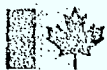


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Department of Communications

Gouvernement du Canada
Ministère des Communications

Spectrum Management Systems
Progress Report
for the
Spectrum Surveillance System
SMS-SSS-005

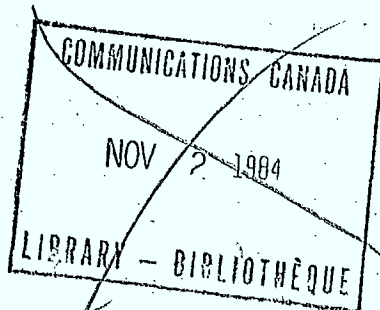
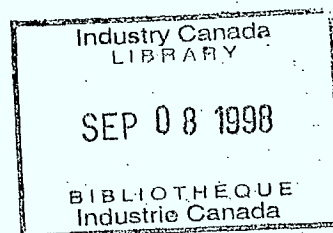
M.C. Chase
J.E. Edmunds
T.E. Racine

August, 1976

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Spectrum Management Systems

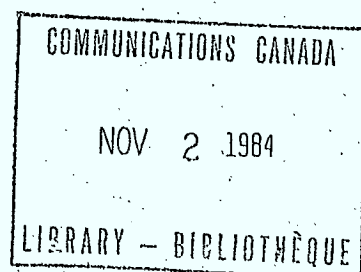
Progress Report
for the
Spectrum Surveillance System

SMS-SSS-005

①
M.C. Chase
J.E. Edmunds
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August, 1976

Department of Communications
Telecommunications Regulatory Service



Abstract

This report records the progress made towards the achievement of the spectrum surveillance system objectives reported in "The Acquisition of Measured Spectrum Occupancy Data" dated May 20, 1975. It refers heavily to the previous "Progress Report for the Pilot Spectrum Surveillance System" dated September, 1975. The report emphasizes the data analysis capabilities which have been developed for the reduction of monitoring data. It recommends further analysis and data collection which will be necessary to develop a monitoring plan for the operational implementation of spectrum surveillance on a small scale.

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0.0 PROLOGUE: Spectrum Surveillance, A Review

0.1 Need For Monitoring Spectrum

One of the most complex frequency management tasks in the private user area is that of the land mobile services. Although every effort should be made to employ modern data processing procedures to improve the assignment records, this effort alone will not solve the land mobile frequency assignment problem because no significant relationship has been found between the number of transmitters on a channel and the channel occupancy. Measured spectrum utilization is therefore necessary if one hopes to quantitatively define the actual spectrum conditions which exist in a given area. This increased knowledge of current spectrum utilization should lead to the development of spectrum use policies which ensure equitable sharing of the available resource. To meet these needs, a pilot project was initiated under the auspices of the Spectrum Management System to investigate the type of data needed to characterize spectrum utilization and to develop a specification for the hardware necessary to implement such a spectrum measurement program on a national scale.

0.2 Monitoring Approach

Stanford Research Institute had developed, under contract to the FCC, a computer-controlled receiver for sampling spectrum activity from the land mobile channels and had developed algorithms for incorporating this utilization data into the frequency assignment process. These procedures were implemented in the Chicago Regional Office experiment. It was decided that spectrum measurement equipment made by SRI should be purchased to evaluate its effectiveness in meeting the specified needs.

0.3 Short Term Objectives of Monitoring

The hardware purchased samples the dynamic occupancy pattern of the VHF portion of the spectrum; a statistical analysis of these samples is then required to obtain population parameters. The major objective of the initial spectrum surveillance experiments was to define the monitoring and data processing methodology necessary to determine these population parameters within a given degree of confidence. This objective would be achieved through the development of a monitoring plan which specified:

- a) the siting criteria for each monitoring site,
- b) the amount of data needed at each site,
- c) the number of sites required to cover a given area,
- d) the optimum time interval before returning to monitor a given site,
- e) data handling requirements.

An important by-product of the monitoring plan will be conclusions concerning the number of automated measurement systems which will be necessary to implement a spectrum surveillance function on a national scale. Insight will also be gained into the degree of sophistication required of such equipment. A set of objectives were therefore developed for the initial SSS work which were reported in "Acquisition of Measured Spectrum Occupancy Data" dated May 20, 1975 as follows:

- To obtain operational experience with automated radio frequency monitoring equipment
- To determine the maintenance requirements of said equipment
- To perform engineering experiments in site monitoring and data analysis to ascertain the validity of the SRI studies to the Canadian situation.
- To gather preliminary data on spectrum utilization in Canada's two largest metropolitan areas

- To identify the sets of user characteristics needed to study which types of users would best be suited for sharing with other types of users.
- To develop and attempt to optimize a monitoring plan and the necessary software for data analysis.

It must be emphasized that the development of the monitoring plan will be an iterative process with all monitoring experience used as feedback in order to optimize this plan.

0.4 What We Have Done So Far

The amount of data which has been collected with the Spectrum Surveillance Equipment is rather limited. Data has been gathered only at four sites: CRC Building 67, Journal Tower South, Clyde Avenue Lab and the CN Tower in Toronto.

The prime constraint faced by the SSS team was the lack of mobility of the equipment. Each time, a moving contractor had to be called to relocate the equipment. Although results from high monitoring sites indicated that the coverage range was extended to thirty miles for base station activity, practical considerations (high capital cost of equipment, number of cities which must be monitored, redundancy of data collected at a specific site if long-term monitoring is employed) dictated that the equipment be suitably mounted in a mobile vehicle so it could be used at a number of different locations and thus be deployed more effectively. The work required to obtain this mobile vehicle and to suitably mount the equipment in it was completed in mid-August, 1976. It is therefore now possible to collect the specific data necessary to answer the questions we have concerning the monitoring plan. In the meantime, considerable work has been done developing data analysis computer programs to extract useful information from the monitoring tapes. A "feel" has also been obtained for the data stationarity in both time and space and for which parameters would be most useful in the short term for

ranking channels for assignment. The state of spectrum congestion measured in Toronto allows us to be optimistic about the usefulness of spectrum monitoring data in the frequency assignment process.

0.5 What Remains To Be Done To Achieve The Short Term Objective of Developing A Monitoring Plan

0.5.1 Determination of Parameter For Initial Channel Ranking

Before deciding how much data is needed to rank channels, it is necessary to determine which parameters will be used for this function. Current parameters available to us are:

- a) average transmission occupancy
- b) average message occupancy
- c) peak transmission occupancy
- d) average waiting time
- e) peak waiting time
- f) a percentile from the distribution of any of the above parameters
- g) average message gap time

The parameter chosen should have the following characteristics if it is to be useful for channel ranking:

- a) the parameter should be stationary so that measurement of it is repeatable
- b) the parameter should be easily derived from the results of the measurements
- c) the parameter should require a minimum of interpretation of the results by the operator
- d) the parameter should be derivable separately for the signal activity due to various stations sharing a channel.

The parameter currently receiving the greatest consideration for channel ranking is the average occupancy. It meets all the prerequisites described above. The stationarity investigations must be furthered before a decision can be made to use it or not. Preliminary work by Dr. M. Burke indicates that 81% of the 175 channels in Ottawa which are occupied more than 5% of the time exhibit good day to day stationarity while 72% do not exhibit significant diurnal variations in their average occupancy. Thus, significant occupancy peaks

0.5.6 Maintenance Requirements

This is also an on-going feature of the site investigations. Some problems have been encountered during the limited monitoring and they have been investigated and corrected. However, no experience has yet been obtained with the mobile vehicle to determine its maintenance requirements and the effects the mobility will have on the monitoring equipment's performance.

0.5.7 Recommended Schedule

In order to collect the data necessary to answer these questions sufficiently, the following schedule is proposed:

- a) One week of monitoring at Clyde Avenue as a run-in period for the mobile
- b) One week of monitoring in downtown Ottawa to determine physical limitations of monitoring sites, equipment performance and compare the monitoring data to that collected atop the Journal Tower South
- c) Repeat the time correlation experiment in Toronto for more channels than in Ottawa to determine if the day-to-day stationarity is as good. (2 weeks monitoring)
- d) Perform a spatial correlation experiment in Toronto on channels selected from the time stationarity experiment as exhibiting good day-to-day stationarity. (Time required to be determined)

0.6 Longer Term Objectives of Spectrum Surveillance

0.6.1 Spectrum Model

The eventual goal of the spectrum surveillance system is to assist in the more effective management of the radio frequency spectrum. The short term objectives described above will assist assignment officers in the operational

which may have rendered the use of average occupancy as a parameter for ranking doubtful, do not occur as frequently as first thought. The channels which do exhibit peaks will be investigated more closely to determine the effects of the diurnal variations and any commonality of channel type or user type which may exist on these frequencies. If the average occupancy does not prove to be a suitable parameter, the most likely next parameter will be a percentile value on the occupancy distribution curve. The disadvantage of the latter would be that a greater amount of analysis and storage would be required to determine it and the amount of data it would be necessary to collect for each channel would increase.

0.5.2. Amount of Data Needed to Determine A Parameter Adequately

Naturally, the answer to this question depends on the parameter to be used. It would seem at this time that 5-minute rasters collected on the channels at forty-five minute intervals for ten hour monitoring periods from 08:00 to 18:00 repeated over three days are more than adequate for ranking channels by their average occupancy. If the day-to-day stationarity were perfect and all diurnal occupancy patterns were perfectly flat, then only one 5-minute raster would be necessary to obtain the average occupancy. However, given the variations which do occur, three days of monitoring data will be necessary. This amount of time spent at a site will also be useful to smooth out large variations due to weather conditions or anomalous propagation. Further work to consider various channel occupancy distributions and the number of samples required to converge on the true value of average occupancy must yet be completed before a final answer to the question can be given.

0.5.3 Number of Sites Needed to Cover a Particular Area

This is the query which still has the most question marks associated with it. No monitoring has yet been completed with the mobile vehicle to determine what its coverage is likely to be. Base station coverage should be

adequate at least to 15 miles; however, the effects of the lower antenna heights and building shielding on the occupancy that will be measured from a mobile unit is yet to be determined. Consideration should also be given to attempt to relate base station occupancy to channel occupancy. If a factor can be found which effectively relates these two numbers then the effects of losing mobile coverage can be minimized. Spatial stationarity experiments and antenna height studies should provide insight in order to answer this question.

0.5.4 How Often Must Each Site Be Revisited?

Two effects will combine to determine the answer to this query. Seasonal variations in the occupancy pattern, if extensive, could require quarterly monitoring of sites. The growth rate of land mobile assignments will also provide input to determine when monitoring should be repeated. If all monitored channels have been assigned new users, then monitoring must definitely be repeated. It is hoped that a suitable interface with the assignment program can be developed which will flag situations where monitoring should be repeated. The investigations in this area will probably best be completed by implementing the spectrum surveillance function on a small scale.

0.5.5 Physical, Environmental and Electromagnetic Siting Requirements

Various effects due to hardware limitations have been observed during the limited site monitoring investigations. Traffic noise was observed at CRC Building 67 since the antenna was almost opposite the roadway (Highway 17). Intermodulation products were measured at the Journal Tower South. This site also suffered deleterious effects from a transmitter located across the road which energized the IF filter over a broad range of frequencies thus contributing non-existent occupancy. The CN tower site was afflicted with a high background noise. Software functions have been developed which assist significantly in nullifying these unwanted signals. Proper siting, however, could be used to ensure that these effects are minimized. Many of the physical siting requirements have yet to be determined although some are known. External power, if available, will reduce the load put on the internal generators and thus decrease the maintenance requirements. More questions of this nature will be answered as site monitoring investigations continue.

implementation of channel sharing among users. They will also, in conjunction with the frequency assignment tools, provide an in-depth view of how spectrum utilization is progressing. This should result in the development of a spectrum model which can be used to study the effects of various spectrum policy decisions.

0.6.2 User Models

A required input to this spectrum model will be the characterization of various user types and the determination of their occupancy parameters. Spectrum surveillance work will probably need to be supplemented with audio monitoring to develop these models. When the spectrum becomes further congested, these models will assist in selecting the best available channel for sharing.

0.6.3 Effects of Combining Users - Sharing Model

When the user models have been sufficiently developed, the effects of combining various user types should be studied as an input to the sharing model in particular, and to the spectrum model in general.

Progress Report for the Spectrum Surveillance System

1.0 INTRODUCTION

This report describes the progress made towards the achievement of the objectives listed in the initial report, "Acquisition of Measured Spectrum Occupancy Data" dated May 20, 1975. It reports on the continuing developments in occupancy data reduction since the "Progress Report for the Pilot Spectrum Surveillance System" dated September, 1975. It must be stated that the foremost objective of developing a monitoring plan for the operational implementation of spectrum occupancy measurements has not been achieved for a variety of reasons, the principal one being the late delivery of the van, delays in refurbishing the latter and mounting the SRI equipment in it for mobile operation. This work has now been completed and it should be possible to obtain the necessary data and analyse it to obtain the answers needed to develop the monitoring plan. Many of the results discussed in this report have previously been included in various seminar presentations of the work with the Spectrum Surveillance System. This report describes the spectrum monitoring activities at the CN tower and Clyde Avenue Lab sites, the results and types of outputs produced and reviews the experimental investigations which must yet be completed in order to achieve the short term objectives of the Spectrum Surveillance System.

2.0 DATA ACQUISITION

The nine scan tables to monitor frequencies every 15 KHz in the band 138-174 MHz (refer to the September, 1975 report) were used to collect data at the CN tower site (1400' level) and at the Clyde Avenue Lab (20' antenna height) in Ottawa. In addition, a special scan table was developed for a time stationarity experiment at the Clyde Avenue site. Two hundred and forty-one frequencies, which had exhibited activity during previous measurements in Ottawa, were selected and included in a scan table named "Scan 10". The frequencies included in this scan table are included as Appendix A. This scan table was used to monitor these frequencies continuously for three ten hour days making a measurement every one half second. This data can then be used for a variety of time stationarity investigations. The following table lists the data tapes which were collected:

<u>Tape</u>	<u>Site</u>	<u>Date</u>	<u>Monitoring Period</u>	<u>Comments</u>
DOC 8480/TOR 1000	CNTWR	Sept 9/75	15:30 to	Tuesday
DOC 8472/TOR 1001	CNTWR	Sept 10/75	17:30 to	Wednesday
DOC 8471/TOR 1002	CNTWR	Sept 11/75		Thursday
DOC 8473/TOR 1003	CNTWR	Sept 12/75	08:00 to 18:00	Friday
DOC 8474/TOR 1004	CNTWR	Sept 12/75	18:05 to 04:00	Friday Eve
DOC 8475/TOR 1005	CNTWR	Sept 13/75	09:00 to 19:00	Saturday
DOC 8476/TOR 1006	CNTWR	Sept 14/75	09:00 to 19:00	Sunday
DOC 8477/TOR 1007	CNTWR	Sept 15/75	08:00 to 18:00	Monday
DOC 8478/TOR 1008	CNTWR	Sept 16/75	08:00 to 18:00	Tuesday
DOC 8479/TOR 1009	CNTWR	Sept 17/75	08:00 to 18:00	Wednesday
DOC 8480/TOR 1010	CNTWR	Sept 18/75	09:00 to 19:00	Thursday
DOC 8481/TOR 1009	CNTWR	Sept 19/75	08:00 to 18:00	Friday
DOC /CLY 2001	CLYDE LAB	Oct 22/75	08:30 to 18:30	Wednesday
DOC 2787/CLY 2002	CLYDE LAB	Oct 23/75	08:30 to 18:30	Thursday
DOC 2784/CLY 2003	CLYDE LAB	Oct 27/75	08:30 to 18:30	Monday
DOC 2781/CLY 2004	CLYDE LAB	Nov 7/75	08:30 to 18:30	SCAN 10
DOC 2786/CLY 2005	CLYDE LAB	Nov 12/	08:30 to 18:30	SCAN 10
DOC 2783/CLY 2006	CLYDE LAB	Nov 13/75	08:30 to 18:30	SCAN 10

3.0 DATA ANALYSIS

3.1 Initial Analysis of Toronto Data

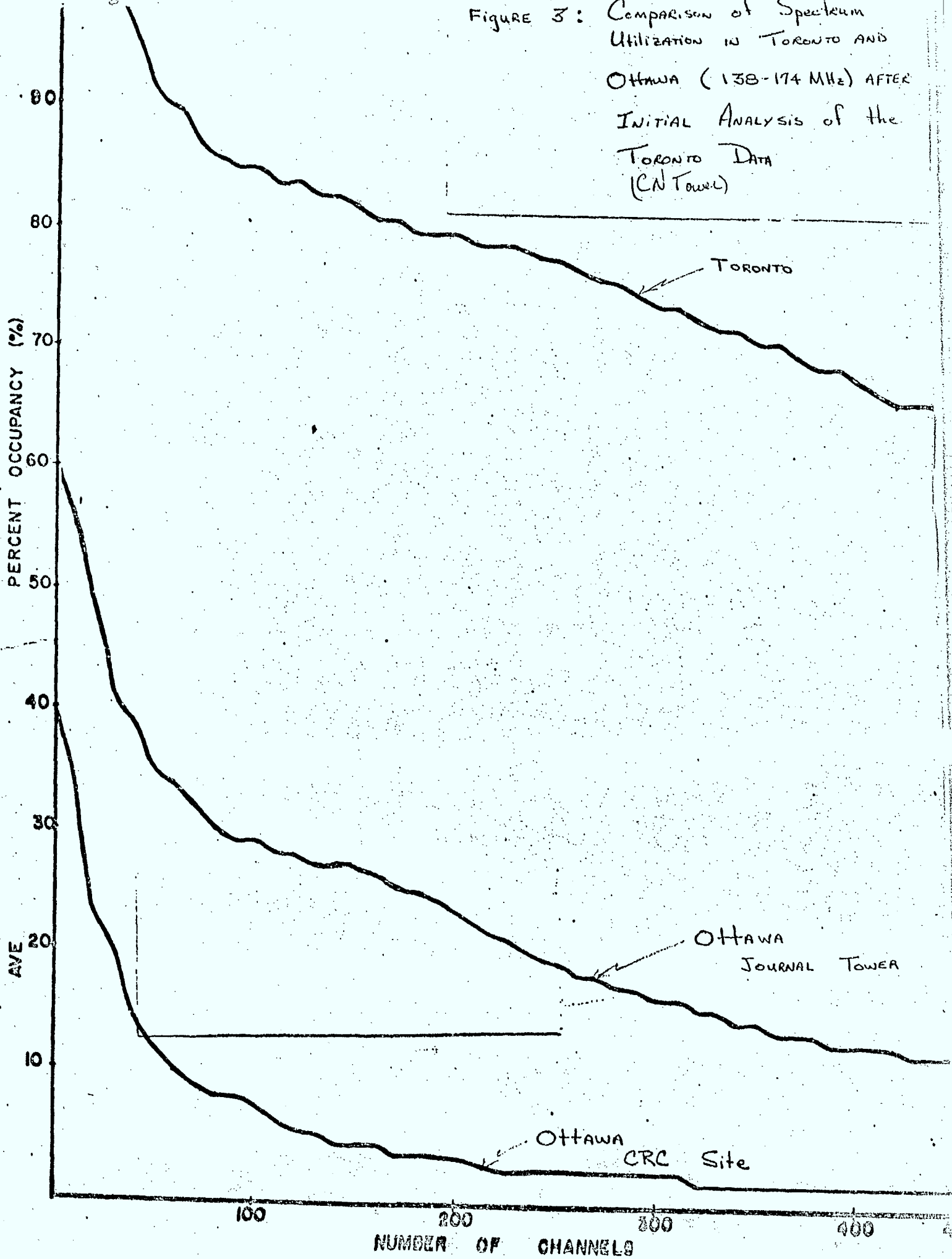
The initial analysis of the Toronto data was completed using the processing programs described in previous reports. The data tapes for the complete week of ten hour days were analyzed (TOR 1007 to TOR 1011). A portion of the histogram output before processing of the noise background with the subtraction of common mode counts is shown in Figure 1. Figure 2 shows that, again, the processing to eliminate the common mode counts serves to "clean-up" the picture considerably. Figure 3 gives a comparison of the spectrum utilization graphs for Toronto and Ottawa. It became evident at this point that the use of a fixed decision threshold (that noise was any signal below $-3 \text{ dB}_\mu\text{V}$ and transmissions were any signal above $-3 \text{ dB}_\mu\text{V}$) would not yield correct results in the analysis of the data acquired at the CN tower. The high noise background and the height of the monitoring site allowing the reception of distant stations precluded the use of this fixed decision threshold. The development work described next was therefore undertaken in order to implement soft decision levels.

3.2 Implementation of a Two Pass Analysis with Soft Decision Levels

The variable level of the background noise floor led to a decision to implement data analysis which would control the threshold level based on the data collected. This required a two pass analysis. The SSS data tapes are first read collecting the data for the amplitude histograms and storing it in the first one hundred and twenty-seven elements of the data base record. This analysis takes place exactly as described previously (see September Report). All analysis of other occupancy parameters such as transmission lengths, gap lengths, etc. has been removed from the first pass. The data from this data base record is then used to decide where the noise threshold should be placed. A sample graph of this raw data plotted on a Tektronics 4010 graphics terminal is given in figure 4. This figure reveals that the data

Figure 2: Channels histogram from CN Tower after noise processing

Figure 3: Comparison of Spectrum Utilization in Toronto and Ottawa (138-174 MHz) After Initial Analysis of the Toronto Data (CNTower)



does not form a smooth curve. This lack of smoothness results both from the calibration procedure which does not allow the measurement of various analog levels and from the analog to digital conversion with its specified absolute accuracy of 2 dB. The development of the threshold level algorithm was complicated by this lack of smoothness. An algorithm was therefore developed to smooth the curves before attempting further analysis. The result of this algorithm on the curve of figure 4 is shown in figure 5. The smoothing algorithm is a peak envelope one rather than an averaging one. A listing of the fortran subroutine which implements this algorithm is given as Appendix B. Since the plotting is done using an APL graphics driver, the algorithm has been converted to APL. The noise level algorithm developed for this smoothed data determines when further counts add less than 1.5 % to the total counts. The fortran code for this algorithm is given as Appendix C. Again, an APL version of this algorithm has been developed.

Since the two pass system was being implemented for the noise threshold decisions, it was felt that we might derive other benefits from the two pass analysis. The amplitude histograms have shown that the activity of two base stations can be separated if their received signal levels are sufficiently different (10 dB for best results). Algorithms were therefore developed which considered the smoothed data, searched for up to four base station peaks, and calculated the window limits (dB μ V) within which signal activity could be considered as being from that particular base station. These levels are stored in each data base record. They can then be used during the second pass to analyse separately the transmission characteristics of each base station. The fortran listings for "PEAKS" and "DECIDE" are included as Appendix D. These routines have not been converted to APL functions.

The second pass through the spectrum surveillance data tapes is used to calculate the transmission characteristics such as average

FIGURE 4: PROBABILITY OF MAKING A MEASUREMENT
AT AN Amplitude Level for a
Specific Frequency (150.275 MHz, CNTWR)

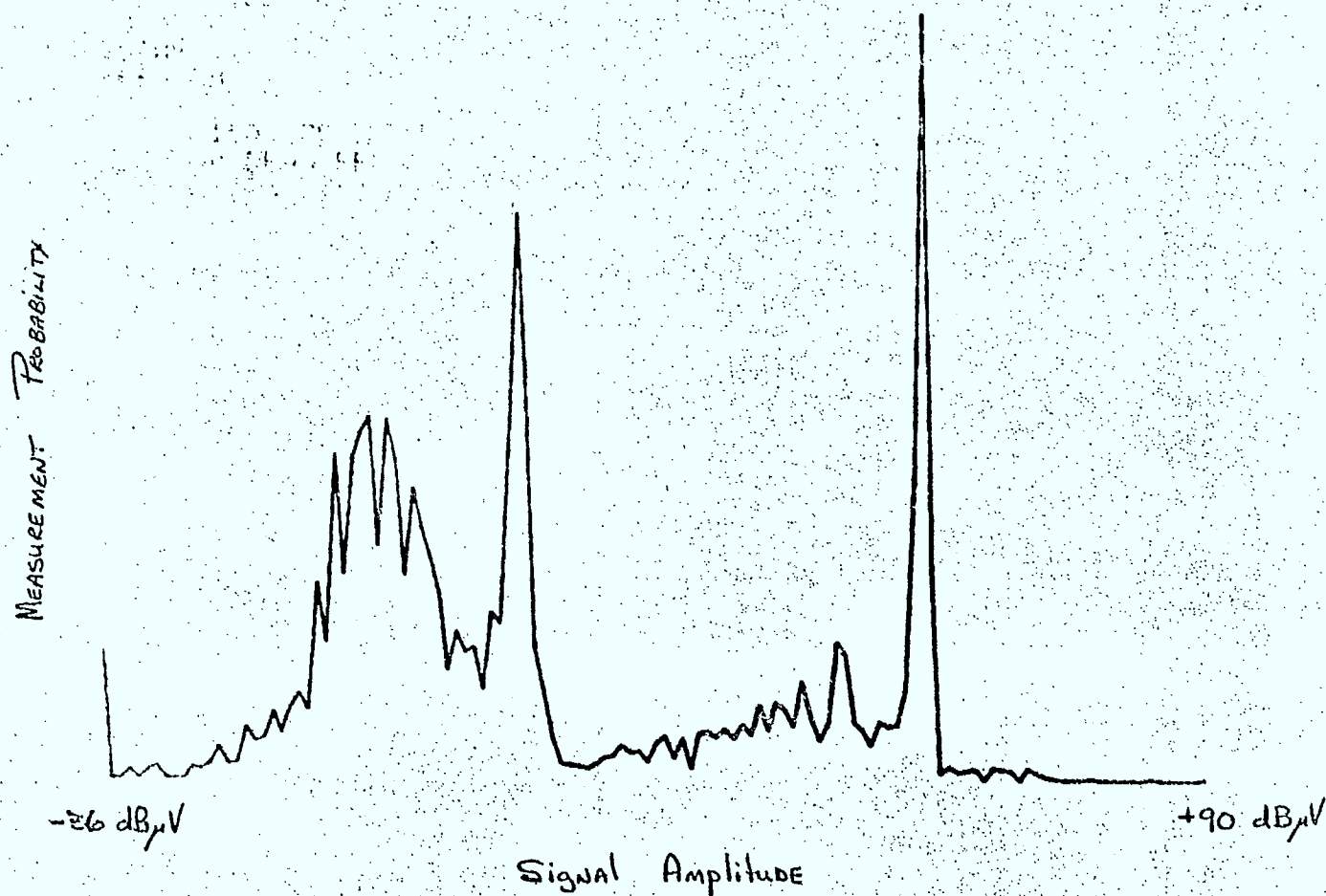
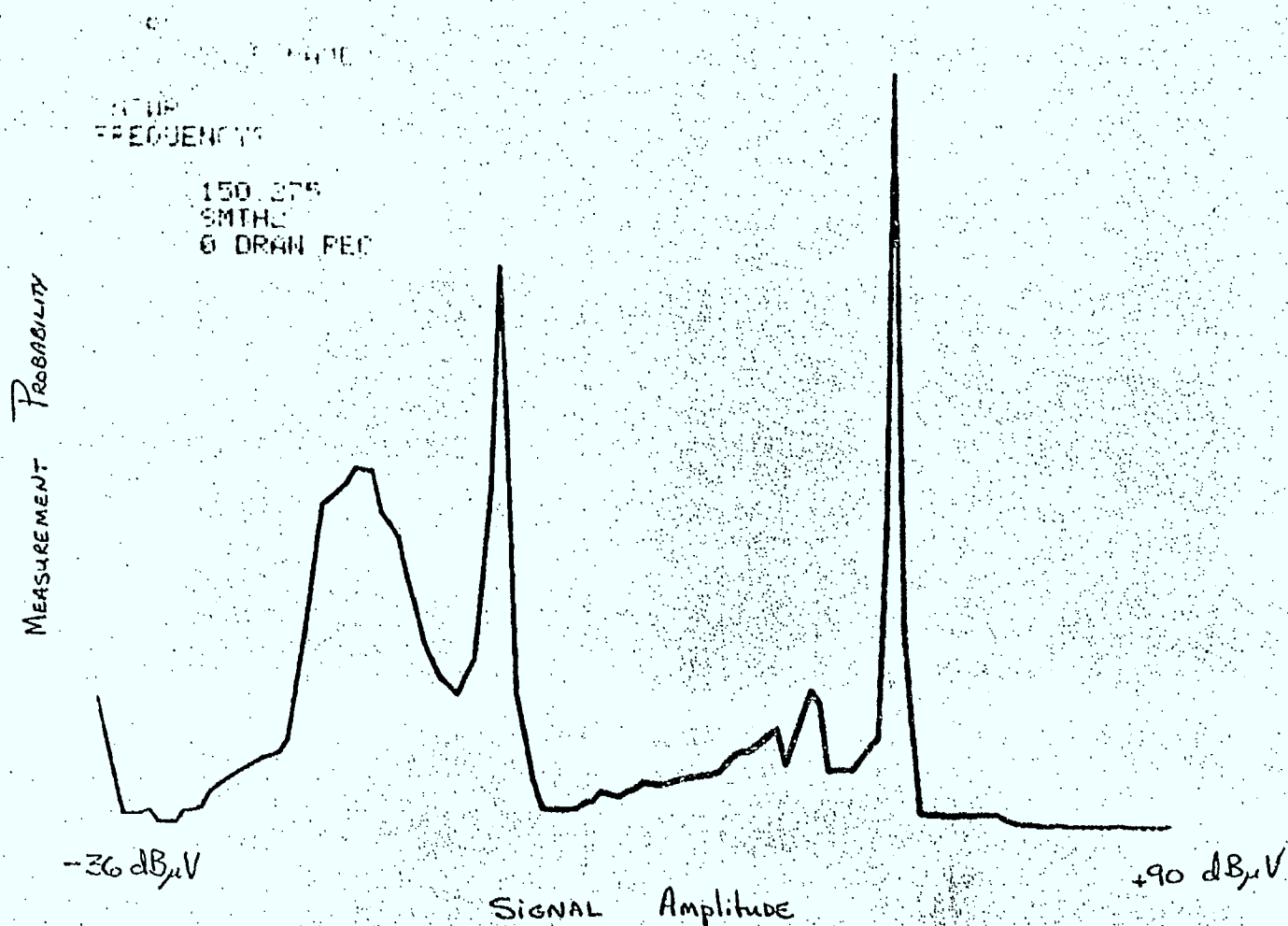


FIGURE 5 : Smoothed Probability of Making a Measurement at an Amplitude Level for a Specific Frequency (150.275 MHz, CNTWR)



transmission gap lengths and average message gap lengths. Since the method of calculation of these parameters has not been described previously, a short explanation is included at Appendix I. The raster summary output has been expanded to report the transmission parameters of each identified peak. Its new format is shown in figure 6. The cumulative averages of these transmission parameters are collected in the data base records as described in the September report. However, they are now recorded separately for each peak. The new data base elements are described in Table 1 below.

TABLE 1

<u>Element No.</u>	<u>Description</u>
1 to 127	Cumulative number of measurements recorded at each amplitude level from -36 dB V to 90 dB V
128	ITG
129	ITCG
130	ITGSQ
131	IMG
132	IMCG
133	IMGSQ
134	# of messages
135	# of frequencies in the scan table
136	ITM for channel
137	ITB for channel
138	# of rasters
139	ITMSQ for channel
140	ITM for peak 1
141	ITB for peak 1
142	ITMSQ for peak 1
143	ITM for peak 2
144	ITB for peak 2
145	ITMSQ for peak 2
146	ITM for peak 3
147	ITB for peak 3
148	ITMSQ for peak 3
149	ITM for peak 4
150	ITB for peak 4
151	ITMSQ for peak 4
152	ITM not in any peak
153	ITB not in any peak
154	ITMSQ not in any peak
155	peak 5 min average occupancy

Figure 6: Raster summary output (transmission parameters for peaks 3 and 4 not shown)

Frequency	Ave occ	Time	Mess gap	σ_M	Channel overall			Peak 1			Peak 2			Not in any peak			Noise		
					TX	σ_{TX}	#TX	TX	σ_{TX}	#TX	TX	σ_{TX}	#TX	TX	σ_{TX}	#TX	Gap	σ_{gap}	No. thresh- gaps hold
150.485	.17	08:18	71.6	51.0	8.9	13.8	10	4.2	4.1	3	.0	.0	0	10.9	16.4	7	3.2	2.3	5-10
150.670	.12	08:18	89.4	83.5	7.3	10.8	9	.0	.0	0	.0	.0	0	7.3	10.8	9	3.9	4.6	5-10
150.845	.15	08:18	52.6	48.0	5.0	5.2	16	2.7	2.3	4	3.6	.0	1	5.9	6.0	11	3.5	4.2	9 -9
150.875	.25	08:18	39.6	36.6	6.3	8.9	21	3.1	2.2	7	.0	.0	0	7.9	10.6	14	3.2	4.0	13 -9
150.965	.12	08:18	89.7	65.9	6.2	8.4	10	.0	.0	0	.0	.0	0	6.2	8.4	10	3.3	3.8	6-10
150.995	.25	08:18	38.7	30.5	4.4	3.3	30	4.0	3.1	6	4.2	3.1	9	4.7	3.6	15	2.2	2.2	22 -9
151.025	.12	08:18	115.3	97.3	7.7	11.5	8	.0	.0	0	.0	.0	0	7.7	11.5	8	1.6	1.4	5-10
151.055	.11	08:18	77.6	52.9	4.2	4.1	14	.0	.0	0	.0	.0	0	4.2	4.1	14	.9	.4	9 -9
151.085	.10	08:18	117.3	91.1	4.3	4.4	13	.0	.0	0	.0	.0	0	4.3	4.4	13	1.0	.5	10 -9
151.265	.10	08:18	156.4	97.3	5.0	5.3	11	.0	.0	0	.0	.0	0	5.0	5.3	11	1.2	.7	9 -9
151.685	.10	08:18	116.6	86.0	3.0	3.8	17	.0	.0	0	.0	.0	0	3.0	3.8	17	1.1	.9	14 -9
151.745	.16	08:18	79.5	69.4	4.1	4.9	21	2.1	1.3	3	4.0	2.3	4	4.5	5.9	14	2.9	3.6	17 -9
151.775	.11	08:18	153.1	97.7	7.6	6.8	8	.0	.0	0	.0	.0	0	7.6	6.8	8	2.1	3.1	6-10
151.955	.12	08:18	114.8	86.9	7.3	7.2	9	.0	.0	0	.0	.0	0	7.3	7.2	9	1.6	1.4	6-10
152.030	.12	08:18	76.4	60.3	5.4	6.2	12	.0	.0	0	.0	.0	0	5.4	6.2	12	1.5	1.5	7-10
152.060	.15	08:18	69.4	83.9	5.1	4.8	16	6.3	4.2	3	.0	.0	0	4.8	5.0	13	2.9	3.3	11-10
152.150	.35	08:18	26.7	17.8	4.8	5.1	39	3.9	2.8	16	4.8	5.3	15	6.5	7.9	8	2.8	2.7	29-10
152.210	.11	08:18	114.6	85.4	4.2	4.4	14	.0	.0	0	.0	.0	0	4.2	4.4	14	1.5	1.5	11-10
152.360	.12	08:18	65.0	61.7	5.9	6.2	11	3.6	.0	1	7.2	.0	1	6.0	6.8	9	2.3	3.4	5-10
152.510	.41	08:18	75.7	95.7	12.1	26.5	18	82.8	53.0	2	.0	.0	0	3.2	2.5	16	1.1	.6	13-10
152.630	.56	08:18	233.7	.0301.7	.0	.0	1301.7	.0	.0	1	.0	.0	0	.0	.0	0	.0	.0	0 -1
152.690	.62	08:18	90.0	101.5	33.5	99.3	10312.5	.0	.0	1	.0	.0	0	2.5	1.9	9	2.2	3.1	9-10
152.810	.64	08:18	95.4	68.8	114.3	119.4	3171.0	114.2	.0	2	.0	.0	0	.9	.0	1	1.8	.0	1 -7
152.840	.23	08:18	128.9	87.9	17.8	43.9	7115.5	.0	.0	1	.0	.0	0	1.5	1.3	6	4.7	2.8	5 -7
152.900	.23	08:18	48.0	37.2	4.0	4.4	30	4.8	6.5	8	4.8	2.9	5	2.2	2.1	12	3.1	2.8	24 -7
153.020	.17	08:18	62.4	52.7	2.9	3.3	31	5.9	4.7	10	3.1	2.7	2	1.3	.8	19	2.8	3.0	26 -8
153.230	.15	08:18	140.9	114.0	10.3	25.6	8	1.8	.0	1	.0	.0	0	11.5	27.5	7	5.1	3.6	6 -7
153.260	.10	08:18	56.6	73.9	2.9	2.3	18	6.3	.0	1	3.6	2.5	3	2.6	2.1	14	2.6	3.1	11 -7
153.320	.05	08:18	158.8	100.3	1.9	2.2	15	.0	.0	0	2.7	.0	1	1.8	2.3	14	2.3	2.5	13 -8
153.470	.16	08:18	61.1	76.3	5.5	12.0	16	23.9	24.0	3	.0	.0	0	1.2	.8	13	2.2	2.7	9 -8
153.560	.07	08:18	65.7	82.6	2.6	2.7	15	3.5	3.1	7	.0	.0	0	1.8	2.4	8	3.8	3.4	9 -8
154.260	.06	08:18	96.7	96.9	3.8	5.7	9	2.7	1.7	2	12.1	10.3	2	.9	.4	5	3.6	4.4	5-10
154.770	.08	08:18	114.2	64.8	4.4	8.5	10	10.4	16.0	3	2.4	1.7	3	1.3	.9	4	4.3	3.3	7-10
154.980	.07	08:18	120.4	89.0	5.2	4.9	7	1.8	.0	1	9.3	5.7	3	2.4	1.9	3	5.4	6.3	3-10
155.010	.01	08:18	105.5	111.7	2.0	2.5	4	.0	.0	0	5.4	.0	1	.9	.5	3	.0	.0	0-10
155.670	.24	08:18	40.3	35.3	2.6	2.0	50	3.6	2.0	5	3.2	1.9	8	2.3	2.0	37	2.7	2.4	43 -9

Table 1 (Con't)

<u>Element No.</u>	<u>Description</u>
156	Noise Level Threshold for this channel
157	Amplitude of First Peak (dB μ V)
158	Amplitude of Second Peak (dB μ V)
159	Third
160	Fourth
161	Fifth
162	Sixth
163	Seventh
164	Eighth
165	# impulse counts
166	# valid counts
167	Lower Window level for Highest Occupancy Peak Above Noise
168	Upper Window Level for Highest Occupancy Peak Above Noise
169	Lower Window Level for Second Highest Occupancy Peak Above Noise
170	Upper Window Level for Second Highest Occupancy Peak Above Noise
171	Lower Third
172	Upper Third
173	Lower Fourth
174	Upper Fourth
175	Frequency Monitored

3.3 Results of Analysis of Spectrum Utilization Data Collected in Toronto

The implementation of the soft decision level algorithms for the analysis of the CN tower data yielded the summary curve in figure 7. This curve allows us to be more optimistic about the usefulness of spectrum monitoring data than the curve of figure 3. By processing out the occupancy due to the distant stations being received from the high monitoring site, the state of current spectrum utilization as represented by figure 7 is such that sharing can be used to assign more users to this spectrum. We see from figure 7 that, of the 1000 "assignable" frequencies in Toronto, nearly two-thirds are occupied less than 20% of the time. These results may be slightly optimistic because of the software techniques used to derive them and should be verified monitoring with the mobile in the near future.

FIGURE 7: CN Tower Spectrum Utilization Data
Sorted By Average Occupancy

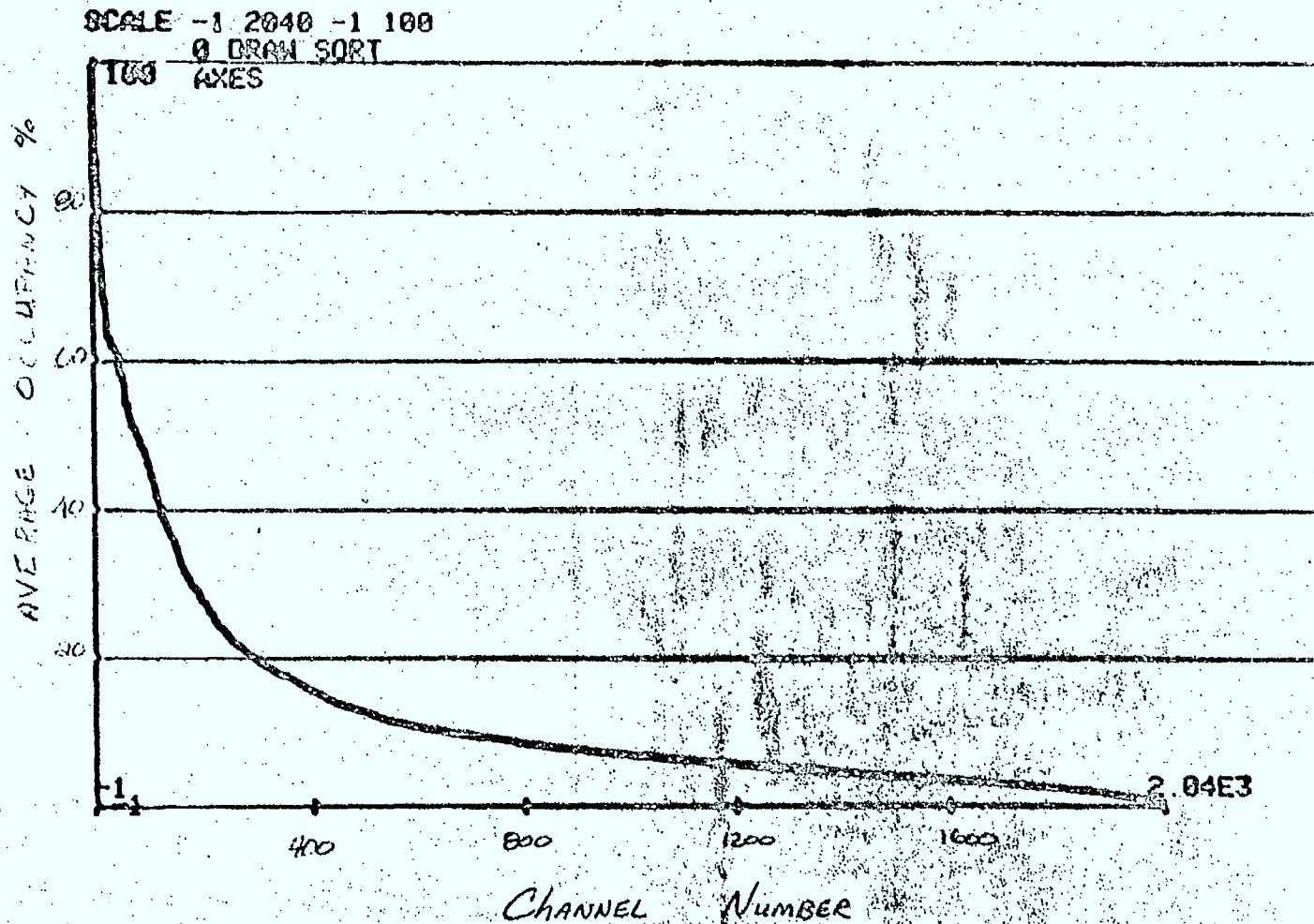


Figure 8 represents the data of figure 7 before sorting by average occupancy. It is therefore an "integrating spectrum analyzer" representation of spectrum congestion. It allows the user to determine whether specific frequency ranges are more highly congested than others. This figure is also useful for determining the effectiveness of the noise decision threshold determination algorithm. Since every second channel being measured is an interstitial and is not normally "assignable" within the monitoring coverage area, its average occupancy should be very close to 0%. The average occupancy values in figure 8 should therefore return to 0% before plotting the average occupancy of the next channel. The residual occupancy (white space) in figure 8 is thus a measure of the effectiveness of the decision algorithm.

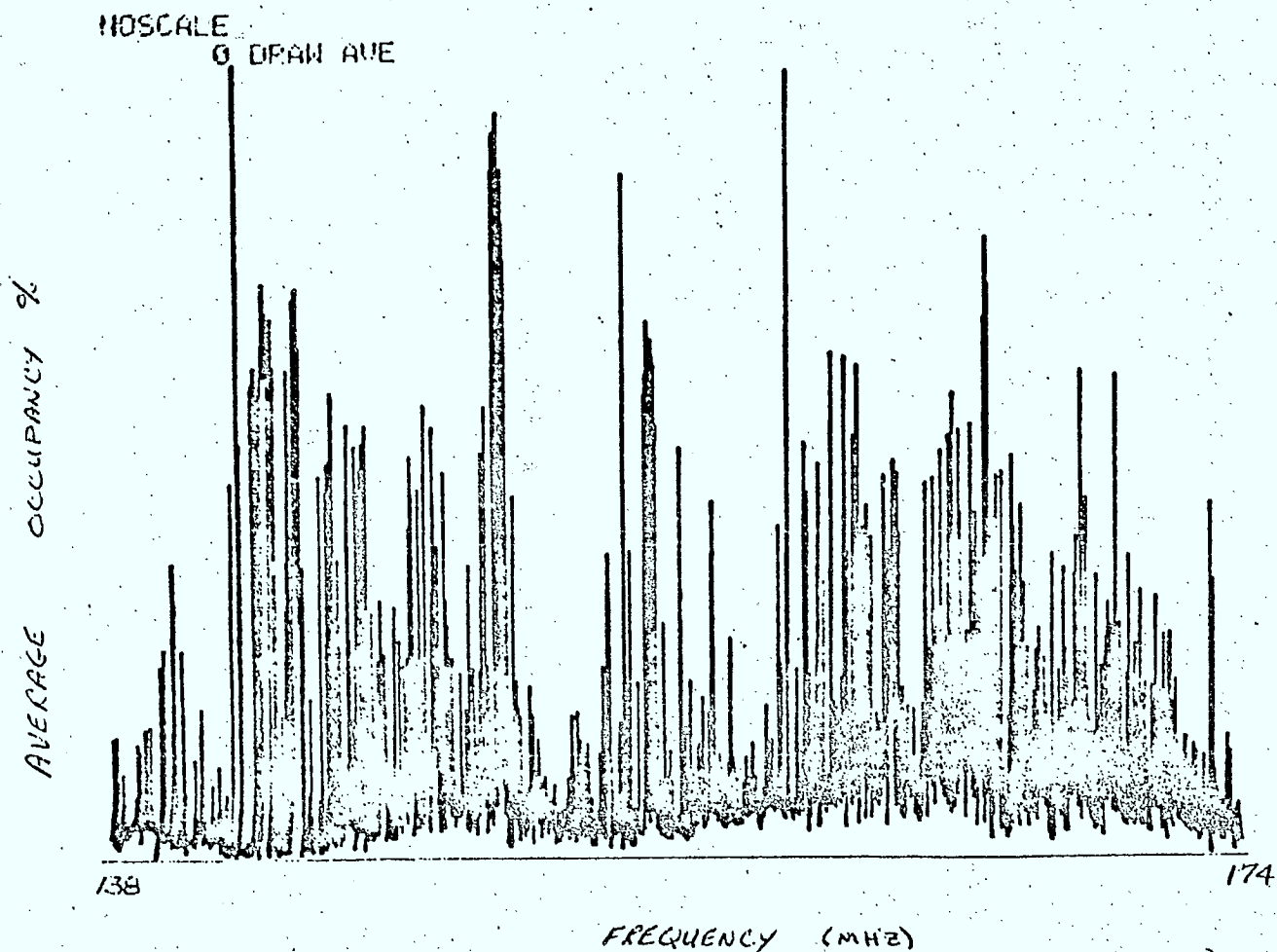
3.4 Calculation of Various Occupancy Parameters

In order to investigate the applicability of certain SRI results to the Canadian environment, programs were developed to use the data base elements to calculate various occupancy parameters and transmission characteristics such as waiting time, ratio of transmission occupancy to message occupancy and ratio of average # of transmissions per message. Listings of the routines which calculate these parameters are given in Appendix J. The format of the output from these routines is shown in figure 9. A thorough investigation of these results has not yet been carried out. However, preliminary analysis indicates that the ratio of message occupancy to transmission occupancy found by SRI to be 1.6 seems to fit well for our simplex channels. A more detailed analysis of this data is required.

3.5 Conversion of Computer Programs for the Interdata

The computer programs which implement the two pass analysis of the spectrum surveillance data tapes and the determination of the noise threshold and window decision levels have been converted for use on the Interdata 7/16 which is used to control the receiver. The analysis takes

FIGURE 8: CN TOWER Spectrum Utilization Data
SORTED BY FREQUENCY



Frequency	Ave. Peak		TX	#TX	Gap	#Gaps	M _{gap}	#Mess	#TX	TX	Mess.	M _{occ}	M _{gt}	Wait
	occ.	occ.							Mess	occ.	occ.	TX	occ.	time
161.655	99	99	57.76	219	1.17	157	102.85	62	3.53	110.99	11.58	1.01	560.20	5399.55
152.630	93	99	20.20	149	2.15	63	70.77	86	1.73	103.58	104.01	1.00	383.08	9939.74
152.510	91	99	13.05	148	4.31	46	60.06	102	1.45	99.55	100.17	1.01	311.07	0922.62
152.570	89	99	14.11	273	3.03	160	53.26	113	2.42	98.34	99.87	1.02	279.95	1113.31
152.540	88	99	34.52	229	4.73	115	52.76	114	2.01	97.25	98.97	1.02	274.99	6455.62
152.480	86	99	11.04	273	4.11	152	46.92	121	2.26	95.70	97.68	1.02	255.69	0743.07
152.660	86	99	34.57	222	4.07	105	61.23	117	1.90	94.32	95.67	1.01	258.99	5717.78
152.720	86	99	68.79	178	4.65	67	66.82	111	1.60	94.85	95.83	1.01	273.47	6289.78
152.690	82	99	24.29	231	4.24	101	66.21	130	1.78	90.64	92.00	1.01	224.15	2576.76
152.780	78	99	36.73	725	2.44	571	55.77	154	4.71	84.08	88.48	1.05	181.93	1397.30
152.810	75	99	82.68	321	1.86	233	133.27	88	3.65	83.78	85.15	1.02	306.50	1757.79
142.065	72	97	21.37	1046	2.55	882	45.01	164	6.38	79.62	87.64	1.10	150.01	1064.01
142.875	70	99	22.04	992	2.53	817	45.30	175	5.67	77.89	85.26	1.09	136.75	790.72
142.155	69	99	22.86	939	2.71	805	64.64	134	7.01	76.47	84.24	1.10	176.45	942.86
142.125	68	99	33.71	633	2.34	476	63.89	157	4.03	76.02	79.99	1.05	143.01	571.75
157.800	67	99	37.28	633	3.74	409	48.74	224	2.83	75.81	80.73	1.06	112.18	469.83
143.025	65	97	12.36	1527	2.51	1325	47.01	202	7.56	67.24	79.10	1.18	109.91	415.93
157.920	65	99	32.95	708	3.89	488	46.82	220	3.22	74.94	81.04	1.08	114.66	490.04
162.870	64	84	5.35	4104	2.44	3971	24.70	133	30.86	70.55	101.68	1.44	237.99	4394.26
141.825	63	99	12.52	1378	2.68	1146	47.24	232	5.94	61.46	72.42	1.18	87.62	230.03
157.950	63	99	28.23	798	3.85	546	43.26	252	3.17	72.36	79.11	1.09	97.72	370.10
163.230	63	87	7.11	3066	2.60	2878	32.41	188	16.31	70.01	94.07	1.34	155.76	2469.59
169.680	63	95	6.83	2853	2.82	2617	34.89	236	12.09	62.61	86.29	1.38	113.32	716.53
170.610	63	88	6.58	2969	2.81	2747	35.70	222	13.37	62.73	87.56	1.40	122.77	864.04
142.035	62	99	61.93	316	3.55	202	107.28	114	2.77	69.72	72.28	1.04	177.07	464.02
157.980	62	99	28.83	741	3.41	518	56.62	223	3.32	68.62	74.30	1.08	103.71	299.76
163.590	62	88	7.37	2912	2.35	2682	31.53	230	12.66	68.91	89.19	1.29	120.72	996.30
157.770	61	99	27.23	788	3.83	567	53.58	221	3.57	68.94	75.91	1.10	106.92	336.84
142.695	60	99	27.52	706	2.84	542	66.50	164	4.30	69.21	74.69	1.08	127.83	377.17
143.865	60	95	8.41	1930	1.81	1749	64.65	181	10.66	57.80	69.11	1.20	107.18	239.82
152.600	60	99	19.22	1067	2.56	825	51.63	242	4.41	64.76	71.43	1.10	93.49	233.68
141.765	59	99	15.86	1039	1.99	837	63.77	202	5.14	58.72	64.67	1.10	89.86	164.46
141.855	59	96	11.26	1404	1.41	1236	79.50	168	8.36	56.30	62.50	1.11	104.43	174.07
141.990	59	98	16.50	993	1.57	805	71.76	188	5.28	58.37	62.87	1.08	93.87	158.95
143.895	58	99	13.26	1262	2.65	1030	51.15	232	5.44	59.62	69.33	1.16	83.88	189.62
157.740	58	99	32.35	660	3.46	448	57.47	212	3.11	68.59	73.57	1.07	108.03	300.70
157.830	58	99	27.99	722	3.84	489	58.19	233	3.10	64.93	70.96	1.09	94.81	231.72
166.170	58	97	34.40	577	5.08	329	56.41	248	2.33	63.77	69.14	1.08	86.78	194.44
150.635	57	85	5.37	3394	2.41	3190	30.71	204	16.64	62.36	88.64	1.42	127.00	991.05
152.270	57	82	5.67	3444	2.97	3221	26.10	223	15.44	61.64	91.79	1.49	130.38	1457.71
148.855	56	89	7.85	1976	2.44	1662	34.63	314	6.29	55.30	69.76	1.26	62.36	143.82
141.435	54	93	8.15	2012	2.10	1878	107.84	134	15.01	51.72	64.16	1.24	151.81	271.79

Figure 9: Channel Statistics Output

approximately four hours and can be run during the evening when data collection for the day has finished. The analysis forms a data base with elements as described in section 3.2. It is not practical to print the raster summaries during the analysis since the on board terminal is low speed (30 cps). The standard deviations of the various parameters as recorded in the data base are also lost because of overflow problems. The results of the analysis are stored on disk and a program has been written to transfer them to tape. Work must yet be completed to allow reading these tapes on the Sigma 9 computer at CRC.

3.6 Time Stationarity

Recently, time stationarity investigations were initiated using the three days of data collected at Clyde Avenue with "SCAN 10" table. Data had been collected on the selected two hundred and forty-one channels continuously for three ten-hour days.

The effects of the raster sampling rate (spacing between five minute samples) on the determination of the average occupancy were investigated. The average occupancy for each channel was calculated based on all samples taken. The differences from these average occupancies were determined for various sampling rates. The standard deviations of these differences considering all 241 channels for various sampling rates are given in Table 2. The distribution of these differences is compared in figure 10 to the normal (1, 1) distribution using the values for the case of one raster every forty-five minutes. This distribution is typical irrespective of the raster sampling rate.

Figure 10: Comparison of distribution of deviations from the average occupancies for every ninth sample to the normal (1,1) distribution

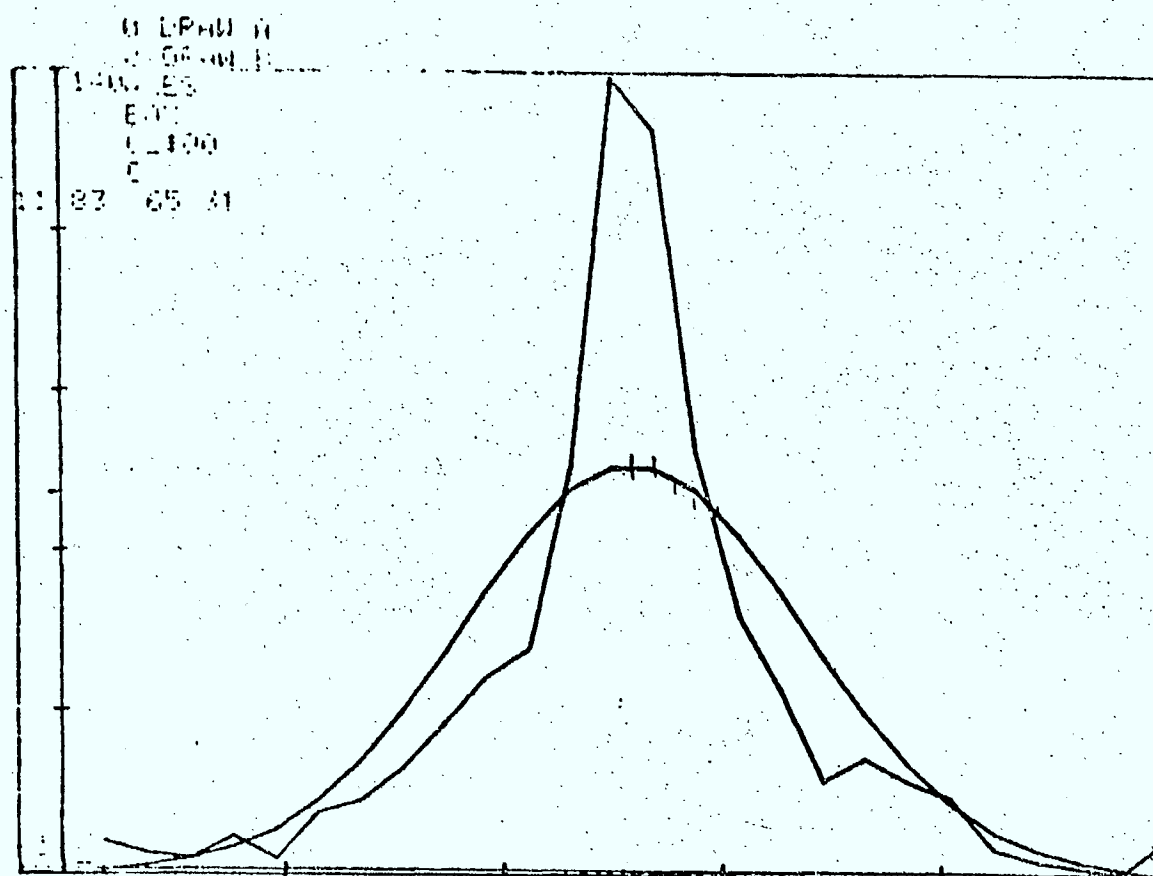


TABLE 2

EFFECT OF SAMPLE FREQUENCY ON STANDARD DEVIATION OF THE DIFFERENCES FROM THE MEANS			
<u>Sample Frequency</u>	<u>σ 5F20</u>	<u>σ 5F21</u>	<u>σ 5F22</u>
1	0 by Definition	0	0
2	.87	0.96%	0.88%
3	1.32	1.47%	1.37%
4	1.64	1.97%	1.60%
5	1.95	2.03%	1.95%
6	2.22	2.29%	2.19%
7	2.50	2.47%	2.55%
8	2.55	2.88%	2.49%
9	2.94	3.13%	2.82%
10	3.05	3.11%	2.96
11	3.36	3.49%	3.44
12	3.44	3.57%	3.21
13	3.48	3.75%	3.67
14	4.00	3.82%	3.66
15	3.78	4.18	3.95
16	4.10	4.41	3.88
17	4.13	4.26	4.20
18	4.40	4.49	4.26
19	4.38	4.57	4.40
20	4.43	4.84	4.63

Preliminary investigations were also undertaken to consider the day-to-day stationarity of the occupancy data. Correlation coefficients were calculated between the following cases:

- 1) Average occupancy of each channel using all three days of data
- 2) Average occupancy of each channel using data from CLY 2005 collected on Wednesday, Nov. 12, 1975.
- 3) Average occupancy of each channel using data from CLY 2006 collected on Thursday, Nov. 13, 1975.
- 4) Average occupancy of each channel using data from CLY 2004 collected on Friday, Nov. 7, 1975.

The correlation coefficients were as given in the following table:

TABLE 3

<u>CORRELATION COEFFICIENTS FOR DAY-TO-DAY STATIONARITY</u>		
Comparison of	# of Channels Considered	Correlation Coefficient
2 with 1	240	0.9799
3 with 1	240	0.9813
4 with 1	236	0.9639
3 with 2	240	0.9520
4 with 2	236	0.9131
4 with 3	236	0.9181

Further investigations will be required before definite conclusions can be arrived at concerning day-to-day stationarity. Other investigations which are possible with the data from this "special" scan table are:

- a) number of 5-minute samples required to characterize an hour's occupancy.
- b) diurnal occupancy patterns (distribution of occupancy over the day).
- c) preliminary calculation of user characteristics for these 240 channels.

3.7 Graphics Capabilities

Some of the graphs in this report have been produced using a Tektronics 4010 graphics terminal interfaced to a 4610 hard copy unit. The terminal is used in conjunction with the graphics driver available in APL from the Xerox Sigma 9 at CRC. A number of programs have been written in APL to produce these graphs and others. They are available in workspace KEYFILES. If these routines are to be used by other people, a DESCRIBE file must be created to explain the operation of each function.

3.8 Dual Output Suggested by Toronto District Office

A visit to the Toronto District Office revealed that the amplitude vs. frequency histograms as in figure 2 could be more useful if combined with a histogram of average occupancy. A sample of this type of output is shown in figure 11.

Another useful representation combining the results of the channel histograms, the statistics output and the DFL entries is shown in figure 12.

FREQUENCY (MHz)

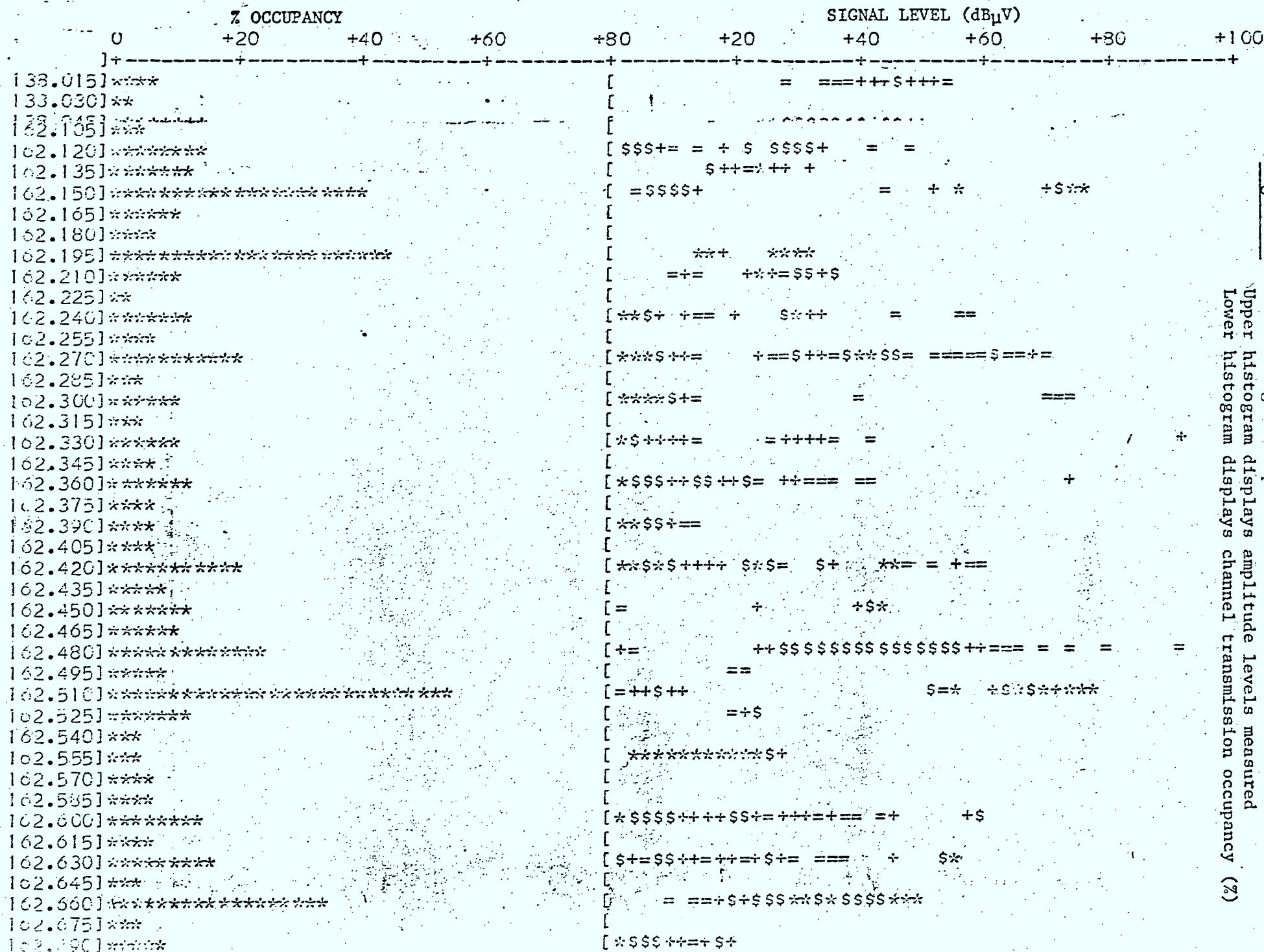


Figure 11: Dual histogram output
Upper histogram displays amplitude levels measured
Lower histogram displays channel transmission occupancy (%)

```

151.115 XNB867HAMILTON 4316 3 794922 2 FBCV 3 4.77 .0 0 .000 803211 33.9
151.115 5 28 2.69 545 3.83 299 105.29 246 2.22 4.62 8.23 1.78 10.60 .95*****
151.115] +=$$$$$$$$$+=+$$+: .....:..- .....:+= =: ..
151.130]
151.145 XJ125 MISSISSG 434326 7939 0 0 FBCV 50 18.89 6.0 120 158.970 854264 14.3
151.145 XJ125 BRAMPTON 434118 794428 0 FBCV 25 16.30 5.6 107 158.970 854264 18.0
151.145 49 9021.86 768 4.68 423 46.02 345 2.23 52.99 59.24 1.12 54.39 79.05*****
151.145] : . . . . . $ +** $*****
151.160]
151.175 33 69 7.51 1476 2.72 1118 55.50 358 4.12 34.98 44.57 1.27 39.43 31.71*****
151.175] =+$$$$$=-$$$$$+--+=+=$*****$,
151.190]
151.205 XJF933SCATHRNS 43 930 791450 0 FBCV 30 20.97 8.0 90 156.015 819499 34.2
151.205 31 77 5.37 1715 2.94 1368 56.95 347 4.94 29.07 41.77 1.44 38.13 27.35*****
151.205] :++$+:-:$*****$+!...:++:::
151.220]
151.235 XJF599MILTON 433053 7953 4 2 FBCV 0 15.85 3.0 0 .000 814584 26.4
151.235 18 75 5.19 1083 3.38 714 64.51 369 2.93 17.74 25.35 1.43 21.76 7.39*****
151.235] $ $$$*$$$- . : .:
151.250 VCX582MISSISSG 433428 7939 8 27 FBCV 30 19.90 6.1 80 .000 817164 14.1
151.250]
151.265 XJF933SCATHRNS 43 930 791450 0 FBCV 30 20.97 8.0 90 156.015 819499 34.2
151.265 26 6710.84 740 2.57 483 88.16 257 2.88 25.34 29.26 1.15 36.06 14.91*****
151.265] :*****$*****$++$.
151.280]
151.295 21 75 5.59 1111 3.64 739 62.43 372 2.99 19.62 28.11 1.43 23.93 9.36*****
151.295] .:-+-$$$$$$***$++:.
151.310]
151.325 XJJ76 WILLOWDL 4346 8 792514 69 FBCV 60 .00 .0 0 .000 804206 8.9
151.325 XJF509WILLOWDL 434317 792734 16 FBCV 25 .00 .0 0 .000 812178 6.5
151.325 22 69 4.79 1483 3.86 1086 53.59 397 3.74 22.42 35.65 1.59 28.45 15.76*****
151.325] - +++- :::-:::-+++=+====-+---:::-:++ . . :=$*+,
151.340 XJF933SCATHRNS 43 930 791450 0 FBCV 30 20.97 8.0 90 156.015 819499 34.2
151.340 XJF934GRIMSBY 4311 4 7934 8 0 FBCV 30 20.97 9.0 80 156.015 819499 32.9
151.340]
151.355 CJP938TORONTO 434336 791753 0 FBCV 60 15.50 5.6 515 151.355 803820 7.3
151.355 26 53 4.46 1849 3.70 1417 45.52 432 4.28 26.05 42.61 1.64 31.24 23.20*****
151.355] .+=+: .....:+===:-++-+==+=+:-+&-==:::-:+$*$.
151.370]
151.385 11 32 2.69 1119 4.00 715 62.40 404 2.77 9.51 18.55 1.95 14.54 3.31*****
151.385] - -+++:+-$++:
151.400 7 28 2.25 913 4.37 500 64.38 413 2.21 6.48 13.38 2.06 10.26 1.58*****
151.400] -:-:-+++-:~... . .
151.415]
151.430]

```

Figure 12: Combined output showing a channel histogram, a statistics summaries and the DFL entries for each channel monitored.

4.0 WORK REMAINING

This section should be read in the context of the original pilot SSS objective to develop a monitoring plan which will provide guidelines to determine when, where and how often to monitor with the SSS to meet the short term operational needs for frequency assignment. It therefore outlines the work remaining to meet this objective.

4.1 Analysis of Currently Available Data

The currently available data must yet be analysed to determine the usefulness of diurnal occupancy patterns in frequency assignment. The extended Toronto monitoring periods should also be analyzed to determine if the ten hour slot from 08:00 to 18:00 is the optimum monitoring period.

4.2 Further Proposed Data Collection

Further data collection will be necessary to confirm the day-to-day stationarity in order to ensure that a single van spatial correlation experiment is useful. Data must then be collected at a number of sites separated by various distances to investigate the spatial stationarity of occupancy parameters.

The output of this data collection and analysis would be a monitoring plan for the operational implementation of SSS data collection as an assistance in the short term to the frequency assignment function.

APPENDIX ASOURCE TABLE FOR SCAN 10

<u>Frequency</u>	<u>Description</u>
138.075	Ottawa Police Mobiles
139.530	Unidentified
141.030	Dept. Ext. Affairs
142.095	Ottawa Police Base
142.485	Ottawa Police
142.725	Ottawa Police Base
142.995	Ottawa Police Base
143.895	Bank of Canada
149.080	Dept. of Communications Intermod?
149.170	Ont. Dept. of Health
149.260	Stanley Aaron
149.770	Bell Canada Tone Pagers 10F2 (several)
150.215	Marc Trepanier
150.425	Belisle Auto/Fred Lafleur Co.
150.485	Brinks Canada
150.670	Hydro Quebec
150.845	Aylmer Cabs/Rene Clement
150.875	Ernest Begin
150.965	Leonard Leeks
150.995	Robert Poirier
151.025	R. Lefebvre/R.W. Proulx
151.055	Costain Estates Ltd.
151.085	Ottawa Citizen
151.265	Touraine Police
151.655	Central Precast Prod (3 , 10') ???
151.685	2
151.745	O'Leary's Ltd (GLCSTRTP)

APPENDIX APAGE 2

<u>Frequency</u>	<u>Description</u>
151.775	Constr
151.955	J.C. Perron
152.030	M.R. Gray Ltd/Rob Lacasse
152.060	Frisby Tire/Bonnermont Utility
152.150	Diamond Taxi
152.210	Bell
152.360	Francon Concrete
152.510	Bell
152.630	Bell
152.690	Bell
152.810	Bell
152.840	Bell
152.870	CBC
152.900	4 fuel Co's (Rptr In?)
152.960	Vanier Public Works
153.020	Capital Sanitation
153.170	CFRA
153.200	Eqpt. Rentals/G. Lefebvre
153.230	CKOY
153.260	Ralph Tire/Campbell Repd ⁿ
153.320	Coinmatic Eastern Ltd.
153.350	CJOH-TV
153.440	Labine Electronique/Geo. Drummond/1
153.470	Ottawa Hydro
153.500	Hull-Constr
153.560	Northern Messenger
153.620	Nat ^L Museum of Canada
153.680	Wells Fargo Armour Express
153.830	Gloucester Fire
153.890	Marc Trepanier
153.920	March Fire
153.980	Pt. Gatineau Fire
154.280	Nepean Police
154.310	Nepean Fire

APPENDIX APAGE 3

<u>Frequency</u>	<u>Description</u>
154.370	Ottawa Fire
154.460	Christie Walther (Mobiles)
154.570	Geo Vidor
154.650	Lucerne Police
154.770	Hull Police Mobiles
154.980	Gatineau Pointe Police
155.010	RCMP
155.130	Aylmer Fire
155.310	Buckingham Police and MNTC
155.640	RCMP
155.670	RCMP
155.700	RCMP
155.760	City of Vanier & Intermod
156.090	RCMP
157.620	Ubaldo Roy Hull
157.770	Bell Mobiles
157.830	Bell Mobiles
157.890	Bell Mobiles
157.950	Bell Mobiles
158.070	Bell Mobiles
158.100	Bell Mobiles
158.370	Alta Vista Mgmt. Co.
158.400	D.K. Davidson
158.430	Mac Farland Constr.
158.460	Beaver Asphalt/Hull Sanitation
158.535	Constr
158.790	Gloucester Police
159.390	Ottawa Fire
159.420	Hull Police
160.080	Cartage & Constr
160.935	CNR

APPENDIX APAGE 4

<u>Frequency</u>	<u>Description</u>
161.115	CFR
161.415	CNR
161.475	CPR
162.060	Ott Mech Ser/Nat ^L Health & Welf.
162.090	Dept. of Agriculture
162.180	M & S Martin Ltd/Hall Fuel
162.210	5 RPTR IN ?
162.270	3
162.300	Hurdman/Beaver Constr
162.330	Hilliars TV/Vetel Ltd
162.360	Gobin Everedy
162.480	Queensway Mobiles
162.510	Eastview Taxi
162.600	CGE
162.660	Bell
162.720	Ottawa Citizen
162.870	Rolland Chartrand
162.900	Excavating/Van's Mobile Wash
162.960	3 Fedec/Leblance
162.990	Frazer Buntile
163.020	Moe Laframboise
163.080	Universal Investigation (+ Intermod?)
163.110	City Ottawa Eng
163.140	Brown Excavating
163.170	Bell
163.200	6 RPTR IN?
163.230	Nepean/Kanata Taxi
163.290	Gen. Investigation (Intermod?)
163.320	3-Precast Specialties
163.350	Grant
163.380	Constr (+Intermod?)
163.501	Christie Walther
163.560	5-RPTR IN?
163.590	Ottawa Taxi Holdings

APPENDIX APAGE 5

<u>Frequency</u>	<u>Description</u>
163.710	Christie Walther RPTR
163.740	Christie Walther RPTR
163.950	Queensway Taxi
163.980	Hoffman Concrete
163.995	Universal Investigation (Walkie-Talkies)
164.040	4 - Delivery
164.235	3 - Hull
164.280	Lyttle Cartage
164.340	Time Comm Ltd. RPTR?
164.370	Paul Mefont Ltd. RPTR?
164.400	Pageette Airsignal
164.460	Christie Walther RPTR
164.490	Time Comm Ltd.
164.580	Christie Walther RPTR?
164.625	CLCSTR Road Dept
164.670	Independent Taxi
164.700	Stanley Arnold Aaron RPTR
164.880	City Ottawa Eng.
164.925	Time Comm Ltd RPTR
164.970	CJRC (Intermod?)
165.000	Ottawa Sanitation
165.060	Deschenes Constr
165.120	Prosperine/Foubert
165.240	Jones Serv
165.270	G.J. Blinn
165.345	Glcstr Rd. Dept. Mobiles
165.405	Minto Constr
165.450	Eastview Taxi (Intermod?)
165.510	Bedard-Templeton
165.600	3
165.675	Christie Walther RPTR
165.720	Auto Parts

APPENDIX APAGE 6

<u>Frequency</u>	<u>Description</u>
165.750	City Ottawa Eng.
165.780	Thomas & Fuller
165.810	Benson Ltd.
165.840	Constr
165.900	Young-Gatineau
156.960	Henry & Sons
165.990	Ontario Motor League (Intermod?)
166.020	Laurentian Cable
166.065	Minto Construction
166.110	Queensway-Base
166.215	Christie Walther RPTR
166.320	4 - IN?
166.350	Blueline Taxi
166.470	Blueline Taxi
166.575	Concrete Curbs
166.620	QPP-2
166.650	Gen Investigation Base?
166.680	QPP-2
166.770	City Ottawa Eng
166.800	QPP
166.830	QPP
166.860	Building Materials
167.070	Concrete
167.130	Blueline Taxi
167.160	11 - RPTR IN Chris Walther
167.190	4 - RPTR IN?
167.340	QPP-2
167.460	11 - RPTR IN Chris Walther
167.520	12 - RPTR IN Chris Walther
167.700	University of Ottawa
167.730	Test & Demonstration
167.910	Gervais/Barette

APPENDIX APAGE 7

<u>Frequency</u>	<u>Description</u>
167.940	Albini LaRoche
168.150	11 - RPTR IN Stan Aaron
168.180	MDM Constr
168.240	Reciprocal
168.360	8 - RPTR IN Time Comm
168.390	Paul Mefont Mobiles
168.420	Pagette Airsignal Mobiles ?
168.480	10 - RPTR IN Chris Walther
168.510	10 - RPTR IN Time Comm
168.540	Pagette Airsignal Mobiles ?
168.600	6 - RPTR IN Chris Walther
168.645	12 - RPTR IN Time Comm
168.720	Ottawa Board of Education
168.765	Citty Ott Eng. Mobile
168.870	Sec. of State (+ Intermod)
168.990	Reciprocal & Intermod
169.050	Pipe Lines
169.110	Nepean Eng
169.170	City Ott Eng Mobiles
169.230	Gloucester Hydro
169.290	Gatineau Fire
169.440	City Ottawa Eng
169.740	City Ottawa Eng Mobiles
169.890	Gatineau Police
169.950	B.P. Canada
169.980	Skyline Cable
170.040	Constr
170.100	Blueline Mobiles
170.280	4
170.310	Dept. Nat ^L Works
170.340	8 - RPTR IN Chris Walther
170.400	Keyes/Lacelle
170.430	Nepean Hydro

APPENDIX APAGE 8

<u>Frequency</u>	<u>Description</u>
170.550	Le Droit
170.580	Blueline Taxi Mobiles
171.030	Honore Houle
171.060	Journal
171.090	Duron Ont. Ltd.
171.120	Man Turf Farms
171.210	Reciprocal
171.270	Blueline Mobiles
171.435	9- RPTR IN Chris Walther
171.751	Richmond Coach Lines
172.080	Reciprocal
172.110	Will Dowdall - Carlton Place
172.260	Firestone Tire
172.290	D'Auray/Gauvreau
172.440	Service Sanitaire Outaouais
172.500	Latang-Gat Pt
172.590	U. of O.
172.620	Rooke-Cyrville
172.830	CKCH

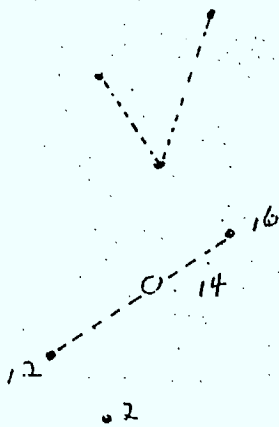
APPENDIX B

SUBROUTINE SMOOTH

This subroutine acts on the data in common block SSS DATA which contains a data base record. Specifically it does an envelope smoothing of the data in elements one to one hundred and twenty-seven. The smoothing takes place in two steps as described below:

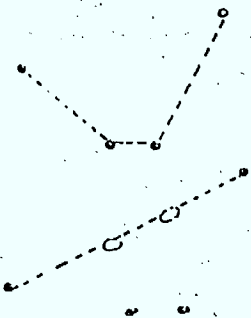
STEP ONE

The subroutine searches the data record for cases in which a data element has a value lower than each of its immediate neighbors as shown in the diagram at left. When it finds such cases, it assigns this data element a new value equal to the average value of these immediate neighboring data elements. For example, if three successive data elements had the values 12, 2 and 16, the subroutine would replace the 2 with the average of 12 and 16 (14). Consequently, when this is drawn, the portion of the curve now appears as at left without the abrupt discontinuity.



STEP TWO

The subroutine also searches for cases where two data elements have values lower than their immediate neighbors as shown at left. When it finds such cases, it reassigns these data elements such as to form a straight line between the neighboring points. The results would be as shown at left.



EDIT SMOOTH

EDIT HERE

*IY0-999

```
1.000 SUBROUTINE SMOOTH
2.000 COMMON /SSSDATA/IBUFF1,XFREQ
3.000 DIMENSION IBUFF1(174)
4.000 DIMENSION IMOD2(124)
5.000 DO 10 K=1,124
6.000 IMOD2(K)=0
7.000 10 CONTINUE
8.000 DO 11 K=4,124
9.000 IF( IBUFF1(K-1).GT.IBUFF1(K).AND.IBUFF1(K+2).GT.IBUFF1(K)
10.000 1.AND.IBUFF1(K-1).GT.IBUFF1(K+1).AND.IBUFF1(K+2).GT.IBUFF1(K+1))
11.000 2IMOD2(K)=1
12.000 11 CONTINUE
13.000 DO 12 K=3,125
14.000 IF( IBUFF1(K-1).GT.IBUFF1(K).AND.IBUFF1(K+1).GT.IBUFF1(K))
15.000 3IBUFF1(K)=(IBUFF1(K+1)+IBUFF1(K-1))/2
15.100 12 CONTINUE
16.000 DO 13 K=3,124
17.000 IF( IMOD2(K).EQ.0)GO TO 13
18.000 IBUFF1(K)=IBUFF1(K-1)+(IBUFF1(K+2)-IBUFF1(K-1))/3
19.000 IBUFF1(K+1)=IBUFF1(K-1)+2*(IBUFF1(K+2)-IBUFF1(K-1))/3
20.000 13 CONTINUE
21.000 RETURN
22.000 END
--EOF HIT AFTER 22.
```

*

APPENDIX C

NOISE SUBROUTINE

The noise subroutine acts on the smoothed data elements in common block SSS DATA to determine the noise threshold. The sum of the first twenty-five data elements is obtained. Successive data elements are then added to the sum and a comparison is made to determine if the number of counts added to the total is less than one and one-half percent of the total. The amplitude at which this occurs becomes the noise decision threshold.

EDIT NOISE

*TYO-999

```
1.000 SUBROUTINE NOISE(NSLEVEL)
2.000 COMMON /SSSDATA/IBUFF1,XFREQ
3.000 DIMENSION IBUFF1(174)
4.000 ISUM=0
5.000 DO 10 K=1,25
6.000 10 ISUM=ISUM+IBUFF1(K)
7.000 DO 11 K=26,126
8.000 ISUM=ISUM+IBUFF1(K)
9.000 IF(IBUFF1(K).LE.(.015*ISUM))GOTO 12
10.000 11 CONTINUE
11.000 12 NSLEVEL=K
12.000 RETURN
13.000 END
```

--EOF HIT AFTER 13.

*

APPENDIX D

THE PEAKS AND DECIDE SUBROUTINES

The PEAKS subroutine operates on the data elements of the common block SSSDATA to determine the peaks of the amplitudes histogram. It thus determines which signal levels exhibit activity characteristic of base stations. The DECIDE subroutine then acts on the data to determine the "windows" within which the activity measured can be assigned to the individual peaks.

EDIT PEAKS

*1Y0-999

```

1.000      SUBROUTINE PEAKS(IPEAK)
2.000      COMMON /SSSDATA/IBUFF1,XFREQ
3.000      DIMENSION IBUFF1(174)
4.000      DIMENSION IPEAK(15)
5.000      ISUM=0
6.000      DO 38 K=1,46
7.000 38    ISUM=ISUM+IBUFF1(K)
8.000      AVE=ISUM/46
8.100      ISUM=0
8.200      DO 39 K=47,126
8.300 39    ISUM=ISUM+IBUFF1(K)
8.400      AVE1=ISUM/75
9.000      DO 37 J=1,15
10.000 37   IPEAK(J)=0
11.000      K2=1
12.000      DO 36 K=5,121
12.100      IF(K.GT.46) AVE=AVE1
12.200      IF(AVE.LT.10) AVE=10
13.000      IF(IBUFF1(K).LT.AVE) GO TO 36
14.000      IF(IBUFF1(K-4).LT.IBUFF1(K).AND.IBUFF1(K-3).LT.IBUFF1(K)
15.000      1.AND.IBUFF1(K-2).LT.IBUFF1(K).AND.IBUFF1(K-1).LT.IBUFF1(K)
16.000      2.AND.IBUFF1(K+1).LT.IBUFF1(K).AND.IBUFF1(K+2).LT.IBUFF1(K)
17.000      3.AND.IBUFF1(K+3).LT.IBUFF1(K).AND.IBUFF1(K+4).LT.IBUFF1(K)
17.100      4.AND.IBUFF1(K-4).LT..9*IBUFF1(K))
18.000      4 IPEAK(K2)=K; K2=K2+1
19.000      IF(K2.GT.15) STOP 'TOO MANY PEAKS'
20.000 36   CONTINUE
21.000 X    WRITE(102,124)(IPEAK(J),J=1,15)
22.000 124  FORMAT(15I4)
23.000      RETURN
24.000      END

```

--EOF HIT AFTER 24.

*

EDIT DECIDE

*TYO-999

```
1.000 SUBROUTINE DECIDE(IPEAK,NSLEVEL,IDEC)
2.000 COMMON /SSSDATA/IBUFF1,XFREQ
3.000 DIMENSION IBUFF1(174),IPEAK(15),IDEC(4,2)
4.000 DO 16 I=1,4
5.000 IDEC(I,1)=111
5.100 IDEC(I,2)=126
5.200 16 CONTINUE
6.000 DO 15 I=1,4
7.000 MAXCT=0
8.000 DO 10 K=1,15
9.000 IF(IPEAK(K).EQ.0)GO TO 10
10.000 IF(IPEAK(K).LT.NSLEVEL)GO TO 10
11.000 IF(IPEAK(K).GT.111)RETURN
12.000 IF(IBUFF1(IPEAK(K)).GT.MAXCT)MAXCT=IBUFF1(IPEAK(K));KMAX=IPEAK(K)
13.000 10 CONTINUE
13.010 IF(MAXCT.EQ.0)RETURN
13.100 DO 18 K=1,15
14.000 IF(KMAX.EQ.IPEAK(K))IPEAK(K)=0
14.100 18 CONTINUE
15.000 DO 11 K=KMAX-1,NSLEVEL,-1
16.000 IF(IBUFF1(K).GT.IBUFF1(K+1).AND.IBUFF1(K+1).NE.0)GO TO 12
17.000 11 CONTINUE
18.000 12 IDEC(I,1)=K+1
19.000 DO 13 K=KMAX+1,111
20.000 IF(IBUFF1(K).GT.IBUFF1(K-1).AND.IBUFF1(K-1).NE.0)GO TO 14
21.000 13 CONTINUE
22.000 14 IDEC(I,2)=K-1
23.000 15 CONTINUE
24.000 DO 17 K=1,15
25.000 IF(IPEAK(K).LT.NSLEVEL)GO TO 17
26.000 IF(IPEAK(K).GT.111)GO TO 17
27.000 IF(IPEAK(K).EQ.0)GO TO 17
28.000 WRITE(102,100)XFREQ
29.000 100 FORMAT('WARNING: MORE THAN FOUR PEAKS ON ',F9.3,' MHZ')
30.000 17 CONTINUE
31.000 END
```

--EOF HIT AFTER 31.

*

APPENDIX E

THE PASS 1 PROCESSING

The PASS 1 programs are designed to read the SSS data tapes and to create a data base record with elements one to one hundred and twenty-seven representing the probability of measuring any analog signal level from -36 to +90 dB μ V for any specific frequency based on an integration of past measurements. For each raster, the ICUME array is used to integrate the number of counts at each signal level for each of the channels monitored (maximum two hundred and forty-six). When processing of the raster is complete, then the data base records are updated using the ICUME values. PASS 1 processes only the scan table information records and the data records; the other record types are read and skipped. The ONECALL and UNBLOCK subroutines were written to handle the non standard spanned block formatted records. The POSITN subroutine is used to avoid processing the first raster on the tape which in our case is usually a set-up run to ensure the equipment is functioning properly.

*1Y0-999

```
1.000 COMMON /SSSDATA/IBUFF1,XFREQ
2.000 INTEGER STATUS
3.000 DIMENSION IBUFF1(174)
4.000 DIMENSION ICUME(246,127)
5.000 IRAST=0
6.000 DIMENSION FREQ(246)
7.000 COMMON /TAPEREC/IBUFF(558),KHAR(2232)
8.000 COMMON /DATA/ILEVEL(246),KSCAN,I3DB,IGAP
9.000 COMMON /LGCLUNIT/ITAPE,IOUT,IN1,IN2,IOUT1,IOUT2
10.000 IRUN=8Z75910C00
11.000 ISCAN=8Z1EB2C000
12.000 ITABLE=8Z6B23C000
13.000 IDATA=8Z56470000
14.000 ITRAIL=8Z23D60000
15.000 ITAPE=1
16.000 IOUT=2
17.000 ICOUNT=0
18.000 10 CALL BUFFERIN(ITAPE,1,IBUFF,558,IND,IWORDS)
19.000 ICOUNT=ICOUNT+1
20.000 IF(IND.EQ.3)GO TO 20
21.000 IEND=0
22.000 IF(IBUFF(1).EQ.IRUN)GO TO 200
23.000 IF(IBUFF(1).EQ.ISCAN)GO TO 300
24.000 IF(IBUFF(1).EQ.ITABLE)GO TO 400
25.000 IF(IBUFF(1).EQ.IDATA)GO TO 500
26.000 IF(IBUFF(1).EQ.ITRAIL)GO TO 600
27.000 OUTPUT(102) 'INVALID RECORD IDENTIFIER'
28.000 GO TO 10
29.000 200 CONTINUE
30.000 GO TO 10
31.000 300 CONTINUE
32.000 GO TO 10
33.000 400 CONTINUE
34.000 CALL UNPACK(IBUFF,2232,KHAR)
35.000 ILOOP=KHAR(18)
36.000 IF(ILOOP.GT.246)STOP '# OF CHS TOO LARGE'
37.000 DO 401 I=1,ILOOP
38.000 CALL PACK(KHAR(9*I+11),4,IFREQ)
39.000 FREQ(I)=IFREQ/10.**6
40.000 401 CONTINUE
41.000 GO TO 10
42.000 500 CONTINUE
43.000 IRAST=IRAST+1
44.000 IF(IRAST.EQ.1)CALL POSITN(300S)
45.000 OUTPUT(102)IRAST
46.000 ICIR=1
47.000 DO 602 KP=1,ILOOP
48.000 DO 602 KA=1,127
49.000 ICUME(KP,KA)=0
50.000 602 CONTINUE
51.000 ISCAN=1
52.000 ISTOP=0
53.000 I3DB=0
54.000 CALL ONECALL(I)
55.000 GO TO 608
56.000 601 CALL UNBLOCK(I,ISTOP)
57.000 608 DO 603 J=1,ILOOP
58.000 ICUME(J,ILEVEL(J)+37)=ICUME(J,ILEVEL(J)+37)+1
59.000 603 CONTINUE
60.000 IF(ISTOP.NE.1)GO TO 601
61.000 DO 604 KP=1,ILOOP
62.000 IFREQ=FREQ(KP)*1000
63.000 KEY=8Z03000000+IFREQ
64.000 CALL KEYREAD(3,0,IBUFF1,175,KEY,STATUS,LEN)
```

```
65.000 IF(STATUS.EQ.0)GO TO 606
66.000 DO 607 I=1,174
67.000 607 IBUFF1(I)=0
68.000 IBUFF1(130)=-999
69.000 XFREQ=FREQ(KP)
70.000 606 DO 605 KA=1,127
71.000 IBUFF1(KA)=IBUFF1(KA)+ICUME(KP,KA)
72.000 605 CONTINUE
73.000 IF(XFREQ.NE.FREQ(KP))STOP 'WRONG RECORD KEYED IN'
74.000 IBUFF1(135)=ILOOP
75.000 IBUFF1(138)=IBUFF1(138)+1
76.000 KEY=8Z03000000+IFREQ
77.000 CALL KEYBUFOUT(3,1,IBUFF1,175,IND,KEY)
78.000 604 CONTINUE
79.000 GO TO 10
80.000 600 CONTINUE
81.000 GO TO 10
82.000 20 IF(IEND.EQ.1)STOP 'END OF TAPE'
83.000 IEND=IEND+1
84.000 GO TO 10
85.000 END
+ EOF HIT AFTER 85.
```

*

*110-999

```
1.000 SUBROUTINE ONECALL(I)
2.000 COMMON /TAPEREC/IBUFF(558),KHAR(2232)
3.000 COMMON /DATA/ILEVEL(246),KSCAN,I3DB,IGAP
4.000 COMMON /LGCLUNIT/ITAPE,IOUT,IN1,IN2,IOUT1,IOUT2
5.000 IDATA=8Z56470000
6.000 DIMENSION IPACK(4)
7.000 CALL UNPACK(IBUFF,2048,KHAR)
8.000 IPACK(1)=8Z00000000
9.000 IPACK(2)=8Z00000000
10.000 IPACK(3)=KHAR(10)
11.000 IPACK(4)=KHAR(11)
12.000 I3DB=KHAR(12)
13.000 IGAP=KHAR(13)
14.000 CALL PACK(IPACK,4,KSCAN)
15.000 IF(KSCAN.EQ.1)GO TO 10
16.000 WRITE(IOUT,100)
17.000 100 FORMAT('WARNING: FIRST DATA RECORD NOT FIRST SCAN')
18.000 CALL POSITN
19.000 STOP 'ERROR RETURN FROM POSITION'
20.000 10 I=14
21.000 11 NCHAN=0
22.000 INDTR=0
23.000 12 NCHAN=NCHAN+1
24.000 IF(KHAR(I).EQ.2Z80)RETURN
25.000 IF(KHAR(I).GT.127)KHAR(I)=KHAR(I)-256
26.000 ILEVEL(NCHAN)=KHAR(I)
27.000 I=I+1
28.000 GO TO 12
29.000 END
30.000 SUBROUTINE UNBLOCK(I,ISTP)
31.000 COMMON /TAPEREC/IBUFF(558),KHAR(2232)
32.000 COMMON /DATA/ILEVEL(246),KSCAN,I3DB,IGAP
33.000 COMMON /LGCLUNIT/ITAPE,IOUT,IN1,IN2,IOUT1,IOUT2
34.000 IDATA=8Z56470000
35.000 DIMENSION IPACK(4)
35.100 IPACK(1)=8Z00000000
35.200 IPACK(2)=8Z00000000
36.000 I=I+1
37.000 IF(I.GT.2043)INDTR=1;GO TO 10
38.000 11 IPACK(3)=KHAR(I)
39.000 I=I+1
40.000 IF(I.GT.2043)INDTR=2;GO TO 10
41.000 12 IPACK(4)=KHAR(I)
42.000 CALL PACK(IPACK,4,KSCAN)
43.000 I=I+1
44.000 IF(I.GT.2043)INDTR=3;GO TO 10
45.000 13 I3DB=KHAR(I)
46.000 I=I+1
47.000 IF(I.GT.2043)INDTR=4;GO TO 10
48.000 14 IGAP=KHAR(I)
49.000 I=I+1
50.000 IF(I.GT.2043)INDTR=5;GO TO 10
51.000 15 NCHAN=0
52.000 INDTR=0
53.000 16 NCHAN=NCHAN+1
54.000 IF(KHAR(I).EQ.2Z80)RETURN
55.000 IF(KHAR(I).EQ.2Z83)ISTP=1;RETURN
56.000 IF(KHAR(I).GT.127)KHAR(I)=KHAR(I)-256
57.000 ILEVEL(NCHAN)=KHAR(I)
58.000 I=I+1
59.000 IF(I.LE.2043)GO TO 16
60.000 10 CALL BUFFERIN(ITAPE,1,IBUFF,512,IND,NWORDS)
61.000 IF(IND.EQ.3)STOP 'END OF DATA ERROR'
62.000 IF(IBUFF(1).NE.IDATA)STOP 'RASTER SENTINEL ERROR'
```

```

63.000 CALL UNPACK(IBUFF,2048,KHAR)
64.000 I=10
65.000 IF(INDTR.EQ.0)GO TO 16
66.000 GOTO(11,12,13,14,15)INDTR
67.000 STOP 'FATAL PGM ERROR--INVALID DATA COUNT INDICATOR'
68.000 END
69.000 SUBROUTINE POSITN(NEXT)
70.000 COMMON /TAPEREC/IBUFF(558),KHAR(2232)
71.000 ISCAN=8Z1EB20000
72.000 COMMON /LGCLUNIT/ITAPE,IOUT,IN1,IN2,IOUT1,IOUT2
73.000 10 CALL BUFFERIN(ITAPE,1,IBUFF,512,IND,IWORDS)
74.000 IF(IND.EQ.3)STOP 'END OF FILE ENCOUNTERED ON CALL POSITN'
75.000 IF(IBUFF(1).EQ.ISCAN)GO TO NEXT
76.000 GO TO 10
77.000 END

```

--EOF HIT AFTER 77.

*

APPENDIX F

LISTING OF MAIN PROGRAM TO CALCULATE THE NOISE
THRESHOLD AND THE WINDOW DECISION LEVELS AND TO
ENTER THEM IN THE DATA BASE RECORDS

EDIT HERE

*1Y0-999

```
1.000 COMMON /SSSDATA/IBUFF1(174),XFREQ
1.100 DIMENSION IPEAK(15),IDEC(4,2)
2.000 10 CALL BUFFERIN(3,1,IBUFF1,175,IND,NWORDS)
3.000 IF(IND.EQ.3)STOP 'END OF FILE'
4.000 CALL SMOOTH
5.000 CALL NOISE(NSLEV)
6.000 CALL PEAKS(IPEAK)
7.000 CALL DECIDE(IPEAK,NSLEV,IDEC)
8.000 CALL POSREC(3,-1)
9.000 CALL BUFFERIN(3,1,IBUFF1,175,IND,NWORDS)
10.000 IFREQ=XFREQ*1000
11.000 KEY=8Z03000000+IFREQ
12.000 DO 20 I=139,174
13.000 IBUFF1(I)=0
14.000 20 CONTINUE
15.000 DO 30 I=128,134
16.000 30 IBUFF1(I)=0
17.000 IBUFF1(136)=0
18.000 IBUFF1(137)=0
19.000 IBUFF1(156)=NSLEV
20.000 IBUFF1(157)=IPEAK(1)
21.000 IBUFF1(158)=IPEAK(2)
22.000 IBUFF1(159)=IPEAK(3)
23.000 IBUFF1(160)=IPEAK(4)
24.000 IBUFF1(161)=IPEAK(5)
25.000 IBUFF1(162)=IPEAK(6)
26.000 IBUFF1(163)=IPEAK(7)
27.000 IBUFF1(164)=IPEAK(8)
28.000 IBUFF1(167)=IDEC(1,1)
29.000 IBUFF1(168)=IDEC(1,2)
30.000 IBUFF1(169)=IDEC(2,1)
31.000 IBUFF1(170)=IDEC(2,2)
32.000 IBUFF1(171)=IDEC(3,1)
33.000 IBUFF1(172)=IDEC(3,2)
34.000 IBUFF1(173)=IDEC(4,1)
35.000 IBUFF1(174)=IDEC(4,2)
36.000 CALL KEYBUFOUT(3,1,IBUFF1,175,IND,KEY)
37.000 GO TO 10
38.000 END
```

--EOF HIT AFTER 38.

*

APPENDIX G

LISTING OF PASS 2 PROGRAMS

The PASS 2 processing is used to calculate and accumulate the various occupancy and transmission parameters of interest. It implements the calculations as described in Appendix I for each frequency in the scan table. The ASCII subroutine is a primitive one for the conversion of ASCII characters to EBCDIC ones. Subroutines are also used to decode each record type.

*110-999

```

1.000 COMMON /SSSDATA/IBUFF1,XFREQ
2.000 INTEGER STATUS
3.000 DIMENSION IBUFF1(174)
4.000 DIMENSION NSLEV(246,9),IDECL(246,9,4),IDECH(246,9,4)
5.000 DIMENSION SRIML(6),ITM(246,6),ITB(246,6),ITE(246)
6.000 DIMENSION IMPC(246),IVAL(246)
7.000 DIMENSION NLEV(246)
8.000 DIMENSION ITG(246),ITGSQ(246)
9.000 DIMENSION ITMSQ(246,6),ITP(246),ITCG(246)
10.000 DIMENSION SIGTL(6)
11.000 DIMENSION IMG(246),IMGSQ(246),IMCG(246)
12.000 DIMENSION ILOOP(9),A0CC3(246)
13.000 DIMENSION IPEAK(15),IDEC(4,2)
14.000 IRAST=0
15.000 DIMENSION FREQ(246,9),NLEVEL(3,246)
16.000 DIMENSION IHD(270)
17.000 COMMON /TAPEREC/IBUFF(558),KHAR(2232)
18.000 COMMON /DATA/ILEVEL(246),NSCAN,I3DB,IGAP
19.000 COMMON /LGCLUNIT/ITAPE,IOUT,IN1,IN2,IOUT1,IOUT2
20.000 IRUN=8Z75910000
21.000 ISCAN=8Z1EB20000
22.000 ITABLE=8Z6B230000
23.000 IDATA=8Z56470000
24.000 ITRAIL=8Z23D60000
25.000 ITAPE=1
26.000 IOUT=2
27.000 DO 15 I=1,246
28.000 DO 15 J=1,9
29.000 FREQ(I,J)=0.0
30.000 ILOOP(J)=0
31.000 15 CONTINUE
32.000 ICOUNT=0
33.000 11 CONTINUE
34.000 CALL BUFFERIN(ITAPE,1,IBUFF,558,IND,IWORDS)
35.000 IF(IND.EQ.3)STOP 'FATAL ERROR ON PRELIM TAPE READ'
36.000 IF(IBUFF(1).EQ.ITABLE)GO TO 12
37.000 GO TO 11
38.000 12 IF(ICOUNT.EQ.0)ICOUNT =ICOUNT+1;GO TO 11
39.000 IF(ICOUNT.EQ.10)GO TO 13
40.000 CALL UNPACK(IBUFF,2232,KHAR)
41.000 ILOOP(ICOUNT)=KHAR(18)
42.000 IF(ILOOP(ICOUNT).GT.246)STOP '# OF CHS TOO LARGE'
43.000 DO 14 I=1,ILOOP(ICOUNT)
44.000 CALL PACK(KHAR(9*I+11),4,IFREQ)
45.000 FREQ(I,ICOUNT)=IFREQ/10.**6
46.000 14 CONTINUE
47.000 ICOUNT=ICOUNT+1
48.000 GO TO 11
49.000 13 REWIND (ITAPE)
50.000 DO 16 KSCAN=1,9
51.000 DO 16 I=1,ILOOP(KSCAN)
52.000 C
53.000 C READ DATA BASE RECORDS AND DETERMINE NOISE LEVELS,
54.000 C UPPER AND LOWER DECISION LEVELS
55.000 C
56.000 IFREQ=FREQ(I,KSCAN)*1000
57.000 KEY=8Z03000000+IFREQ
58.000 CALL KEYREAD(3,0,IBUFF1,175,KEY,STATUS,LEN)
59.000 IF(STATUS.EQ.0)GO TO 17
60.000 STOP 'IRRECOVERABLE READ ERROR'
61.000 17 NSLEV(I,KSCAN)=IBUFF1(156)-36
62.000 DO 18 J=1,4
63.000 IDECL(I,KSCAN,J)=IBUFF1(165+J*2)-36
64.000 IDECH(I,KSCAN,J)=IBUFF1(166+J*2)-36

```

```

09.000 10 CONTINUE
70.000 X WRITE(IOUT,150)FREQ(I,KSCAN),NSLEV(I,KSCAN),(IDECL(I,KSCAN,J),
71.000 X IDECH(I,KSCAN,J),J=1,4)
72.000 150 FORMAT(1X,F9.3,15,4(2X,I3,2X,I3))
73.000 16 CONTINUE
74.000 KSCAN=0
75.000 10 CALL BUFFERIN(ITAPE,1,IBUFF,558,IND,IWORDS)
76.000 IF(IND.EQ.3)GO TO 20
77.000 IEND=0
78.000 IF(IBUFF(1).EQ.IRUN)GO TO 200
79.000 IF(IBUFF(1).EQ.ISCAN)GO TO 300
80.000 IF(IBUFF(1).EQ.ITABLE)GO TO 400
81.000 IF(IBUFF(1).EQ.IDATA)GO TO 500
82.000 IF(IBUFF(1).EQ.ITRAIL)GO TO 600
83.000 OUTPUT(102) 'INVALID RECORD IDENTIFIER'
84.000 GO TO 10
85.000 200 CONTINUE
86.000 WRITE(IOUT,100)
87.000 100 FORMAT('DEPARTMENT OF COMMUNICATIONS',/,
88.000 1 'OPERATIONAL TECHNICAL SUPPORT DIVISION',/,
89.000 2 'SPECTRUM SURVEILLANCE SYSTEM TAPE ANALYSIS',/,,)
90.000 CALL RUNHD
91.000 GO TO 10
92.000 300 CONTINUE
93.000 CALL UNPACK(IBUFF,270,KHAR)
94.000 DO 301 I=10,270
95.000 CALL ASCII(KHAR(I),IHD(I))
96.000 301 CONTINUE
97.000 GO TO 10
98.000 400 CONTINUE
99.000 IF(KSCAN.EQ.0)KSCAN=1;CALL POSITN(300S)
100.000 IF(KSCAN.EQ.10)KSCAN =1
101.000 GO TO 10
102.000 500 CONTINUE
103.000 IRAST=IRAST+1
104.000 OUTPUT(102)IRAST
105.000 ICTR=1
106.000 DO 701 KP=1,ILOOP(KSCAN)
107.000 IVAL(KP)=0
108.000 IMPC(KP)=0
109.000 ITG(KP)=0
110.000 ITP(KP)=0
111.000 ITGSQ(KP)=0
112.000 ITE(KP)=0
113.000 NLEV(KP)=0
114.000 ITCG(KP)=0
115.000 IMG(KP)=0
116.000 IMCG(KP)=0
117.000 IMGSQ(KP)=0
118.000 DO 701 J=1,6
119.000 ITMSQ(KP,J)=0
120.000 ITM(KP,J)=0
121.000 ITB(KP,J)=0
122.000 701 CONTINUE
124.000 ISTOP=0
125.000 I3DB=0
126.000 CALL ONECALL(I)
127.000 GO TO 502
128.000 504 CALL UNBLOCK(I,ISTP)
129.000 502 CONTINUE
130.000 DO 503 J=1,246
131.000 NLEVEL(ICTR,J)=ILEVEL(J)
132.000 503 CONTINUE
133.000 IF(ICTR.GE.3)GO TO 702
134.000 ICTR=ICTR+1

```

```

136.000 702 DO 500 LB=1, ILOOP(KSCAN)
137.000 546 IF(NLEVEL(1, LB).LE.NSLEV(LB, KSCAN).AND.NLEVEL(3, LB).LE.-2.AND.NLEVEL
138.000 IEL(2, LB).GE.(NSLEV(LB, KSCAN)+6))GO TO 703
139.000 GO TO 697
140.000 703 IMPC(LB)=IMPC(LB)+1
141.000 GO TO 565
142.000 697 CONTINUE
143.000 C TRANSMISSION LENGTH
144.000 1127 IF(NLEVEL(2, LB).LT.NSLEV(LB, KSCAN))GO TO 1411
145.000 ITE(LB)=ITE(LB)+1
146.000 NLEV(LB)=NLEV(LB)+NLEVEL(2, LB)
147.000 IF(ISTP.NE.1)GO TO 1410
148.000 1411 IF(ITE(LB).EQ.0)GO TO 1410
149.000 ITM(LB, 1)=ITM(LB, 1)+ITE(LB)
150.000 ITMSQ(LB, 1)=ITMSQ(LB, 1)+ITE(LB)*ITE(LB)
151.000 ITB(LB, 1)=ITB(LB, 1)+1
152.000 ILEV=NLEV(LB)/ITE(LB)
153.000 DO 202 J=2, 5
154.000 IF(ILEV.GE.IDECL(LB, KSCAN, J-1).AND.ILEV.LE.IDECH
155.000 1(LB, KSCAN, J-1))GO TO 203
156.000 202 CONTINUE
157.000 J=6
158.000 203 CONTINUE
159.000 ITM(LB, J)=ITM(LB, J)+ITE(LB)
160.000 ITMSQ(LB, J)=ITMSQ(LB, J)+ITE(LB)*ITE(LB)
161.000 ITB(LB, J)=ITB(LB, J)+1
162.000 ITE(LB)=0
163.000 NLEV(LB)=0
164.000 1410 CONTINUE
165.000 C TRANSMISSION GAP LENGTH
166.000 IF(NLEVEL(2, LB).GE.NSLEV(LB, KSCAN))GO TO 1511
167.000 ITP(LB)=ITP(LB)+1
168.000 IF(ISTP.NE.1)GO TO 1510
169.000 1511 IF(ITP(LB).EQ.0)GO TO 1510
170.000 C
171.000 C MODIFICATION FOR INTRA-MESSAGE TRANSMISSION GAPS
172.000 C ASSUME TRANSMISSION GAPS ARE LESS THAN 14 SAMPLES LONG
173.000 C
174.000 IF(ITP(LB).GE.(3444/ILOOP(KSCAN)))GO TO 1512
175.000 C
176.000 C INTRA-MESSAGE GAPS
177.000 C
178.000 ITG(LB)=ITG(LB)+ITP(LB)
179.000 ITGSQ(LB)=ITGSQ(LB)+ITP(LB)*ITP(LB)
180.000 ITCG(LB)=ITCG(LB)+1
181.000 GO TO 1513
182.000 1512 CONTINUE
183.000 C
184.000 C INTER-MESSAGE GAP
185.000 C
186.000 IMG(LB)=IMG(LB)+ITP(LB)
187.000 IMGSQ(LB)=IMGSQ(LB)+ITP(LB)*ITP(LB)
188.000 IMCG(LB)=IMCG(LB)+1
189.000 1513 CONTINUE
190.000 ITP(LB)=0
191.000 1510 CONTINUE
192.000 565 NLEVEL(1, LB)=NLEVEL(2, LB)
193.000 NLEVEL(2, LB)=NLEVEL(3, LB)
194.000 560 CONTINUE
195.000 IF(ISTP.NE.1)GO TO 504
199.000 SLENG=.0037*FLOAT(ILOOP(KSCAN))
200.000 DO 930 I=1, ILOOP(KSCAN)
201.000 IVAL(I)=NSCAN-IMPC(I)
202.000 AB=1./FLOAT(IVAL(I))
203.000 AOCC3(I)=AB*FLOAT(ITM(I, 1))

```



```

205.000 SRIML(J)=SIGTL(J)=0.0
206.000 SIGMG=SRITG=SIGTG=AMG=0.0
207.000 IF(ITB(I,J).GT.0)SRIML(J)=(FLOAT(ITM(I,J))*SLENG)/FLOAT(ITB(I,J))
208.000 IF(ITB(I,J).GT.1)SIGTL(J)=SQRT((FLOAT(ITMSQ(I,J))-FLOAT(ITB(I,J))
209.000 1SRIML(J)**2)/FLOAT(ITB(I,J)-1))*SLENG
210.000 250 CONTINUE
211.000 IF(ITCG(I).GT.0)
212.000 1SRITG =SLENG*FLOAT(ITG(I))/FLOAT(ITCG(I))
213.000 IF(IMCG(I).GT.0)AMG =SLENG*FLOAT(IMG(I))/FLOAT(IMCG(I))
214.000 IF(ITCG(I).GT.1)
215.000 1SIGTG =SLENG*SQRT((FLOAT(ITGSQ(I))-FLOAT(ITCG(I))*SRITG **2)
216.000 2/FLOAT(ITCG(I)-1))
217.000 IF(IMCG(I).GT.1)SIGMG =
218.000 1SLENG*SQRT((FLOAT(IMGSQ(I))-FLOAT(IMCG(I))*AMG **2)/
219.000 2FLOAT(IMCG(I)-1))
220.000 IF(SRIML(1).LT.2.0.AND.SRIML(2).LT.2.0.AND.SRIML(3).LT.2.0.
221.000 1AND.SRIML(4).LT.2.0.AND.SRIML(5).LT.2.0)GO TO 930
222.000 X IF(AOCC3(I).GE..05.AND.ITB(I,1).GE.3)
223.000 WRITE(4,122)FREQ(I,KSCAN),AOCC3(I),(IHD(J),J=15,18),AMG,
224.000 1SIGMG,(SRIML(J),SIGTL(J),ITB(I,J),J=1,6),SRITG,SIGTG,ITCG(I),
225.000 2NSLEV(I,KSCAN)
226.000 930 CONTINUE
227.000 122 FORMAT(F9.3,1X,F4.2,1X,2R1,' ',2R1,1X,
228.000 1F5.1,1X,F5.1,6(F5.1,F5.1,14),F5.1,F5.1,13,13)
229.000 116 FORMAT(1X,14,1X,11,10I5)
230.000 C *****
231.000 DO 604 KP=1,ILOOP(KSCAN)
232.000 IFREQ=FREQ(KP,KSCAN)*1000
233.000 KEY=8Z03000000+IFREQ
234.000 CALL KEYREAD(3,0,IBUFF1,175,KEY,STATUS,LEN)
235.000 IF(STATUS.EQ.0)GO TO 606
236.000 STOP 'IRRECOVERABLE READ ERROR'
237.000 606 CONTINUE
238.000 IF(XFREQ.NE.FREQ(KP,KSCAN))STOP 'WRONG RECORD KEYED IN'
239.000 IBUFF1(128)=IBUFF1(128)+ITG(KP)
240.000 IBUFF1(129)=IBUFF1(129)+ITCG(KP)
241.000 IBUFF1(130)=IBUFF1(130)+ITGSQ(KP)
242.000 IBUFF1(131)=IBUFF1(131)+IMG(KP)
243.000 IBUFF1(132)=IBUFF1(132)+IMCG(KP)
244.000 IBUFF1(133)=IBUFF1(133)+IMGSQ(KP)
245.000 IBUFF1(134)=IBUFF1(134)+ITB(KP,1)-ITCG(KP)+1
246.000 IBUFF1(136)=IBUFF1(136)+ITM(KP,1)
247.000 IBUFF1(137)=IBUFF1(137)+ITB(KP,1)
248.000 IBUFF1(139)=IBUFF1(139)+ITMSQ(KP,1)
249.000 IBUFF1(140)=IBUFF1(140)+ITM(KP,2)
250.000 IBUFF1(141)=IBUFF1(141)+ITB(KP,2)
251.000 IBUFF1(142)=IBUFF1(142)+ITMSQ(KP,2)
252.000 IBUFF1(143)=IBUFF1(143)+ITM(KP,3)
253.000 IBUFF1(144)=IBUFF1(144)+ITB(KP,3)
254.000 IBUFF1(145)=IBUFF1(145)+ITMSQ(KP,3)
255.000 IBUFF1(146)=IBUFF1(146)+ITM(KP,4)
256.000 IBUFF1(147)=IBUFF1(147)+ITB(KP,4)
257.000 IBUFF1(148)=IBUFF1(148)+ITMSQ(KP,4)
258.000 IBUFF1(149)=IBUFF1(149)+ITM(KP,5)
259.000 IBUFF1(150)=IBUFF1(150)+ITB(KP,5)
260.000 IBUFF1(151)=IBUFF1(150)+ITMSQ(KP,5)
261.000 IBUFF1(152)=IBUFF1(152)+ITM(KP,6)
262.000 IBUFF1(153)=IBUFF1(153)+ITB(KP,6)
263.000 IBUFF1(154)=IBUFF1(154)+ITMSQ(KP,6)
264.000 IOCC=100*AOCC3(KP)
265.000 IBUFF1(155)=MAX0(IBUFF1(155),IOCC)
267.000 IBUFF1(166)=IBUFF1(166)+IVAL(KP)
268.000 IBUFF1(165)=IBUFF1(165)+IMPC(KP)
269.000 KEY=8Z03000000+IFREQ
270.000 CALL KEYREAD(3,0,IBUFF1,175,KEY,STATUS,LEN)

```


272.000 KSCAN=KSCAN+1
273.000 GO TO 10
274.000 600 CONTINUE
275.000 CALL TRAIL
276.000 GO TO 10
277.000 20 IF(IEND.EQ.1)STOP 'END OF TAPE'
278.000 IEND=IEND+1
279.000 GO TO 10
280.000 END

--EOF HIT AFTER 280.

*

EDIT ASCII

*FY0-999

```

.100 C    TEST SUBROUTINE
.110 X10   CONTINUE
.200 X     READ(1,100)IN
.210 X     IF(IN.EQ.8Z00000000)STOP
.300 X100  FORMAT(Z8)
.400 X     CALL ASCII(IN,IOUT)
.500 X     WRITE(2,101)IOUT
.600 X101  FORMAT(A4)
.610 X     GO TO 10
.700 X     STOP
.800 X     END

```

1.000 SUBROUTINE ASCII(IN,IOUT)

2.000 DIMENSION ICHAR(40)

3.000	DATA ICHAR//	0	1	2	3	4	5	6	7
4.000	1' 8 9 A B C D E F G H I								
5.000	2' J K L M N O P Q R S T								
6.000	3' U V W X Y Z - = */								

6.100 DATA ITEM// @//

6.110 IOUT=ITEM

7.000 IF(IN.EQ.2Z30)IOUT=ICHAR(1)

8.000 IF(IN.EQ.2Z31)IOUT=ICHAR(2)

8.010 IF(IN.EQ.2Z32)IOUT=ICHAR(3)

8.020 IF(IN.EQ.2Z33)IOUT=ICHAR(4)

8.030 IF(IN.EQ.2Z34)IOUT=ICHAR(5)

8.040 IF(IN.EQ.2Z35)IOUT=ICHAR(6)

8.050 IF(IN.EQ.2Z36)IOUT=ICHAR(7)

8.060 IF(IN.EQ.2Z37)IOUT=ICHAR(8)

8.070 IF(IN.EQ.2Z38)IOUT=ICHAR(9)

8.080 IF(IN.EQ.2Z39)IOUT=ICHAR(10)

8.090 IF(IN.EQ.2Z41)IOUT=ICHAR(11)

8.100 IF(IN.EQ.2Z42)IOUT=ICHAR(12)

8.110 IF(IN.EQ.2Z43)IOUT=ICHAR(13)

8.120 IF(IN.EQ.2Z44)IOUT=ICHAR(14)

8.130 IF(IN.EQ.2Z45)IOUT=ICHAR(15)

8.140 IF(IN.EQ.2Z46)IOUT=ICHAR(16)

8.150 IF(IN.EQ.2Z47)IOUT=ICHAR(17)

8.160 IF(IN.EQ.2Z48)IOUT=ICHAR(18)

8.170 IF(IN.EQ.2Z49)IOUT=ICHAR(19)

8.180 IF(IN.EQ.2Z4A)IOUT=ICHAR(20)

8.190 IF(IN.EQ.2Z4B)IOUT=ICHAR(21)

8.200 IF(IN.EQ.2Z4C)IOUT=ICHAR(22)

8.210 IF(IN.EQ.2Z4D)IOUT=ICHAR(23)

8.220 IF(IN.EQ.2Z4E)IOUT=ICHAR(24)

8.230 IF(IN.EQ.2Z4F)IOUT=ICHAR(25)

8.240 IF(IN.EQ.2Z50)IOUT=ICHAR(26)

8.250 IF(IN.EQ.2Z51)IOUT=ICHAR(27)

8.260 IF(IN.EQ.2Z52)IOUT=ICHAR(28)

8.270 IF(IN.EQ.2Z53)IOUT=ICHAR(29)

8.280 IF(IN.EQ.2Z54)IOUT=ICHAR(30)

8.290 IF(IN.EQ.2Z55)IOUT=ICHAR(31)

8.300 IF(IN.EQ.2Z56)IOUT=ICHAR(32)

8.310 IF(IN.EQ.2Z57)IOUT=ICHAR(33)

8.320 IF(IN.EQ.2Z58)IOUT=ICHAR(34)

8.330 IF(IN.EQ.2Z59)IOUT=ICHAR(35)

8.340 IF(IN.EQ.2Z5A)IOUT=ICHAR(36)

8.350 IF(IN.EQ.2Z2D)IOUT=ICHAR(37)

8.360 IF(IN.EQ.2Z20)IOUT=ICHAR(38)

8.370 IF(IN.EQ.2Z0D)IOUT=2Z15

8.380 IF(IN.EQ.2Z3D)IOUT=ICHAR(39)

9.000 RETURN

10.000 END

--EOF HIT AFTER 10.

*

*110-

```

1.000 SUBROUTINE RUNHD
2.000 COMMON /TAPEREC/IBUFF(558),KHAR(2232)
3.000 COMMON /LGCLUNIT/ITAPE,IOUT,INI,IN2,IOUT1,IOUT2
4.000 DIMENSION IHD(126)
5.000 CALL UNPACK(IBUFF,126,KHAR)
6.000 DO 10 I=10,126
7.000 CALL ASCII(KHAR(I),IHD(I))
8.000 10 CONTINUE
9.000 WRITE(IOUT,100)(IHD(I),I=10,25),(IHD(I),I=28,126)
10.000 100 FORMAT('TAPE REEL NAME: ',16R1,
11.000 1/ 'RUN ID : ',9R1,/,
12.000 2 'DATE : ',2R1,2X,3R1,/,
13.000 3 'TIME : ',2R1,2X,2R1,/,
14.000 4 'OPERATOR : ',3R1,
15.000 5/ 'COMMENTS : ',78R1)
16.000 RETURN
17.000 END
18.000 SUBROUTINE SCANHD
19.000 COMMON /TAPEREC/IBUFF(558),KHAR(2232)
19.100 COMMON /LGCLUNIT/ITAPE,IOUT,INI,IN2,IOUT1,IOUT2
19.200 DIMENSION IHD(270)
20.000 CALL UNPACK(IBUFF,270,KHAR)
21.000 DO 10 I=10,270
22.000 CALL ASCII(KHAR(I),IHD(I))
23.000 10 CONTINUE
24.000 WRITE(IOUT,100)(IHD(I),I=10,90)
25.000 WRITE(IOUT,101)(IHD(I),I=91,270)
26.000 100 FORMAT('SCAN START DATE : ',2R1,2X,3R1,4X,2R1,2X,2R1,/,
27.000 1 'LONGITUDE : ',3R1,2X,3R1,2X,3R1,2X,3R1,/,
28.000 2 'LATITUDE : ',3R1,2X,3R1,2X,3R1,2X,3R1,/,
29.000 3 'ANT 1 HT AGL : ',3R1,2X,FT,/,
30.000 4 'ANT 2 HT AGL : ',3R1,2X,FT,/,
31.000 5 'ANT 3 HT AGL : ',3R1,2X,FT,/,
32.000 1 'STRUCTURE HT ANT1 : ',3R1,2X,FT,/,
33.000 2 'STRUCTURE HT ANT2 : ',3R1,2X,FT,/,
34.000 3 'STRUCTURE HT ANT3 : ',3R1,2X,FT,/,
35.000 6 'ANT 1 SUPPORT : ',9R1,/,
36.000 7 'ANT 2 SUPPORT : ',9R1,/,
37.000 8 'ANT 3 SUPPORT : ',9R1,/,
38.000 9 'SCAN TABLE ID : ',9R1,/)
39.000 101 FORMAT('3-DB MODE : ',1R1,/,
40.000 1 '# OF CHANNELS : ',8R1,/,
41.000 1 'OPERATOR ID : ',3R1,/,
42.000 2 'COMMENTS : ',72R1,/,72R1,/,24R1)
43.000 RETURN
44.000 END
45.000 SUBROUTINE SCANINFO(FREQ,ILOOP)
46.000 COMMON /TAPEREC/IBUFF(558),KHAR(2232)
47.000 DIMENSION FREQ(246)
48.000 CALL UNPACK(IBUFF,2232,KHAR)
49.000 WRITE(IOUT,111)KHAR(18)
50.000 111 FORMAT('NUMBER OF CHANNELS SCANNED: ',I3,/, 'FREQUENCIES: ',/)
51.000 ILOOP=KHAR(18)
52.000 IF(ILOOP.GT.246)STOP '# OF CHS TOO LARGE'
53.000 DO 10 I=1,ILOOP
54.000 CALL PACK(KHAR(9*I+11),4,IFREQ)
55.000 FREQ(I)=IFREQ/10.**6
56.000 10 CONTINUE
57.000 C WRITE(IOUT,112)(FREQ(I),I=1,ILOOP)
58.000 112 FORMAT(6(2X,F8.4))
59.000 RETURN
60.000 END
61.000 SUBROUTINE TRAIL
COMMON /TAPEREC/IBUFF(558),KHAR(2232)

```

```

02.000 COMMON /TAPE REC/ IOUT1, IOUT2, KHAR(2252)
62.100 COMMON /LGCLUNIT/ ITAPE, IOUT, IN1, IN2, IOUT1, IOUT2
62.200 DIMENSION IHD(126)
63.000 CALL UNPACK(IBUFF, 126, KHAR)
64.000 DO 10 I=10, 126
65.000 CALL ASCII(KHAR(I), IHD(I))
66.000 10 CONTINUE
67.000 WRITE(IOUT, 100) (IHD(I), I=10, 126)
68.000 100 FORMAT('TAPE REEL NAME: ', 18R1, '/',
69.000 1 'RUN ID: ', 9R1, '/',
70.000 2 'DATE: ', 2R1, 2X, 3R1, '/',
71.000 3 'TIME: ', 2R1, ':', 2R1, '/',
72.000 4 'OPERATOR ID: ', 3R1, '/',
73.000 5 'COMMENTS: ', //, 80R1)
74.000 RETURN
75.000 END
--EOF HIT AFTER 75.

```

*

APPENDIX H

RUN INSTRUCTIONS FOR PROCESSING A TAPE

The following lists the commands which must be used under the CP-V executive language to process a tape of collected SSS data.

```
! BUILD fid
    1,000 Cr (fid is the file name of the
    2,000 Cr data base to be created)
! MESSAGE PLEASE MOUNT (TAPE#), NO RING.

! SET F:1 FT #(TAPE#)

! SET F:3/ fid; KEYED; INOUT

! PASS 1.006009C

! EDIT fid

* DE 1
* END

! LEVEL .006009C
! SET F: 2 UC
! SET F:4/ RASTER OUT; OUT
! PASS 2 .006009C
```

APPENDIX I

METHOD OF CALCULATION OF TRANSMISSION CHARACTERISTICS FROM SSS DATA

Consider a single frequency which is being monitored by the spectrum surveillance equipment. Figure 13 shows typical channel activity which is being sampled. (Activity diagrams of this type can be extracted from the SSS data tapes and displayed on the 4010 graphics terminal.) The figure displays a specific eighteen seconds of elapsed time depicting the variation in the signal amplitude. The flat-topped amplitudes at 40 dBuV depict base station transmissions. The varying amplitudes in the range from 7 seconds to 11 seconds depict a transmission from a mobile which suffers multipath effects. The signal at 12.5 seconds represents an impulse noise. When signals are not present on the channel, the noise varies in amplitude in a gaussian manner. The heavy dots (.) on the figure represent points at which samples would be taken with the SSS equipment. If we consider the signal levels which would appear on the SSS data tape for the example, they would be as follows:

-15, -16, -12, -15, -15, 40, 40, 40, 40, 40, 40, 40, -15, -15, -12, 15,
17, 18, 16, 10, 10, 2, 4, -12, -13, 35, -18, -10, -14, 40, 40, 40, 40, 40, 40,
40, -12

The following acronyms are defined in PASS 2 and will be used here to explain the method of calculation of the transmission characteristics:

ITM	number of transmission counts
ITB	number of transmissions
ITG	number of transmission gap counts
ITCG	number of transmission gaps
IMG	number of message gap counts
IMCG	number of message gaps
IMPC	number of impulse noise counts
ITP	temporary store of gap counts
ITE	temporary store of transmission counts

The program action can then be represented by the following logic:

1. INITIALIZE ALL PARAMETERS
2. Read in first recorded amplitude value
3. Read in second recorded amplitude value
4. Read in third recorded amplitude value
5. If second amplitude value is greater than the noise threshold
but first and third amplitude values are less than this threshold,
then this is an impulse count ($IMPC = IMPC + 1$)
Execute Step 17.
6. Else continue
7. If second amplitude value is greater than the noise threshold
then this is a transmission count.
Add 1 to the temporary store ($ITE = ITE + 1$)
And execute step 11
8. Else continue
9. If there are counts in the transmission temporary store
then a transmission has just ended.
Sum the temporary counts to the transmission counts ($ITM = ITM + ITE$)
Add one to the # of transmissions ($ITB = ITB + 1$)
Restore ITE to zero.
10. Else continue.
11. If second amplitude value is less than noise threshold,
then This is a Gap Count.
Add 1 to the temporary store ($ITP = ITP + 1$)
and Execute step 17.
12. Else continue.
13. If there are counts in the gaps temporary store,
then a gap has just ended.
14. If the gap was less than 7 seconds, then it was a transmission
gap - sum the temp. store counts to the transmission gap
counts ($ITG = ITG + ITP$)
Add 1 to the # of transmission gaps ($ITCG = ITCG + 1$)
Restore ITP to zero.

15. Else it was a message gap
 sum the temp store counts to the message gap counts ($IMG = IMG + ITP$)
 Add 1 to the # of message gaps
 Restore ITP to zero
16. Else continue
17. Replace first amplitude value with second amplitude value.
18. Replace second amplitude value with third amplitude value.
19. If more amplitude values
 Then read a new third amplitude value and start execution at step 5
20. Else stop

Figure 14 depicts how the variables are changing as the amplitude values recorded on successive scans are processed. When this type of processing is completed, transmission characteristics can easily be computed. The average transmission length, \bar{TX} (seconds) is simply the number of transmission counts (ITM) divided by the number of transmissions (ITB) multiplied by the time in seconds for one scan. For our example, using the time for one scan as being 0.5 seconds,

$$\bar{TX} = \frac{15}{2} \times 0.5 = 3.75 \text{ seconds}$$

Similarly, the elapsed time for the average transmission gap and the average message gap can be computed. Although, the method was primarily used to calculate parameter means for a raster, it is also useful for accumulating averages over larger periods of time.

Figure 13
Signal Amplitude (μV)

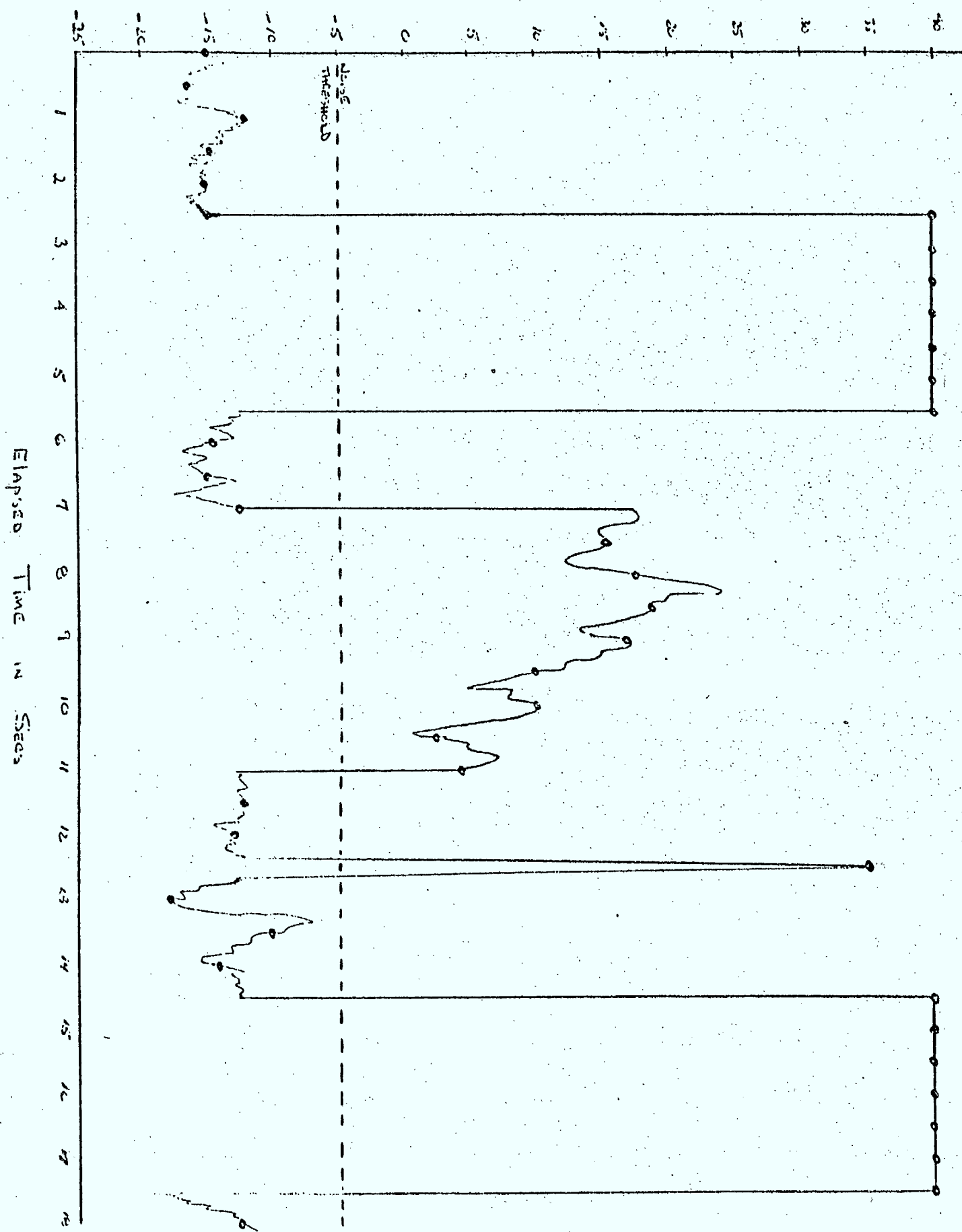


FIGURE 14 : RESULTS OF PROCESSING AMPLITUDES OF FIGURE 13

STEP #	LEVEL 1	LEVEL 2	LEVEL 3	ITP	ITE	ITM	ITB	ITG	ITCG	IMG	IMCG	IMPR		
1	0	0	0	0	0	0	0	0	0	0	0	0		
2	-15													
3		-16												
4			-12											
5,6,7,8,9,10														
11				1										
17,18,19	-16	-12	-15											
5,6,7,8,9,10														
11				2										
17,18,19	-12	-15	-15											
5,6,7,8,9,10														
11				3										
17,18,19	-15	-15	40											
5,6,7,8,9,10														
11				4										
17,18,19	-15	40	40											
5,6,7														
11,12,13,14				0	1			4	1					
17,18,19	40	40	40											
5,6,7					2									
11,12,13,14,15														
17,18,19	40	40	40											
5,6,7					3									
11,12,13,14,15														
17,18,19	40	40	40											
5,6,7					4									
11,12,13,14,15														
17,18,19	40	40	40											
5,6,7					5									
11,12,13,14,15														
17,18,19	40	40	40											
5,6,7					6									
11,12,13,14,15														
17,18,19	40	40	-15											
5,6,7					7									
11,12,13,14,15														
17,18,19	40	-15	-15											
5,6,7,8,9														
				0	7	1								

FIGURE 1A CONTINUED 1

[illegible]

FIGURE 14 : CONTINUED 2

STEP #	LEVEL 1	Level 2	level 3	ITP	ITE	ITM	ITB	ITG	ITCG	IMG	IMCG	IMPL
CONT'D	-12	-13	35	2	0	15	2	7	2	0	0	0
17, 18, 19	-13	35	-18									
5												1
17, 18, 19	35	-18	-10									
5, 6, 7, 8, 9, 10												
11				3								
17, 18, 19	-18	-10	-14									
5, 6, 7, 8, 9, 10												
11				4								
17, 18, 19	-10	-14	40									
5, 6, 7, 8, 9, 10												
11				5								
17, 18, 19	-14	40	40									
5, 6												
7					1							
11, 12, 13, 14				0				12	3			
17, 18, 19	40	40	40									
5, 6, 7					2							
				ET		CETERA						

APPENDIX J

LISTING OF STATISTICS ROUTINES

The listings of the STATSMAIN 2 control program and the STATISTICS subroutine are included in this appendix. These programs are used to calculate and print summary statistics for any channel monitored.

- IOCC 1 - average occupancy calculated by integration of amplitude distribution counts.
- AOCC 2 - average transmission occupancy calculated by using the percentage of the total counts which are transmission counts.
- AOCC 3 - average message occupancy calculated by using the percentage of the total counts which are transmission counts or transmission gap counts.
- RATIO 1- the ratio of the message occupancy to the transmission occupancy.
- RATIO 2- the average number of transmissions per message.
- XMLGTBAR- the average message length
- WAIT - the waiting time calculated using the SRI algorithm.

!EDIT STATISMAONIN2

EDIT HERE

*TYI-99

```
1.000      COMMON /SSSDATA/IBUFF1(174),XFREQ
2.000      COMMON /STATOP/SRIML(6),SIGTL(6),SRITG,SIGTG,AMG,SIGMG,IMG
3.000 10    CALL DIRECT
4.000      CALL STATS
5.000      ITOTAL=0
6.000      CALL AVEOCC(IBUFF1(156),IOCC1)
7.000      DO 20 I=1,127
8.000      ITOTAL=ITOTAL+IBUFF1(I)
9.000 20    CONTINUE
10.000     AOCC2=FLOAT(IBUFF1(136))/FLOAT(ITOTAL)*100
11.000     AOCC3=FLOAT(IBUFF1(136)+IBUFF1(128))/FLOAT(ITOTAL)*100
12.000     RATIO1=FLOAT(AOCC3)/FLOAT(AOCC2)
13.000     RATIO2=FLOAT(IBUFF1(137))/FLOAT(IMG)
14.000     XMLGTBAR=SRIML(1)*RATIO2+SRITG*(RATIO2-1)
15.000     WAIT=AOCC3/100.*XMLGTBAR/(1-AOCC3/100.)
16.000     WRITE(2,100)XFREQ,IOCC1,IBUFF1(155),SRIML(1),IBUFF1(137),
17.000     1SRITG,IBUFF1(129),AMG,IMG,RATIO2,AOCC2,AOCC3,RATIO1,XMLGTBAR,WAIT
18.000 100  FORMAT(F8.3,13,13,F5.2,15,F5.2,15,F7.2,14,F6.2,F6.2,F6.2,F6.2,F7
19.000     ,F7.2)
20.000     GO TO 10
21.000     END
--EOF HIT AFTER 21.
```

*IN3

```
3.000 10    CALL BUFFERIN(1,1,IBUFF1,175,IND)
```

*IN3.1

```
3.100      IF(IND.EQ.3)STOP 'END OF FILE'
```

*END

COPY STATS

```
SUBROUTINE STATS
COMMON/SSSDATA/IBUFF1(174),XFREQ
COMMON/STATOP/SRIML(6),SIGTL(6),SRITG,SIGTG,AMG,SIGMG,IMG
SLENG=0.0037*FLOAT(IBUFF1(135))
IMG=0
AMG=SIGM=SRITG=SIGTG=0.0
DO 250 J=2,6
SRIML(J)=SIGTL(J)=0.0
IF(IBUFF1(135+3*J).GT.0)SRIML(J)=
1(FLOAT(IBUFF1(134+3*J))*SLENG)/FLOAT(IBUFF1(135+3*J))
IF(IBUFF1(135+3*J).GT.1)SIGTL(J)=
1SQRT((FLOAT(IBUFF1(136+3*J))-FLOAT(IBUFF1(135+3*J))*SRIML(J)**2)
2/FLOAT(IBUFF1(135+3*J)-1))*SLENG
250 CONTINUE
SRIML(1)=SIGTL(1)=0.0
IF(IBUFF1(137).GT.0)SRIML(1)=
1(FLOAT(IBUFF1(136))*SLENG)/FLOAT(IBUFF1(137))
IF(IBUFF1(137).GT.1)SIGTL(1)=
1SQRT((FLOAT(IBUFF1(139))-FLOAT(IBUFF1(137))*SRIML(1)**2)
2/FLOAT(IBUFF1(137)-1))*SLENG
IF(IBUFF1(129).GT.0)SRITG=SLENG*FLOAT(IBUFF1(128))/FLOAT
1(IBUFF1(129))
IF(IBUFF1(129).GT.1)SIGTG=SLENG*SQRT((FLOAT(IBUFF1(130))-
1FLOAT(IBUFF1(129))*SRITG**2)/FLOAT(IBUFF1(129)-1))
IF(IBUFF1(132).GT.0)AMG=SLENG*FLOAT(IBUFF1(131))/
1FLOAT(IBUFF1(132))
IF(IBUFF1(132).GT.1)SIGMG=SLENG*SQRT((FLOAT(IBUFF1(133))
1-FLOAT(IBUFF1(132))*AMG**2)/FLOAT(IBUFF1(132)-1))
IMG=IBUFF1(137)-IBUFF1(129)
RETURN
END
```