CANADA EAST-CENTRAL (EC) BEAM

Satellite Longitude 117.5° W.
EIRP in dBW

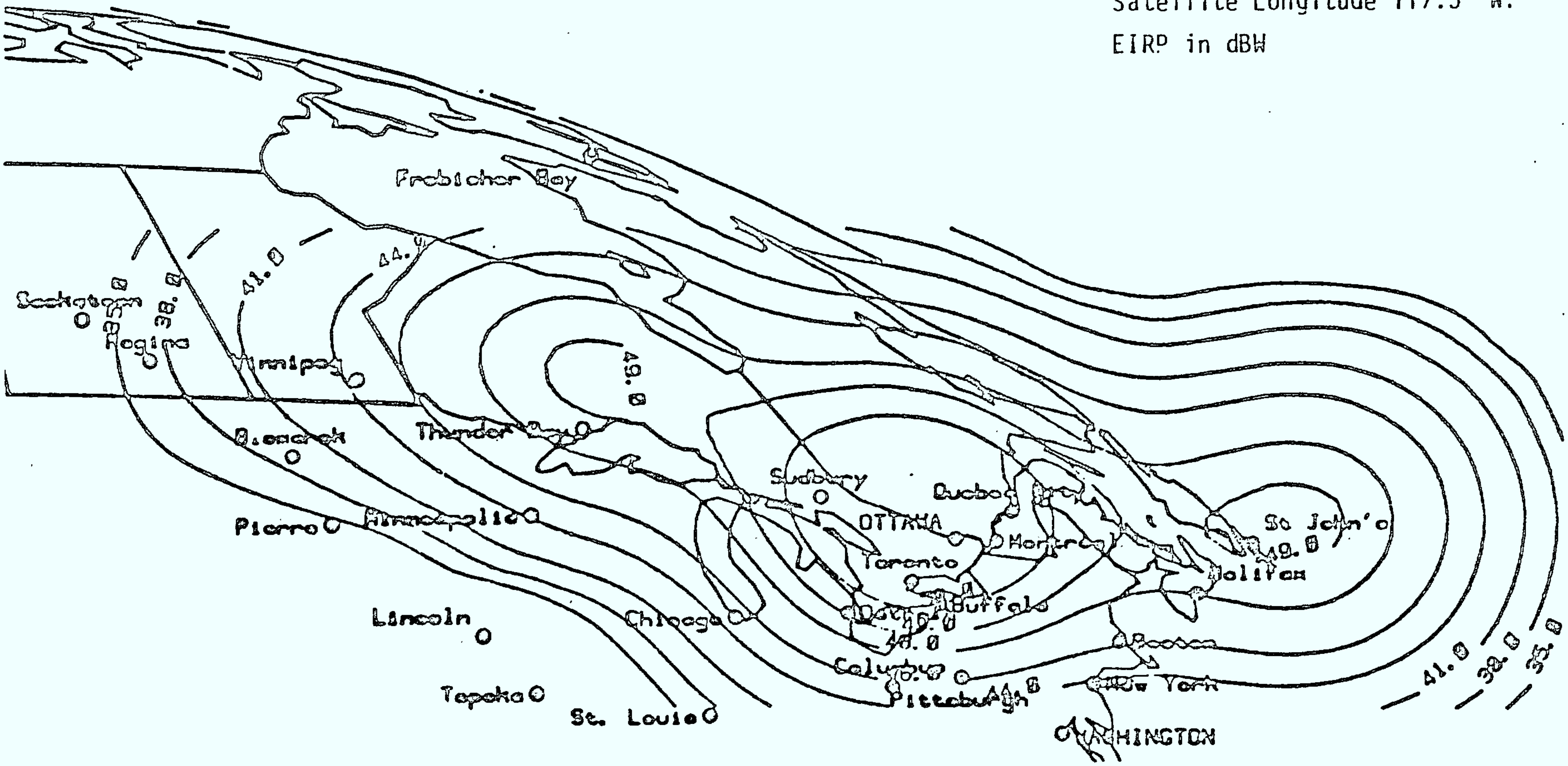
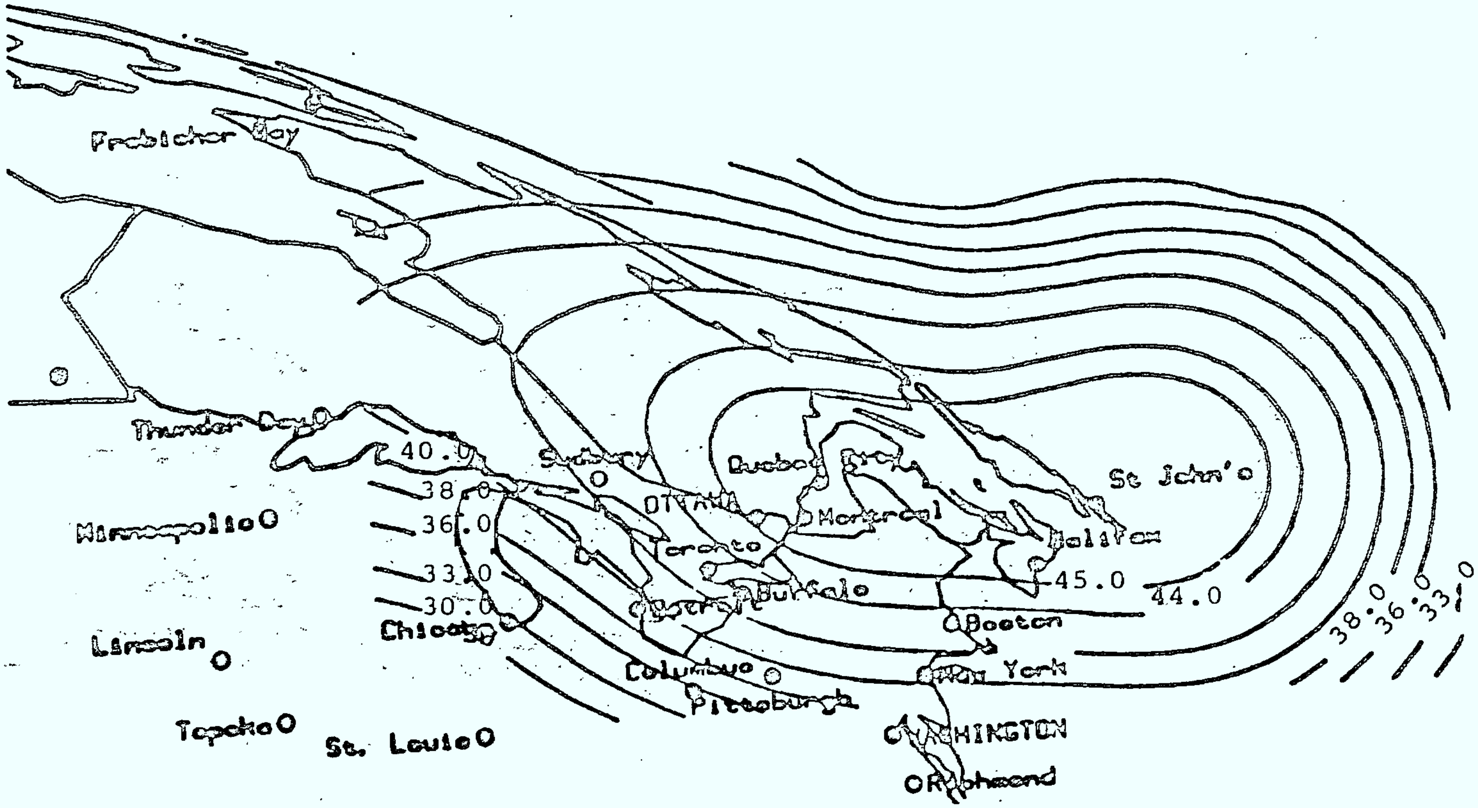


FIGURE 3

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0° TILT

1/2 CANADA COMBINED EAST/EAST-CENTRAL (E/EC) BEAM



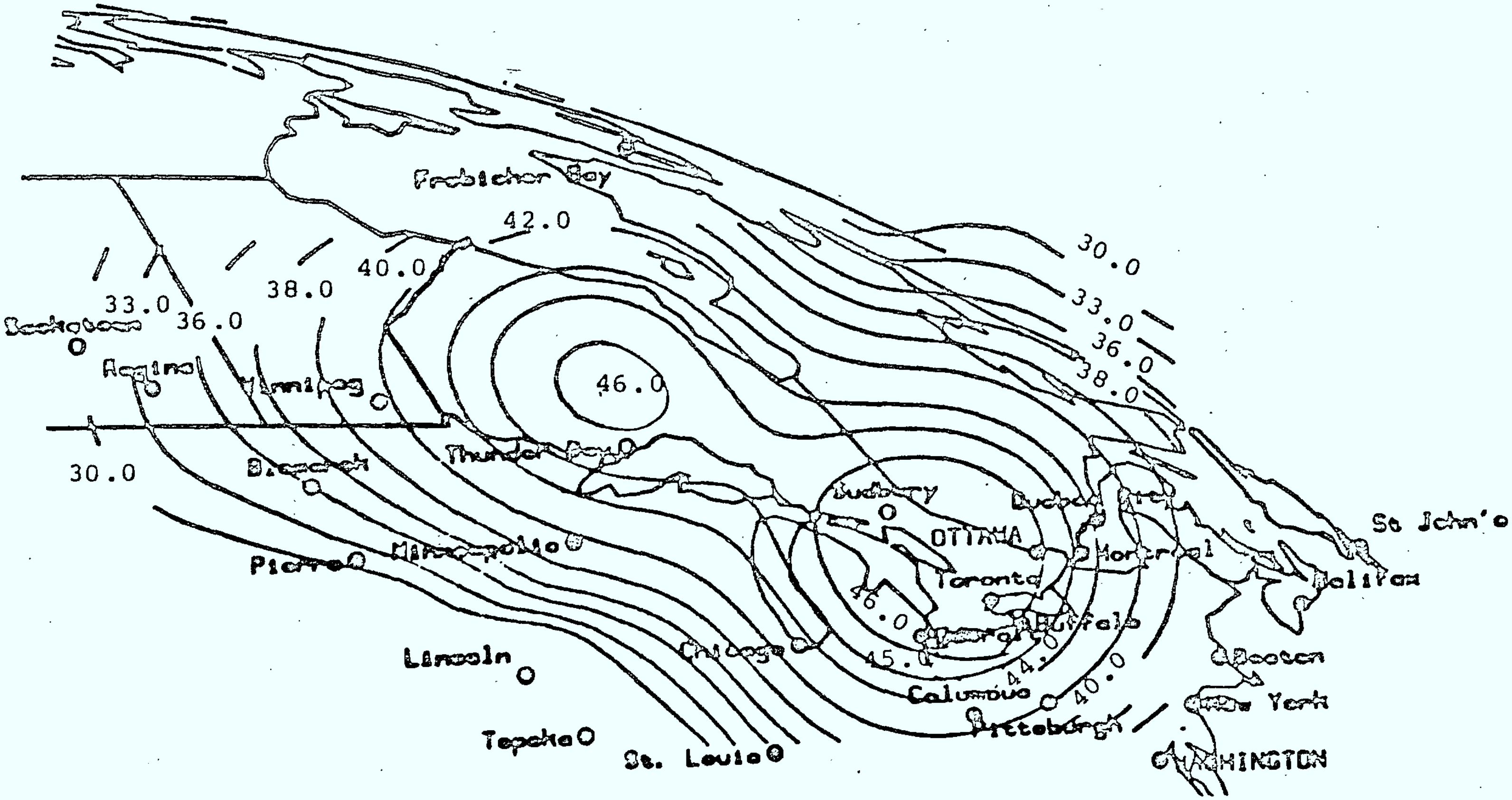
Satellite Longitude 117.5° W
EIRP in dBW.

FIGURE 7

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0° TILT

1/4 CANADA EAST (E) BEAM

The above EIRP contours are for one RF Channel (27 MHz) Video Service operating in a 5dB output power backoff mode.



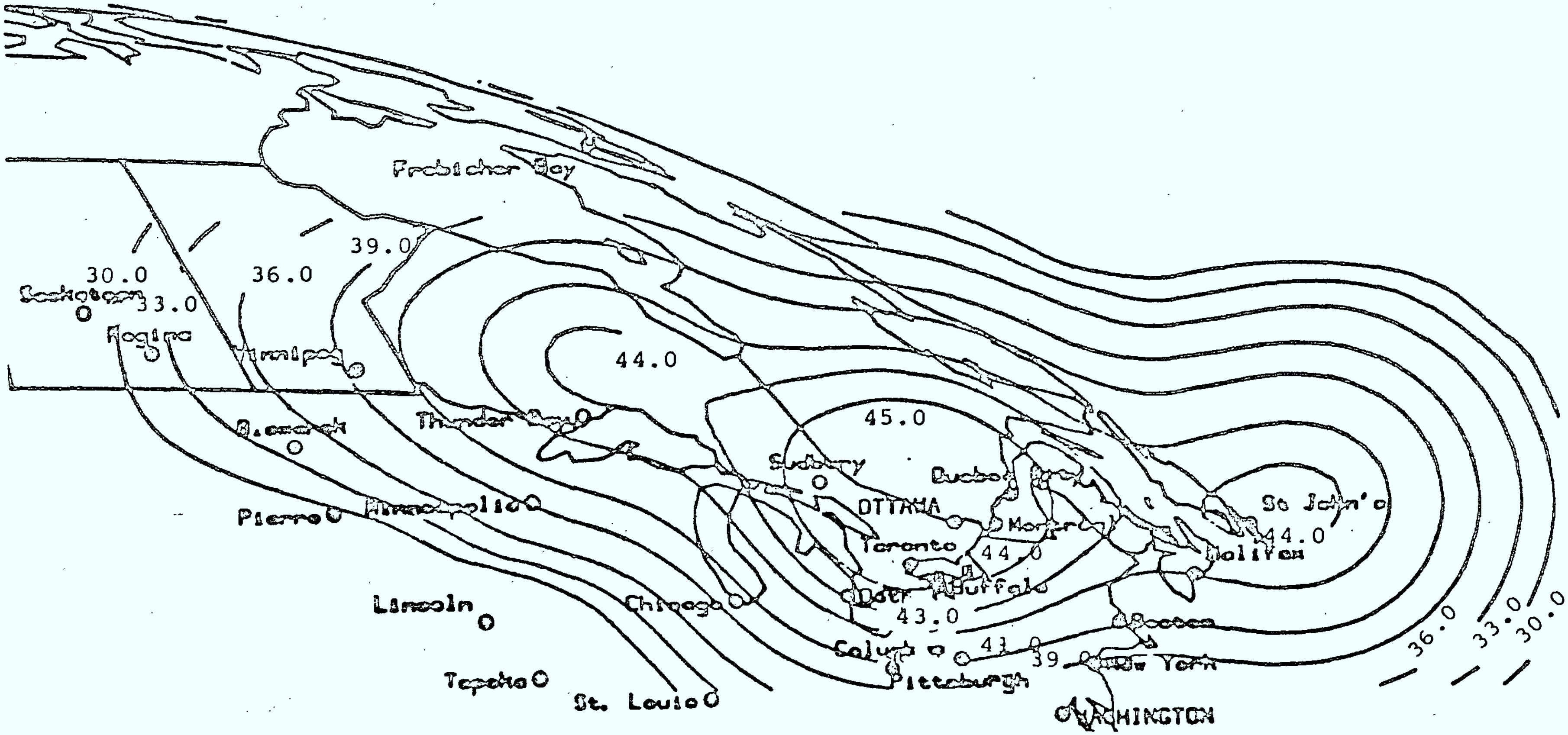
Satellite Longitude 117.5° W
EIRP in dBW.

FIGURE 8

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0° TILT

1/4 CANADA EAST-CENTRAL (EC) BEAM

The above EIRP contours are for one RF Channel (27 MHz) Video Service operating in a 5dB output power backoff mode.



Satellite Longitude 117.5° W
EIRP in dBW

FIGURE 9

TYPICAL ANIK C TRANSMIT ANTENNA PATTERN 0° TILT

1/2 CANADA COMBINED EAST/EAST-CENTRAL (E/EC) BEAM

The above EIRP contours are for one RF Channel (27 MHz) Video Service operating in a 5dB output power backoff mode.

APPENDIX F

GLOBECOM '82 PROGRAM

PLENARY SESSION

Bal Masque Room—Tuesday 8:00 a.m. - 9:00 a.m.

WIDER BANDWIDTH TRANSMISSION—SOCIAL OPPORTUNITIES AND TECHNICAL CHALLENGES

Speaker: Dr. Robert W. Lucky, *Bell Laboratories*

SESSION A1

FIBER OPTICS COMMUNICATION—SELECTED PAPERS

Organizer: J. G. Nault, *Bell-Northern Research*
Chairman: J. G. Nault
Sponsor: COMSOC—Transmission Systems

A1.1 Experimental Adaptive Digital Multiplexer For Fiber Optic Generation Using Digital Run-Length Modulation Technology
Y. Takahashi, K. Nagano, S. Yamada and Y. Tasaki, *Hitachi Ltd., Japan*
A1.2 Large Cross Section FT3 Lightwave Route
J. J. Baldini and L. E. Forman, *Bell Labs*
A1.3 A Light Powered Telephone Set for an All-Optical Distribution Network
A. Brosio, A. Moncalvo, M. Perino and P. Solina, *CSELT, Italy*
A1.4 Optical Loop Data Highway for Subway Power Control System
K. Watanabe and M. Yamasawa, *Fujitsu Ltd., Japan*
A1.5 Propagation of Pulses in a Single-Mode Optical Fibre
H. R. D. Sunak and M. G. Destro, *UNICAMP, Brazil*

SESSION A2

PACKET NETWORK COMMUNICATION PERFORMANCE

Organizer: D. Raychaudhuri, *RCA Laboratories*
Chairman: D. Raychaudhuri
Sponsor: COMSOC—Data Communication Systems

A2.1 Theoretical Analysis on Slotted ALOHA, CSMA, and CSMA-CD Protocols
Y. C. Jenq, *Bell Labs*
A2.2 Diversity ALOHA—A Random Access Scheme for Satellite Communications
G. L. Choudhury and S. S. Rappaport, *SUNY, Stonybrook*
A2.3 Stability and Performance of a Packet Reservation System for Satellite Broadcast Channels
S. Tasaka and Y. Ishibashi, *Nagoya Institute of Technology, Japan*
A2.4 Synchronous and Carrier-Sense Asynchronous Dynamic Group-Random-Access Schemes for Multiple-Access Communications
I. Rubin, *UCLA*
A2.5 Effect of Window Mechanism on a Delay System Model of Packet Network
I. Akiyoski, *Kobe University,* H. Nakanishi, H. Sanada and Y. Tezuka, *Osaka University, Japan*
A2.6 A Multibeam Packet Satellite Using Random Access Techniques
J.-F. Chang, *National Taiwan University, Taiwan*

Tuesday A.M.

SESSION A3

INTERFERENCE, FADING AND DIGITAL TECHNIQUES FOR MOBILE RADIO

Organizer: J. Huang, *Farinon Electric*
Chairman: R. Singh, *Kansas State University*
Sponsor: COMSOC—Radio Communication

A3.1 A Hybrid Multi-Channel Hardware Simulator for Frequency-Selective Mobile Radio Paths
H. W. Arnold and W. F. Bodtmann, *Bell Laboratories*
A3.2 2400 BPS Digital Speech for Land Mobile Radio
M. McLaughlin, *Motorola, Inc.*
A3.3 Outage Probability in Mobile Telephony Due to Multiple Log-Normal Interferers
Y. S. Yeh, *Bell Labs* and S. C. Schwartz, *Princeton University*
A3.4 Adjacent Cell Interference in FH-MFSK Cellular Mobile Radio System
R. Viswanathan and S. C. Gupta, *Southern Methodist University*
A3.5 Downstream Power Control for a Spread Spectrum Cellular Mobile Radio System
H. Alavi and R. W. Nettleton, *Michigan State University*
A3.6 Power and Bandwidth Efficient Modulation Techniques
T. Le-Ngoc, *SR Telecom Inc.* and K. Feher, *University of Ottawa, Canada*
A3.7 Diversity Improvement in Frequency Hopping Multilevel FSK Systems Under the Influence of Rayleigh Fading and Log-Normal Shadowing
R. Muammar and S. C. Gupta, *Southern Methodist University*

SESSION A4

TELEMATIQUE ARCHITECTURE AND PROTOCOLS DESIGN CONSIDERATIONS

Organizer: H. Zimmerman, *CNET*
Chairman: A. Pugh, *British Telecom*
Sponsor: COMSOC—Computer Communication

A4.1 A Global Approach of Telematic Services Architecture and Protocols
B. Marti, *CCETT, France*
A4.2 Use of the Teletex Protocols in Message Systems
R. J. Gillman and D. Steedman, *Bell-Northern Research, Ltd., Canada*
A4.3 Teletex-Protocols: A Suitable Basis for General Purpose Session Protocols for Telematic Services and for OSI
K. Nemeth, *SIEMENS AG, Federal Republic of Germany*
A4.4 Broadcast and Interactive Videotex
G. Harper, *Com/Tech Communication Technologies Inc.*
A4.5 An ISO OSI Layered Architecture for the Canadian Broadcast Telidon System
M. Sablatash, *Communications Research Centre* and R. FitzGerald, *Norpak Ltd., Canada*

SESSION A5

SATELLITE MODULATION AND PROCESSING TECHNIQUES

Organizer: K. Feher, *University of Ottawa*
Chairman: P. J. McLane, *Queen's University*
Sponsor: COMSOC—Satellite and Space Communication

A5.1 Performance Evaluation of Differential Detection of MSK
S. Crozier, B. Mazur and R. Matyas, *Miller Communications Systems Ltd., Canada*

A5.2 A New Baseband Equalizer for More Efficient Utilization of Earth Station Amplifiers Used for QPSK Transmission
H. Girard, *Spar Aerospace Ltd.*, and K. Feher, *University of Ottawa, Canada*

A5.3 TSI-OQPSK for Multi-Carrier Satellite Systems
H. P. Van, *Spar Aerospace Ltd.*, and K. Feher, *University of Ottawa, Canada*

A5.4 Companded Single Sideband Satellite Transmission
R. J. Brown, M. L. Guha, R. A. Hedinger, and M. L. Hoover, *Bell Labs*

A5.5 Effect of Echo Canceler on International Signal and Maintenance Systems
G. S. Fang, *AT&T International*

A5.6 Demodulation of PPM for Reed-Solomon Coded Optical Space Channel
D. Divsalar, *California Institute of Technology*
R. M. Gagliardi, *University of Southern California* and
J. H. Yuen, *California Institute of Technology*

SESSION A6

MODERN TECHNIQUES FOR COMPUTER/ COMMUNICATIONS SECURITY

Organizer B. E. McNair, *Bell Laboratories*
Chairman: B. E. McNair
Sponsor: COMSOC - Signal Processing and Communication Electronics

A6.1 Overview of Communications Security and Vulnerabilities
J. M. Nye, *Marketing Consultants International, Inc.*

A6.2 An Analog Scrambler for Speech Based on Sequential Permutations in Time and Frequency
R. V. Cox, N. S. Jayant and B. J. McDermott, *Bell Labs*

A6.3 A Single-Chip VLSI Implementation of the Discrete Exponential Public Key Distribution System
K. Yiu and K. Peterson, *Hewlett-Packard Laboratories*

A6.4 A Highly Secure Cryptographic Algorithm for High Speed Transmission
Y. G. Desmedt, J. Vandewalle and R. J. M. Govaerts, *Katholieke University, Belgium*

A6.5 A Robust 4800 bps Full-Band Speech Coder
M. Copperi, *CSELT, Italy*

SESSION A7

NONLINEAR CHANNEL AND SYSTEMS MODELLING AND PERFORMANCE

Organizer: V. K. Jain, *University of Southern Florida*
Chairman: V. K. Jain
Sponsor: COMSOC--Communication Theory

A7.1 Performance of Staggered Quadrature Modulations Over Nonlinear Satellite Channels With Uplink Noise and Intersymbol Interference
M. K. Simon, *Jet Propulsion Laboratory*, J. K. Omura, *UCLA* and D. Divsalar, *Jet Propulsion Laboratory*

A7.2 Analysis of AGC Nonlinear Effects Using Volterra Models
D. Harel, *RCA American Communications* and D. Weiner, Syracuse University

A7.3 On the Theory of Volterra Expansions
I. W. Sandberg, *Bell Labs*

A7.4 Volterra Transfer Functions From Pulse Tests for Mildly Nonlinear Channels
V. K. Jain, *University of Southern Florida*, A. M. Bush, *Georgia Institute of Technology* and D. J. Kenneally, *Rome Air Development Center*

A7.5 Characterization and Compensation of Nonlinearities in Microwave Transmitters
D. R. Green, Jr., *Bell Labs*

Tuesday A.M.

A7.6 A New Method for Determining AM/AM and AM/PM Conversion In Microwave Radio Devices
J. P. Moffatt, *Bell Labs*

A7.7 The Effect of Soft Limiters on Lth Phase Tracking Systems
I. Sasase and S. Mori, *Keio University, Japan*

SESSION A8

LOW-BIT-RATE SPEECH CODING FOR TELECOMMUNICATION NETWORKS

Organizer: K. Okimi, *NTT*, and A. Sawai, *NEC*
Chairman: M. R. Aaron, *Bell Laboratories*
Sponsors: COMSOC Transmission Systems and Signal Processing and Communication Electronics

A8.1 Network Applications of New Speech Encoding Technologies
M. Yoshikawa, M. Taka, I. Tokizawa and T. Aoyama, *NTT, Japan*

A8.2 Network Performance Issues in 32 kb/s Coding of Speech and Voiceband Data
P. Mermelstein and G. Williams, *BNR, Canada*

A8.3 32 Kbps ADPCM-DLQ Coding for Network Applications
D. W. Petr, *Bell Labs*

A8.4 Per-Channel ADPCM Codec for Multi-Purpose Applications
R. Maruta, S. Aikoh, T. Nishitani and N. Kawayachi, *NEC, Japan*

A8.5 A 60-Channel PCM-ADPCM Converter Robust to Channel Errors
D. Cointot and G. de Passoz, *S.A.T., France*

Tuesday P.M.

SESSION B1

FIBER OPTICS TRANSMISSION SYSTEMS— OPERATIONAL AND MAINTENANCE ASPECTS

Organizer: G. W. Goddard, *Bell-Northern Research*
Chairman: R. W. DeWitt, *Continental Telephone Service Corp.*
Sponsor: COMSOC—Transmission Systems

B1.1 Cost-Benefit Analysis of Fiber Optic Maintenance
D. Griffith, *Pacific Northwest Bell*

B1.2 Discussion of Maintenance Experience on Optical and Copper Cable Systems
S. M. Sorensen, *USDA Rural Electrification Administration*

B1.3 Reliability and Restoration of Fiber Optic Cables
O. Szentesi, *Siecor Optical Cable*

B1.4 Design for Rapid Lightguide Restoration
N. E. Hardwick, III, C. F. Cottingham, P. D. Patel and A. L. Hale, *Bell Labs*

B1.5 Design and Performance of Filled Fiber Optic Cables
P. R. Bark and D. O. Lawrence, *Siecor/Optical Cable*

B1.6 Dynamic Air Pressure Systems Enhance Fiber Cable Performance and Maintenance
J. D. Pue-Gilchrist, *Bell-Northern Research, Canada*

SESSION B2

PERFORMANCE ANALYSIS OF INTEGRATED COMMUNICATION NETWORKS

Organizer: J. Silvester, *University of Southern California*
Chairman: J. Silvester
Sponsor: COMSOC—Computer Communication

B2.1 Traffic Analysis Tools for Integrated Digital Time Division Synchronous and Asynchronous Link Multiplexing
E. Arthurs and B. W. Stuck, *Bell Labs*

B2.2 Discrete-Time Analysis of Voice Data Multiplexers With and Without Speech Activity Detectors
K. Sriram, P. K. Varshney, *Syracuse University* and J. G. Shanthikumar, *University of Arizona*

B2.3 Express Pipe Networks
R. A. Pazos Rangel and M. Gerla, *UCLA*

B2.4 Performance Analysis of a Multiple Access Channel With Heterogeneous Traffic and Capture
N. Shacham, *SRI International*

B2.5 A Distributed Local Area Network Packet Protocol for Combined Voice and Data Transmission
J. O. Limb and L. E. Flamm, *Bell Labs*

SESSION B3

SPECTRUM-EFFICIENT RADIO STYSTEMS: BASIC METHODS, TECHNIQUES AND PERFORMANCE

Organizer: L. E. Zegers, *Philips Research Labs*
Chairman: L. E. Zegers
Sponsor: COMSOC--Radio Communication

B3.1 On Frequency Assignment in Mobile Automatic Telephone Systems
A. Gamst and W. Rave, *Philips Research Labs, Federal Republic of Germany*

B3.2 Combined Source and Channel Coding for Matching the Speech Transmission Rate to the Quality of the Channel
D. J. Goodman and C.-E. Sundberg, *Bell Labs*

B3.3 64-QASK Sensitivity to Modem Imperfections and to Interferences
J.-C. Bic, D. Duponteil and J.-C. Imbeaux, *CNET, France*

B3.4 GMSK Transmission Performance in Land Mobile Radio
K. Hirade, K. Murota and M. Hata, *YECL, NTT, Japan*

B3.5 A Noncoherent Receiver for GTFM Signals
K. S. Chung, *Philips Research Labs, The Netherlands*

B3.6 Noncoherent Detection of Controlled-Phase-Modulated Signals
J. S. Bourgenot and H. Ganem, *Thomson-CSF DTC, France*

B3.7 Performance Evaluation of Generalized MSK
P. Galko and S. Pasupathy, *University of Toronto, Canada*

B3.8 Practical Considerations for Speech Digitizing Systems at Rates From 64.0 to 0.6 KBPS
H. M. Heggestad, R. J. McAuley and J. Tierney, *MIT Lincoln Laboratory*

SESSION B4

DISTRIBUTED PROCESSING SYSTEMS

Organizer: H. T. Mouftah, *Queen's University*
Chairman: H. T. Mouftah
Sponsor: COMSOC—Communication Systems Disciplines

B4.1 Intelligent Network Processors
G. S. Deshpande, *ESE Ltd.*, and J. Fairweather, *Codex Corp., Canada*

B4.2 Performance Evaluation of Local Access Systems in Computer Networks
S. Bhatia, *BNR* and H. T. Mouftah, *Queen's University, Canada*

B4.3 End-to-End Flow Control with a New Hybrid Switching in Computer Networks
M. Ilyas and H. T. Mouftah, *Queen's University, Canada*

B4.4 Design Algorithms for Buffer Allocation Strategies in a Computer Network Node
T. P. Yum, *Chinese University of Hong Kong* and C. Dou, *National Taiwan University, Taiwan*

B4.5 Congestion Control in a Distributed Computer Network
E. W. Soueid, *Wayne State University* and J. J. Metzner *Oakland University*

SESSION B5

PROGRESS OF LSI/VLSI COMMUNICATION SYSTEMS

Organizers: N. Kuroyanagi, *MECL, NTT* and M. Kawashima, *Fujitsu Labs*
Chairmen: H. Ho, *Bell Labs* and Y. Mochida, *Fujitsu Labs*
Sponsors: COMSOC—Signal Processing and Communication Electronics

B5.1 Use of LSI Technology in Synchronous Digital Terminals
K. Aihara, *YECL, NTT* and H. Nakahama, *Engineering Bureau, NTT, Japan*

B5.2 The VLSI Chip of the Time Compression Multiplexer for the Circuit Switched Digital Capability
C. H. Hao and S. V. Kartalopoulos, *Bell Labs*

B5.3 Subscriber Line Circuits Using LSI Technology for Digital Local Switching System
T. Kimura and F. Mano, *MECL, NTT, Japan*

B5.4 A Single Chip Digital Signal Processor
M. Cand, P. LeScan and A. Roset, *CNET, France*

B5.5 32Mb/s Integrated Dual-In-Line Packaged Fiber Optic Transmitter and Receiver Modules
I. Ikushima, K. Nagano, Y. Minai and S. Yamada, *Hitachi Ltd., Japan*

B5.6 Hardware Design Concepts of LSI Optical Data Link
Y. Mochida, T. Tsuda, K. Yamaguchi, T. Chujo, *Fujitsu Labs*, and H. Iwamoto, *Fujitsu Ltd., Japan*

SESSION B6

IMAGE PROCESSING IN COMMUNICATIONS

Organizers: V. K. Jain, *University of Southern Florida* and T. L. Lim, *Bell Laboratories*
Chairmen: V. K. Jain and T. L. Lim
Sponsors: COMSOC--Data Communication Systems and Signal Processing and Communication Electronics

B6.1 Digital Broadcast TV at 45 Mb/s
R. Brainard and A. Netravali, *Bell Labs*

B6.2 Predictive Coding of the Component Color TV Signal
C. E. Li, *Rockwell International* and K. R. Rao, *University of Texas*

B6.3 Transmission of Two NTSC Color Television Signals Over a Single Satellite Transponder Via Time-Frequency Multiplexing
R. L. Schmidt and B. G. Haskell, *Bell Labs*

B6.4 Displacement Estimation by Prediction Coefficient Energy Concentration
C. D. Bowling and R. A. Jones, *University of Arkansas*

B6.5 Image Processing Based on Runlength Coding and Its Application to an Intelligent Facsimile
T. Tsuiki, T. Aoki and S. Kino, *Mitsubishi Electric Corp., Japan*

B6.6 Trends in Computer Vision
A. Rosenfeld, *University of Maryland*

B6.7 Information Preserving Coding for Broadcast Television Signals
N. Suzuki, K. Iinuma and T. Ishiguro, *NEC, Japan*

SESSION B7

TOPICS IN COMMUNICATION THEORY

Organizer: D. Kazakos, *University of Virginia*
Chairman: R. Pickholtz, *George Washington University*
Sponsor: COMSOC—Communication Theory

B7.1 FSK Signals for Minimum Spectral Occupancy: A Solution in Sampled Form
M. Campanella, U. Lo Faso and G. Mamola, *Universita di Palermo, Italy*

B7.2 Spectral Properties of M-ARY Variable Index PFM: Full Response Signaling
K. M. S. Murthy and K. W. Cattermole, *University of Essex, U. K.*

B7.3 A Comparison Between Performance of Normal and Staggered Systems Over Frequency Selective Microwave LOS Channels
K. Pahlavan, *Northeastern University* and P. A. Bello, *Milcom, Inc.*

B7.4 Realizable Arm Filters In I and Q Receivers for MSK-Type Continuous Phase Modulations
D. J. Vajsey, *BNR* and P. J. McLane, *Queen's University, Canada*

B7.5 Filtering for Spread Spectrum Channels with Frequency-Hop Interference
J. Grosspietsch and D. Graupe, *Illinois Institute of Technology*

B7.6 An Efficient Time Domain Sample Value Scrambling Scheme Eliminating Frame Synchronization Requirement for Secure Speech Communications
L. Lee and G. Chou, *National Taiwan University, Taiwan*

B7.7 False Lock Phenomenon of Costas Loop with Residual Carrier
T. Fujiwara and M. Nakagawa, *Keio University, Japan*

SESSION B8

INTRA-ESTABLISHMENT COMMUNICATIONS SYSTEMS

Organizer: G. F. Abbott, *IBM Corporation*
Chairman: G. F. Abbott
Sponsors: COMSOC—Communication Systems Disciplines and Communications Terminals

B8.1 The Digital Data Exchange (DDX)
A Broad Band Data Switching System—A System Overview
G. F. Abbott, *IBM Corp.*

B8.2 DDX: A Wideband 2000-Line Space Division Exchange Architecture and Software
C. M. Melas, *IBM Corp.*

B8.3 The Digital Data Exchange (DDX) Physical Implementation
M. A. Patten, *IBM Corp.*

B8.4 The Digital Data Exchange Packaging and Power Systems
J. A. Dickerson, *IBM*

B8.5 A Communications Front-End Processor for X.25 Networks
P. Fink and J. Quale, *Duke University*

Wednesday A.M.

SESSION C1

FIBER OPTIC SYSTEMS

Organizer: M. Arozullah, *Catholic University*
Chairman: M. Arozullah
Sponsor: COMSOC—Communication Systems Disciplines

C1.1 Application of Fiber Optics to Biomedical Monitoring
C. Tocci, *Clarkson College* and M. Arozullah, *Catholic University*

C1.2 Coherent Two Pulse Sampling Noise Measurement System
M. C. Wernicki, *Fairleigh Dickinson University* and S. A. Miller, *N.O.S.C. California*

C1.3 Receiver Design for Binary Optical Fibre Communication
J. R. F. da Rocha and J. J. O'Reilly, *University of Essex, U.K.*

C1.4 70 MHz IF Band Optical Link for Satellite Ground Station
S. Hanacka, K. Ohta, *Fujitsu Ltd.*, H. Nakamura, N. Hanano and Y. Mochida, *Fujitsu Labs, Japan*

SESSION C2

INTEGRATED SERVICES IN LOCAL AREA NETWORKS

Organizers: Howard Blank and Karl Kummerle, *Communications Technology Management*
Chairmen: Howard Blank and Karl Kummerle
Sponsor: COMSOC—Data Communication Systems

C2.1 Physical, Procedural and Functional Interaction Between Voice and Data Elements in a Local-Area Communication Network
D. A. Pitt, *IBM Corp.*

C2.2 Data Network Modules
A. G. Fraser, *Bell Labs*

C2.3 Analytic Modeling of an Adapter to Local-Area Networks
J. W. Wong, *University of Waterloo, Canada* and W. Bux, *IBM Zurich, Switzerland*

C2.4 Local Area Communications on the Basis of an EPABX With Integrated Voice/Data Features
H. Evers, *Siemens AG, Federal Republic of Germany*

SESSION C3

VOICE AND DATA: SERVICES, INTEGRATION AND STANDARDS

Organizer: G. T. Clark, *Bell Canada*
Chairman: J. A. Blackman, *DOD*
Sponsor: COMSOC—Communication Switching

C3.1 Network Planning for the Information Network System (INS)
O. Iimura and T. Koide, *Engineering Bureau, NTT, Japan*

C3.2 Voice Storage Communication Facility for the Information Network System
T. Morisawa, H. Miyabe and M. Ohyama, *MECL, NTT, Japan*

C3.3 64-kbit/s Switching of Text, Data and Voice Using the EDS Switching System
R. Hagen, *Siemens AG, Federal Republic of Germany*

C3.4 Topics in Analysis and Design of Generalized Packet Communication Networks
G. Barberis and G. Tamburelli, *CSELT, Italy*

C3.5 Comparative Evaluation of Path Routing Strategies for Mixed Voice and Data Communication Network
J.-D. Kao, J.-T. Wang and T.-S. Kuo, *National Taiwan University, Taiwan*

C3.6 Multiservice Functional Architecture Application to the ISDN
M. Morvan, *CNET, France*

SESSION C4

PRESENT PLANS AND FUTURE OF TELEMATIC SERVICES

Organizer: D. Bodson, *National Communications Systems*
Chairman: H. Silbiger, *AT&T*
Sponsor: COMSOC—Standards Coordination and Liaison Committee

C4.1 The Role of CCITT Study Groups I and VIII in the Telematic Services
A. R. Pugh, *British Telecom, U.K.*

C4.2 Group 4 Apparatus: A Standards Viewpoint
R. Grant, 3M Company

4.3 The TransCanada Telephone System (TCTS) Teletex Service in Canada (The Market, The Implementation and The Testing Philosophy)
D. R. McKnight and P. R. Shea, *TransCanada Telephone System, Canada*
4.4 Mixed Mode Capabilities for Teletex Service
A. Chaillat and C. Drougnot, *CCETT, France*
4.5 Videotex—The Development of a Standard
J. D. Wetherington, *AT&T*
4.6 Common High Level Protocols
R. G. Bantel And A. C. Schmidt, *Bell Labs*

SESSION C5

RURAL APPLICATIONS OF SATELLITE COMMUNICATIONS

Organizers: W. Jui, *Hughes Aircraft* and R. L. Nickelson, *CCIR*
Chairman: R. L. Nickelson
Sponsor: COMSOC—Satellite and Space Communication

C5.1 Appropriate Satellite Systems for Rural Telecommunications
R. L. Nickelson, *CCIR, ITU, Switzerland*
C5.2 A Satellite Telecommunication System for Remote and Rural Areas in Africa
W. Laufenberg, *INTELPLAN, Switzerland*
C5.3 Interfaces in Rural Satellite Telephone Systems
J. M. Fraser, *J. M. Fraser and Associates, Inc.*
C5.4 Rural Satellite Communication System Network Considerations
K. Johannsen, *Hughes Aircraft Company*
C5.5 An Earth Station Design for Rural Telecommunications
G. F. Tustison, *Communication By Satellite, Inc.*

SESSION C6

INFORMATION-THEORETIC ASPECTS OF COMPUTER COMMUNICATIONS NETWORK

Organizer: P. Papantoni-Kazakos, *University of Connecticut*
Chairman: P. Papantoni-Kazakos
Sponsor: COMSOC—Computer Communication and Information Theory Group

C6.1 Universal Decoding for Channels with Finite Memory
J. Ziv, *Bell Labs*
C6.2 Data Transmission Using Error Detection Codes
R. Padovani and J. K. Wolf, *University of Massachusetts*
C6.3 Spectral Resolution of Multiple Sources
K. Yao, *University of California*
C6.4 Message Delay Distributions for a TDMA Scheme Under a Non-Preemptive Priority Discipline
L. F. DeMoraes, *INPE, Brazil* and I. Rubin, *UCLA*
C6.5 On Random Multiple-Access Communications and Group Testing
N. Mehravari and T. Berger, *Cornell University*

SESSION C7

TOPICS IN DIGITAL COMMUNICATIONS

Organizer: S. C. Sun, *Westinghouse Corporation*
Chairman: S. C. Sun
Sponsor: Technical Program Committee

C7.1 A Realistic Approach to Jitter Evaluation by Time Domain Simulation
T. Favretto, S. Improta and P. Sarti, *FATME, Italy*
C7.2 Analysis of Jitter Accumulation in a Chain of Digital Regenerators
J. Wu, E. L. Varma, *Bell Labs*

Wednesday A.M.

C7.3 Jitter in Digital Transmission Systems—Characteristics and Measurement Techniques
J. J. Baldini, M. W. Hall and R. J. S. Bates, *Bell Labs*
C7.4 Receiver Optimization for IJF and PR-IJF Signals
P. Vandamme, *CNET, France*, T. Le-Ngoc, *SR Telecom.*, and K. Feher, *University of Ottawa, Canada*
C7.5 Measurement of Phase-Locked Loop Performance Using the Statistical Loop Analyzer
W. C. Lindsey, *LinCom Corp.* and J. Seyl, *NASA*
C7.6 A Two-Dimensional Sequential Coding Scheme for Blob Pictures
K. Takahashi and M. Ohta, *Nagoya Institute of Technology, Japan*
C7.7 Conditional Runlength Coding for Picture Image
K. Kim, S. Kim, and J. Kim, *KAIST, Korea*

SESSION C8

ADAPTIVE SIGNAL PROCESSING

Organizer: R. Pickholtz, *George Washington University*
Chairman: D. Kazakos, *University of Virginia*
Sponsor: COMSOC—Communication Theory

C8.1 Synthesis of Multiple Random Processes Based Upon a Cholesky Decomposition
H. Urkowitz, *RCA*
C8.2 Cross Coupled PLL Interference Canceller with Closed Loop Amplitude Control
Y. Bar-Ness, *Drexel University*, F. A. Cassara, R. DiFazio and H. Schachter, *Polytechnic Institute of New York*
C8.3 Theory and Design of a Passband Echo Canceller for a 80 kbits/s Full-Duplex DPSK Modem
P. di Tria and L. Zoso, *CSELT, Italy*
C8.4 A Comparison of Three Hybrid ARQ Schemes Using Convolutional Codes on a Non-Stationary Channel
L. Lugand and D. J. Costello, Jr., *Illinois Institute of Technology*
C8.5 Error Correction Coding for Frequency-Hopping Multiple-Access Spread Spectrum Communication Systems
T. J. Healy, *University of Santa Clara*
C8.6 A Hybrid ARQ Scheme Using Multiple Shortened Cyclic Codes
K. Wu, *Shandong University*, S. Lin, *Texas A&M University* and M. J. Miller, *So. Australian Institute of Technology, Australia*

Wednesday P.M.

SESSION D1

THE EVOLVING SPC NETWORK

Organizer: D. P. Dodd, *South Central Bell*
Chairman: D. Sheinbein, *AT&T*
Sponsor: COMSOC—Communications Software

D1.1 Stored Program Controlled Network: Service Capabilities Architecture for the '80s
J. J. Lawser, *Bell Labs*
D1.2 Teleconferencing in the Stored Program Controlled Network
C. O. Brooks, *AT&T*
D1.3 The Evolving Call Handling, CCIS, Interprocessor Communications Network
P. G. Spring, *Bell Labs*
D1.4 Implementation of the Common Channel Signaling System No. 7 in the AFDT1 Nodal Exchanges of the SDN Italian Network
R. Puntaloro and C. Spinelli, *TELLETTRA, Italy*

 Wednesday P.M.

D1.5 A New Protocol for Call Handling Functions for the SPC Network
G. W. Gawrys, R. L. Asmuth, M. A. Gauldin, R. F. Stone, M. P. Yuhas and R. M. Ermann, *Bell Laboratories*

SESSION D2

CUSTOMER SIGNALING FOR THE ISDN

Organizers: P. E. White, *Bell Laboratories* and M. Decina, University of Rome
Chairman: M. Decina
Sponsor: COMSOC--Communication Switching

D2.1 Approaches to User Interconnection Reference Models for ISDN Communication
W. L. Hoberecht and S. Srinivas, *Bell Labs*

D2.2 ISDN User/Network Interface Protocol-Overall Architecture
S. Kano, K. Kitami and H. Ohnishi, *NTT, Japan*

D2.3 ISDN Customer to Network Signalling D Channel Protocol Level 1 Aspects
B. W. Moore, A. J. Whall and B. R. Kerswell, *British Telecom, U. K.*

D2.4 D-Channel Protocol: Role, Requirements, Level 2 Implications
R. Parodi, M. Romagnoli, *SIP*, and R. Preti, *CSELT, Italy*

D2.5 A Level 3 Signaling Architecture for ISDN Subscriber Access
J. W. Leth and P. E. White, *Bell Labs*

SESSION D3

MULTIPATH PROPAGATION AND DIGITAL RADIO PERFORMANCE

Organizer: W. D. Rummler, *Bell Laboratories*
Chairman: W. D. Rummler
Sponsor: COMSOC--Radio Communication

D3.1 Experimental Results on the Effects of Selective Fadings on 70 Mbit/s 8O-PSK Digital Radio
E. Damosso, S. De Padova, *CSELT*, R. Failli, *SIP*, and B. Lingua, *CSELT, Italy*

D3.2 Field Evaluation of MDR-6 8-PSK Digital Radio System With a Double Adjacent Channel Interference in a Severe Fading Environment
M. E. Evans, *Rockwell International*

D3.3 Hawaiian Telephone Company 65 Mile Propagation Tests
J. Tennis, *Hawaii Tel.*, J. Thielen and A. Walker, *Harris Corp.*

D3.4 Design and Performance of a 4.5 bit/s/Hz Digital Radio Using Reduced Bandwidth QPSK
M. T. Dudek, J. M. Robinson and J. K. Chamberlain, *The General Electric Company, U.K.*

D3.5 The Behavior of Spectrum Conserving RBQPSK Digital Radio During Multipath Propagation
G. D. Richman, *British Telecom Research Labs, U.K.*

D3.6 TD-45A, A System for 45-Mb/s Digital Transmission Over the TD Radio Network
R. T. Cooney and S. A. Harvey, *Bell Labs*

D3.7 Measured Performance of 45-MB/s Transmission Over the Bell System 4-GHz Radio
W. P. Jaeger, P. L. Penney and S. L. Vonrump, *Bell Labs*

SESSION D4

JOINT STUDIES OF PICTURE CODING TECHNIQUES LEADING TO A EUROPEAN VIDEOCONFERENCE SYSTEM

Organizer: J. E. Thompson, *British Telecom Research Labs*
Chairman: H. Seguin, *PTT/DGT*
Sponsor: COMSOC--Communications Terminals

D4.1 Objectives and Results of Project COST 211
J. E. Thompson, *British Telecom, U.K.*

D4.2 Optimization of Coding Algorithms by Computer Simulation Studies
L. Stenger, *FTZ, Federal Republic of Germany*, Th. Kremers, *Philips, Netherlands*, and R. Govaerts, *KUL, Belgium*

D4.3 The Development of the European Videoteleconference Codec
R. C. Nicol, *British Telecom, U. K.*, L. Chiariglione, *CSELT, Italy*, and P. Schaefer, *FTZ, Federal Republic of Germany*

D4.4 The Influence of Network Aspects on the Codec Design
J.-P. Temime, *CNET, France*

D4.5 Definition and Validation of Methods for the Subjective Assessment of Visual Telephone Picture Quality
N. Gleiss, *Telecom's Administration, Sweden*, J. W. Allnatt, *British Telecom, U. K.*, F. Kretz, *CCETT, France*, M. Sciarappa, *CSELT, Italy*, and E. Van der Zee, *IPO, Netherlands*

D4.6 Field Trials Results in a Satellite Network Via OTS
V. Speziale, *Telespazio, Italy*, and J. R. Taylor, *British Telecom, U. K.*

SESSION D5

BROADCASTING SATELLITE SYSTEMS

Organizer: R. G. Gould, *Telecommunications Systems*
Chairman: R. G. Gould
Sponsor: COMSOC—Space Communication

D5.1 National Service Requirements, Planning Methods and System Parameters for the 1983 Broadcasting-Satellite Planning Conference
E. E. Reinhart, *Satellite Television Corporation*

D5.2 Satellite Broadcasting in the 12 GHz Band: WARC-77 Frequency Plan and European Projects
D. Sauvet-Goichon, *Telediffusion de France, France*

D5.3 Digital Techniques in Satellite Broadcasting—Current Studies and Prospects in Europe
H. Mertens, *European Broadcasting Union, Belgium*

D5.4 Proposed U. S. Broadcasting-Satellite Systems
J. F. Clark, *RCA Corporation*

D5.5 Sharing Between the Broadcasting-Satellites and Other Services
R. G. Gould, *Telecommunications Systems*

D5.6 Broadcasting Satellite Feeder Links—Characteristics and Planning
J. W. Kiebler, *NASA Headquarters*

SESSION D6

LOCAL AREA NETWORKS

Organizers: B. W. Stuck and J. O. Limb, *Bell Laboratories*
Chairman: B. W. Stuck
Sponsors: COMSOC—Computer Communication and Data Communication Systems

D6.1 Synchronization Failures in a Chain of Repeaters
H. Meyr, L. Popken, *Technical University RWTH, Federal Republic of Germany*, H. Keller and H. R. Muller, *IBM, Zurich Research Lab, Switzerland*

D6.2 The Experimental Broadband Network
W. M. Hubbard and A. Albanese, *Bell Labs*
D6.3 Bidirectional Lightwave Bus
A. Albanese and B. L. Kasper, *Bell Labs*
D6.4 Panel Discussion: Local Area Networks Design Considerations
B. W. Stuck, *Bell Labs*, D. Potter, *INTERLAN*, D. Sze, *AMDAX, Corp.*, O. Gary, *Harris Corp.*, L. Garlick, *Xerox*, W. Smith, *Sytek*, and D. Nelson, *Apollo Computers*

SESSION D7

MODULATION AND SYNCHRONIZATION

Organizer: J. M. Aein, *IDA*
Chairman: A. Weinberg, *Stanford Telecom.*
Sponsor: COMSOC--Communication Theory

D7.1 Synchronization Properties of Continuous Phase Modulation
T. Aulin and C.-E. Sundberg, *University of Lund, Sweden*
D7.2 The Optimization of a Quadrature Coherent Detector for Partial Response Continuous Phase Modulation With Modulation Index 1/2
M. S. El-Tanany, J. S. Wight and H. M. Hafez, *Carleton University, Canada*
D7.3 Simplified Performance Analysis for Biternary FM
C. S. Ng, and T. T. Tjhung, *National University of Singapore, Singapore*
D7.4 2.5 Bit/Detected Photon Demonstration Program: Description, Analysis and Phase 1 Results
J. R. Lesh, J. Katz, H. H. Tan and D. Zwillinger, *Jet Propulsion Laboratory*
D7.5 Bit Synchronization and Detection by Extended Kalman Filtering Algorithm Implemented with Microprocessor
E. Akinci, *ENST*, M. Oberle, *CNET*, and G. Maral, *ENSAE, France*
D7.6 Optimum Waiting Time for Acquisition of Return Link PN Signals
W. Kolata, *Stanford Telecommunications, Inc.*
D7.7 Quaternary Minimum Shift Keying
N. Ekanayake, *Memorial University of Newfoundland, Canada*

SESSION D8

SIGNAL PROCESSING TECHNIQUES IN COMMUNICATIONS

Organizer: T. G. Marshall, Jr., *Rutgers University*
Chairman: T. G. Marshall, Jr.
Sponsor: COMSOC--Signal Processing and Communication Electronics

D8.1 New Realization of Discrete Fourier Transform Applied to Telephone Signaling System CCITT No. 5
Y. Ikeda and M. Norigoe, *Kokusai Denshin Denwa Co., Ltd., Japan*
D8.2 An Experimental Model of an Echo Canceller Using an Adaptive Linear Predictive Algorithm
S. Yamamoto and S. Kitayama, *Kokusai Denshin Denwa Co., Ltd., Japan*
D8.3 A Full-Duplex 4800 bps Modem for Switched Telephone Networks
K. Y. Cheng and A. J. Carlson, *Anderson Jacobson, Inc.*
D8.4 A Baud-Rate Line-Interface for Two-Wire High-Speed Digital Subscriber Loops
C. A. Ehrenbard and M. F. Tompsett, *Bell Labs*
D8.5 Codes and Algorithms for Simultaneous Error Correction and Rate Reduction Implementable with Standard Digital Signal Processors
T. G. Marshall, Jr., *Rutgers University*
D8.6 An Improved Design of a Quadrature Detection Multi-frequency Receiver
V. Cappellini and E. Del Re, *Istituto di Elettronica and IROE, Italy*

SESSION D10 (Evening Session)

BEST OF INTERNATIONAL SYMPOSIUMS ON SUBSCRIBER LOOPS

Organizer: R. W. Wyndrum, *Bell Telephone Laboratories*
Chairman: R. E. Mosher, *AT&T International*

Summaries of selected papers from the International Symposium on Subscriber Loops and Services held in September, 1982 will be presented and discussed.

D10.1 Evolution of ISDN in Europe
Speaker: Lars Ackzell, *Swedish Telecommunications Administration*
D10.2 Positioning the Subscriber Loop Network for Digital Services
Speaker: Ronald Coburn, *AT&T*
D10.3 Customer Access System Design
Speaker: Peter Wilcock, *Bell-Northern Research*
D10.4 A Highly Distributed Mechanized Loop Testing System
Speaker: Robert W. Vetter, Jr., *Bell Labs*
D10.5 Large-Scale Integration of Hybrid-Method Digital Subscriber Loop
Speaker: David G. Messerschmitt, *University of California, Berkley College of Engineering*

Thursday A.M.

SESSION E1

LOCAL AREA NETWORKS USING FIBER OPTICS

Organizer: D. Hanson, *Hewlett-Packard Company*
Chairman: D. Hanson
Sponsor: COMSOC—Transmission Systems

E1.1 Interaction of Network Design and Fiber-Optic-Component Design in Local Area Networks
N. L. Rhodes, *Hewlett-Packard Company*
E1.2 D-Net, A New Scheme for High Data Rate Optical Local Area Networks
C.-W. Tseng and B.-U. Chen, *TRW Technology Research Center*
E1.3 High Speed Fiber Optic Data Bus System for Local Data Communications
D. R. Porter, P. R. Couch and J. W. Schelin, *ITT*
E1.4 A Fiber Optic LAN/OCS Using a Broadband PBX
E. H. Hara, *Department of Communications, Canada*

SESSION E2

VISUALLY AUGMENTED TELECONFERENCING

Organizer: B. Prasada, *Bell-Northern Research*
Chairman: B. Prasada
Sponsor: COMSOC—Data Communication Systems

E2.1 A Low Bandwidth Virtual Space Video Teleconferencing System
C. W. Kelly III, Defense Advanced Research Projects Agency
E2.2 Some Psychological Variables in Visually Augmented Teleconferencing
E. Baker, *New South Wales Institute of Technology, Australia*
E2.3 Human Factors Design of PICTUREPHONE Meeting Service
A. J. Kames and W. G. Heffron, *Bell Labs*
E2.4 Teleconferencing in France
G. Eude, C. Petit, and J P. Temime, *CNET, France*

2.5 1.5 Mbit/s Interframe Codec for Video Teleconferencing Signals
H. Kuroda, N. Mukawa, T. Matsunka and S. Okubo, *YECL, NTT, Japan*

2.6 A Codec for International Visual Teleconferencing
T. S. Duffy, *McMichael, Ltd.* and R. C. Nicol, *British Telecom U. K.*

ESSION E3

ERIFICATION AND SYNTHESIS OF OMMUNICATION SOFTWARE

rganizer: M. Kajiwara, *MECL, NTT*
hairman: S. Aizawa, *NTT*
ponsor: COMSOC—Communication Software

3.1 An Intelligent Link-Oriented Program Generation Under Permuting States of Markov Chains
T. Nakamura, N. Endo and Y. Shigei, *Tohoku University, Japan*

3.2 Specification and Verification of Switching Software
M. Kajiwara, H. Ichikawa, M. Itoh and Y. Yoshida, *MECL, NTT, Japan*

3.3 A System Generator for ESS Based on the Distributed State State Transition Method
N. Mizuhara, O. Takada, K. Hiyama and T. Kurosaki, *Hitachi Ltd., Japan*

3.4 Interactive Data Generator for Centennial II PABX
H. Aoyagi and N. Ubukata, *Oki Electric Co., Ltd., Japan*

3.5 Software Quality Assurance in Electronic Switching System Development
K. Nakamura, H. Fujimoto, K. Satoh and T. Kanai, *Fujitsu, Ltd., Japan*

ESSION E4

ANEL—POST-DIVESTITURE INTERWORKING OF UBLIC SWITCHED NETWORKS

ganizer: E. V. Farinholt, *Satellite Business Systems*
hairman: P. Polishuk, *Information Gatekeepers*
ponsor: COMSOC—Social Implications of Technology

.1 The Network in Transition (Panel Overview)
E. V. Farinholt, Satellite Business Systems

4.2 S. L. Mathison, *GTE Telenet Communications*

4.3 Post Divestiture Interworking of Public Switched Networks
I. Dorros, *AT&T*

.4 D. Geraghty, *United Telephone Co. of Ohio*

.5 E. V. Farinholt, *Satellite Business Systems*

4.6 R. Spears, *MCI Telecommunications*

ESSION E5

ULTIPLE SMALL USER SATELLITE SYSTEMS

ganizer: R. J. F. Fang, *COMSAT Laboratories*
hairman: R. J. F. Fang
onsor: COMSOC—Satellite and Space Communications

.1 Data Collection Platform Services via Ku-Band Transponders
R. J. F. Fang and W. A. Sandrin, *COMSAT Labs*

.2 A New Possibility for Aeronautical Satellite Communications
D. W. Lipke, *Communications Satellite Corporation*

5.3 Modelng and Simulating the L-Band Maritime Channel
L. Palmer, *COMSAT Labs*

E5.4 Fading Reduction Antenna in Maritime Satellite Communications
S. Ohmori and S. Miura, *Radio Research Labs, MOPT, Japan*

E5.5 Signal Design for INMARSAT Standard C Ship Earth Stations
S. Rhodes, W. Hagmann, P. Chang and R. Fang, *COMSAT Labs*

E5.6 Fading Statistics and Data Transmissions for the Emergency Buoy Satellite Channel
F. Edbauer and J. Hagenauer, *DFVLR, Federal Republic of Germany*

E5.7 Signalling Characteristics in Satellite-Aided Land Mobile Communications
R. E. Anderson, *General Electric Co.*

SESSION E6

ADVANCES IN SPEECH CODING

Organizer: A. Gersho, *University of California*
Chairman: A Gersho
Sponsor: COMSOC—Communication Theory

E6.1 Digital Voice Processing for Transmission and Storage
J. L. Flanagan, *Bell Labs*

E6.2 Vector Quantization for Very-Low-Rate Coding of Speech
S. Roucos, R. Schwartz and J. Makhoul, *Bolt, Beranek and Newman, Inc.*

E6.3 A 500-800 bps Adaptive Vector Quantization Vocoder Using a Perceptually Motivated Distance Measure
D. B. Paul, *MIT Lincoln Laboratory*

E6.4 New Directions in Speech Coding at Low Bit Rates
B. S. Atal, *Bell Labs*

E6.5 Product Code Vector Quantizers for Speech Waveform Coding
M. J. Sabin and R. M. Gray, *Stanford Univeristy*

E6.6 Adaptive Differential Vector Coding of Speech
V. Cuperman and A. Gersho, *University of California*

SESSION E7

CODING AND ERROR CONTROL

Organizer: J. D. Gibson, *Texas A&M University*
Chairman: J. D. Gibson
Sponsor: Technical Program Committee

E7.1 A Parity-Retransmission Hybrid ARQ Using a Convolutional Code and Viterbi Decoding for Error Control
S. Lin, *Texas A&M University* and Y.-M. Wang, *Northwest Telecom's Engineering Institute, Peoples Republic of China*

E7.2 Minimum Euclidean Distance for Short Convolutional Codes and Continuous Phased Modulation
T. Aulin, G. Lindell and C.-E. Sundberg, *University of Lund, Sweden*

E7.3 Performance Analysis of Coded D/S Spread-Spectrum A/J Receivers with Jammer State Estimates
F. El-Wailly and D. Costello, Jr., *Illinois Institute of Technology*

E7.4 On the Probability of Undetected Error of Linear Block Codes
T. Kasami, *Osaka University, Japan*, S. Lin, *Texas A&M University* and T. Klove, *University of Bergen, Norway*

E7.5 New Performance Analyses for the Golay and Shortened Golay Codes
P. L. Patterson, *E-Systems, Inc.*

E7.6 Detection Performance of Band-Limited Continuous Phase Modulation
T. Aulin and C.-E. Sundberg, *University of Lund, Sweden*

E7.7 Low Complexity Decoders for Bandwidth Efficient Digital Phase Modulations
S. J. Simmons and P. H. Wittke, *Queen's University, Canada*

SESSION E8

TOPICS IN SWITCHING AND PROTOCOL

Organizer: J. R. Story, *Florida International University*
Chairman: J. R. Story
Sponsor: Technical Program Committee

E8.1 Satellite Link Augmentation of Ground Based Packet Switched Data Networks
J. B. Farrell, *Defense Research Establishment Atlantic*, P. J. McLane and L. L. Campbell, *Queen's University, Canada*

E8.2 Experimental Frequency Switching TDMA Equipment for Countermeasure Against Rainfall Attenuation
K. Kosaka, N. Hamamoto and R. Suzuki, *MOPT*, Y. Umeda and H. Ito, *Mitsubishi Electric Corp., Japan*

E8.3 Communication Satellite Ground Station Receiver Performance at Low Data Rates
L. P. Riddle, *Westinghouse Electric Corporation*

E8.4 Computer Aided Digital Transmission Protection Switching System
Y. Suzuki, K. Takahashi, H. Nakahama and K. Yamagishi, *Engineering Bureau, NTT, Japan*

E8.5 Design of a System for the Surveillance of Telegraph Messages
B. Furht, *University of Miami*

E8.6 A Multiple-Access Scheduling Protocol with Limited Queue Information
G. D. Marcus and P. Papantoni-Kazakos, *University of Connecticut*

E8.7 The Concurrent Request Processing Protocol
C. N. Nikolaou, *IBM and S. A. Schuman, Massachusettes Computer Associates, Inc.*

Thursday P.M.

SESSION F1

EVALUATION OF COMPUTER NETWORKS

Organizer: S. Yuill, *Bell Laboratories*
Chairman: S. Yuill
Sponsor: COMSOC—Computer Communication

F1.1 Implementing Computer Communications with OEM Microprocessors: Survivable Network Routing System
K. Brayer, *MITRE Corporation*

F1.2 Implementing Computer Communications with OEM Microprocessors: Survivable Routing System Performance
K. Brayer, *MITRE Corporation*

F1.3 Optimization of the Structure of Data Networks
J.-M. Mepuis, *CNET, France*

F1.4 DCA Communication Systems Access Protocol and Maintenance Aspects
H. Johansson, *Ellemtel, Sweden*

F1.5 Improving Total Throughput in Packet Switching Networks with Window Flow Control
J. P. Sauve, J. W. Wong, and J. A. Field, *Univeristy of Waterloo, Canada*

F1.6 Performance Modeling of Buffered CSMA—An Iterative Approach
J. Silvester and I. Lee, *University of Southern California*

Thursday P.M.

SESSION F2

TRENDS TOWARDS DIGITAL ELECTRONICS IN THE LOOP PLANT

Organizer: A. J. Karia, *Northern Telecom Canada, Ltd.*
Chairman: M. Frame, *Northern Telecom Canada, Ltd.*
Sponsor: *COMSOC—Transmission Systems*

F2.1 A 128 Line Digital Subscriber Loop System with Distributed Line Capability
G. M. Campbell, *Anaconda-Ericsson*

F2.2 Multiple Bit Rate Synchronous Terminals Towards ISDN
K. Aihara, K. Kikuchi, H. Yamaguchi, *YECL, NTT, Japan*

F2.3 An Implementation Scheme for ISDN Multi-Service Subscriber Access
R. Lueder, *Siemens AG, Federal Republic of Germany*

F2.4 A Modular Subscriber Loop System
S. C. Dunning, J. E. Sutherland and C. R. Ellison, *ITT Telecommunications*

SESSION F3

DIGITAL RADIO SYSTEMS AND SUBSYSTEMS

Organizer: T. S. Giuffrida, *AT&T*
Chairman: R. P. Hartmann, *Rockwell*
Sponsor: COMSOC—Radio Communication

F3.1 A 40 GHz PCM-FSK Transmitter-Receiver
O. Kasuga and K. Sakamoto, *NEC, Japan*

F3.2 New Concepts in Narrow-Band Coherent Digital Microwave Radio Systems
I. Frigyes, T. Berceli and Z. Szabo, *Research Institute for Telecommunications, Hungary*

F3.3 Universal Carrier Recovery Loop for QASK and PSK Signal Sets
A. Leclert and P. Vandamme, *CNET, France*

F3.4 A Comparative Performance Evaluation of Slope Equalizers and Decision-Directed Weight Control Equalizers
C. L. Chao and G. L. Lui, *TRW*

F3.5 A Comparison of Equalization Techniques on 16 QAM Digital Radio Systems During Selective Fading
H. Sari, *Laboratories d'Electronique et de Physique Appliquee, France*

F3.6 A Baseband Adaptive Equalizer for a 16-State QAM Digital System Over Mastergroup Band Analog Networks
Y.-L. Kuo and T. J. Aprille, *Bell Labs*

F3.7 Bootstrapping Adaptive Interference Cancelers: Some Practical Limitations
Y. Bar-Ness, *Drexel University*, J. W. Carlin and M. L. Steinberger, *Bell Labs*

SESSION F4

PANEL—DESIGN AND DEVELOPMENT METHODOLOGIES FOR REALTIME SOFTWARE SYSTEMS

Organizer: R. C. Cheung, *Harris Corporation*
Chairman: R. C. Cheung
Sponsor: COMSOC—Communication Software

F4.1 Panel Overview
R. C. Cheung, *Harris Corporation*
F4.2 R. Aubin, *Bell-Northern Research, Canada*
F4.3 V. L. Hoberecht, *IBM*
F4.4 J. W. Johnson, *Bell Labs*
F4.5 D. A. Lawson, *ITT North*
F4.6 D. A. Mnichowicz, *GTE Automatic Electric Lab*
F4.7 J. Tebes, *Siemens Corporation*

...ION F5

...ATELLITE COMMUNICATION SYSTEMS

...ganizer: S. N. Verma, *Western Union Telegraph Co.*
...hairman: S. N. Verma
...ponsor: COMSOC - Satellite and Space Communication

...5.1 A Multibeam Antenna System for the ITALSAT Satellite
A. Saitto, M. Lepriore, *European Space Agency, Netherlands* and C. Marcecchio, *Consiglio Nazionale Delle Ricerche, Italy*

...5.2 TDMA Burst Scheduling Within the INTELSAT System
D. J. Kennedy, J. A. Jankowski, Jr., *International Telecommunications Satellite Organization,* and C. A. King, *COMSAT Labs*

...5.3 Multiple Access Technique For a Central Databank System
B. Jabbari, *Southern Illinois University*

...5.4 Small Traffic Domestic Satellite Communication System with a K-Band Transponder
S. Isobe, H. Sasaoka, K. Kosaka and Y. Otsu, *Radio Research Labs, MOPT, Japan*

...5.5 An Automated Satellite Carrier Monitoring System
S. N. Verma, W. F. Callanan, *Western Union Telegraph Co.,* D. Hill and P. Rossiter, *Miller Communications Systems, Canada*

...5.6 The P, Q-Plane Approach for Restoring the Polarization Orthogonality in a Multiple Access Satellite System
F.-T. Tseng, *Directorate General of Telecoms.* and L.-S. Lee, *National Taiwan University, Taiwan*

...5.7 DUV Technology on the COMSTAR Satellite vs. Terrestrial Facilities—An Error Performance Comparison of Two Digital Data Channels
R. Paolucci, *Bell Labs*

SESSION F6

NEW SWITCHING TECHNOLOGY AND TRAFFIC PROCEDURES

Organizer: G. T. Clark, *Bell Canada*
Chairman: L. K. Pollen, *GTE Products*
Sponsor: COMSOC—Communication Switching

...6.1 Multifrequency Digital Signalling Transceivers
M. Dinaro and N. D'Onofrio, *TELETTRA, Italy*

...6.2 32-Bit VLSI Processor For Switching and Communications Processing
A. Niwa and T. Yamada, *MECL, NTT, Japan*

...6.3 R-Switch: A VLSI Switch Architecture for Integrated Services
H. C. Torng, *Cornell University*

F6.4 Is a Nonblocking Digital Matrix Essential, Or is Essentially Nonblocking Acceptable?
J. R. Boucher, *GTE Sylvania*

...6.5 Revised Traffic-Related Procedures for Line Concentrators
R. K. Even, *Bell Labs*

...6.6 DIEM—Digital Introduction Evaluation Model
J. P. Combot, *CIT-ALCATEL, France*

SESSON F7

SPEECH PROCESSING IN COMMUNICATIONS

Organizer: J. S. Sells, *University of Miami*
Chairman: B. Furht, *3University of Miami*
Sponsor: Technical Program Committee

F7.1 Speech Signal Analysis by Error-Weighted LPC
V. K. Jain, *University of Southern Florida*

F7.2 Vocoder Quality: An Automatic Procedure to Measure the Performance of Pitch Extractors
N. Dal Degan, *CSELT, Italy*

F7.3 Subjective Effects of Variable Delay and Speech Loss In Dynamically Managed Voice Systems
J. Gruber and L. Strawczynski, *Bell-Northern Research, Canada*

F7.4 A 192-To 24 Channel Digital Interpolation System Using TDHS/ARC
R.-H. Wang, J. L. Melsa and M. A. Herro, *University of Notre Dame*

F7.5 Hybrid Companding Delta Modulation with Silence Detection
D. H. Cho and C. K. Un, *Korea Advanced Institute of Science and Technology, Korea*

F7.6 A Comparative Study of 32K Bits/sec Adaptive Delta Modulation System Using Higher Order Predictors
A. Alcaim and J. R. B. De Marca, *Pontificia University, Brazil*

F7.7 PRIMAT System for Domestic Communication
R. N. Mutagi and P. Kumar, *Space Applications Centre (ISRO), India*

SESSION F8

COMMUNICATION TERMINALS AND SYSTEMS

Organizer: R. D. Slayton, *Teletype Corporation*
Chairman: R. A. Thompson, *Bell Laboratories*
Sponsor: *COMSOC--Communication Systems Disciplines*

F8.1 An Interactive Video Information Terminal
R. D. Gordon, *Bell Labs*

F8.2 An Animation Processor for Action Oriented Three-Dimensional Color Graphics
H. G. Alles, *Bell Labs*

F8.3 An Intelligent Electronic Book System and Publishing Facility
R. D. Gordon, *Bell Labs*

F8.4 An Audio Response Unit With Unlimited Vocabulary, and Its Applications for Public Services
K.-y. Murakami and S. Takeuchi, *YECL, NTT, Japan*

F8.5 Picture Memory Architecture for Facsimile Storage and Conversion Communication System
K. Hanabe, *YECL, NTT, Japan*

F8.6 Design Considerations on Word Processing Printers
c. E. Vidales, *Dataproducts Corp.*