

STUDY OF SPECTRUM ALLOCATION POLICY
AND METHODS OF MODELLING TO ASSIST
IN THE FORMULATION OF SPECTRUM POLICY

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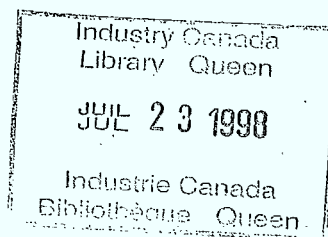
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DEMAND FOR RADIO STATION LICENCES - ATLANTIC REGION

INTRODUCTION

This study was carried out, at the request of the Atlantic Region, principally to assist regional management in staffing and workload requirements planning. It grew out of an earlier preliminary study carried out by Chung Lee at D.G.T.E. in October/November 1976 ("Demands for Mobile Radios in the Atlantic Region: Trends and Forecasts", draft report dated November 9, 1976). The memorandum from D.G.T.E. to Regional Director, Atlantic which accompanied that report stressed serious problems with data quality and the difficulties of disaggregating the available data down to the provincial and D.O. levels. Lee, in his report, also expressed serious misgivings about the quality of the available data on the time-series of net licences in use in the period 1960-75, because of the methods of maintaining such data. The problems are well known to all concerned, and they revolve mainly around the fact that data files are created and maintained principally to expedite the operational tasks such as issuing licences, collecting fees, and processing changes. These data, as reflected in the reports available from the Integrated Radio Licencing System (IRLS), are totally inadequate for forecasting demand for new licences.

The present study was initiated to provide a response to the request from R.D.A. that forecasts be prepared which would be useful at the regional level in assessing future workloads. Specifically, R.D.A. requested:

- i) that forecasts be prepared on a district office and provincial level, and
- ii) that the forecasts focus on new licences and cancellations rather than the actual (gross) number of licences in effect at year end.

Although it was not a formal part of the present task, D.G.T.E. indicated a need for some methodology for the reconstruction of true historical series from the existing data files. Such methodology has been developed and, although it is not a part of the present report, it is being supplied to D.G.T.E. as a model for future similar studies in other regions.

This report consists firstly of a brief discussion of data availability and quality problems and of the method used to produce a data base which can be used for forecasting. We then describe the alternative forecasting models considered and rationalize the choices made. Forecasts are then presented and discussed, and some summary remarks made. The data used appear as an appendix to this report.

DATA SOURCES

There are a number of sources which can be consulted in a search for reliable data on new radio station licences issued in a given region in a given year. J.H.C. Braden, Statistical Information Services Directorate, prepared a memorandum in March 1975 ("The Organization of Spectrum Statistics:

Sources of Data, Difficulties and Problems" - March 20, 1975) in which he described five sources of data and outlined some of the problems in using them for Policy and Planning purposes. The five sources he included are: Licencing files, frequency data tapes (DFL), licencing tapes, US tapes, and Microwave data tapes. His general conclusion was that none of the sources is reliable for policy purposes, either because of limitations imposed by data organization or because of gross errors in the files (for example 'there is a high probability that a significant number of SIC codes are incorrect'). Braden also concludes that 'it would require several man-years to obtain the exact data (by reconstructing the licencing files) -a mammoth undertaking! We have carried out a significant part of this task for the Atlantic Region in order to prepare this report. The starting point is the I.R.L.S. The Integrated Radio Licencing System is the principal repository of information regarding licences issued, active, cancelled, or relocated in a given year. Unfortunately, once a licence has been cancelled (or relocated in another district or region) it does not appear in the system. For this reason, a look at the current version of the data base gives a seriously distorted view of the history of licences, and partially to overcome this defect, the I.R.L.S. current status at year-end (late March each year) is stored on a 'year-end tape'. These tapes, which have been prepared each year since 1972 are maintained at Systems Dimension Limited (S.D.L.) and form the basis for the present study. Each record on the tape refers to an unique licence and contains three types of records:

- i) File 'A' (Accounts)-Account Header Records

- ii) File 'B' (type # 205 and type # 206)-Individual Licence Details.
- iii) Any number (from 1 to 90) of Licence Body Records (# 301 to # 390).

These records contain a great deal of account, administrative, and file management data, including the following:

- i) Administrative Office
- ii) Company Code
- iii) Licence Code (Land, mobile, ship, coast, earth, A/C, space)
- iv) Licence Region
- v) Licence Number
- vi) Service Categories (List attached - Appendix A4)
- vii) Fee Amount
- viii) Fee Status (Fee /No Fee)
- ix) Number of Municipal Stations
- x) S.I.C. Code
- xi) New Licence Indicator
- xii) Date of Issue of Licence
- xiii) Licence Amendment Code
- xiv) Termination Flag (Active, cancelled, relocated)

These data, together with an indication of the year-end tape used, and the number of frequency assignments per licence, are an adequate basis for forecasting.

We requested, and received a computer tape containing the sixteen items described above, from each available year-end data file (1972; 73; 74; 75; 76; 77). This tape contained 179,094 individual records, each of length 54 characters, and after a number of problems with respect to format, data conversion and inter-computer compatability (I.B.M. to C.D.C.) were overcome, we produced among other things, the summaries attached as appendices. This is the third data base upon which we have attempted to produce forecasts (after considerable time and effort with two previous data sets provided by D.O.C. it was learned from R.D.A. that the basic data were grossly inaccurate and unsuitable). The forecasts herein presented assume that this data base is a fair representation actual history for the Region - in any event, with respect to the variables studies, it is the only data available. It should also be noted here that, short of an actual physical search of written files of licences, it is impossible to determine the actual number of new licences issued in any year prior to '72 because, for example, a licence issued in 1968 and cancelled in 1971 will appear nowhere on any year-end tape. One would need the true cancellation and relocation rates by office and by licence code, together with the numbers of licences issued and still in force for each year, to reconstruct the history. The latter item is available, but the former two are not. A possible solution is to estimate cancellation and relocation rates on the basis of 1972-1977 data and to assume these applied in prior years. This procedure is totally unsuitable because of the extreme variability in these rates from year to year, region, to region, and code to code. The resultant uncertainty in the estimates would be so extreme as to com-

pletely overshadow any possible gain in forecasting accuracy due to having a longer historical series. It can be seen for example, in Administrative Office 665 (St. John) that the rates range from 0% to almost 30% of the actual number of new licences issued in 1973, and differences of rates of 2 or 3 orders of magnitude are not uncommon. To base a forecast on reconstructed data having such extremely large error limits is certain to be unsatisfactory.

The conclusion is that the data in the attached tables labelled 'NEW' must be the basis for the forecasts, that is, forecasts must be based on 5 years of reliable data rather than more years of data of highly dubious and unverifiable reliability. In the next section we discuss forecasting methods for such short series.

FORECASTING METHODOLOGY

As we have seen, reliable data at the level of disaggregation of the district office for the number of new licences issued each year in each licence class are available only from detailed analysis of the year-end tapes. These data, which cover five years in most cases, and only four years in the case of 661 and 669, are summarized in the tables of Appendix A₂ - New Summary. We should note that the figures labelled 1977 in all tables represent not a full year, but the licences issued from year-end in late March 1977 until the data tape was prepared in late August 1977. They thus represent only about 5 months of the year, and were not used in forecasting. They are the only reliable basis for

forecasting future demand to issue new licences. The data in Appendix A₃ represent the total number of licences, which were not first issued during a particular year, and which are active or were cancelled or relocated during that year. The data on cancellations and relocations may also have some use in workload planning (even though the rates are so inconsistent and variable) because a cancellation or relocation does involve some workload allocation.

The shortness of the time series available preclude the use of overly complicated forecasting models, however we have fitted a large number of possible models (smoothing, regression and time series models) to arrive at the best model in the present context. The variables which we have considered as possible predictors in these models include time, various economic measures, population measures, and various lagged values of the series to be forecast. The economic and population measures, besides being unavailable at a satisfactory level of disaggregation, make no significant contribution to the models. It is worthy of note that the same condition pertains at the regional level. At an earlier stage of this work we recomputed forecasts on the data used by Lee and found that the population and net income variables in fact were contributing very little to the explanatory power of the models. We have also explored the use of a number of possible transformations of the data series in order to produce better, more parsimonious models. With series such as OLD (Appendix A₃) for example, logarithmic transformations are effective, but for our short series, which do not exhibit any symptoms of exponential, or even consistent growth, no transformations yield significant improvements in forecasting accuracy.

The class of models which provide, uniformly, the best fit to all series for which a forecast can reasonably be made, consists of multiple regression models using time and the lag-one value of the series as predictor variables. This partially auto-regressive class of models is represented generically by:

$$\hat{X}_t = A_0 + A_1 t + A_2 X_{t-1}$$

where \hat{X}_t represents the forecast value of the series at time t (and X_{t-1} its value the previous year), t is the time in years ($t = 1$ means 1972). A_0 , A_1 , and A_2 are the constants to be determined from series to series by means of least squares in such a way as to obtain the best fit of model to data. Adopting this standard model allows the results to be presented in a consistent and easily followed format. In the next section we present the forecasting results, by D.O. and by type of licence. No forecasts are produced for 661 because of the obvious pattern of shutting down the issue of licences, nor are forecasts prepared for Coast or for Earth/Space because of extremely sparse data. In a few other cases the models are unreliable and in these cases no forecasts are produced.

RESULTS

This section contains one page for each D.O. (662-669). Each page has two tables, one containing the values of A_0 , A_1 and A_2 in the forecasting model.

$$\hat{X}_t = A_0 + A_1 t + A_2 X_{t-1},$$

and one table giving forecasts to 1980. All models for which forecasts are presented showed sufficiently accurate fits to be reliable and those which are unreliable are not forecast.

For example, in D.O. 662, the model for the series of Mobile licences is:

$$X_t = 7.43 + 48.88t - .069 X_{t-1}$$

and the forecasts for 1977 to 1980 are:

286,330,376,421

An asterisk (*) in Table 1 indicates unreliable models - no forecasts appear in Table 2.

ADMINISTRATIVE OFFICE: 662

Table 1 - Model Parameters

TYPE	A ₀	A ₁	A ₂
Land	2.28	11.50	0.193
Mobile	7.43	48.88	-0.069
Ship*	6.42	-1.17	-0.093
Aircraft	2.96	2.39	0.039
TOTAL	21.03	58.32	0.037

Table 2 - Data and Forecasts

TYPE	HISTORICAL DATA					FORECASTS			
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Land	47	0	36	63	75	86	99	113	128
Mobile	121	3	98	297	207	286	330	376	421
Ship*									
Aircraft	11	0	10	10	18	17	19	21	24
TOTAL	190	3	144	374	302	382	443	504	565

ADMINISTRATIVE OFFICE: 663

Table 1 - Model Parameters

TYPE	A ₀	A ₁	A ₂
Land	89.38	24.55	0.192
Mobile	717.61	172.68	-0.615
Ship*	181.21	- 8.39	-0.776
Aircraft	45.93	6.41	-0.805
TOTAL	1085.96	208.19	-0.582

Table 2 - Data and Forecasts

TYPE	HISTORICAL DATA					FORECASTS			
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Land	160	142	194	238	253	285	316	346	377
Mobile	607	531	963	823	1082	1088	1257	1326	1456
Ship*									
Aircraft	32	22	52	32	51	43	56	52	62
TOTAL	899	761	1331	1156	1467	1481	1681	1773	1928

ADMINISTRATIVE OFFICE: 664

Table 1 - Model Parameters

TYPE	A ₀	A ₁	A ₂
Land	72.29	2.64	0.759
Mobile	29.51	54.26	- 0.374
Ship	.711	.822	-0.705
Aircraft	3.34	- .009	0.435
TOTAL	114.39	57.29	-0.413

Table 2 - Data and Forecasts

TYPE	HISTORICAL DATA					FORECASTS			
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Land	42	47	45	48	49	51	52	54	55
Mobile	44	137	171	170	228	270	308	348	388
Ship	17	12	8	10	14	16	17	20	22
Aircraft	2	6	8	6	5	5	6	6	6
TOTAL	105	202	232	234	296	336	377	417	458

ADMINISTRATIVE OFFICE: 665

Table 1 - Model Parameters

TYPE	A ₀	A ₁	A ₂
Land	- 27.03	13.25	0.924
Mobile	1292.90	-32.26	-0.736
Ship *	53.60	- 5.92	-0.613
Aircraft	62.06	0.776	-0.844
TOTAL	1700.99	-47.71	-0.744

Table 2 - Data and Forecasts

TYPE	HISTORICAL DATA					FORECASTS			
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Land	171	143	110	133	179	218	267	326	393
Mobile	787	449	917	566	682	597	627	573	580
Ship*									
Aircraft	33	39	31	38	34	38	35	38	37
TOTAL	1023	650	1076	762	903	742	814	713	740

ADMINISTRATIVE OFFICE: 666

Table 1 - Model Parameters

TYPE	A ₀	A ₁	A ₂
Land	136.67	0.10	-0.317
Mobile	442.31	79.38	-1.131
Ship *	388.08	-45.71	-0.685
Aircraft *	16.72	-0.759	0.049
TOTAL	653.19	37.18	-0.347

Table 2 - Data and Forecasts

TYPE	HISTORICAL DATA					FORECASTS			
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Land	113	92	89	125	97	107	104	105	104
Mobile	253	322	265	471	322	554	371	658	413
Ship *									
Aircraft *									
TOTAL	596	570	505	708	551	685	676	716	739

ADMINISTRATIVE OFFICE: 667

Table 1 - Model Parameters

TYPE	A ₀	A ₁	A ₂
Land	81.25	-1.025	-0.208
Mobile	144.08	29.98	-0.354
Ship*	23.18	-2.37	0.316
Aircraft	13.86	1.47	-0.107
TOTAL	403.56	14.60	-0.523

Table 2 - Data and Forecasts

TYPE	HISTORICAL DATA					FORECASTS			
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Land	60	63	88	55	57	63	61	60	59
Mobile	122	155	207	188	217	247	266	290	311
Ship*									
Aircraft	13	15	19	18	18	21	22	23	25
TOTAL	276	259	345	295	303	333	332	347	354

ADMINISTRATIVE OFFICE: 669

Table 1 - Model Parameters

TYPE	A ₀	A ₁	A ₂
Land*	137.14	-11.70	-0.984
Mobile	213.10	12.86	-0.654
Ship*	2.86	-0.214	-0.571
Aircraft*	3.25	-0.50	0.50
TOTAL	343.27	3.11	-0.696

Table 2 - Data and Forecasts

TYPE	HISTORICAL DATA					FORECASTS			
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Land*									
Mobile		139	173	154	171	178	186	194	202
Ship*									
Aircraft*									
TOTAL		201	226	198	217	211	218	216	221

FREQUENCY ANALYSIS

As a final attempt to assist in the assessment of future workload we have analyzed the number of occurrences of frequency assignments on all licences. These data, which are also broken down by Fee/No Fee status and by D.O. should be useful in estimating real workload for those functions where the assignment and checking of a frequency is the principal workload determinant. These data could also be broken down by type of licence and by service category but the very high cost of computing and the time constraints imposed by delays in obtaining reliable data have prevented this being done to date. The attached table shows the number of licences which had 0 or 1 or 2 or etc. number of frequencies listed on it (or on attachments), together with the average number.

Table 3 - Distribution of Frequency Occurrences per Licence
Non-Fee Paying

FREQUENCIES PER LICENCE	ADMINISTRATIVE OFFICE								
	661	662	663	664	665	666	667	668	669
0	133	10	224	10	139	301	5	6	2
1	2343	742	5836	85	6036	2576	227	175	705
2	1483	303	1893	245	1652	601	52	103	257
3	1575	94	2605	53	939	345	10	8	34
4	1054	34	329	37	702	734	4	40	101
5	413	17	532	27	202	42	0	2	60
6	325	17	684	17	2053	98	2	0	0
7	119	30	138	11	984	402	3	0	0
8	68	16	36	1	94	25	0	0	2
9	15	2	9	0	7	14	0	0	4
10	1	4	7	0	16	4	0	0	0
11	15	4	10	0	8	0	0	3	0
12	24	0	5	0	8	3	0	6	0
13	3	0	6	0	249	0	0	0	0
>13	5	1	20	0	10	3	0	0	0
MEAN	2.69	1.89	2.24	2.57	2.21	2.30	1.35	1.98	1.78

Table 4 - Distribution of Frequency Occurrences per Licence For Paying

FREQUENCIES PER LICENCE	ADMINISTRATIVE OFFICE								
	661	662	663	664	665	666	667	668	669
0	64	1763	10524	1603	5303	6942	1985	1996	1007
1	889	5634	24768	5394	15800	9125	5886	4030	3572
2	738	1120	3834	666	2882	3485	1408	995	251
3	379	301	411	157	798	766	211	388	52
4	1000	1249	1541	318	655	1178	200	936	277
5	102	66	155	36	221	193	136	294	27
6	56	25	366	127	165	423	113	723	5
7	23	11	61	34	10	66	8	134	0
8	152	246	42	14	26	54	3	53	8
9	11	6	22	4	23	35	3	5	0
10	24	18	31	1	39	25	7	8	2
11	14	11	11	0	6	7	0	3	0
12	13	11	13	3	25	4	2	0	3
13	6	8	9	0	2	3	0	4	0
>13	55	46	69	0	77	12	1	0	3
MEAN	3.15	1.66	1.10	1.18	1.21	1.28	1.18	1.95	1.09

APPENDIX A₁ - NEW

Each record in each year-end tape which was coded 'new' in field 11 of the data file was counted and accumulated by administrative office, by year, by licence code and by termination flag (active, cancelled, relocated).

ADMINISTRATIVE OFFICE: 661

NEW						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	43	57	67	33	1	0
Mobile	152	230	427	65	0	0
Ship	3	0	7	4	0	0
Coast	1	0	0	0	0	0
Earth	3	0	0	1	0	0
Aircraft	1	1	0	0	0	0
Total	203	288	501	103	1	0
CANCELLED						
Land	0	8	0	0	0	0
Mobile	0	0	0	0	0	0
Ship	0	0	0	0	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	0	0	0	0	0
Total	0	8	0	0	0	0
RELOCATED						
Land	0	0	0	14	1	0
Mobile	0	0	1	111	12	0
Ship	0	0	0	3	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	1	0	0	0	0	0
Total	1	0	1	128	13	0
GRAND TOTAL	204	296	502	231	14	0

ADMINISTRATIVE OFFICE: 662

NEW						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	0	0	36	57	72	37
Mobile	0	0	98	293	202	90
Ship	0	0	0	3	2	2
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	1	0	10	10	16	4
Total	1	0	144	363	292	133
CANCELLED						
Land	1	0	0	0	1	0
Mobile	0	0	0	0	0	0
Ship	0	0	0	0	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	0	0	0	0	0
Total	1	0	0	0	1	0
RELOCATED						
Land	46	0	0	6	2	2
Mobile	121	3	0	4	5	0
Ship	11	0	0	1	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	10	0	0	0	2	0
Total	188	3	0	11	9	2
GRAND TOTAL	190	3	144	374	302	135

ADMINISTRATIVE OFFICE: 663

		NEW					
YEAR		1972	1973	1974	1975	1976	1977
ACTIVE							
Land		156	141	192	232	244	164
Mobile		601	525	954	796	1070	697
Ship		100	66	120	62	78	56
Coast		0	0	0	1	0	0
Earth		0	0	0	0	0	0
Aircraft		31	21	51	32	51	21
Total		888	753	1317	1123	1443	938
CANCELLED							
Land		1	0	1	2	2	0
Mobile		2	0	7	18	4	3
Ship		0	0	1	0	0	0
Coast		0	0	0	0	0	0
Earth		0	0	0	0	0	0
Aircraft		1	1	1	0	0	0
Total		4	1	10	20	6	3
RELOCATED							
Land		3	1	1	4	7	0
Mobile		4	6	2	9	8	2
Ship		0	0	1	0	3	1
Coast		0	0	0	0	0	0
Earth		0	0	0	0	0	0
Aircraft		0	0	0	0	0	2
Total		7	7	4	13	18	5
GRAND TOTAL		899	761	1331	1156	1467	946

ADMINISTRATIVE OFFICE: 664

NEW						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	42	45	44	46	48	32
Mobile	44	137	151	164	208	78
Ship	16	9	8	10	14	1
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	2	5	8	6	5	0
Total	104	196	211	226	275	111
CANCELLED						
Land	0	0	0	0	1	0
Mobile	0	0	0	0	17	3
Ship	1	1	0	0	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	1	0	0	0	0
Total	1	2	0	0	18	3
RELOCATED						
Land	0	2	1	2	0	0
Mobile	0	0	20	6	3	0
Ship	0	2	0	0	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	0	0	0	0	0
Total	0	4	21	8	3	0
GRAND TOTAL	105	202	232	234	296	114

ADMINISTRATIVE OFFICE: 665

NEW						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	158	88	104	129	174	74
Mobile	751	340	907	548	667	354
Ship	28	16	17	25	8	6
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	31	33	31	38	33	7
Total	968	477	1059	740	882	441
CANCELLED						
Land	2	1	1	2	2	0
Mobile	10	1	3	17	9	0
Ship	0	0	0	0	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	1	3	0	0	0	0
Total	13	5	4	19	11	0
RELOCATED						
Land	11	54	5	2	3	0
Mobile	26	108	7	1	6	0
Ship	4	3	1	0	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	1	3	0	0	1	0
Total	42	168	13	3	10	0
GRAND TOTAL	1023	650	1076	762	903	441

ADMINISTRATIVE OFFICE: 666

NEW						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	89	89	86	124	91	77
Mobile	214	312	256	470	318	321
Ship	215	126	126	93	111	92
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	6	18	16	15	11	20
Total	524	545	484	702	531	510
CANCELLED						
Land	0	1	1	1	0	0
Mobile	0	0	9	1	0	0
Ship	2	8	7	2	8	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	2	0	1	0	0
Total	2	11	17	5	8	0
RELOCATED						
Land	24	2	2	0	6	1
Mobile	39	10	0	0	4	3
Ship	1	1	2	1	2	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	6	1	0	0	0	0
Total	70	14	4	1	12	4
GRAND TOTAL	596	570	505	708	551	514

ADMINISTRATIVE OFFICE: 667

NEW						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	57	61	63	48	55	49
Mobile	177	153	148	176	217	137
Ship	21	26	24	32	11	25
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	13	15	15	15	17	15
Total	268	255	250	271	300	226
CANCELLED						
Land	0	0	1	5	1	0
Mobile	0	0	5	12	0	0
Ship	0	0	0	0	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	0	1	0	1	0
Total	0	0	7	17	2	0
RELOCATED						
Land	3	2	24	2	1	0
Mobile	5	2	54	0	0	0
Ship	0	0	7	1	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	1	0	0
Aircraft	0	0	3	3	0	0
Total	8	4	88	7	1	0
GRAND TOTAL	276	259	345	295	303	226

ADMINISTRATIVE OFFICE: 668

NEW						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	33	53	51	84	76	37
Mobile	108	165	122	323	149	118
Ship	23	37	44	37	45	24
Coast	0	0	0	0	0	0
Earth	0	0	0	2	0	0
Aircraft	17	19	11	26	21	30
Total	181	274	228	472	291	209
CANCELLED						
Land	0	0	0	1	0	0
Mobile	0	0	0	0	0	0
Ship	0	0	1	0	1	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	1	0	0	0	0	0
Total	1	0	1	1	1	0
RELOCATED						
Land	2	1	1	1	1	0
Mobile	1	1	20	0	3	0
Ship	0	0	0	0	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	0	0	0	1	0
Total	3	2	21	1	5	0
GRAND TOTAL	185	276	250	474	297	209

ADMINISTRATIVE OFFICE: 669

NEW						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	0	57	48	36	41	28
Mobile	0	139	172	154	161	117
Ship	0	2	0	2	1	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	3	4	4	2	4
Total	0	201	224	196	205	149
CANCELLED						
Land	0	0	0	1	0	0
Mobile	0	0	0	0	0	5
Ship	0	0	0	0	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	0	0	0	0	0
Total	0	0	0	1	0	5
RELOCATED						
Land	0	0	1	1	2	0
Mobile	0	0	1	0	10	1
Ship	0	0	0	0	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	0	0	0	0	0
Total	0	0	2	1	12	1
GRAND TOTAL	0	201	226	198	217	155

APPENDIX A₂ - NEW SUMMARY

Tables A₁ are summarized by administrative office, year
and licence code.

NEW - SUMMARY

ADMINISTRATIVE OFFICE: 661

YEAR	1972	1973	1974	1975	1976	1977
LICENSE						
Land	43	65	67	47	2	0
Mobile	152	230	428	176	12	0
Ship	3	0	7	7	0	0
Coast	1	0	0	0	0	0
Earth	3	0	0	1	0	0
Aircraft	2	1	0	0	0	0
TOTAL	204	296	502	231	14	0

ADMINISTRATIVE OFFICE: 662

YEAR	1972	1973	1974	1975	1976	1977
LICENSE						
Land	47	0	36	63	75	39
Mobile	121	3	98	297	207	90
Ship	11	0	0	4	2	2
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	11	0	10	10	18	4
TOTAL	190	3	144	374	302	135

ADMINISTRATIVE OFFICE: 663

YEAR	1972	1973	1974	1975	1976	1977
LICENSE						
Land	160	142	194	238	253	164
Mobile	607	531	963	823	1082	702
Ship	100	66	122	62	81	57
Coast	0	0	0	1	0	0
Earth	0	0	0	0	0	0
Aircraft	32	22	52	32	51	23
TOTAL	899	761	1331	1156	1467	946

NEW - SUMMARY

ADMINISTRATIVE OFFICE: 664

YEAR	1972	1973	1974	1975	1976	1977
LICENSE						
Land	42	47	45	48	49	32
Mobile	44	137	171	170	228	81
Ship	17	12	8	10	14	1
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	2	6	8	6	5	0
TOTAL	105	202	232	234	296	114

ADMINISTRATIVE OFFICE: 665

YEAR	1972	1973	1974	1975	1976	1977
LICENSE						
Land	171	143	110	133	179	74
Mobile	787	449	917	566	682	354
Ship	32	19	18	25	8	6
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	33	39	31	38	34	7
TOTAL	1023	650	1076	762	903	441

ADMINISTRATIVE OFFICE: 666

YEAR	1972	1973	1974	1975	1976	1977
LICENSE						
Land	113	92	89	125	97	78
Mobile	253	322	265	471	322	324
Ship	218	135	135	96	121	92
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	12	21	16	16	11	20
TOTAL	596	570	505	708	551	514

NEW - SUMMARY

ADMINISTRATIVE OFFICE: 667

YEAR	1972	1973	1974	1975	1976	1977
LICENSE						
Land	60	63	88	55	57	49
Mobile	122	155	207	188	217	137
Ship	21	26	31	33	11	25
Coast	0	0	0	0	0	0
Earth	0	0	0	1	0	0
Aircraft	13	15	19	18	18	15
TOTAL	276	259	345	295	303	226

ADMINISTRATIVE OFFICE: 668

YEAR	1972	1973	1974	1975	1976	1977
LICENSE						
Land	35	54	52	86	77	37
Mobile	109	166	142	323	152	118
Ship	23	37	45	37	46	24
Coast	0	0	0	0	0	0
Earth	0	0	0	2	0	0
Aircraft	18	19	11	26	22	30
TOTAL	185	276	250	474	297	209

ADMINISTRATIVE OFFICE: 669

YEAR	1972	1973	1974	1975	1976	1977
LICENSE						
Land	0	57	49	38	43	28
Mobile	0	139	173	154	171	123
Ship	0	2	0	2	1	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	3	4	4	2	4
TOTAL	0	201	226	198	217	155

APPENDIX A₃ - OLD

Each record which was coded 'not new' in field 11 was accumulated by administrative office, by year, by licence code and by termination flag.

ADMINISTRATIVE OFFICE: 661

OLD						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	488	745	741	307	26	6
Mobile	388	1248	1444	501	38	4
Ship	97	127	125	43	15	14
Coast	0	7	6	4	1	1
Earth	4	7	7	3	1	1
Aircraft	1	15	12	12	2	0
Total	978	2149	2335	870	83	26
CANCELLED						
Land	1	34	17	11	1	1
Mobile	0	47	47	11	0	0
Ship	6	6	2	11	0	1
Coast	0	0	1	0	0	0
Earth	0	0	0	1	0	0
Aircraft	0	0	4	0	0	0
Total	7	87	71	34	1	2
RELOCATED						
Land	0	15	48	495	313	599
Mobile	5	13	4	1385	529	967
Ship	2	4	0	80	32	92
Coast	0	0	0	2	3	0
Earth	0	0	0	3	3	0
Aircraft	0	0	1	0	10	44
Total	7	32	53	1965	890	1702
GRAND TOTAL	992	2268	2459	2869	974	1730

ADMINISTRATIVE OFFICE: 662

OLD						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	0	2	257	507	707	738
Mobile	4	3	475	1106	1371	1457
Ship	1	0	13	14	14	12
Coast	0	0	0	0	3	3
Earth	0	0	0	0	0	0
Aircraft	0	0	23	27	40	51
Total	5	5	768	1654	2135	2261
CANCELLED						
Land	48	0	3	16	27	20
Mobile	104	0	1	59	102	88
Ship	18	0	0	5	5	2
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	11	0	0	5	8	6
Total	181	0	4	85	142	116
RELOCATED						
Land	548	0	2	5	14	1495
Mobile	844	4	9	4	29	3200
Ship	76	2	0	0	0	670
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	31	2	0	2	0	79
Total	1499	8	11	11	43	5444
GRAND TOTAL	1685	13	783	1750	2320	7821

ADMINISTRATIVE OFFICE: 663

OLD						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	1377	1449	1506	1699	1908	2059
Mobile	2776	3245	3403	4383	4796	5619
Ship	531	527	497	573	566	600
Coast	0	0	0	2	3	3
Earth	0	0	0	0	3	3
Aircraft	66	76	81	101	96	132
Total	4750	5297	5487	6758	7372	8416
CANCELLED						
Land	102	96	83	115	114	67
Mobile	395	272	384	346	563	284
Ship	116	117	97	91	95	50
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	12	20	20	31	38	18
Total	625	505	584	583	810	419
RELOCATED						
Land	45	26	45	35	35	367
Mobile	84	19	8	49	10	660
Ship	29	2	5	3	13	108
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	1	1	1	0	2	6
Total	159	48	59	87	60	1141
GRAND TOTAL	5534	5850	6130	7428	8242	9976

ADMINISTRATIVE OFFICE: 664

OLD						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	280	302	321	343	363	417
Mobile	384	402	488	571	627	904
Ship	82	80	76	68	71	79
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	5	6	10	16	14	18
Total	751	790	895	998	1075	1418
CANCELLED						
Land	31	20	28	31	29	27
Mobile	76	28	51	73	109	41
Ship	20	20	16	16	19	8
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	1	1	2	8	1
Total	127	69	96	122	165	77
RELOCATED						
Land	22	9	7	7	8	1028
Mobile	22	3	3	2	4	2619
Ship	1	1	0	0	9	357
Coast	0	0	0	0	0	1
Earth	0	0	0	0	0	0
Aircraft	0	0	0	1	0	101
Total	45	13	10	10	21	4106
GRAND TOTAL	923	872	1001	1130	1261	6301

ADMINISTRATIVE OFFICE: 665

OLD						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	1048	851	877	1045	1144	1214
Mobile	2282	2388	2459	3500	3767	3948
Ship	234	219	201	191	186	164
Coast	2	2	2	2	2	0
Earth	0	0	0	0	0	0
Aircraft	90	72	72	85	93	111
Total	3656	3532	3611	4723	5192	5437
CANCELLED						
Land	102	73	39	28	44	34
Mobile	377	240	229	202	301	243
Ship	68	23	27	23	31	30
Coast	0	0	0	0	0	1
Earth	0	0	0	0	0	0
Aircraft	21	28	24	16	31	13
Total	568	364	319	269	407	321
RELOCATED						
Land	95	299	42	8	15	4
Mobile	258	416	61	16	20	1
Ship	81	20	9	6	0	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	3	22	16	3	3	1
Total	437	757	128	33	38	6
GRAND TOTAL	4661	4653	4058	5025	5637	5764

ADMINISTRATIVE OFFICE: 666

OLD						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	780	753	848	878	990	955
Mobile	950	1006	1218	1303	1806	1862
Ship	468	440	471	538	471	492
Coast	1	1	1	1	1	1
Earth	0	0	0	1	1	1
Aircraft	59	46	48	51	52	50
Total	2258	2246	2586	2772	3321	3361
CANCELLED						
Land	115	65	41	79	67	129
Mobile	320	111	105	186	221	295
Ship	93	132	94	86	155	92
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	20	16	13	13	14	13
Total	548	324	253	364	457	529
RELOCATED						
Land	206	81	12	62	7	5
Mobile	616	57	13	135	9	0
Ship	12	114	2	0	5	2
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	35	6	3	0	0	0
Total	869	258	30	197	21	7
GRAND TOTAL	3675	2828	2869	3333	3799	3897

ADMINISTRATIVE OFFICE: 667

OLD						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	361	456	233	268	283	414
Mobile	679	817	481	561	627	974
Ship	125	126	82	86	100	99
Coast	0	0	0	0	0	1
Earth	0	0	0	0	0	0
Aircraft	18	35	26	37	44	50
Total	1183	1434	822	952	1054	1538
CANCELLED						
Land	0	20	38	28	35	19
Mobile	0	75	78	58	112	53
Ship	2	24	31	17	17	11
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	7	14	7	10	13
Total	2	116	161	110	174	96
RELOCATED						
Land	2	12	273	4	2	5
Mobile	0	13	500	11	0	0
Ship	0	0	48	4	4	2
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	0	26	3	1	0
Total	2	25	847	22	7	7
GRAND TOTAL	1187	1575	1830	1084	1235	1641

ADMINISTRATIVE OFFICE: 668

		OLD					
YEAR	1972	1973	1974	1975	1976	1977	
ACTIVE							
Land	186	256	275	304	359	416	
Mobile	551	640	660	694	977	1086	
Ship	10	132	140	158	161	180	
Coast	0	0	0	0	0	0	
Earth	0	0	0	2	4	4	
Aircraft	34	44	56	52	62	53	
Total	781	1072	1131	1210	1563	1739	
CANCELLED							
Land	0	13	36	28	45	34	
Mobile	0	58	150	88	42	43	
Ship	0	11	33	29	40	25	
Coast	0	0	0	0	0	0	
Earth	0	0	0	0	0	0	
Aircraft	0	10	10	15	15	31	
Total	0	92	229	160	142	133	
RELOCATED							
Land	1	10	5	6	11	6	
Mobile	0	2	0	0	19	1	
Ship	0	0	0	1	1	1	
Coast	0	0	0	0	0	0	
Earth	0	0	0	0	0	0	
Aircraft	0	1	1	0	2	0	
Total	1	13	6	7	33	8	
GRAND TOTAL	782	1177	1266	1377	1738	1880	

ADMINISTRATIVE OFFICE: 669

OLD						
YEAR	1972	1973	1974	1975	1976	1977
ACTIVE						
Land	0	229	284	343	377	411
Mobile	0	372	455	656	810	935
Ship	0	16	19	17	17	19
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	13	16	17	21	16
Total	0	630	774	1033	1225	1381
CANCELLED						
Land	0	0	13	8	15	11
Mobile	0	0	65	33	75	53
Ship	0	0	3	2	1	1
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	0	1	3	1	7
Total	0	0	82	46	92	72
RELOCATED						
Land	0	0	4	4	3	2
Mobile	0	0	2	3	2	19
Ship	0	0	0	0	1	0
Coast	0	0	0	0	0	0
Earth	0	0	0	0	0	0
Aircraft	0	0	0	0	0	0
Total	0	0	6	7	6	21
GRAND TOTAL	0	630	862	1086	1323	1474

APPENDIX A₄

SERVICE CATEGORY CODES

1. Licence for a coast station (code 4) performing:
 - A. Limited Maritime Mobile Service
 - B. Private Maritime Mobile Service

2. Licence for a land station (code 1) performing:
 - A. Public Commercial Service
 - B. Restricted Public Commercial Service
 - C. Private Commercial Service
 - D. United States of America Military Service
 - E. Provincial Government Service
 - F. Municipal Service
 - G. Experimental Service
 - H. Amateur Experimental Service
 - I. Public Commercial Receiving Service
 - J. Private Commercial Receiving Service
 - K. Public Commercial Automatic Repeater Service
 - L. Private Commercial Automatic Repeater Service
 - N. Aeronautical Mobile Service
 - P. Amateur Relay

3. Licence for mobile and AC station (code 2 for mobile & 6 for A/C) performing:
 - A. Public Commercial Service
 - B. Private Commercial Service
 - C. United States of America Military Service
 - D. Provincial Government Service
 - E. Municipal Service
 - F. Experimental Service
 - G. Public Commercial Receiving Service
 - H. Private Commercial Receiving Service
 - I. Aircraft Navigation Service
 - K. Aeronautical Mobile Service

4. Licence for a ship station (code 3) fitted with:
 - A. Transmitting and Receiving Apparatus
 - B. Receiving Apparatus for Navigational Purposes

Licences code 5 and 7 do not have a service category.

