DOMESTIC LONG-DISTANCE COMMUNICATIONS NETWORK STUDY

COMMUNICATIONS SYSTEMS ENGINEERING

FORECASTING INTRA-PROVINCIAL VOICE CIRCUIT REQUIREMENTS

by

T.A.J. Keefer
Needs and Environmental Research Group

October 1973

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TABLE OF CONTENTS

1. INTRODUCTION

Forecasts are provided of total (public switched and other) end-to-end voice circuit requirements for the years 1973, 1980, 1985 and 1990 over the major intra-provincial links in Alberta, Saskatchewan, Ontario and Quebec. These very approximate forecasts were derived from extremely limited data using an indirect and highly subjective approach.

This report provides forecasts of total (public switched and "other"[1]) end-to-end voice circuit requirements over major intra-provincial links for the years 1973, 1980, 1985 and 1990. The need for forecasts of intra-provincial traffic and voice circuit requirements over the major links shown in Figure 1 was noted in Section 9 of DLDCNS Report No. 2: "Forecasting Traffic Requirements". The provision of traffic forecasts would enable the elements of the "expanded diagonal", shown by X's in Table 1, to be filled in; similarly forecasts of total voice circuit requirements would enable the corresponding elements of the "expanded diagonal" of a voice circuit requirements matrix to be filled in.

1. The composite "other" includes leased line voice circuits, voice circuits used for data, etc.

This report does not in fact produce intra-provincial traffic forecasts; instead it is concerned solely with producing forecasts of the corresponding total end-to-end voice circuit requirements. These forecasts are based primarily upon the new improved forecasts of total inter-provincial voice circuit requirements given in DLDCNS Report No. 4: "Updated Forecasts of Total Inter-Provincial Voice Circuit Requirements". It must be noted that these forecast requirements relate only to total end-to-end voice circuits; no data was available to enable intra-provincial video and audio requirements to be forecast. It must also be emphasized that the forecasts given in this report are very approximate; they are derived from extremely limited data which did not even include information on traffic over any intra-provincial links. An indirect and highly subjective forecasting approach therefore had to be used.

Since these end-to-end voice circuit requirements are not directed with respect to a source and a sink, only half-matrices need to be considered. For simplicity, the forecasts determined in this report have been tabulated in the form of Table 2.

2. DATA EMPLOYED

The data employed in forecasting intra-provincial end-to-end total voice circuit requirements includes yearly forecasts of total numbers (public switched and other) of end-to-end voice circuits emerging from each province and going to the other provinces, population projections for major cities and for urban provincial populations (which enabled the fraction of urban provincial populations contained within the "catchment areas" of each province's major cities to be determined), coefficient values from inter-provincial gravity modelling, inter-city distances, and coefficient values of general log-log relationships used to convert traffic forecasts to forecasts of total end-to-end voice circuit requirements.

As noted at the end of the previous section, limited data had to be used for forecasting intra-provincial end-to-end total voice circuit requirements. This data can be listed in a number of series.

The first series of data employed consists of forecasts for the years 1973, 1980, 1985 and 1990 of total numbers of total end-to-end voice circuits (public switched and "other") emerging from each province and going to all the other provinces. This data, tabulated in Table 3 for the provinces of Alberta,

Saskatchewan, Ontario and Quebec, was obtained by simple summation from Tables 11 to 14 of DLDCNS Report No. 4. Two figures are shown in Table 3 for each province for each year: a lower forecast, derived using linearly extrapolated traffic forecasts, and an upper forecast derived using exponentially extrapolated traffic forecasts.

The second series of data employed consists of population projections made by the Systems Research Group; projections for the years 1966, 1973, 1980, 1985 and 1990 are given in Table 4 for populations of census metropolitan areas (i.e. major cities) and in Table 5 for urban provincial populations.[2] The population projections given in Table 4 relate only to census metropolitan areas; population projections are really wanted for the whole (telecommunications related) "catchment areas" surrounding and including these metropolitan areas. These populations may be calculated from Table 4 using the subjectively estimated conversion factors given in Table 6.

Figure 1 indicates that we are really only interested in the intra-provincial end-to-end total voice circuit requirements of four provinces, namely Alberta, Saskatchewan, Ontario and Quebec. For each of these, Table 7 gives the fractions of urban provincial populations (from Table 5) that are or will be contained within the catchment areas of the appropriate major cities for the years 1973, 1980, 1985 and 1990; these fractions were determined using Tables 4 and 6.

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2. Systems Research Group, Canada Population Projections to the Year 2000, S.R.G., Toronto, 1970. Table 4 is taken from p. 18; Table 5 is obtained from pp. 16 and 101.

The third series of data employed relates to gravity modelling of inter-provincial end-to-end telephone traffic, and consists of the gravity model coefficient values, given in Table 8, which were obtained (in Section 2 of DLDCNS Report No. 4) using both linearly and exponentially derived traffic forecasts for the years 1973, 1980, 1985 and 1990. Gravity modelling, which is described in Section 2 of DLDCNS Report No. 2, has previously been used to derive forecasts of total end-to-end voice circuit requirements for inter-provincial links other than those for which data was available; gravity modelling is used in this report to generate similar forecasts for intra-provincial links. Required as an input to this modelling are the intra-provincial distances between major cities, as given in Table 9.

The final data employed consists of the coefficients of general log-log relationships used for converting traffic forecasts to forecasts of total end-to-end voice circuit requirements. These coefficients, derived in Section 3 of DLDCNS Report No. 4 using 1973 forecasts of inter-provincial total end-to-end voice circuit requirements, are given in Table 10.

3. FORECASTING TOTAL END-TO-END VOICE CIRCUIT REQUIREMENTS OVER SINGLE INTRA-PROVINCIAL LINKS

Forecasts are produced of total end-to-end voice circuit requirements over single intra-provincial links within Alberta, Saskatchewan and Quebec for the years 1973, 1980, 1985 and 1990. Each forecast is obtain as the product of the total number of total end-to-end voice circuits forecast to emerge from each province going to all the other provinces, the fraction of the province's uraban population contained within the catchment areas of its major cities, and a subjectively determined factor.

It is scarely surprising that considerable difficulty was encountered in attempting to forecast intra-provincial total voice circuit requirements for Alberta, Saskatchewan, Ontario and Quebec using the extremely limited series of data given in the previous section.

One further piece of information is available: it has been estimated, very approximately, that the number of inter-provincial telephone calls made from each province and going to all the other provinces is of the order of one-tenth the number of intra-provincial long distance telephone calls made during the same period. It may therefore be very roughly estimated that the number of trunk voice circuits within a province is approximately ten times the number of end-to-end

voice circuits emerging from the province and going to all the other provinces.

Very rough forecasts of total numbers of intra-provincial total voice circuit (public switched and other) trunks may now be obtained as ten times the total numbers of total end-to-end voice circuits emerging from each province and going to all the other provinces; these total numbers of intra-provincial trunk voice circuits are thus estimated as ten times the numbers tabulated in Table 3 for Alberta, Saskatchewan, Ontario and Quebec for the years 1973, 1980, 1985 and 1990.

A major problem arises, however, in attempting to estimate what proportion of these intra-provincial trunk voice circuits should be attributed to each of the major intra-provincial links which are shown in Figure 1. The first step required in this estimation involves applying a factor to account for the fact that, for any province, all of the urban population is not contained within the (telecommunications related) catchment areas of the cities (indicated in Figure 1) between which there are major intra-provincial links. Corrected numbers of intra-provincial trunk voice circuits are considered hereafter; these numbers are obtained as the product of the total numbers of intra-provincial trunk voice circuits estimated above and the appropriate fractions given in Table 7.

We return now to the estimation of the proportion of these intra-provincial trunk voice circuits which should be attributed to the single (i.e. only one in a province)

intra-provincial links shown in Figure 1. The highly subjective estimate is made that, for any province, approximately one-fortieth (i.e. 0.025) of this corrected number of trunk voice circuits can be attributed to these single major intra-provincial links.

Combining this estimate with the corrected numbers given above, it is now suggested that the total numbers of intra-provincial voice circuits over the single major links shown in Figure 1 are of the order of one-quarter the product of the total numbers given in Table 3 and the corresponding fractions given in Table 7. Very simple forecasting may therefore be undertaken for those provinces for which only a single intra-provincial link is considered, namely Alberta, Saskatchewan and Quebec. For these intra-provincial links:

Calgary	-	Edmonton
Regina	-	Saskatoon
Quebec	-	Montreal

forecasts of the number of total (public switched and other) end-to-end voice circuit trunks are directly obtained for the years 1973, 1980, 1985 and 1990; these forecasts are given in Tables 11 to 14.

For 1973 single forecasts are given (in Table 11) since the basic voice circuit data used was that provided by the Inter-Regional Working Group. For later years, three forecasts are given in Tables 12 to 14 for each link: a lower forecast (based upon the appropriate linearly derived lower forecast of Table 3), an upper forecast (based upon the appropriate

exponentially derived upper forecast of Table 3), and a preferred forecast calculated as the geometric mean between these lower and upper forecasts.

Our 1973 forecasts are obviously identical to those which would be derived using Working Group forecasts, since our basic end-to-end voice circuit forecasts were benchmarked to these for 1973 using the methodology described in Section 4 of DLDCNS Report No. 4. Intra-provincial forecasts for 1980, similar to those given in Table 12 but obtained using the Inter-Regional Working Group's forecasts for 1980 (given in Table 10 of DLDCNS Report No. 4), are given in Table 15. A comparison of Tables 12 and 15 indicates that, not surprisingly, our intra-provincial forecasts are quite similar to those derived using Working Group data.

4. GRAVITY MODELLING TO ALLOCATE ONTARIO FORECASTS

Yearly forecasts of total voice circuit requirements for Ontario are determined as if only a single major intra-provincial link was involved. These are allocated among six major links, according to the relative traffic volumes calculated using gravity models based upon inter-provincial traffic forecasts. This allocation gives estimates of the total end-to-end voice circuit requirements over each of the intra-provincial links considered for Ontario.

The forecasting methodology described in the previous section was also applied to Ontario, giving the total numbers of total (public switched and other) voice circuits tabulated in Table 16. Unfortunately, however, this single link methodology does not indicate how to allocate these total numbers among the six major intra-provincial links of concern in Ontario, namely:

Sudbury	-	Ottawa
Sudbury	-	Toronto
Sudbury	-	Windsor
Ottawa	-	Toronto
Ottawa	-	Windsor
Toronto	-	Windsor

This allocation is now undertaken using gravity modelling. The gravity model hypothesizes that the traffic T between two point populations P_1 and P_2 situated a distance R apart is

$$T = e^{A} \frac{P_1 P_2}{R^B} \qquad \ldots\ldots 1$$

where e^A and B are appropriate fitted constants. This equation can be re-written as

$$\ell n\left(\frac{T}{P_1 P_2}\right) = A - B\, \ell n(R) \qquad \ldots\ldots 2$$

Table 8 gives values of the coefficients A and B for gravity models fitted to lower and upper forecasts (obtained using linear and exponential extrapolation respectively) of inter-provincial commerical traffic for various years. Using the population projections obtained from Tables 4 and 6 with the inter-city distances of Table 9, these gravity models can be applied directly to Ontario's major intra-provincial links giving lower and upper forecasts of commercial traffic over these major links. For each year the proportion of the total of this traffic going over each major link is taken to give the proportion of voice circuits (from Table 16) to be allocated to that link.

This allocation of the voice circuit forecasts given in Table 16 produces estimated numbers of total end-to-end voice circuits forecast for Ontario's major intra-provincial links. For 1973 single forecasts are given (in Table 10) since the basic voice circuit data used was that provided by the Inter-Regional Working Group; similar forecasts for 1980 based upon Working Group data are given in Table 14. For the years 1980, 1985 and

1990 Tables 11 to 13 give three forecasts for each link: a lower forecast (derived from linearly extrapolated data) an upper forecast (derived from exponentially extrapolated data), and a preferred forecast calculated as the geometric mean between these lower and upper forecasts.

5. FORECASTING TOTAL VOICE CIRCUIT REQUIREMENTS USING GRAVITY MODELLING

Gravity modelling was also used to give direct forecasts of intra-provincial traffic; these were then converted into forecasts of total end-to-end voice circuit requirements using general log-log relationships previously determined. The new 1973 forecasts thus produced are very close to those already produced for major Ontario links, but other new forecasts of total end-to-end voice circuit requirements generally lie well below those already forecast. Since these new forecasts are considerably lower than expected, the forecasts produced in the previous section are recommended.

It is now suggested that, rather than merely using gravity modelling to give *relative* allocations of already determined numbers of total voice circuits, this modelling could be used directly to give *absolute* forecasts of intra-provincial traffic, using the data listed in Tables 4, 6, 8 and 9. These traffic forecasts could then be converted into forecasts of total end-to-end voice circuit requirements using the general log-log relationships given in Table 10.

It is not, however, certain that this direct approach is really justified. Since different factors may influence the growth of inter- and intra-provincial traffic, gravity models

derived using inter-provincial traffic may not be appropriate for generating intra-provincial traffic data. Moreoever, the general log-log conversion relationship of the form

$$\ell n\ (T_{VC}) = C + D\ \ell n\ (T) \qquad \ldots\ldots 3$$

used to convert traffic forecasts (T) to forecasts of total voice circuit requirements (T_{VC}) is not universally applicable, as noted in Section 4 of DLDCNS Report No. 4.

In spite of these reservations, this new approach is used to produce direct forecasts of total end-to-end voice circuit requirements over major intra-provincial links. For each of the years 1973, 1980, 1985 and 1990 Tables 17 to 20 provide three forecasts for each link: a lower forecast (derived using lower forecast data), an upper forecast (derived using upper forecast data), and a preferred forecast calculated as the geometric mean between these lower and upper forecasts.

It is of interest to compare these new forecasts with those given in Tables 11 to 14. Apart from a very close correspondence between 1973 forecasts for major Ontario links, the newly forecast total end-to-end voice circuit requirements generally lie well below the requirements previously forecast. This discrepancy is particularly noteworthy for the Regina-Saskatoon link, for which the preferred forecasts differ by a multiplicative factor of 27; it is also striking for the Calgary-Edmonton link for which the preferred forecasts differ by a multiplicative factor of 12.

Unfortunately there is no specific data available which would enable us to choose one of these sets of forecasts as being decidely "better" than the other. It may, however, be observed that the newly determined forecasts are somewhat lower than might otherwise be expected. The forecasts tabulated in Tables 11 to 14 are therefore recommended in preference to those given in Tables 17 to 20.

TABLE 1

TRAFFIC MATRIX

SINK

SOURCE		B.C.	ALTA.		SASK.		MAN.	ONT.				P.Q.		N.B.	N.S. (& P.E.I.)	NFLD
		V	E	C	S	R	W	S	O	T	W	M	Q	F	H	S.J.
B.C.	V	■														
ALTA.	E		■	X												
	C			■												
SASK.	S				■	X										
	R					■										
MAN.	W						■									
ONT.	S							■	X	X	X					
	O								■	X	X					
	T									■	X					
	W										■					
P.Q.	M											■	X			
	Q												■			
N.B.	F													■		
N.S. (& P.E.I.)	H														■	
NFLD.	S.J.															■

FIGURE 1

A SIMPLIFIED REPRESENTATION OF THE CANADIAN TELECOMMUNICATIONS NETWORKS

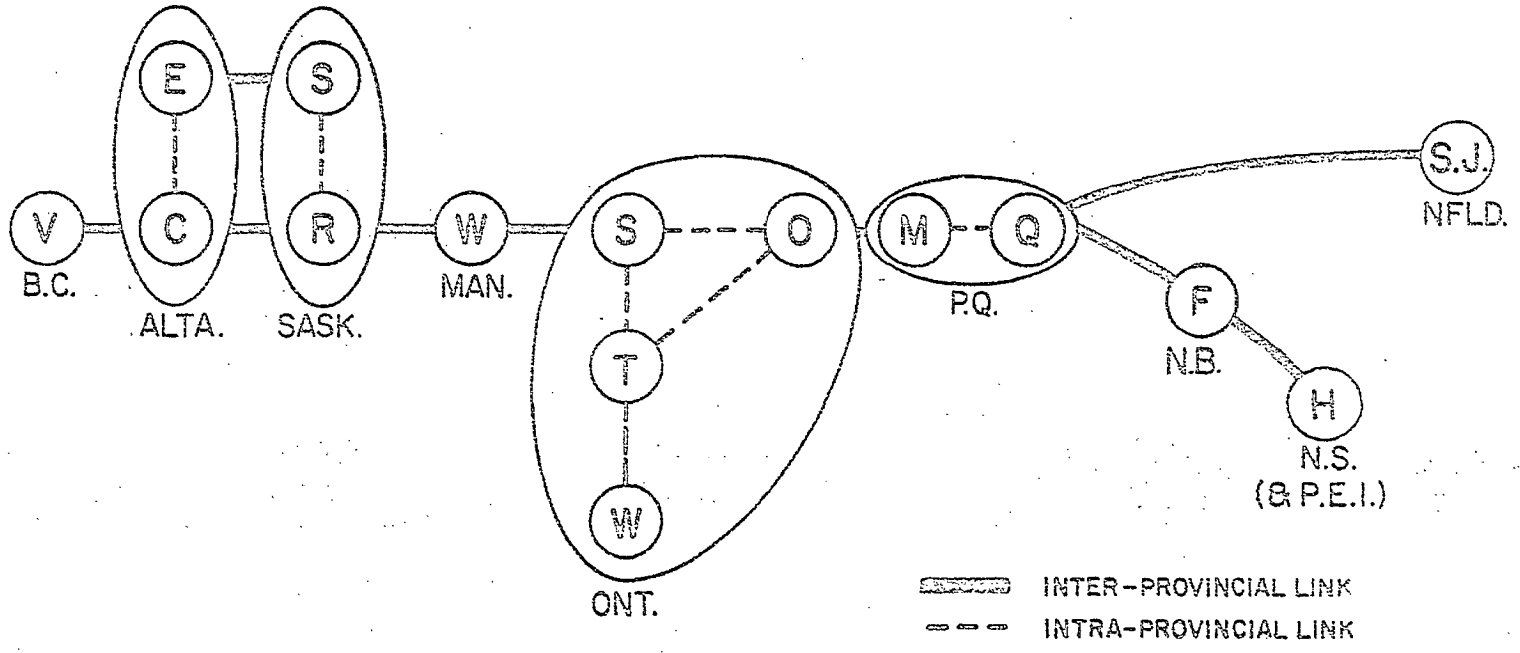
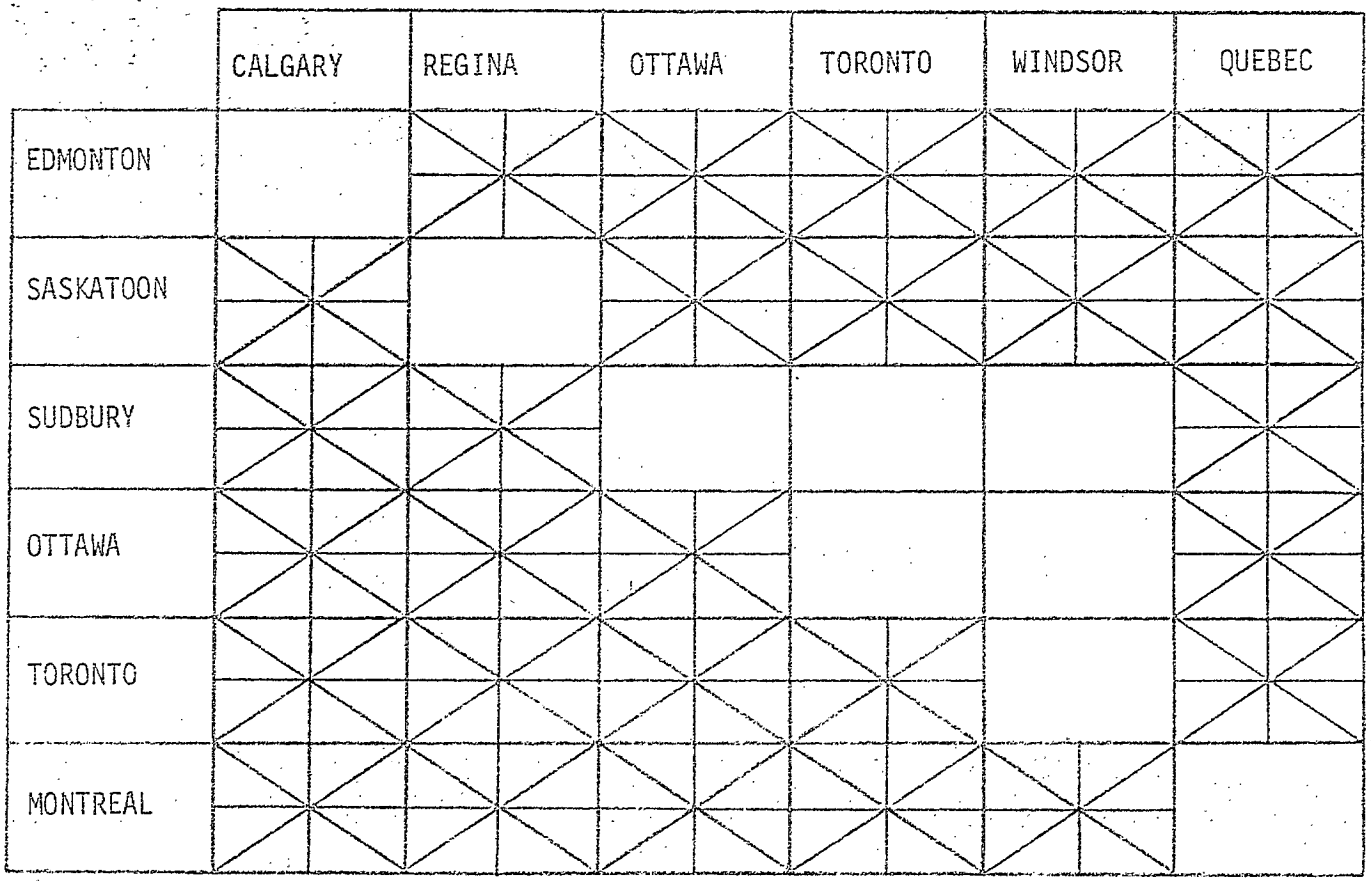


TABLE 2 : FORECASTS OF TOTAL NUMBERS (PUBLIC SWITCHED AND OTHER) OF VOICE CIRCUITS REQUIRED BETWEEN MAJOR CITIES FOR THE YEAR 19__.



(END-TO-END REQUIREMENTS)

FORECASTS:
UPPER
PREFERRED
LOWER

TABLE 3: TOTAL NUMBERS OF TOTAL END-TO-END VOICE CIRCUITS (PUBLIC SWITCHED AND OTHER) EMERGING FROM EACH PROVINCE LISTED AND GOING TO ALL THE OTHER PROVINCES.

	YEAR			
PROVINCE	1973	1980	1985	1990
Alberta	2,190 2,190	9,171 4,108	27,322 5,633	86,531 7,290
Saskatchewan	1,376 1,376	4,596 2,429	11,003 3,192	26,632 3,943
Ontario	6,298 6,298	22,139 10,852	60,413 14,105	180,173 17,362
Quebec	5,839 5,839	16,054 9,712	34,025 12,481	74,678 15,253

FORECASTS: UPPER / LOWER

TABLE 8

GRAVITY MODEL COEFFICIENT VALUES OBTAINED IN MODELLING INTER-PROVINCIAL END-TO-END TELEPHONE TRAFFIC (USING METHODOLOGY OF SECTION 2 OF DLDCNS REPORT NO. 4)

GRAVITY MODEL: $\ell n\left(\frac{T}{P_1 P_2}\right) = A - B\ \ell n(R)$

YEAR	FORECASTS USED	GRAVITY MODEL COEFFICIENT VALUES	
		A	B
1973	Lower	11.4106	1.03524
	Upper	11.2174	0.990715
1980	Lower	11.5044	1.01094
	Upper	10.2081	0.687273
1985	Lower	11.6587	1.02427
	Upper	9.52488	0.472846
1990	Lower	11.8354	1.04577
	Upper	8.86558	0.258088

LEGEND: T - Thousands of commercial telephone calls/year.

P_1, P_2 - Urban population in millions.

R - Mileage between centres.

TABLE 9

INTRA-PROVINCIAL DISTANCES IN MILES BETWEEN MAJOR CITIES

	Calgary	Regina	Ottawa	Toronto	Windsor	Quebec
Edmonton	175					
Saskatoon		150				
Sudbury			280	220	320	
Ottawa				220	440	
Toronto					220	
Montreal						145

TABLE 10

COEFFICIENT VALUES OF GENERAL LOG-LOG RELATIONSHIPS DETERMINED FOR CONVERTING 1973 TRAFFIC FORECASTS TO FORECASTS OF TOTAL END-TO-END VOICE CIRCUIT REQUIREMENTS.
(USING METHODOLOGY OF SECTION 3 OF DLDCNS REPORT NO. 4)

CONVERSION RELATIONSHIP: $\ell n\ (T_{vc}) = C + D\ \ell n\ (T)$

	COEFFICIENTS	
FORECASTS USED	C	D
Lower	-0.466449	1.00745
Upper	-0.640105	1.01678

LEGEND: T_{vc} - Total (public switched and other) voice circuit requirement.

T - Thousands of commercial telephone calls/year.

TABLE 11 : FORECASTS OF TOTAL NUMBERS (PUBLIC SWITCHED AND OTHER) OF VOICE CIRCUITS REQUIRED BETWEEN MAJOR CITIES FOR THE YEAR 1973.

	CALGARY	REGINA	OTTAWA	TORONTO	WINDSOR	QUEBEC
EDMONTON	456					
SASKATOON		251				
SUDBURY			23	155	12	
OTTAWA				643	38	
TORONTO					397	
MONTREAL						921

(END-TO-END REQUIREMENTS)

TABLE 12 : FORECASTS OF TOTAL NUMBERS (PUBLIC SWITCHED AND OTHER) OF VOICE CIRCUITS REQUIRED BETWEEN MAJOR CITIES FOR THE YEAR 1980.

	CALGARY	REGINA	OTTAWA	TORONTO	WINDSOR	QUEBEC
EDMONTON	1,924 1,288 862					
SASKATOON		871 634 461				
SUDBURY			79 53 36	509 358 252	42 28 18	
OTTAWA				2,322 1,633 1,149	154 97 61	
TORONTO					1,347 948 667	
MONTREAL						2,550 1,984 1,543

(END-TO-END REQUIREMENTS)

FORECASTS: UPPER
PREFERRED
LOWER

TABLE 13: FORECASTS OF TOTAL NUMBERS (PUBLIC SWITCHED AND OTHER) OF VOICE CIRCUITS REQUIRED BETWEEN MAJOR CITIES FOR THE YEAR 1985.

	CALGARY	REGINA	OTTAWA	TORONTO	WINDSOR	QUEBEC
EDMONTON	5,809 2,638 1,198					
SASKATOON		2,187 1,178 634				
SUDBURY			214 97 44	1,328 648 316	113 49 21	
OTTAWA				6,379 3,108 1,514	467 187 75	
TORONTO					3,579 1,744 850	
MONTREAL						5,458 3,306 2,002

(END-TO-END REQUIREMENTS)

FORECASTS: UPPER
PREFERRED
LOWER

TABLE 14: FORECASTS OF TOTAL NUMBERS (PUBLIC SWITCHED AND OTHER) OF VOICE CIRCUITS REQUIRED BETWEEN MAJOR CITIES FOR THE YEAR 1990.

	CALGARY	REGINA	OTTAWA	TORONTO	WINDSOR	QUEBEC
EDMONTON	18,706 5,430 1,576					
SASKATOON		5,618 2,162 832				
SUDBURY			630 179 51	3,765 1,183 372	330 89 24	
OTTAWA				19,108 6,003 1,886	1,544 369 88	
TORONTO					10,369 3,259 1,024	
MONTREAL						12,143 5,488 2,480

(END-TO-END REQUIREMENTS)

FORECASTS:
- UPPER
- PREFERRED
- LOWER

TABLE 15 : FORECASTS OF TOTAL NUMBERS (PUBLIC SWITCHED AND OTHER) OF VOICE CIRCUITS REQUIRED BETWEEN MAJOR CITIES FOR THE YEAR 1980.

	CALGARY	REGINA	OTTAWA	TORONTO	WINDSOR	QUEBEC
EDMONTON	1,078					
SASKATOON		628				
SUDBURY			52	346	27	
OTTAWA				1,581	94	
TORONTO					917	
MONTREAL						2,128

(FORECASTS OBTAINED USING FORECASTS OF END-TO-END REQUIREMENTS MADE BY THE INTER-REGIONAL WORKING GROUP)

TABLE 16: FORECASTS OF TOTAL NUMBERS OF TOTAL (PUBLIC SWITCHED AND OTHER) VOICE CIRCUITS REQUIRED END-TO-END IN ONTARIO BETWEEN SUDBURY, OTTAWA, TORONTO AND WINDSOR.

	FORECASTS	
YEAR	LOWER	UPPER
1973	1,268	1,268
1980	2,183	4,453
1985	2,820	12,080
1990	3,445	35,746
1980 (Working Group)	3,017	3,017

TABLE 17: FORECASTS OF TOTAL NUMBERS (PUBLIC SWITCHED AND OTHER) OF VOICE CIRCUITS REQUIRED BETWEEN MAJOR CITIES FOR THE YEAR 1973.

(FORECASTS OBTAINED USING DIRECT GRAVITY MODELLING)

	CALGARY	REGINA	OTTAWA	TORONTO	WINDSOR	QUEBEC
EDMONTON	75 72 68					
SASKATOON		14 13 12				
SUDBURY			24 23 22	164 158 152	12 12 11	
OTTAWA				691 670 650	38 37 36	
TORONTO					425 412 398	
MONTREAL						500 479 460

(END-TO-END REQUIREMENTS)

FORECASTS:
UPPER
PREFERRED
LOWER

TABLE 18: FORECASTS OF TOTAL NUMBERS (PUBLIC SWITCHED AND OTHER) OF VOICE CIRCUITS REQUIRED BETWEEN MAJOR CITIES FOR THE YEAR 1980.

(FORECASTS OBTAINED USING DIRECT GRAVITY MODELLING)

	CALGARY	REGINA	OTTAWA	TORONTO	WINDSOR	QUEBEC
EDMONTON	181 159 140					
SASKATOON		31 28 26				
SUDBURY			57 47 38	379 320 270	30 24 19	
OTTAWA				1,775 1,488 1,246	112 85 64	
TORONTO					1,020 857 720	
MONTREAL						1,075 966 868

(END-TO-END REQUIREMENTS)

FORECASTS: UPPER
PREFERRED
LOWER

TABLE 19 : FORECASTS OF TOTAL NUMBERS (PUBLIC SWITCHED AND OTHER) OF VOICE CIRCUITS REQUIRED BETWEEN MAJOR CITIES FOR THE YEAR 1985.

(FORECASTS OBTAINED USING DIRECT GRAVITY MODELLING)

	CALGARY	REGINA	OTTAWA	TORONTO	WINDSOR	QUEBEC
EDMONTON	369 272 201					
SASKATOON		62 48 37				
SUDBURY			116 75 49	743 513 354	60 38 24	
OTTAWA				3,665 2,514 1,724	256 147 84	
TORONTO					2,036 1,400 963	
MONTREAL						1,987 1,534 1,185

(END-TO-END REQUIREMENTS)

FORECASTS:	
	UPPER
	PREFERRED
	LOWER

TABLE 20: FORECASTS OF TOTAL NUMBERS (PUBLIC SWITCHED AND OTHER) OF VOICE CIRCUITS REQUIRED BETWEEN MAJOR CITIES FOR THE YEAR 1990.

(FORECASTS OBTAINED USING DIRECT GRAVITY MODELLING)

	CALGARY	REGINA	OTTAWA	TORONTO	WINDSOR	QUEBEC
EDMONTON	750 455 276					
SASKATOON		122 79 51				
SUDBURY			237 119 60	1,458 805 445	122 59 28	
OTTAWA				7,609 4,171 2,286	589 248 104	
TORONTO					4,087 2,246 1,235	
MONTREAL						3,693 2,396 1,555

(END-TO-END REQUIREMENTS)

FORECASTS:
UPPER
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