Communications
Canada

A STUDY OF THE TELEPHONE NUMBERING PLAN REQUIREMENTS AND DEVELOPMENT OF OPTIONS FOR CANADA

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AUTHOR: W.B. ROBERTS

CONTRACTOR: TELECOM CANADA
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EXECUTIVE SUMMARY

This report presents the findings of "A Study of the Telephone Numbering Requirements and Development of Options for Canada". The contract for the study was awarded by the Department of Communications to Telecom Canada in October 1988. The contract specified that a report should be produced by March 31, 1989. the terms of Reference for the study are provided in Addendum A and B.

The purpose of the study was to assess the economic, operational, competitive and service benefits to the Canadian telecommunications system in operating under the existing North American Numbering Plan (NANP) and to assess options for securing numbering resources to accommodate Canada's growth in telecommunications into the next century.

The study also was required to recognize that the level of telecommunications network competition will probably advance significantly over the life of the numbering plan. In addition to the local Public Switched Telephone Network (PSTN) requirements for numbering resources, a number of long distance interexchange carriers might enter the telecommunications market and several Integrated Services Digital Networks (ISDNs) could be introduced offering a range of new or improved voice, data, text and image services. The full interworking between the PSTN, ISDNs, Public Data Networks (PDNs), cellular and satellite mobile networks, private networks and specialized networks may also prevail. The evolution of the telecommunications environment in the next 30 to 40 years is an important consideration in forecasting the demand for numbering resources for Canada, as under the NANP structure, the demand for available numbering resources by U.S.A. carriers could have an impact on the Area Codes, known technically as Numbering Plan Area (NPA) codes, available to Canada in the long term.

It is particularly opportune, at this time, for Canada to identify its requirements for numbering resources, to formulate its position on NPA use and to assess its administrative procedures for good management of these limited numbering resources.

The Department of Communications, in initialing the study, stated that:

"As the telecommunications system evolves towards providing a greater choice of services and facilities to end users through a more competitive provisioning environment, it is important to assess the long-term numbering resource requirements to permit an orderly and efficient development of the Canadian telecommunications system. Also, some government review of the administration and acquisition of the numbering resource within the NANP is an important factor in ensuring that Canada's public interest is served. In particular, since the allocation of numbers can provide competitive advantages and affect the level of services, it is important that all Canadian carriers have full and fair access to NPA and central office codes under conditions consistent with Canadian telecommunications policy and industry structure."

Section 1.0 Background

Over the years, the planning and operation of the PSTN in Canada has evolved as part of a closely integrated North American telephone network. Furthermore, this telephone network has developed under a common NANP within a CCITT (International Telegraph and Telephone Consultative Committee) designated World Zone. This approach has served North America well to the present time by simplifying long distance calling and providing significant operational and economic benefits.

However, the growth of telephone stations and new services has all but exhausted the current capacity of the NANP. The telecommunications industry is currently expanding this numbering capacity to increase the total number of area codes (or NPAs) five-fold and the number of central office codes by 25% per area code. The completion date for the conversion which will expand the total number of area codes in North America is currently July 1, 1995. The administration of the NANP is currently performed by Bell Communications Research (Bellcore) of New Jersey, U.S.A. on behalf of all telecommunications carriers in North America. Telecom Canada, acting as Canadian co-ordinator, has participated in the administration of the NANP and has made all acquisitions of new area codes on behalf of Canadian industry. To date, the federal administrations and regulatory authorities in the U.S.A. and Canada have left the administration of the telephone numbering plan to the common carrier industry and have only intervened on special occasions.

With the advent of ISDN, an ad hoc committee was established in the U.S.A., under the direction of U.S.A. national standards organizations, to develop acceptable technical schemes to enable ISDN services to be accommodated under the existing telephone numbering plan. Discussions have focused on how to best meet the numbering requirement of Non-operating Telephone Company ISDNs in the interim period (to 1995) and in the long-term (after 1995). The principal telecommunications organizations in Canada (Telecom Canada, Teleglobe Canada Incorporated and CNCP Telecommunications) have taken an active part in these discussions.

Section 1.0 of the report provides a detailed description of the NANP and how it is currently being expanded in order to meet the future requirements of the some 16 different countries which it serves. In particular it describes the proposed expansion of the NANP using <u>interchangeable central office NPA codes</u> wherein the number of Area Codes available will be expanded by using the digits 2 to 9 as middle digits in addition to the digits 0 and 1 used at present. The implementation of the new, or interchangeable, codes in the <u>numbering plan</u> is fully described in this section.

<u>Section 2.0 Other Numbering Plans</u>

This section of the report describes the various international guidelines for numbering plans which are, or will be, used in Canada in conjunction with the NANP, to provide numbering for service networks such as ISDNs and PDNs. The section relates the numbering plans to the international numbering plan recommendations with which they conform. A synopsis of the relevant recommendations is provided in Addendum C.

<u>Section 3.0 Canadian Numbering Requirements</u>

An important aspect of the study was to assess the long-term numbering resource requirements for the Canadian telecommunications industry in order that it may respond efficiently to both changing telecommunications policy and industry structure.

This section forecasts Canada's numbering requirements based on input provided by Teleglobe Canada Incorporated, CNCP Telecommunications, Telesat Canada and Cantel Incorporated. Telecom Canada provided its forecast of the requirements of the Canadian PSTN.

Summaries of each of these inputs are included in the report. It is expected that Canada will require a maximum of 13 additional area codes or NPAs to the year 2050.

Five of these 13 additional area codes will be required for new geographic NPAs for the Canadian telephone network which, in this time-frame, will be evolving to an ISDN. These new NPAs will be required to provide for continued growth in services such as public switched voice, integrated digital, cellular radio and paging, as certain existing NPAs in Canada approach their maximum number of available Central Office codes.

Section 4.0 Numbering Alternatives for Canada

The study was required to assess alternatives that could ensure that Canada has adequate numbering resources as well as administrative control over its future numbering requirements and resources. This included considering whether Canada should acquire a separate Country Code (CC), what should be the role of government in the administration of numbering resources and what particular criteria and processes would be required to efficiently allocate domestic numbering resources.

Section 4.0 presents the scenario for, and impacts of, Canada adopting a separate CC. It concludes that there would be little practical advantage for Canada in adopting its own CC, compared with continuing to operate within the NANP, in view of the expected high cost of such an approach and the hardship it is likely to impose on customers initiating telephone calls between Canada and the U.S.A. It is projected that capital outlays in the order of $275 million would be needed to modify and/or expand the Canadian telephone network to accommodate a unique CC operation. This expenditure is mostly to provide for telephone traffic between Canada and the U.S.A. Moreover, the U.S.A. telephone network could incur capital construction costs in the order of ten times the estimated Canadian amount to accommodate telephone traffic between the two countries if Canada operates under a separate country code. This alternative could also result in a slower speed of setting up calls and a less efficient interworking of the telephone networks between Canada and the U.S.A. Also it was found that it would not be in the interest of good NANP administration to pre-assign NPA codes to countries or regions before there is a proven need.

Section 5.0 Study Conclusions and Recommendations

Section 5.0 highlights the following conclusions and recommendations:

i) the additional NPAs (or Area Codes) which will be needed to support PSTN, ISDN and other service network requirements, until the year 2050, are projected at 13.

ii) by no later than mid-1995 the public telephone network will have been fully converted to the use of interchangeable codes. This will increase the number of CO codes available in every NPA from 640 to 792, and the total number of NPA codes from the current 152 to 792. Good management of the expanded NANP and the efficient use of the additional NANP resources is expected to ensure a sufficient number of NPA codes throughout the 21st century.

iii) it is neither in the interests of good administration, nor of the NANP participants, to pre-assign NPA codes to a country or a region in advance of there being an immediate need for these resources.

iv) there is little advantage for Canada in opting our of the North American Numbering Plan. Canada must ensure, however, that it effectively participates in and influences all decision making regarding the future of the NANP including that the available numbering resources are to be used and managed to the benefit of all. Telecom Canada should continue to be the NANP administrator and coordinator for Canada with the responsibility to ensure that the Canadian needs are met, adequate consultation is carried out with all interested parties and an equitable and non-discriminatory approach continue to be applied to all Canadian applicants for NPAs.

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INTRODUCTION

This report presents the findings of "A study of the Telephone Numbering Requirements and Development of Options for Canada" which was contracted to Telecom Canada by the Department Of Communications, Canada.

Canada's future numbering requirements can only be developed and expressed through an understanding of the numbering plan already in place, which means an understanding of the development, make-up and future of the North American Numbering Plan (NANP). Therefore, in order to understand how the future requirements forecast in this study were developed, and to be able to put Canada's future requirements in perspective, it is necessary to have an understanding of the NANP and its make-up.

For this reason, a major part of the report is devoted to a detailed explanation of the NANP, its origins, its format, and its various components. Explanations are also given of how the NANP is being expanded so that it will continue to meet the telephone numbering requirements of World Zone 1, and how its various components are forecast through the use of the Central Office Code Utilization Survey (COCUS).

Also provided is an explanation of numbering plans other than that used for the Public Switched Telephone Network in Canada, including those for ISDN and data network numbering. In both sections, explanations are framed within the context of the various international recommendations to which the numbering plans conform, and for ease of reference, an addendum provides relevant extracts from these various CCITT Recommendations.

The report goes on to provide information on the various requirements for telephone numbering which are, or will be, required in Canada, as well as information on the source of the forecasts used as input to the study. It then examines alternatives to Canada's continued participation in the NANP including the adoption of a unique Country Code for Canada and all this would entail both in Canada and the rest of World Zone 1.

Finally the report provides a summation of Canada's total telephone numbering requirements to the year 2050, together with the conclusions reached and the recommendations made by the study.

ABBREVIATIONS

ANC	All Number Calling
AT&T	American Telephone and Telegraph Inc.
Bellcore	Bell Communications Research
CAMA	Centralized Automatic Message Accounting
CC	Country Code
CCITT	Comité Consultatif International Télégraphique et Téléphonique: International Telegraph and Telephone Consultative Committee
CIC	Carrier Identification Code
CNCP	Canadian National Canadian Pacific
CO	Central Office
COCUS	Central Office Code Utilization Survey
DCC	Data Country Code
DDD	Direct Distance Dialing
DDO	Direct Dialing Overseas
DNIC	Data Network Identification Code
FNPA	Foreign NPA
HNPA	Home NPA
IC	Interexchange Carrier (U.S.A.)
IDDD	International DDD (U.S.A.)
INWATS	Incoming Wide Area Telephone Service
ISDN	Integrated Services Digital Network
LEC	Local Exchange Carrier (U.S.A.)
MSAT	Mobile Radio-Satellite
N	Any number from 2 to 9
NANP	North American Numbering Plan
NPA	Numbering Plan Area
NPI	Numbering Plan Indicator
NSN	National Significant Number
0/1	Either 0 (zero) or 1 (one)
OTC	Operating Telephone Company

Abbreviations Cont'd.

PDN	Public Data Network
POTS	Plain Ordinary Telephone Service
PSTN	Public Switched Telephone Network
SAC	Service Access Code
SN	Station Number
TC	Trunk Code
TMI	Telesat Mobile Inc.
X	Any number from 1 to 0

SECTION 1.0 BACKGROUND

1.1 INTERNATIONAL TELEPHONE NUMBERING

1.1.0 World Numbering Zones

For international telephone numbering purposes, the world is divided into nine zones. In all zones except World Zones 1 and 7, each sovereign country or geographic area within the zone is assigned a two or three digit Country Code which has the World Zone number as its first digit. Some examples are: the United Kingdom in World Zone 4 is assigned Country Code 44; Mexico in World Zone 5 is assigned Country Code 52 and Saudi Arabia in World Zone 9 is assigned Country Code 966.

1.1.1 World Zone 1

The exceptions to the above are World Zone 1 and World Zone 7 in which none of the countries or geographic areas use individual Country Codes. All of World Zone 7 (the U.S.S.R.) uses the single digit 7 as its Country Code and the countries of World Zone 1, which consists of the 50 states of the U.S.A., Canada, Bermuda, Puerto Rico and the Virgin Islands and certain other Caribbean islands, use the single digit 1 as their Country Code. In these cases the entire zone must adhere to a common numbering plan, which for World Zone 1 is the North American Numbering Plan (NANP).

1.2 THE NORTH AMERICAN NUMBERING PLAN (NANP)

1.2.0 Recommendation E.163 and the NANP

The NANP, which is used for the Public Switched Telephone Network (PSTN) throughout World Zone 1, conforms internationally to CCITT Recommendation E.163. This recommendation is summarized in Addendum C. The following illustrates the parameters established by Recommendation E.163 and how the NANP relates to those parameters.

CCITT Recommendation E.163

<table>
<tr><td colspan="4"><—— Overall Address ——></td></tr>
<tr><td></td><td colspan="3"><—— International Number ——></td></tr>
<tr><td>P
R
E
F
I
X</td><td>Country Code
(1 to 3 digits)
or
Trunk Prefix
(1 or 2 digits)</td><td colspan="2"><—— National Significant Number ——>
(8 to 10 digits)

<—— National Number ——></td></tr>
<tr><td></td><td></td><td>Trunk Code (TC)
(1 to 3 digits)</td><td>Subscriber Number
(8 to 10 digits)</td></tr>
<tr><td>*</td><td>WORLD ZONE 1
1</td><td colspan="2">NANP NATIONAL NUMBER</td></tr>
<tr><td></td><td></td><td>Area Code</td><td>Central Office code
+
Station Number</td></tr>
</table>

* Canadian Prefix: North American = 0 or 1; International = 01 or 011.

1.2.1 Development and Administration of the NANP

The NANP was originally developed in the late 1940s by AT&T and Bell Telephone Laboratories in the U.S.A. At that time The Bell Telephone Company of Canada, as it was then known, had close business, manufacturing and research ties with both these U.S.A. organizations and, personnel from the Canadian company, on secondment to Bell Telephone Laboratories, participated in the formulation of the plan and represented Canadian interests.

Until the early 1980s the NANP was administered by AT&T, but with divestiture in the U.S.A., Bell Communications Research (Bellcore) assumed this responsibility. The NANP administrator's address is:

Bell Communications Research
290 West Mt. Pleasant Avenue,
Livingston, New Jersey
U.S.A. 07039

Since the inception of the NANP, the Telecom Canada (previously The TransCanada Telephone System) organization, in close co-ordination with the U.S.A. administrator, has generally coordinated and administered the plan within Canada. This responsibility resides in the central staff planning organization and is currently under the jurisdiction of:

Telecom Canada
Director-Fundamental Planning
410 Laurier Avenue West,
Ottawa, Ontario
Canada K1P 6H5

The NANP administrator is responsible for ensuring that the plan is administered in a fair and equitable manner for the common good of all participants in the North American network. Every attempt is made to bring about change through consensus and, to date, there has never been a case in which Canada's views have not received full and equitable consideration and its legitimate needs met.

1.2.2 Operating Telephone Company Responsibilities

The NANP administrators are responsible for all aspects of the plan including assignment of Numbering Plan Area (NPA) codes. However, once an NPA code is assigned to a geographical area, the administration responsibility for the Central Office (CO) codes within that NPA rests with the Operating Telephone Company (OTC).

Thus the OTCs in Canada have traditionally been responsible for assigning CO codes for the telephone exchanges within their own areas and for the use and conservation of those codes in accordance with established NANP guidelines.

Where there is more than one OTC within an NPA, the larger company normally assumes prime responsibility.

1.2.3 NANP Numbering Format

The NANP is based on the "destination code" principle which requires the assignment of a unique telephone number to each telephone station in the PSTN. It is also a "closed" numbering plan, in which each telephone number has ten digits.

The ten digit number is made up of three separate code fields consisting of a three digit NPA code, a three digit CO code and a four digit Station Number.

The nomenclature used to represent the format of these codes is:

X = Any number from 1 to 0

N = Any number from 2 to 9

0/1 = Either 0 or 1

Use of the term "Central Office" is sometimes misleading in telecommunications. For example, a telephone building which houses more than one 10,000 line local exchange may be referred to as a Central Office. It is therefore common practice to use NNX code (for the 640 non-interchangeable CO codes) or NXX code (for the 792 interchangeable CO codes) in place of the term CO code.

1.2.4 NANP Access Codes

As well as providing for a unique telephone number for every station in the PSTN, the NANP must also make provision for a series of digits for dialed access to the various services such as Operator Assistance and Long Distance which are an integral part of the PSTN.

These codes are known as Access Codes. They are never part of a telephone number and are always separate from it.

Access codes should be simple and convenient to use and, if possible, should be universal throughout the network. Also, in combination with a telephone number, they must not form a digit string which is ambiguous to the switching system.

The digits 0 and 1, used singly, or in two or three digit combinations, are designated exclusively for use as access codes under the NANP. Thus 0 is used for Operator assistance, 1 for Direct Distance Dialing (DDD), 011 for International/Overseas DDD, 01 for Operator assisted international/overseas DDD.

In order to avoid ambiguity when these access codes are combined with a telephone number, the digits 1 and 0 are not used as the first digits of either an NPA or a CO code in the NANP. For example <u>1 + 613</u> + NXX-XXXX and <u>161</u>-XXXX would be ambiguous.

This means that 200 (000 to 199) of the 1000 possible three digit code combinations are not available as NPA or CO codes in the NANP, leaving only 800 usable codes.

1.2.5 NANP Special Three Digit Codes

In addition to the need for access codes, there are other essential telephone services for which it is considered necessary to use a form of easily remembered abbreviated dialing. For these purposes the eight three digit codes having an N11 configuration (ie. 211 through 911) are designated as special codes for local telephone use.

Probably the most familiar of these is the 911 emergency code now used in most major metropolitan areas throughout North America. Others such as 411 and 611 are designated for local Directory Inquiries, Repair Services.

As a result of the designation of the eight codes as special codes, there are only 792 three digit codes available for possible use as NPA and CO codes.

1.2.6 Non-Interchangeable Codes

The NANP was originally designed to permit intra-NPA toll calls to be dialed on a 1+7 digit basis rather than the full 1+10 digits required for inter-NPA calls.

To do this without introducing unwanted delays in routing the call, it is necessary for the switching system to be able to distinguish between an NPA code and a CO code, and this requires the two types of code to be of a different format. (The dialing procedures involved are discussed in more detail in 1.4.6).

As a result, of the 792 three digit codes available, only those with 0 or 1 as a middle digit were designated for use as NPA codes, while the remainder were designated for use as CO codes. This means that an NPA code cannot be used as a CO code and vice-versa. Such codes are called non-interchangeable codes. Their format and the quantities available are:

FIELD	NUMBERING PLAN AREA CODE	CENTRAL OFFICE CODE	STATION NUMBER
FORMAT	N0/1X	NNX	XXXX
NUMBER OF CODES	152	640	10,000

1.2.7 The Use of Alpha/Numeric Codes

Prior to the development of the NANP, all COs were identified by name and this was originally carried over into the NANP by assigning alpha/numeric codes using the first two letters of these names. For example, the Pennsylvania #6 Central Office was designated PE6 (hence, PE6-5000).

This practice not only limited the number of Central Office codes to 540 (because the letters used must always spell the first two letters of a word), but it also tended to cause dialing errors because of confusion between letter O and digit 0, and letter I and digit 1. Name designations for COs were gradually phased out through the 1950s and 1960s as All Number Calling (ANC) was established throughout the network. Thus COs became identified solely by a three digit numeric code, permitting the use of all 640 NNX codes.

1.2.8 NANP Service Access Codes

Some of the 152 N0/1X format NPA codes are used as Service Access Codes (SACs) which provide for certain special types of network services. They are used in the NPA field in the ten digit number, but do not designate a specific geographic area.

The eight N00 format codes have been designated for use as SACs under the NANP and examples of the use of such codes are; 800, which is used for for Incoming Wide Area Telephone Service (INWATS) and 900, which is used for Information Delivery Services.

Two other virtual SACs, but which have an N0/1X format, are also used within the NANP for service access. These are 710, which is assigned to U.S.A. government service and 610, which is an exclusively Canadian code used currently for TWX and Datalink services. An extension of the use of 610 for Canadian non-operating telephone company ISDNs is discussed.

Like NPA codes, SACs are never used alone, but are always followed by a three digit CO code and a four digit SN to form a complete ten digit number. Unlike the NXX codes associated with geographical NPAs, the NXX codes within a SAC are assigned by the NANP administrator. However, the OTCs are responsible for the four digit station numbers associated with each NXX.

1.2.9 Carrier Identification Codes (CICs)

As a result of the Modification of Final Judgement (AT&T Divestiture) in the U.S.A. new dialing procedures had to be developed to permit most callers in the U.S.A to specify the Interexchange Carrier (IC) of their choice. There are three dialed access arrangements in use in the U.S.A. and these are designated Feature Group A, Feature Group B and Feature Group D.

Feature Group A simply uses a local 7 digit number (NXX-XXXX), which is assigned to the individual IC. A caller dialing this number reaches the equipment of the specific IC and then receives a second dial tone. Use of this feature group requires the caller to have Touch Tone calling.

The access arrangements known as Feature Groups B and D, require the use of a three digit Carrier Identification Code (CIC) of the format XXX.

The three Feature Groups are illustrated below:

ACCESS PLAN		DIALING PROCEDURE
Feature Group A	NXX-XXXX	+ second dial tone + ID code + called number (7 or 10 digit)
Feature Group B	(1) + 950-0XXX, or (1) + 950-1XXX	
Feature Group D	(10XXX) + (0/1) + Called Number (7D or 10D)	

CICs (XXX) are assigned by Bellcore, the NANP administrator, to the individual ICs in the U.S.A. although the code is actually used by the Local Exchange Carriers (LECs) to route the call through their own switching system to the designated IC's network.

There are currently in the order of 800 assignable three digit CICs and, by October 1988, some 600 had been assigned for domestic use.

Strict conservation rules regarding the assignment of these codes prevail and contingency discussions have taken place between Bellcore and U.S industry regarding future expansion plans should this become necessary.

Up to the present time, no CICs have been assigned in Canada as there are no competing ICs. However in 1985, discussions took place between Telecom Canada and Bellcore, where agreement was reached on a set of written guidelines providing for the application to Bellcore for, and the assignment by them of, CICs to Canadian ICs, should they be required in the future.

CICs were developed solely for the selection of an IC by a local telephone user and for no other purpose. They are only intended for use as an integral part of access plans similar to the Feature Groups described above.

1.3 ASSIGNMENT OF NPA CODES

1.3.0 NPA Code and SAC Code Administration

All NPA codes and SACs in the NANP are assigned by Bellcore, the NANP administrator, and one of its major responsibilities in this area is to ensure that stringent code conservation practices are always exercised. It must always be conscious of the fact that the assignment of an NPA code or SAC means the allocation of 8 million subscriber numbers. The need for strict conservation is particularly important at this time and the situation will remain critical until the entire North American network is modified to accommodate interchangeable NPA codes in 1995. This is necessary in order to ensure that the current supply of 152 NPA codes is not exhausted prior to that time.

Through COCUS (explained in detail in 1.3.3), also administered by Bellcore, Bellcore is aware of the year in which each NPA is expected to exhaust its supply of CO codes. Well before the indicated exhaustion date arrives, the process of ongoing communication between the Bellcore Numbering Planning Organization and the LEC or OTC (and in Canada's case also with the Telecom Canada administrator) ensures that the need for a new NPA code can be verified by means of engineering studies, and that whatever assistance may be required in planning for the change can be given. The assignment of a new NPA code then becomes part of the ongoing process and the actual assignment of a new code by Bellcore takes place some two years before the NPA split.

Requests for the assignment of a unique SAC for a service which will only ever have a requirement for a small number of NXX codes in that SAC will always be very difficult to deal with. In such cases strong consideration should be given to using the same SAC for a number of different services. It can never be expected that simply asking for a code will be sufficient, as again it must be stressed that the assignment of any code at the NPA level inhibits the use of the 8 million numbers contained within that code.

1.3.2 Current NPA Code Assignments Under the NANP

The following list of Current NPA assignments (as of January 1 1989), shows that only 15 of the 152 N0/1X format NPA codes are currently unassigned. Of these 15 codes, five are reserved for use as SACs (N00 codes), which means that only ten of the codes currently remain for assignment as geographical NPA codes.

The NPA codes 706 and 905 assigned to Mexico, are actually pseudo NPA codes. Mexico falls within World Zone 5, not World Zone 1, and the codes are used only within the NANP to provide a convenient method of direct dialing to certain parts of Mexico which have a community of interest with World Zone 1. However their use for DDD calls to Mexico is now being phased out and replaced by the normal method of International Direct Distance Dialing to another World Zone. The change has already been put into place in Canada and, Mexico is now reached by dialing the Overseas Direct Distance Dialing access code 011, followed by the Mexican Country Code 52 plus the Mexican telephone number.

Where they are still in use in the U.S.A. steps are currently being taken to eliminate the use of these two codes for dialing to Mexico and they will eventually be recovered and used for NPA codes within World Zone 1.

The SAC codes 510, 710, 810 and 910, were originally assigned to TWX service in the U.S.A. However they were withdrawn from this service in 1983. They were designated as unassigned NPA codes at that time. 710 is now in use for government purposes in the U.S.A. and SAC 610 is still used exclusively by Canada.

CURRENT NPA ASSIGNMENTS 1989 01 01

200 -
201 - NEW JERSEY
202 - DIST.OF COLUMBIA
203 - CONNECTICUT
204 - MANITOBA
205 - ALABAMA
206 - WASHINGTON
207 - MAINE
208 - IDAHO
209 - CALIFORNIA
210 -
212 - NEW YORK
213 - CALIFORNIA
214 - TEXAS
215 - PENNSYLVANIA
216 - OHIO
217 - ILLINOIS
218 - MINNESOTA
219 - INDIANA
300 -
301 - MARYLAND
302 - DELAWARE
303 - COLORADO
304 - WEST VIRGINIA
305 - FLORIDA
306 - SASKATCHEWAN
307 - WYOMING
308 - NEBRASKA
309 - ILLINOIS
310 -
312 - ILLINOIS
313 - MICHIGAN
314 - MISSOURI
315 - NEW YORK
316 - KANSAS
317 - INDIANA
318 - LOUISIANA
319 - IOWA
400 -
401 - RHODE ISLAND
402 - NEBRASKA
403 - ALBERTA
404 - GEORGIA
405 - OKLAHOMA
406 - MONTANA
407 - FLORIDA
408 - CALIFORNIA
409 - TEXAS
410 -
412 - PENNSYLVANIA
413 - MASSACHUSETTS
414 - WISCONSIN
415 - CALIFORNIA
416 - ONTARIO
417 - MISSOURI
418 - QUEBEC
419 - OHIO
500 -
501 - ARKANSAS
502 - KENTUCKY
503 - OREGON
504 - LOUISIANA
505 - NEW MEXICO
506 - NEW BRUNSWICK
507 - MINNESOTA
508 - MASSACHUSETTS
509 - WASHINGTON
510 -
512 - TEXAS
513 - OHIO
514 - QUEBEC
515 - IOWA
516 - NEW YORK
517 - MICHIGAN
518 - NEW YORK
519 - ONTARIO
600 -
601 - MISSISSIPPI
602 - ARIZONA
603 - NEW HAMPSHIRE
604 - BRIT. COLUMBIA
605 - SOUTH DAKOTA
606 - KENTUCKY
607 - NEW YORK
608 - WISCONSIN
609 - NEW JERSEY
610 - CAN.TWX/D.LINK
612 - MINNESOTA
613 - ONTARIO
614 - OHIO
615 - TENNESSEE
616 - MICHIGAN
617 - MASSACHUSETTS
618 - ILLINOIS
619 - CALIFORNIA
700 - IC SERVICES
701 - NORTH DAKOTA
702 - NEVADA
703 - VIRGINIA
704 - NORTH CAROLINA
705 - ONTARIO
706 - N/W MEXICO
707 - CALIFORNIA
708 - ILLINOIS (89 11 11)
709 - NEWFOUNDLAND
710 - U.S.A GVT.
712 - IOWA
713 - TEXAS
714 - CALIFORNIA
715 - WISCONSIN
716 - NEW YORK
717 - PENNSYLVANIA
718 - NEW YORK
719 - COLORADO
800 - INWATS
801 - UTAH
802 - VERMONT
803 - SOUTH CAROLINA
804 - VIRGINIA
805 - CALIFORNIA
806 - TEXAS
807 - ONTARIO
808 - HAWAII
809 - BERMUDA,PUERTO RICO, VIRGIN ISLANDS & OTHER CARIBBEAN ISLANDS.
810 -
812 - INDIANA
813 - FLORIDA
814 - PENNSYLVANIA
815 - ILLINOIS
816 - MISSOURI
817 - TEXAS
818 - CALIFORNIA
819 - QUEBEC
900 - INFO.DEL.SVCES.
901 - TENNESSEE
902 - NOVA SCOTIA & PEI
903 -
904 - FLORIDA
905 - MEXICO CITY
906 - MICHIGAN
907 - ALASKA
908 -
909 -
910 -
912 - GEORGIA
913 - KANSAS
914 - NEW YORK
915 - TEXAS
916 - CALIFORNIA
917 -
918 - OKLAHOMA
919 - NORTH CAROLINA

1.3.3 The Central Office Code Utilization Survey (COCUS)

The Central Office Code Utilization Survey (COCUS) is conducted by the NANP administrator on an annual basis. It is compiled from data gathered from each NPA in the North American network and one of its main purposes is to establish the actual and projected use of Central Office codes in all NPAs in the NANP.

The input data consists of current actual use, and year by year projections for the next six years, of all telephone numbers and CO codes required for all purposes, by the OTCs, in every NPA in the PSTN.

Using this data, COCUS predicts when NPAs can be expected to reach CO code exhaustion, either at 640 codes when conversion to interchangeable CO codes will be required, or 792 codes when the NPA will need to be split. From this can be developed an estimate of when, and how many, new NPA codes will be required for the PSTN in the future.

COCUS was conducted for many years on a five yearly basis, but, since 1986, with the anticipated approach of the exhaustion of the 152 N0/1X format NPA codes, Bellcore has carried out the survey annually.

The results of the COCUS are dependent upon the accuracy of the input from each of the OTCs. However, it is in each companies interest to ensure that its input data is as accurate as possible, as it is submitting data which is monitoring the use of the CO codes within its NPA(s). In addition telephone demand is subject to many external influences, such as both long and short term regional and national economic and/or demographic change, which can profoundly affect all forecasts.

Despite this, COCUS results have proved to be accurate enough to ensure that all operating telephone companies have received adequate warning of the need to plan for, and implement, necessary interchangeable CO code conversions and NPA splits in the network. Telecom Canada co-ordinates COCUS within Canada, by gathering the data from each OTC verifying the inputs and resolving any obvious discrepancies before forwarding the data to Bellcore as a complete Canadian package. The results of the Canadian portion of the survey are returned directly to Telecom Canada, which forwards the appropriate data to each OTC. COCUS input and output data sheets are regarded as proprietary information.

1.3.4 The 1988 COCUS Results

The COCUS results for 1988 became available in October 1988 and have been distributed to all participants including those in Canada. They indicate which NPAs are expected to exhaust throughout the North American PSTN over the next ten years together with their projected exhaust date:

RANK	NPA	EXHAUST YEAR	RANK	NPA	EXHAUST YEAR
1.	215	1989	15.	301	1993 *
2.	312	1989	16.	404	1994 *
3.	313	1990	17.	512	1994 *
4.	214	1990 *	18.	602	1995 *
5.	201	1991 *	19.	813	1995
6.	803	1991	20.	804	1996
7.	205	1991	21.	619	1996
8.	919	1992	22.	202	1996 *
9.	416	1992	23.	612	1996
10.	213	1992 *	24.	703	1997 *
11.	714	1992	25.	203	1997
12.	415	1992 *	26.	206	1997
13.	212	1993 *	27.	913	1998
14.	809	1993	28.	303	1999

* -.Indicates that interchangeable codes are already in use in these NPAs, therefore they must be split. It is anticipated that the remainder will defer the need for an NPA split by adopting interchangeable CO codes.

1.4 EXPANSION OF THE NANP

1.4.0 NANP Expansion Plans

The use of non-interchangeable codes in the NANP limits the number of three digit code combinations which can be used for both CO and NPA codes. The total of 792 codes available provides for only 152 N0/1X format NPA codes and 640 NNX format CO codes.

Within a few years of the implementation of the NANP, it became evident that the rapid post-World War II growth in telephone demand in North America, would continue and that, in the foreseeable future, it would become necessary to expand the NANP to provide more numbers.

Consequently, the means by which the NANP would be expanded were established very soon after the original plan was developed. It was proposed that, as and when it became necessary to expand the NANP, the practice of using CO and NPA codes in the NANP, which were recognizably different, ie. non interchangeable codes, would be discontinued, and interchangeable codes would be adopted.

The requirement to modify the switching system to accommodate interchangeable codes was established at that time, as was the need to modify certain abbreviated dialing procedures associated with intra NPA toll dialing. Also at that time, the date by which it would be necessary for the PSTN to adopt interchangeable NPA codes was estimated to be about the year 2000 but, within the last few years, this has been revised so that it is currently planned that the North American network will be ready to use interchangeable NPA codes by July 1, 1995.

1.4.1 Interchangeable CO Codes

Individual NPAs are converted to the use of interchangeable CO codes when the supply of 640 non-interchangeable codes in that NPA approaches exhaustion. Interchangeable CO codes can be and have been, implemented in many NPAs in the U.S.A. without any effect on the dialing procedures or switching system arrangements in any other NPAs, thereby increasing the supply of assignable CO codes in at least 10 NPAs, to 792.

Within the NPAs concerned, all switching systems have been modified to accept codes of the format N0/1X as the first three digits of a local (seven digit) number, as well as the first three digits of a ten digit number and the use of 1+7 digit dialing has, consequently been discontinued.

This has permitted the available CO codes for those NPAs to be increased to a maximum of 792.

Interchangeable CO codes will be introduced into the first Canadian NPA in the early 1990s.

1.4.2 Interchangeable NPA Codes

Unlike the interchangeable CO code case, interchangeable NPA codes must, and will be, implemented simultaneously throughout the entire network.

Before the first NPA code having an NNX format can be assigned, every switching system in the NANP will have to have been converted to accept codes with an NNX format as NPA codes. Also the traditional use of 1+7 digit dialing must be changed throughout the network, as described in 1.4.6.

Based on current surveys and anticipated future network requirements, the date by which it is planned to complete all preparations for the North American network to adopt interchangeable NPA codes is July 1, 1995.

1.4.3 Implementing the NANP Expansion

As stated previously, interchangeable CO codes have already been implemented in more than ten NPAs in the U.S.A. and more such conversions will be required between now and 1995.

However, at some time prior to July 1, 1995, those NPAs which have not had to carry out these conversions because of a shortage of CO codes, must undertake the same conversions in order to prepare the entire network to use interchangeable NPA codes. This also means that after July 1995, the network will have a fully Interchangeable Code capability (see 1.4.4.) as the modifications and changes required to convert an NPA to interchangeable CO codes also makes that NPA capable of handling interchangeable NPA codes and vice-versa.

The only reason the conversions are not being carried out in all NPAs now, is that there are cost advantages in delaying them. The electronic switching machines which are gradually proliferating throughout the network, under switch modernization programs, cost less to convert than the older electromechanical machines.

1.4.4 Fully Interchangeable Codes

Fully Interchangeable Codes mean that CO codes and NPA codes will no longer be recognizably different and will be fully interchangeable. In the nomenclature used for describing code formats, both CO and NPA codes would then have an NXX format.

This will mean that the maximum number of assignable CO codes in each NPA will be 792 and, most significantly, the number of NPA codes available for assignment will also be 792. This will constitute a more than five-fold increase in the number of NPA codes available for use in the NANP.

Even with the more than five-fold increase in NPA codes which will become available after the introduction of interchangeable codes, code conservation practices will still be necessary in order to conserve the numbering resources in North America. The assignment of an NPA code or SAC will still mean the allocation of 8 million telephone numbers and even with an additional 640 NPA codes available, under-use of an NPA code or SAC resource cannot be justified.

The format of Interchangeable Codes and the quantities available in each field of the ten digit number, are summarized in the following table:

FIELD	NUMBERING PLAN AREA CODE	CENTRAL OFFICE CODE	STATION NUMBER
FORMAT	NXX	NXX	XXXX
NUMBER OF CODES	792	792	10,000

1.4.5 Modifications to the Switching Systems

Designed for use in a network using only non-interchangeable codes, all machines in the switching system originally rejected any N0/1X format code appearing in the CO code field, or any NNX format code appearing in the NPA code field.

Thus in order to be able to use interchangeable codes, each machine must be modified to enable it to accept as CO codes, those codes having an N0/1X format in addition to the NNX format codes traditionally used as CO codes and accept as NPA codes, those codes having an NNX format in addition to the N0/1X format codes traditionally used as NPA codes.

1.4.6 Modifications to Toll Dialing Procedures

An additional requirement when introducing interchangeable codes is that some existing dialing procedures must be changed.

The use of non-interchangeable codes permits 1+7 digit dialing to be used for intra-NPA toll calls (ie. toll calls within the Home NPA (HNPA)), instead of the 1+10 digits always required for toll calls to a Foreign NPA (FNPA).

Toll calls to the HNPA and toll calls to a FNPA are routed differently and it is necessary for the switching system to be able to determine which type of call is being made as early in the process as possible.

The use of non-interchangeable codes enables the switching system, simply by examining the middle or second digit of the first three digits of the number dialed, to be able to determine whether a 1+7 digit call, or a 1+10 digit call, is being dialed (ie. if the middle or second digit is a 0 or a 1, it is a 1+10 digit or FNPA call, whereas if the digit is 2 through 9, it is a 1+7 digit, or HNPA call).

However, interchangeable codes are ambiguous and, with their introduction, the switching system is no longer able to distinguish between the two types of call by the above method. An alternative to using recognizably different codes so as to permit 1+7 digit dialing to be retained, would be to introduce a four second delay in the switching machine process after receipt of the seventh digit. If no further digits are received in this period, the call is processed as a 7 digit toll call. Such a processing delay is not generally regarded as acceptable in today's network.

Under these circumstances, the use of 1+7 digit dialing will no longer be sustained in an NPA when it adopts interchangeable CO codes and will no longer be used anywhere in the network, after 1995, with the advent of interchangeable NPA codes.

Currently, 1+7 digit dialing is standard in all NPAs across Canada, but will no longer be used in NPA 416 with the introduction of interchangeable CO codes in that NPA in the early 1990s. Finally, from 1995, with the entire PSTN converted to the use of interchangeable NPAs, 1+7 digit dialing will no longer be used in Canada.

1.4.7 NPA Splitting

As discussed previously, an NPA which is using only non-interchangeable CO codes has a maximum of 640 CO codes available. Therefore, when the 640 CO codes approach exhaustion the normal procedure is to convert the NPA to interchangeable CO codes. This increases the number of available codes in that NPA to 792 and defers the need for an NPA split usually by a number of years.

However, 792 is the absolute maximum number of assignable CO codes in one NPA and, before this is reached, the geographical size of the NPA must be reduced. In practice the actual number of COs which can be accommodated is somewhat less than the maximum, as certain CO codes are not used in the NPA. For example, the HNPA code is not used as a CO code because of possible dialing confusion.

Reducing the geographical size of an existing NPA means that a number of existing COs in that NPA fall outside the geographical area served by that NPA code The CO codes can be used to designate new COs in the smaller NPA. The geographical size of an NPA is usually reduced by splitting the NPA into two areas and assigning a new code to one of the areas.

Splitting an NPA is an extremely costly and disruptive procedure, thus every effort is directed towards deferring an NPA split for as long as possible. This is why it is important that CO code conservation practices are adhered to throughout the network.

The adoption of interchangeable CO codes in an NPA is currently regarded as an essential step when that NPA approaches the exhaustion of the 640 NNX codes. Not only does this defer the NPA split, it also defers the need to assign a new NPA code. It is important that every effort is made to conserve NPA codes as insurance that the date by which it will be necessary to introduce interchangeable NPA codes into the network will not have to be advanced.

It has always been recognized by the industry, that the cost of converting the network to the use of interchangeable NPA codes is largely a function of the type of switching systems involved. For example, electromechanical systems are generally more expensive to convert than electronic switching systems and the ongoing replacement of electromechanical systems with electronic ones will therefore have a favourable impact on that cost. However it is still anticipated that the conversion cost for the entire network will still be large.

For this reason it has always been planned to defer the adoption of interchangeable NPA codes for as long as possible, without risking the disruption to the network which would result from running out of the current supply of 152 NPA codes.

1.4.8 Code Conservation Rules

As the administrators of the NANP, Bellcore is the code conservation "watch dog" and, as such, it makes every effort to ensure that code conservation is practiced by all users. However, Bellcore is only recognized as the administrator, operating mainly by the use of consensus and specific code conservation rules would not only be extremely difficult to enforce, but would continuously be subject to challenge.

Until fairly recently, the major users of NANP codes were the OTCs which have a vested interest in supporting all aspects of code conservation. The OTCs realize that they would have to bear the brunt of the heavy costs, network disruption and customer dissatisfaction arising from almost any code exhaustion condition such as NPA splits or numbering plan changes, and they will therefore actively undertake code conservation in order to defer these for as long as possible. On the other hand, the newer and less prolific users of codes in the NANP are not bound by the same concerns and may be more inclined to place commercial considerations before code conservation. For them there may be no recognizable penalty for ignoring a specific conservation rule. Thus on one hand, specific rules regarding code conservation are not necessary and, on the other, such rules can be very difficult to enforce.

Once codes have been assigned, Bellcore has little control over whether those codes will be conserved or not, therefore it attempts to enforce conservation through the assignment process. As administrator Bellcore is more able to refuse to assign a code which may be under used, than it is able to enforce conservation rules once a code has been assigned.

Thus the following guidelines, which are concerned with code conservation, are applied by Bellcore at the assignment stage.

NPA Codes - Currently these are only assigned for the creation of a new NPA where an existing NPA must be split. The request must be supported by documented evidence, such as current and forecasted NXX usage tracked by COCUS over a number of years, and engineering economic studies to confirm the need for a new NPA (versus a boundary change). These are usually combined with meetings of an interrogative nature, between the applicant and Bellcore, to confirm actual dates for assignment of the new code.

SACs - There are currently no specific groundrules regarding the assignment of SACs. In the past these codes were assigned to specific services for which there was a large demand throughout the network. However today they are being considered for use as non-geographical NPAs by individual non-OTC networks and, under these circumstances, could be requested largely on purely theoretical forecasts of demand. Again the assignment of a unique SAC means the allocation of 792 NXX codes and 8 million numbers, but the potential users of these codes perceive that there is a commercial disadvantage in sharing a SAC with another network, no matter how few NXX codes are actually required by them for their own network. Unless some sort of assignment groundrules are established for these codes, when they are used as non-geographical NPAs, this could lead to the serious wastage of numbering resources in the future.

SAC 800 NXX CODES (INWATS Service) - Bellcore assigns the NXX codes within SAC 800 to individual INWATS service providers. The initial assignment is based on adequate proof that the applicant is a potential 800 service provider. Thereafter Bellcore requires the applicant to furnish extensive documented proof of an average 70 to 75% utilization for all the 800 NXX codes already held by the applicant, before it will assign an additional NXX code.

SAC 900 NXX CODES (Mass Calling Services) - Only a small number of 900 NXX codes are assigned by Bellcore within this SAC. These are used for terminating mass calling on a North American network basis. However, SAC 900 is also used for mass calling on a regional basis when NXX codes from within that region are used. In such cases these are not network calls and Bellcore is not involved. SAC 900 is generally regarded as an under-used code in the network and, under the right circumstances, could be shared with another service.

NXX Codes in NPAs - Bellcore does not assign NXX codes in the geographical NPAs. This is the responsibility of the LECs and OTCs (See 1.2.2). However Bellcore does nominate some three digit codes (NNX) to be used consistently for special purposes throughout the network (See 1.2.5).

SECTION 2.0 OTHER NUMBERING PLANS

2.1 CCITT RECOMMENDATION E.164

2.1.0 Integrated Services Digital Network (ISDN) Numbering

CCITT Recommendation E.164 is entitled: "A Numbering Plan for the ISDN Era". There is some misconception that within this numbering plan there is a service identification capability. This is contrary to numbering plan principles and is not provided for by Recommendation E.164. As in the PSTN today, the purpose of the number is to provide for destination routing and it will not identify the particular nature of the service, the type of connection or quality of service required. Such information will be included in prefixes or subaddress digits which are not part of, and are separate from, the number.

2.1.1 Recommendation E.164 and the PSTN

CCITT Recommendation E.164, issued in 1984, was developed on the assumption that most major ISDNs throughout the world would evolve from existing PSTNs. The ISDN numbering plan was therefore structured so that it could evolve from the numbering plan already in use by the PSTNs. It was anticipated that the elements of E.163 which exist in the PSTN could be applied to E.164 in such a way that any existing user of the PSTN would not be involved in numbering or addressing changes simply because the telephone network evolved into an ISDN.

Ideally, this means that most PSTN users must be able to continue using the same telephone numbers, dialing procedures and sequences for their calls as they do today. If new or more complex procedures associated with numbering or dialing are necessary, they should, wherever possible, be confined to the more sophisticated services offered by ISDN.

It is also inferred that a subscriber who wishes to change from Plain Old Telephone Service to ISDN-type service and vice-versa, should be able to do so without a change of telephone number.

The following shows the fields and parameters of Recommendations E.163 and E.164, respectively, to illustrate the compatibility of the two numbering plans:

Recommendation E.163

FIELD	COUNTRY CODE OR TRUNK PREFIX	TRUNK CODE	SUBSCRIBER NUMBER
NUMBER OF DIGITS	1 to 3 or 1 or 2	1 to 3	7 to 10
	<——INTERNATIONAL PSTN NUMBER MAX 12 DIGITS——>		

Recommendation E.164

FIELD	COUNTRY CODE	NATIONAL DESTINATION CODE	SUBSCRIBER NUMBER
NUMBER OF DIGITS	1 to 3	To meet national routing requirements.	7 to 10
	<——INTERNATIONAL ISDN NUMBER MAX 15 DIGITS——>		

2.1.2 E.164 and Non-LEC Public ISDNs in the U.S.A.

In 1986 consensus was reached throughout the North American telephone industry that the NANP would continue to be used for the public ISDN(s) which would evolve from the PSTN. It was also agreed that non-LEC public ISDNs in the U.S.A and non-OTC public ISDNs in Canada would also be integrated into the NANP.

However, despite many industry meetings held under the auspices of Bellcore in the ISDN Numbering Plan Forum, consensus could not be reached regarding the level at which the non-LEC public ISDNs would be integrated into the numbering plan.

At the time of this study, industry in the U.S.A. is still divided as to whether integration should take place at the CO code level or the NPA code level. Under the CO code plan, non-LEC public ISDNs would be assigned CO codes within the existing geographic NPAs in the U.S.A. In other words, the CO codes in the existing (and future) geographic NPAs would be used by both the LEC and non-LEC network providers.

Under the NPA code plan, the non-LEC public ISDN providers would be assigned CO codes from certain specific non geographic NPA codes or SAC.

Both methods of integration have drawbacks from the U.S.A. industry point of view. In the case of the CO code plan, concern centres around the fact that this may well advance the date by which certain critical NPAs may have to be split. As a result, the LECs concerned would incur much inconvenience and expense.

On the other hand, although the use of an NPA code or SAC to designate one specific network more closely follows the intent of Recommendation E.164 for the use of Destination Network (DN) codes, the assignment of each NPA code or SAC uses up some 8 million telephone numbers and there is concern regarding the possible under-use of codes until some estimate can be made of the future number and size of non-LEC public ISDNs in the U.S.A.

Representatives from the telephone industry in Canada participated in all meetings and fora and presented a united Canadian industry front, which took into account the special needs and conditions in Canada. These are different from those in the U.S.A., particularly with regard to routing of calls to Canada from overseas, as well as in regulatory and interconnection conditions. The Canadian representatives stated that Canada would need to integrate any non-OTC public ISDN numbering at the NPA level and that the NPA code must be unique to Canada. This position was accepted by the U.S.A. industry and Bellcore, but with the understanding that, because of the shortage of NPA codes at least until 1995 when interchangeable NPA codes become available, Canada would utilize unused resources (unassigned NXX codes) within SAC 610.

SAC code 610 is unique to Canada and, up to this time, has been used only for TWX and Datalink services offered by the OTCs. (Details of how SAC 610 will be used in Canada are contained in 3.2: "Other Canadian Numbering Requirements under the NANP").

2.2 CCITT RECOMMENDATION E.165

2.2.0 Time "T" and Network Requirements

To support the evolution from Recommendation E.163 to E.164, a timetable has been drawn up for the implementation of the ISDN numbering plan and issued as Recommendation E.165. Its full title is: "Timetable for Coordinated Implementation of the Full Capability of the Numbering Plan for the ISDN Era (Recommendation E.164)". Among other things, this recommendation sets the date, known as Time "T", by which the existing PSTN will become "ISDN compatible networks". The date for Time "T" has been set to 31 December 1996 at 23h 59m Coördinated Universal Time (UTC).

The network requirements for Time"T" are described in E.165 and are summarized in Addendum C to this document under E.165 "TIMETABLE FOR IMPLEMENTATION OF TIME 'T'. These will require existing networks to be able to process 15 digit numbers instead of the 12 digits required by Recommendation E.163, ie. a Canadian PSTN user may have to dial, and the PSTN may have to forward, up to 15 digits when making a an international call, compared with the maximum of 12 digits required at present. Also, overseas gateway switches must be prepared to analyze up to the first 6 digits (including the Country Code) of an international number, rather than the 4 digits required under E.163.

2.3 CCITT RECOMMENDATION X.121

2.3.0 Data Network Numbering

CCITT Recommendation X.121 provides the international numbering plan for Public (Switched) Data Networks (PDNs). X.121 was developed with the recognition that there could be several PDNs within a country or geographic area and is therefore structured to provide an explicit identification of the destination network which serves the called data terminal.

Under X.121, each country or geographic area has at least one three digit Data Country Code (DCC) assigned to it and each DCC can accommodate up to ten PDNs. (The DCCs have no relationship to the "telephone" Country Codes provided under CCITT Recommendation E.163).

Individual networks are accommodated by adding a fourth digit to the three digit DCC to provide a Data Network Identification Code (DNIC) for each network. Under X.121 an international number is restricted to a maximum of 14 digits. The DNIC requires 4 digits, thus the data subscriber number, or Network Terminal Number, is restricted to a maximum of 10 digits, as illustrated below:

ELEMENT	DATA NETWORK IDENTIFICATION CODE (DNIC)	NETWORK TERMINAL NUMBER
NUMBER OF DIGITS	4	MAX 10

2.3.1 Canadian DNICs

The DCC for Canada is 302 which provides 10 DNICs. Canadian DNICs are assigned by the Canadian Department of Communications and current users are:

USER	DNIC
Telecom Canada	3020 and 3021
Teleglobe Canada	3024 and 3025
CNCP Telecommunications	3027,3028 and 3029
Unassigned Canadian DNICs	3022,3023 and 3026

2.3.2 Numbering Plan Interworking in the ISDN Era

Numbering plan interworking is a fundamental requirement for the successful completion of calls routed between networks using different numbering plans, such as E.164 and X.121.

The following table illustrates the significant differences between the numbering plans discussed in this document:

RECOMMENDATION	NETWORK	NUMBER ELEMENT	MAX NUMBER LENGTH
E.163	PSTN	CC + TC +SN	12 DIGITS
E.164	ISDN	CC + NDC + SN	15 DIGITS
X.121	PDN	DNIC + NTN	14 DIGITS

Where **CC** = Country Code
TC = Trunk Code
SN = Subscriber Number
PDN = Public data Network
NDC = National Destination Code
DNIC = Data Network Identification Code
NTN = Network Terminal Number
PSTN = Public switched Telephone Network
ISDN = Integrated Services Digital Network

As illustrated previously, the structure of the PSTN and ISDN numbering plans (Recommendations E.163 and E.164 respectively) is such that integration can be readily accomplished. However, CCITT Recommendation X.121 is based on the explicit identification of each individual destination network and the make-up and format of numbers is quite different. There are no plans for integrating the X.121 numbering plan into E.164.

To permit an ISDN subscriber to set up calls intended for completion on other types of networks which do not conform to Recommendation E.164, will require the use of a Numbering Plan Indicator (NPI) (CCITT Recommendation Q.931) or an escape code (CCITT Recommendation E.166).

For example, Recommendation E.166 recommends the use of "0" as the escape code for numbering plan interworking between E.164 and X.121.

SECTION 3.0 CANADIAN NUMBERING REQUIREMENTS

3.1 THE CANADIAN PSTN

3.1.0 Canadian PSTN Requirements

All Canadian NPAs currently use non-interchangeable CO codes, and the only Canadian geographic NPA which will be concerned with a shortage of CO codes in the immediate future is NPA 416. According to the 1988 COCUS results, this NPA will exhaust its current supply of 640 CO codes by 1992. This means that, at some time prior to 1992, NPA 416 must convert to the use of interchangeable CO codes. This will increase the number of assignable CO codes in the NPA to 792. According to the same 1988 COCUS results, it is anticipated that these 792 CO codes will last until about 1996/97, at which time NPA 416 must be split and a new NPA created.

The current forecasts also indicate that no other NPA in Canada will exhaust its currently available 640 CO codes before the year 2000 and no additional NPA codes will be required for an NPA split in Canada until about 2014.

This is reflected in the following table which shows the years in which the NPAs in Canada will, by projection of the 1988 COCUS results, reach the maximum of 792 CO codes. Before this happens the NPA in question will have to be split and a new NPA code will be required. The following table provides a forecast of Canada's anticipated NPA code needs for the PSTN.

FORECAST OF CO CODE EXHAUSTION IN CANADIAN NPAs			
	NPA	YEAR 640 CO CODES ARE EXHAUSTED	YEAR 792 CO CODES ARE EXHAUSTED
1.	416	1992	1997
2.	514	2002 *	2014
3.	403	2004 *	2047
4.	709	2025 *	2063
5.	306	2031 *	2069
6.	204	2032 *	2063
7.	604	2037 *	2098
8.	506	2045 *	2064
9.	418	2113 *	2189
10.	819	2259 *	2411
11.	519	2268 *	2420
12.	613	2709 *	3013
13.	902	2735 *	3039
14.	807	2979 *	3283

* Interchangeable CO code capability (792 codes) will already be in effect.

Based on current forecasts then, the PSTN in Canada will require only one new NPA code in the next 25 years. This will be required to accommodate the splitting of NPA 416 in 1996 or thereabouts.

Also shown are the years in which it is anticipated that each of the Canadian NPAs will exhaust its currently available 640 non-interchangeable CO code.

Normally this would require the NPA concerned to undergo the conversion to interchangeable CO codes as the year of exhaustion approaches, as will be the case for NPA 416 in the early 1990s. However it should be remembered that beyond 1995, all NPAs will have an interchangeable CO code capability because of the modifications which provide for interchangeable NPAs. (Modifications to provide for interchangeable NPAs automatically provide for interchangeable CO codes and vice-versa). This means that all NPAs in the NANP will have a capacity for 792 CO codes after 1995.

This modification of the entire North American Network by July, 1995, to enable it to use interchangeable NPA codes, means that, within the next six years, all switching systems in Canada must be modified to accept interchangeable codes. The use of 1+7 digit dialing will be discontinued, as discussed in 1.4.6.

3.1.1 PSTN Numbering Requirements in the ISDN Era

Although the Canadian PSTN will evolve to an ISDN, it will never be able to relinquish its PSTN function of providing for POTS customers. In fact, there will almost certainly always be many more individual POTS customers than those requiring the more sophisticated ISDN services.

It is also quite feasible to expect that many ISDN customers will already be POTS customers who simply convert to ISDN service while retaining the same number. With this in mind, it cannot be anticipated that the advent of ISDN will, in itself, generate a large increase in demand for new telephone numbers. It can also reasonably be assumed that the future demand for numbers for the combination of POTS/ISDN type services under the NANP will remain more or less as currently forecast, subject only to the same possibilities of unforeseen economic and/or demographic change.

3.2 OTHER CANADIAN REQUIREMENTS

3.2.0 Canadian non-OTC Public ISDN Numbering

As discussed in 2.1.2., at the time of this study the U.S.A. had not reached consensus on how its non-LEC public ISDNs should be integrated into the NANP, however the method of integration for Canadian non-OTC ISDNs has been agreed and approved by industry.

During the last months of 1988, discussions and negotiations involving CNCP Telecommunications, Teleglobe Canada and Telecom Canada, representing its member companies, reached agreement on the groundrules which will be used to administer and assign SAC 610 NXX codes to non-OTC public ISDN providers in Canada. Basically, assignment of the codes will be administered by a board consisting of a single representative from each of CNCP Telecommunications, Teleglobe Canada and Telecom Canada. The assigning organization in Telecom Canada will carry out the actual assignments under the direction of the board which will resolve questions of eligibility, quantity of codes. Assignment of the codes will follow established NANP groundrules regarding the codes which may or may not not be used, code conservation practices. A copy of the agreement is attached to this report as Addendum D.

As a result of this agreement, approved non-OTC public ISDN providers in Canada may use 7 digit dialing in the format NXX-XXXX within their own networks, while calls into their networks will use 10 digit dialing in the format 610 NXX-XXXX.

It is anticipated that the unassigned NXX codes available in SAC 610 will meet all Canadian requirements until beyond 1995. If and when use of SAC 610 approaches exhaustion, an additional unique Canadian SAC will be requested from the NANP administrator.

3.2.1 CNCP Telecommunications' Requirements

CNCP Telecommunications stated requirement for non-OTC public ISDN numbering is summarized as follows:

YEAR	NUMBER OF CO CODES
1995	125
2000	200
2005	322
2010	520

In January 1989, the Administration Board and assigning organization, assigned 16 NXX codes from SAC 610 to CNCP Telecommunications for non-OTC public ISDN purposes.

It is CNCP Telecommunications' stated intention to seek the assignment of its own unique (Canadian) SAC for non-OTC public ISDN purposes when interchangeable NPA codes become available within the NANP. (1995)

3.2.2 Telesat Canada Requirements

Telesat's stated requirement for numbering within the NANP is for Mobile Telephone Services (MTS) which it plans to establish via Mobile Radio-Satellite (MSAT) under a subsidiary, Telesat Mobile Incorporated (TMI). Telesat expects a growth potential of up to 120,000 voice terminals by the year 2000 and expects that anywhere from 50% to 80% of those terminals would require PSTN connection. It therefore expects that there could be approximately 100,000 MTS users in that time frame. It also states that Canada/U.S.A. compatibility will be required.

Although the requirement for MSAT to interface with the PSTN has been discussed briefly, no decision has yet been taken regarding the level at which this numbering arrangement would be integrated into the telephone network. However, as the service will be a country-wide, it appears that it will be necessary to interface at the NPA level, through the use of a SAC.

Although the Telesat requirement is not for ISDN numbering such a requirement may have to be met, at least until 1995, by means of NXX assignments from the unique Canadian SAC 610, with an initial requirement of from 5 to 10 NXX codes. It is anticipated that there will be enough vacant codes in SAC 610 to accommodate this should it become necessary. Telesat's input to this study indicates that it anticipates being assigned its own unique NPA code in the post 1995 period.

3.2.3 Teleglobe Canada Requirements

Teleglobe Canada's code requirement is expressed as follows:

"In the post-1995 era, Teleglobe could anticipate the need for six (6) NPA level numbers for services it may wish to offer directly to the customer. Such services might include, for example, international facsimile, messaging service (Globetex), voice and video mail, and possibly others".

Teleglobe's proposed use of these NPA level codes dictates that they would be of the SAC type rather than geographic NPAs.

3.2.4 Cellular Radio Requirements

To be of any consequence in a study of Canada's overall numbering needs, the quantity of numbers required to meet cellular radio requirements must be in the order of tens of thousands, so that meeting the requirement will require the assignment of dedicated NXX codes. Even if the requirement for additional numbers translates into a large number of additional NXX codes, an NPA experiencing normal telephone growth, and which is not approaching CO code exhaustion, will normally have enough NXX codes available to accommodate the demand.

Although demand for cellular radio service cannot be forecast with any great degree of accuracy at this time, it can be anticipated that the majority of any increases in demand will usually take place in specific areas of the country and these will translate into a demand for additional NXX codes in the NPAs in which those areas are located.

Cantel Incorporated provided the study with a 20 year telephone number forecast by area code. However, because of the quantity of numbers involved, and to enable a better comparison to be made with other requirements discussed in this study, the quantities have been expressed in terms of NXX codes by the simple expedient of inflating each quantity to the next higher 10,000 and dividing by 10,000. Quantities or increases of only a few hundred numbers are ignored for the purposes of this exercise.

CANTEL FORECAST (AS CUMULATIVE NXX CODE REQUIREMENTS)

NPA	1989	1994	1999	2004	2009
204	-	1	2	2	3
306	-	-	1	2	2
403	1	3	5	7	10
416	6	21	35	48	62
418	-	1	2	2	2
506	-	1	1	2	3
514	3	9	13	19	23
519	1	2	4	6	7
604	1	4	6	10	11
613	1	3	5	6	8
705	1	2	4	5	7
709	-	-	-	1	1
807	-	-	-	-	1
819	-	1	1	1	2
902	-	1	2	2	2

Cellular radio requirements are also included in the COCUS data for each NPA. They are shown as NXX codes dedicated to cellular radio in yearly increments up to 1995 in the case of the 1988 COCUS.

The following table reflects these forecasts by NPA for 1988 and 1995:

1988 COCUS FORECAST OF DEDICATED NXX CODES

NPA	1988	1995	NPA	1988	1995	NPA	1988	1995
416	5	22	519	0	2	204	1	1
403	7	9	613	1	3	902	2	2
604	1	2	705	0	0	506	4	10
418	2	2	807	0	0	709	1	1
514	4	18	819	0	0	306	0	1

Both forecasts indicate that, in specific NPAs, there will be large increases in demand for NXX codes dedicated to cellular radio. However, in all NPAs but one, these increases will be accommodated without forcing the NPA into premature CO code exhaustion. It should be remembered that, by 1995, all NPAs in Canada will have the capability of accommodating 792 CO codes and, even if requirements increase beyond forecast in some NPAs, the only long range effect on the numbering plan would be to advance the need to split that NPA by one or two years from the dates stated in 3.1.0.

The single exception is NPA 416, which already has the highest cellular radio density in Canada and is approaching CO code exhaustion. The conversion of this NPA to interchangeable CO codes (792 codes) will be completed in time to accommodate most anticipated increases in the next few years, but it is recognized that continued very large increases in demand could contribute to the need to advance the date by which NPA 416 must be split. (Such a split is currently anticipated in the period 1996-1997).

Thus, with the exception of NPA 416, a growth in Cellular Radio numbering requirements does not, of itself, appear to pose any major threat to existing plans for meeting Canada's numbering requirements in the foreseeable future and will not drastically increase Canada's need for additional NPA codes.

3.2.5 Paging Requirements

Requirements for telephone paging numbers are also included in COCUS inputs by the OTC concerned and, although in some NPAs the demand is increasing, it is expected that it will be accommodated under normal development growth. Only in those NPAs where CO code exhaustion is critical could a large and unforeseen demand for numbers result in major numbering planning changes, ie. advancing the date for conversion to interchangeable CO codes or an NPA split.

SECTION 4.0 NUMBERING ALTERNATIVES FOR CANADA

4.1 ALTERNATIVES TO THE NANP

4.1.0 Withdrawing from the NANP

From time to time, it has been suggested that Canada should withdraw from participation in the NANP and adopt its own Country Code. This is most often suggested because of the fear that there are just not enough codes within the NANP to meet all World Zone 1 needs and/or that, in the event of shortages, the U.S.A. would be inclined to meet its numbering needs at the expense of the rest of World Zone 1. Other reasons have included the desire for a more flexible method of routing incoming overseas calls and the desire for a more positive indication that an overall call has a Canadian destination. In almost all cases the underlying view is that Canada should be more completely in control of its own destiny with regard to numbering.

This study presents the advantages and disadvantages of three options:

- a unique Canadian Country Code for overseas calls only.

- a unique Canadian Country Code for all overseas calls and for calls from all other countries in World Zone 1.

- maintain status quo.

4.1.1 Assigning a Canadian Country Code

Until discussions are undertaken with the International Telecommunication Union (ITU) or other responsible international bodies, the specific Country Code which would be assigned to Canada cannot be determined. However it is worthwhile examining the general guidelines and specific restrictions which appear to prevail today and which may influence the final choice.

CCITT Recommendation E.163 provides an up-to-date listing of the currently assigned Country Codes in each World Zone. Of the nine World Numbering Zones, seven contain a number of areas or countries, each with its own two or three digit code. Spare three digit codes are also shown for these World Zones.

World Zones 1 and 7 each use their World Zone number as a single digit Country Code and no spare unassigned Country Codes are shown for these zones. Originally, each area or country was assigned a one, two or three digit code based on the anticipated number of telephones it would serve by the year 2000, but it is not possible to say how this would be applied today.

All assigned Country Codes currently have as their first digit, the number of the World Zone in which they are located. However, Recommendation E.163 does state that, in the case where all the Country Codes in a World Zone have been assigned, and an additional code is required in that zone, a spare Country Code from another World Zone can be used. There is no way of predicting if, or how, spare codes would be developed for World Zone 1 and an application by Canada would create a precedent in this regard. It is therefore entirely possible that Canada could be assigned a spare code from another World Zone.

4.1.2 A Unique Canadian Country Code

The idea of Canada having a unique Country Code presents relatively few technical problems when considered only from the point of view of Canada interfacing with overseas countries. However, achieving numbering plan independence is not quite so straightforward because of the important question of how Canada would interface with the rest of World Zone 1 (ie. the U.S.A.).

One proposal which has been put forward detailed advantages in using a unique Canadian Country Code for overseas calling only, ie. calls from outside World Zone 1 to Canada would use a unique Country Code, while calls between Canada and the rest of World Zone 1 would remain more or less the same. This may have some advantages for Canada's overseas carriers in that more flexible routing and a clearer identification of Canadian calls may result, but it would not provide for a Canadian withdrawal from the NANP. By itself it would do nothing to increase the maximum quantity of NPA codes available as, unless the Canadian network is completely separated from the rest of World Zone 1, none of the three digit NPA codes available under the NANP can be duplicated.
Apart from being very costly and disruptive, this would have a traumatic effect on the entire Canadian PSTN and its users as it would entail universal number changes and switching machine modifications. It is also recognized that it would be very difficult to find a numbering format which would be as straightforward, flexible and "user friendly" as the existing closed ten digit format.

An additional drawback to changing the Canadian numbering format would be a probable increase in ongoing development costs, because of Canada's departure from the use of switching machine designs which use the NANP closed numbering format, and which are presently available within the North American telecommunications mass market.

The only acceptable solution which would make additional codes available would be for Canada to place itself in complete isolation from the rest of World Zone 1, under its own unique Country Code, while continuing to use the existing 10 digit numbering format. Telecom Canada has examined this alternative in some detail as follows.

4.1.3 Retaining Country Code 1 Within World Zone 1

In any study regarding a unique Canadian Country Code, certain assumptions have to be made. One of the assumptions of this study is that the major part of World Zone 1, the U.S.A., would, always wish to retain the use of Country Code 1. It is likely that the U.S.A.'s preference would have world-wide agreement.

4.1.4 A Two Digit Country Code

Within World Zone 1 there are only two, two digit Country Codes which could be used, namely Country Codes 10 and 11. This is because, with the rest of World Zone 1 continuing to use Country Code 1, Canada's use of a Country Code with a 1N configuration (ie. codes 12 through 19) would be ambiguous to overseas calls incoming to World Zone 1.

As an example, were Canada to use Country Code 12, a call from an overseas country destined for Canada would require the originator to dial 12 + NPA + NXX-XXXX, whereas a call to New York would require 1 + 212 + NXX-XXXX to be dialed. These digit strings would be ambiguous to the switching system in the originating country which relies on the first one or two digits to route the call to Canada or the U.S.A.

Ambiguity would not arise with Country Codes 10 or 11 as no NPAs in World Zone 1 have 1 or 0 as initial digits.

4.1.5 A Three Digit Country Code

In the unlikely event that Canada should wish to adopt a unique Country Code prior to 1997, there would be no alternative to Canada using a two digit Country Code, as it would be necessary to comply with CCITT Recommendation E.163, which requires that an international number (Country Code + National Number) be limited to 12 digits.

With a National Number format of 10 digits, Canada would be limited to a two digit Country Code until 1996. After 1996 the number of digits permitted is increased to 15 digits and a three digit Country Code could be accommodated.

There are reasons why Canada may not be permitted to use a two digit Country Code. It may, for example, be considered that Canada's telephone density would not warrant a two digit code and this, together with the precedent set over the last decade or so of only having to assign three digit codes in any of the other World Zones, may result in a decision to assign Canada a three digit country code. Furthermore as discussed in 4.1.4., there are only two usable two digit codes with a 1X configuration (ie. codes 10 and 11). It may be considered that the single two digit code, which would remain after one of them had been assigned to Canada, would be insufficient to provide for the possibility that, based on the precedent set by Canada, other countries within World Zone 1 may wish to adopt their own unique Country Code.

For some or all of these reasons, it may be decided that only a three digit code would be assigned, in which case it could be made from some 16 codes having 10N and 11N formats.

4.1.6 Country Code Selection - A Summary

Thus the choice of a Country Code for Canada would be dictated by the following:

1. Prior to 1997, Canada would be required to use a two digit Country Code.

2. After 1997 Canada may be assigned either a two digit or a three digit Country Code. (A three digit code seems slightly more likely).

3. The only usable World Zone 1 two digit Country Codes would be 10 and 11.

4. Usable World Zone 1 three digit codes would be 10N and 11N format codes.

5. Canada could conceivably be assigned a Country Code from another World Zone.

4.1.7 Interworking With the Rest of World Zone 1

Interworking between Canada and the rest of World Zone 1 was examined on the basis of what must be done to provide for cross border interworking between a segregated Canadian PSTN and the PSTN in the U.S.A.

The existing integration of the Canadian and U.S.A. portion of the total network, under a common numbering plan means that all calls between Canada and the U.S.A. are intra-network calls and are made in exactly the same way as any 10 digit long distance call within the originator's own country.

Canada's adoption of its own Country Code would mean that a cross border call would be an inter-network call and must, therefore be more complex, both from a call processing point of view and for the user.

Changing from intra-network calling to inter-network calling between Canada and the U.S.A. would be a major undertaking on both sides of the border and it should be remembered that most of what must be done in Canada to accommodate the change would also have to be done in the U.S.A. and would be an order of magnitude larger.

4.1.8 Prefixes and Access Codes

Because calls between Canada and the U.S.A. would be inter-network calls, it would be necessary for the originator to indicate to the switching system that such a call was being dialed. This would be done by preceding the dialed number with either a prefix or an access code.

Access codes require processing by the local Central Office and, in Canada, always consist of either an abbreviated three digit number or a seven digit number to reach a specific termination in the caller's own Central Office. They are used more extensively in the U.S.A. in connection with interexchange carrier access and often involve the use of a second dial tone. Their use for Canada-U.S.A. inter-networking was examined briefly, but the method would be cumbersome for the purposes of Canada-U.S.A. calling and it was not pursued.

Prefixes are one, two or three digit codes which precede the dialed number, but are not part of it, and are dialed to gain access to standard network services such as Operator (0+ NXX-XXXX), Direct Distance Dialing (DDD) (1+ NPA NXX-XXXX), Overseas DDD (011+ Country Code + National Number). It is anticipated that inter-network dialing between Canada and the U.S.A. would require the use of a prefix. However there are few suitable unused prefixes available.

4.1.9 <u>Direct Dialing Overseas and International Direct Distance Dialing between Canada and the U.S.A.</u>

The existing dialing procedures used for Direct Dialing Overseas (DDO) in Canada and International Direct Distance Dialing (IDDD) in the U.S.A. entail the use of prefixes and, apart from being the traditional method of making a call to a foreign country, would be the most suitable and obvious method of providing for Canada-U.S.A. inter-network dialing.

The prefixes used for dialing such calls are standard throughout both Canada and the U.S.A., ie. 011 for Station-Paid Direct-Dialed calls and 01 for Caller-Dialed Operator-Serviced calls. These prefixes indicate to the originating switching system that an international call is being made and, in all cases, the prefix is followed by the destination Country Code, then the National Number of the called country. Unfortunately, there is a problem of ambiguity if these access codes were to be used with a Country Code having 1 as its first digit.

International calls originating anywhere in World Zone 1 involve the dialing of Country Codes with initial digits between 2 and 9. Consequently there is no ambiguity between the 01 and 011 access codes and the Country Codes being dialed. However, if Canada were assigned a Country Code starting with 1, and the rest of World Zone 1 continued to use 1 as its Country Code, then in all calls between Canada and the U.S.A., the prefix 01 would be followed by a Country Code which has 1 as its first digit. There would therefore be ambiguity between prefix 01 and 011, ie the switching system would "read" 011 (the Caller-Dialed Operator-Serviced prefix) in all cases.

<u>Example:</u> Canada to U.S.A. calls = <u>01 + 1</u> - NPA NXX-XXXX

U.S.A. to Canada calls = <u>01 + 11</u> - NPA NXX-XXXX

or U.S.A. to Canada calls = <u>01 + 11</u>N - NPA NXX-XXXX

To overcome this ambiguity, it would be necessary to change the prefix for Caller-Dialed Operator-Serviced DDO and IDDD calls in both Canada and the U.S.A. A possible candidate for a replacement prefix is 010, which, in the NANP according to Bellcore, "Is not used at present, but has long been reserved for potential international use."

Were Canada to be assigned a Country Code from another World Zone it would only be necessary for Canada to change its 01 prefix, as Canada would be dialing 1 as a Country Code, but callers to Canada from the rest of World Zone 1 would be dialing a Country Code starting with a digit other than 1.

4.1.10 DDO/IDDD International Routing

Dialing prefixes 01 or 011 route the call directly to a specific type of toll switch equipped with DDO/IDDD functions. In the U.S.A. some local switches handle 011 calls directly. Such switches are capable of storing and analyzing the Country Code which follows the access code and performing two stage outpulsing. The switch receives and stores the dialed Country Code and National Number and, based on the Country Code received, outpulses a special intermachine routing code to establish a transmission path to the appropriate international gateway switch. When ready, the gateway switch returns a signal and the DDO/IDDD function equipped switch outpulses the Country Code plus the National Number. The procedure is the same for both 01 and 011 prefix calls, except that the 01 prefix associates an Operator position with the call and the forwarding of the call to the gateway switch is controlled by the Operator.

4.1.11 DDO/IDDD Canada-U.S.A. Routing

The existing DDO/IDDD arrangements could be used for Canada-U.S.A. calling, except that the two stage dialing feature would not be required as all numbers dialed to the rest of World Zone 1 would be 10 digit numbers. To accomplish this the following would be required:

A) arrange for all Canadian DDO function switches to recognize Country Code 1 and to translate it to a three digit inter-machine routing code (1XX). This will provide for tandem routing from those Canadian DDO function machines, which do not have direct trunks to the U.S.A., to Canada-U.S. interface switches, which do. In those cases where the DDO equipped switch does have direct trunks to the U.S.A., a routing code would not be generated.

On a direct Canada-U.S.A. trunk, the 10 digit World Zone 1 number (NPA NXX-XXXX) would then be forwarded into the U.S.A. network.

B) arrange for the recognition and translation of the new Canadian Country Code into a three digit routing code in all IDDD equipped machines in the U.S.A. As none of the existing Canada-U.S.A. interface switches are IDDD equipped, the three digit routing code will always be required to tandem route the call to an interface switch.

In all cases, the inter-machine routing codes will be confined to the originating network.

4.1.12 Additional DDO/IDDD Requirements

Routing of Canada-U.S.A. traffic via the existing DDO/IDDD machines, is technically feasible, however further discussions with switching machine manufacturers would be necessary to finalize new software details and costs. Detailed investigations into the augmentation of the DDO/IDDD function machines in the network would also be required. The load on these machines would be considerably increased, both in terms of traffic handling and machine processing, as they would have to handle all Station-Paid Direct-Dialed calls between Canada and the U.S.A. This would be particularly necessary in Canada where Canada-U.S.A. calling forms a very large percentage of total toll traffic in the Canadian network.

Extensive and detailed network servicing studies would be required in order to establish the traffic flow patterns which would result from routing all Canada-U.S.A. calls via the DDO/IDDD function machines. For example, traffic which is presently routed over 1 + DDD trunks to the ordinary toll machines, would now route over the Operator controlled trunks to the DDO/IDDD function machines. If such studies established that augmentation of the existing machines and associated network rearrangements were not an acceptable solution, it would be necessary to consider the decentralization of the DDO/IDDD capability. This would require that, instead of a limited number of specially equipped toll machines providing the Station-Paid Direct-Dialed (011) function, as many local switches as possible would be equipped to provide it. This function is identified as being available as a manufacturers' option in GTD-3 and DMS switching machines in Canada, but the cost of applying it to the entire network has not been estimated.

4.1.13 Alternative Prefixes to 01 and 011

Alternatives to the use of the existing DDO/IDDD prefixes (01 and 011) for Canada-U.S.A. calling were examined.

Two unique prefixes would be required one of which must be suitable for directing Operator-Serviced calls to the Traffic Operator Position System (TOPS) or Traffic Service Position System (TSPS) and the other to route Direct Dialed calls to the toll machines. This would require one access code to have an 0XX configuration and the other to have a 1XX configuration. In addition modifications may be required in some local switches to enable such codes to be used without ambiguity or conflict with existing codes.

The use of alternative prefixes for Canada-U.S.A. interworking would enable such calls to be disassociated from traditional DDO or IDDD calling and therefore the dialing of a Country Code would not be necessary. However, to alert an Operator to a Canada-U.S.A. call, Caller-Dialed Operator-Serviced calls would require an identifier. As NPAs are not duplicated under the NANP, an operator is able to easily identify such calls at present. Under a system which employs a unique Canadian Country Code ambiguity could arise).

A method of processing and routing only 10 digits to the destination network from the TOPS/TSPS switching machine, based on the 0XX prefix, would also be required.

Station-Paid Direct-Dialed calls would require modifications to all toll machines in the network to enable them to analyze all, or part of, the 1XX prefix when it is received from the local switch and to ensure that only the 10 digit destination number is passed to the destination network.

Verifying the feasibility of the modifications discussed in this alternative, including the selection of the unique prefixes and their application in the end offices, would require detailed technical research into the various types of end offices in use, as well as all TOPS, TSPS and toll machines used in the network. Consultation with, and research by, manufacturers would be required to establish feasibility and costs.

4.1.14 A Study Scenario and its Impact

In order to determine what may be considered as the minimum requirements for Canada to be able to adopt its own unique Country Code, a study scenario was drawn up which took into account all the factors discussed above. The scenario chooses the simplest and most feasible solutions wherever possible and attempts to use existing technology in order to minimize network changes and, therefore, costs.

While Canada would be acquiring its own Country Code and, from Canada's point of view, an almost infinite supply of NPA codes, the only advantage to the NANP would be the immediate acquisition of some sixteen or seventeen additional NPA codes. This is a relatively small number of codes when compared with the additional 640 codes being added to the NANP in 1995. It should therefore be assumed that there would be considerable resistance from the other countries in World Zone 1, to incurring the considerable expenditures resulting from by Canada's adoption of a unique country code.

Despite any attempt to keep changes to a minimum implementation of the scenario within Canada would require major alterations to the existing network and how it carries today's traffic between Canada and the U.S.A. Users of the network for calls between Canada and the U.S.A. would be very much affected and, making the users' calling procedures more complex and time consuming, would meet with some resistance.

The scenario consists of the following options:

A) Canada to obtain a unique Country Code.

Note: A two or three digit code would make little difference to implementation costs in Canada. However costs for the rest of World Zone 1 would be affected depending on whether the Canadian Country Code is assigned from World Zone 1 or from another World Zone. (See 4.1.2)

B) Interworking with overseas countries to continue as at present, but incoming calls to Canada would be identified by the Country Code alone, rather than by the NPA as at present. The NPA would determine the gateway destination in Canada if necessary.

C) Calls from Canada to the U.S.A., and from the U.S.A. to Canada to be DDO/IDDD calls and dialed as 01/010 + CC + NPA + NXX-XXXX.

All calls would be routed via DDO/IDDD feature equipped switching machines and it would be necessary for all such existing machines to be modified to enable them to:

analyze Country Code 1 in Canada and the Canadian Country Code in the U.S.A.,

generate a routing code for use where direct trunking is not available from that machine to the destination network; and

forward only the 10 digit number to the destination network.

D) Change the prefix used nationally for Caller-Dialed Operator-Serviced calling from 01 to 010. this would be required in all of World Zone 1 if Canada adopts a Country Code from World Zone 1 but only in Canada if the code was adopted from another World Zone (See 4.1.2).

E) Augment existing DDO/IDDD feature equipped machines to accommodate all Station-Paid Direct-Dialed calling between Canada and the U.S.A.

F) Rearrange and augment facilities to accommodate rerouted Canada-U.S.A. traffic.

4.1.15 Establishing Costs

The scenario described in 4.1.14 could be used as the basis for developing order of magnitude costs for providing customer dialing between Canada and the U.S.A.

To develop more accurate costs would be a major undertaking, requiring the involvement of staff from Telecom Canada and its member companies, in order to determine the changes required to the many different types and vintages of switching machines involved and to examine the necessary facility rearrangements required. Manufacturers would be required to establish actual costs for modifying the various types of switching systems involved. Non-telephone company costs, such as those incurred by the telephone customer for changes in advertising, new letter heads, business cards would also have to be investigated.

4.1.16 Order of Magnitude Costs

An estimate of the costs involved is as follows:

A. The average cost of modifications to permit the use of access code 010, and to provide the trunk facility changes necessary for the change of traffic from Centralized Automatic Message Accounting (CAMA) to Operator trunk use could be in the order of $10,000 per end office.

B. The costs required to modify existing TOPS/TSPS machines to enable them to recognize and route calls using Country Code 1 and the necessary enhancements to permit them to handle 100% of Canada to U.S.A. traffic, together with the rearrangement and enhancement of trunks between the existing TOPS/TSPS machines and the switching nodes in the U.S.A., are estimated to be in order of $500,000 per existing installation.

C. Certain areas in the Maritimes, Newfoundland, Manitoba and Saskatchewan, do not have DDO. Therefore in order to replace the direct dialed access to the U.S.A., which have today through the use of DDD, it would be necessary to provide DDO capability in these areas. Depending on such factors as the homing arrangements and/or the type of end office switching machines which exist, it could cost in the order of $20 to $100 million to convert to DDO.

D. Expenses for such items as advertising, publicity, training and customer education, could amount to some $5 million across Canada.

E. Changed traffic patterns could well require an extensive reconfiguration of the network. How extensive this would be can not be determined until detailed traffic studies are performed. This cost is included as a contingency cost of $30 million.

F. Because of the additional traffic which will flow through the existing TOPS/TSPS machines, it is possible that detailed traffic studies would indicate the need for additional TOPS/TSPS machines at certain points in the network. These could cost in the order of $15 to $30 million per installation, including the necessary facility rearrangements and network reconfigurations.

The total Order of Magnitude costs, expressed in millions of dollars, could be as follows:

		MIN. COST	MAX. COST
1.	Changes and modifications to some 3,360 end offices at a cost of $10,000 per office.	$34	$ 34
2.	Changes and modifications at some 32 TOPS/TSPS installations at an average cost of $500,000 per office.	16$	$16
3.	Costs to provide DDO feature in areas where this does not presently exist.	$20	$100
4.	Advertising, publicity, customer education etc.	$ 5	$ 5
5.	Possible contingency cost to provide for rearrangement or reconfiguration of the network.		$ 30
6.	Possible costs of adding between one and three TOPS/TSPS machines in the network.		$ 90
		$75	$275

It must be stressed that the major concern with regard to Canada adopting a unique Country Code is the question of calling between Canada and the U.S.A. Considerably more study and planning would be required to confirm the feasibility of this part of the scenario and to accurately identify the costs involved. Such a change would be a very large and complex undertaking which could affect all aspects of social intercourse between Canada and the U.S.A. and could well have adverse affects on Canada-U.S.A. business relations and trade.

The possible magnitude of the above affects can perhaps be demonstrated by the fact that, in 1987, of the three types of toll message calls made on a network basis, a over 37% were Trans-Canada calls, a over 11% were overseas calls, while over 51% were Canada-U.S.A. calls. No consideration has been given, in this brief examination to the possible loss of revenue to the telecommunications industry, because of the necessity to use a more complex and less efficient method of cross border telecommunications between Canada and the U.S.A.. Finally, the above are only Canadian costs. To obtain similar detailed information about the larger and more complex network in the U.S.A. would require the co-operation of several U.S.A. organizations over many months. However, it can be assumed that the costs for the remainder of World Zone 1 to accommodate the Canadian change could be at least ten times those of Canada.

SECTION 5.0 STUDY CONCLUSIONS AND RECOMMENDATIONS

5.1 TOTAL CANADIAN REQUIREMENTS

This study assesses Canada's numbering requirements at the NPA level. Not only is the NPA code or SAC the largest element in the numbering format, it is also the level at which, except for one or two zone-wide SAC applications, numbers are allocated by the NANP administrator. Each geographic NPA or SAC assigned to Canada places 792 NXX codes at Canada's disposal and analyzing the various inputs to the study on this basis makes it possible to derive a forecast of Canada's total numbering requirements to the middle of the 21st century.

POTS, PSTN/ISDN, cellular radio and paging all require numbers from within the geographical NPAs. Future requirements can therefore be assessed in terms of when these requirements will exhaust the CO or NXX codes in the existing NPAs to the point where a new NPA must be established.

The following shows the Canadian geographic NPAs which will be exhausted prior to the year 2050 and the time frame in which it is anticipated this will happen.

Existing NPA	Anticipated Exhaustion	NPA Required
416	1995-1996	1
514	2010-2015	1
416 (2nd Split)	2010-2015	1
403	2035-2045	1
709	2045-2050	1
	Total new NPAs Required	5

The requirement for non-OTC public ISDN numbering is probably the most difficult to predict as there is no way of knowing, at this time, how many non-OTC ISDNs there will be in Canada in the future, much less their size and numbering requirements.

This forecast indicates that non-OTC Public ISDN numbering requirements will be met to 1995 by the assignment of NXX codes from SAC 610. After 1995 there may be a need for one unique SAC to meet these needs to 2050.

Requirements for services other than ISDN services, and involving the use of dedicated SACs, are identified by Teleglobe Canada which predicts the need for 6 SACs for various services; and by Telesat Canada which identifies the need for one unique SAC for MSAT. It is assumed in both cases that these codes will meet requirements to beyond 2050.

The foregoing requirements can be added together to provide Canada's total forecast telephone numbering requirement at the NPA level, from now to 2050, as follows:

Geographic NPAs	=	+5
SACs for ISDNs	=	+1
Other SAC requirements	=	+7
Total Code Requirements	=	+13

5.2 CANADA'S NANP REQUIREMENT

By mid 1995 at the latest, the NANP will have been expanded to make available an additional 640 NPA level codes for a total of 792 codes. By about 1995, the NANP will have used up 152 of these 792 codes, mostly for POTS growth in the geographic NPAs. Considering that POTS in the U.S.A. and Canada is considered to be well over the 90% saturation level, it can be anticipated that these requirements will not continue at the same level for the next 50 years. However, there are, and will probably continue to be, increased demand for numbers for non-POTS requirements such as mobile radio, paging, facsimile.

Many new services will require the use of SACs and this is where the demand will probably be highest into the next century.

The demand generated by new services will be less easy to forecast than the demand for geographical NPAs as each service, and each seller of each service, will consider that they should have a unique SAC, no matter how small the actual requirement.

However, by good numbering plan management combined with education about the consequences of wasting a limited resource, it is considered unlikely that demands for numbering will exhaust the supply of NPA level codes in the NANP before the end of the 21st century.

5.3 CONCLUSIONS AND RECOMMENDATIONS

It is therefore the conclusion of this study that Canada's telephone numbering requirements will be met between now and 2050 by the assignment, during that period, of 13 codes at the NPA level.

There is no reason to assume that the current ratio of assigned NPA level codes in the rest of World Zone 1, versus those assigned to Canada will change from the current 8:1. On this basis, if Canada will have 13 additional codes assigned by the year 2050, the rest of World Zone 1 will have been assigned approximately 105 additional codes. Together with the current supply of 152 codes which will have been exhausted by about 1995, this will bring the total codes assigned to about 270 by the middle of the 21st century, or only about 34% of the total of 792 available under the NANP.

There is therefore no reason to assume that the requirements of Canada and the rest of World Zone 1 cannot be met quite adequately by the NANP.

These conclusions enhance the finding of the study that there would be little advantage in Canada seeking an alternative to participation in the NANP. Certain advantages can be postulated for Canada having its own unique Country Code. However, as the study indicates, even if the unquestionably large cost of doing so is ignored, and the high probability of a deterioration in the speed and efficiency of telecommunications between Canada and the U.S.A. is accepted together with the possibility of increased charges for calls; it is still difficult to find justification for adopting this course. It is therefore the recommendation of this study that Canada continue to participate in the NANP.

Arising from the recommendation that Canada should remain in the NANP, the proposal that Canada should be permitted to have a quantity of NPA level codes assigned to it after the introduction of interchangeable NPA codes in 1995 was examined. The conclusion was reached that from a NANP administration point-of-view this would not be permitted.

One of the strictest groundrules of the NANP has always been that there shall be no pre-assignment of codes. Before any codes are assigned, proof of need must be established. Any attempt to deviate from this practice would require major changes in the NANP administration which would require the approval of all users. In addition, the study could find no advantage in or see any need for, such pre-assignments.

It is also strongly recommended that, as the second largest user of the NANP resources in World Zone 1, Canada must ensure that it continues to take part in all decision-making regarding the future of the NANP, even when the decisions may not appear to directly affect Canada. Close liaison with the Bellcore NANP Administrator must be maintained and all events and decisions affecting the NANP closely monitored, so as to ensure that Canada's interests can continue to be safeguarded. However, at this time no government role is foreseen in any of these activities.

Telecom Canada is the NANP administrator and co-ordinator for Canada with responsibility to ensure compliance with the above recommendations. In its co-ordination role it is also responsible for initiating and co-ordinating activities in connection with Canadian numbering plan issues of public interest. An example of this area of responsibility is the development and establishment of administration and assignment groundrules for the use of 610 NXX codes by non-OTC public ISDN providers in Canada (see Addendum #D).

TERMS OF REFERENCE

REQUEST FOR PROPOSAL

The task to be addressed by the contractor described in the Request for Proposal and the reply to the Request for Proposal was as follows:

The Request for Proposal summarized the task as follows:

3. Task

The contractor will assess the economic, operational, competitive and service benefits and costs of the NANP and other proposals to allocate numbering resources in Canada into the next century. It should be recognized that telecommunications competition will probably advance significantly over the life of the new numbering plan. In addition to the local PSTN requirements, a number of long distance interexchange carriers might enter and a number of ISDN networks could be introduced offering various combinations of voice, data, text and image services. The full interworking between PSTN-ISDN, ISDN-ISDN, ISDN-CSPDN, ISDN-PSPDN, ISDN-others (such as cellular mobile networks, private networks, specialized networks) may also prevail. The evolution of the telecommunications environment in the next 30 to 40 years is an important aspect in forecasting the future numbering resources for Canada. Also, under the present administration of the NANP, the utilization of the numbering resources by U.S. carriers would have the dominant impact on the number of NPA codes available for Canada in the long term. Unless a number of Area Codes were set aside for each administration, Canada might not be allocated sufficient NPA codes for its medium term requirement due to its less aggressive timetable for full interexchange competition.

a) i) Outline the plan of the operating telephone companies to expand the NANP using interchangeable NPA and central office codes

- summarize the plans and strategy to expand the number of NPA codes from 152 to 792 and the number of central office NXX codes from 640 to 792, the schedule and general approaches

- outline the operation, network changes, level of magnitude of investment, cost-benefit, NPA requirements following the NPA/NXX codes conversions, etc...

ii) Outline the present administration of the North American Numbering Plan

- describe the organization, participants mandate and the basis for that mandate in both Canada and the U.S.;

- describe existing principles/criteria for allocating NPA codes and new principles being considered with the availability of a larger number of NPA codes in 1996 (outline any modified criteria for allocating NPA codes in Canada);

- discuss the allocation of NXX for cellular mobile operators in Canada and the U.S., and the allocation of NPA/NXX to non-dominant carriers in Canada and the U.S.;

b) i) Discuss the merits/drawbacks of Canada developing and operating the public telephone network under a common zone 1 code (NANP) rather than a separate country code

- what are the service aspects?

- what are the operational and economic aspects?

- what are the future numbering resources needed for network development, flexibility and ability to operate under a unique Canadian environment?

ii) Discuss the advantages for Canada of having a separate country code or the exclusive administration of a block of NPA codes

- given the long term numbering requirement for Canada, are there clear advantages for Canada to have a separate country code? or

- for Canada to administer a block of NPA codes and, in this case should any conditions be placed upon the codes acquired to reduce the cost of the next adjustment?

- how is or will the network be structured to handle Canada-U.S. traffic under existing NANP or a separate country code?

c) Forecast the number of NPA codes required for the Canadian telecommunications system for the next 30 or 40 years

- based on an evolution of the telecommunication and regulatory environment to permit network interworking, interconnection and a number of public telecommunications networks, including ISDNs, cellular mobile telephones, V-SAT networks, etc.;

- based on open-regulatory environment supporting more facility-based competition and an increasing number of access line terminals;

- based on consultation with the potential users of the numbering plan, including cellular mobile telephone carriers.

d) Consider alternatives that will ensure that Canada has adequate administrative control of numbering resources

- approach under the expanded NANP;

- organizational structure to provide reasonable representation by existing and potential Canadian users;

- Departmental role in numbering plan administration;

- the role of the CRTC and the provincial regulator in influencing the allocation of NXX or part of NXX codes to support interconnection.

e) Review the activity and proposals of the ISDN Numbering Forum and identify the best position for the participating Canadian organizations

- summarize the progress of the Forum and the proposals;

- discuss the position of the Canadian carriers;

- suggest the best long term approach for Canada to follow to support a well balanced ISDN networks competitive environment.

f) In conclusion, develop appropriate options

- on the administration of the NANP;

- on a separate country code;

- on the number of NPA's required for Canada;
- on the role of Government regarding the numbering resources;
- on particular criteria and processes to allocate numbering resources in Canada.

ADDENDUM B

TERMS OF REFERENCE
TELECOM CANADA
REPLY TO REQUEST FOR PROPOSAL

The Technical Proposal submitted by Telecom Canada in its reply to the Request for Proposal stated that its report would consist of:

(1.0) TECHNICAL PROPOSAL

Telecom Canada will produce a written report which will be in accordance with the Statement of Work and provide "An Assessment of the Telephone Numbering Plan Requirements and Options for Canada". The report will contain a detailed description of the North American Numbering Plan (NANP) and its application in World Zone 1, an overview of North America's current and future numbering requirements, and a detailed examination of Canada's needs, indicating how these can best be met now, and into the next century. The report will consist of:

(1) A brief history of the NANP, and Canada's involvement and participation in its original development and growth to the present day. An assessment of the advantages and disadvantages which have resulted from Canada's participation in the plan. A detailed description of the NANP, and how it is applied today in the Public Switched Telephone Network in the U.S.A., Canada, and the rest of World Zone 1 (WZ1), how the various countries in WZ1 interface on an international (overseas) basis, how Canada operates within the framework of the plan, and how it could continue to do so while retaining sovereignty over its own portion of the network.

Description of all aspects of NANP administration, and the criteria used for the assignment of all numbering plan components. An examination of Canada's participation and level of influence, and how these can be continued or increased, in order to ensure that Canada's current and future telecommunications numbering needs are met.

(2) A full description of existing plans to expand the NANP, including the introduction, use, and application, of both interchangeable Central Office (CO) and interchangeable Numbering Plan Area (NAP) codes in the U.S.A. and Canada, with an overall description of the involvement of the Canadian Operating Telephone Companies (OTCs) in the expansion.

A forecast of Canada's needs in regard to all numbering plan components for the next 50 years, together with an assessment of how, and how well, the expanded NANP will meet these needs. The position Canada should take in order to ensure these needs are met, will be addressed.

(3) An examination of, and comments on, methods of modifying the existing administration of the NANP, so as to permit Canada to assign all its own numbering plan components. Included in this will be a detailed description of technical requirements, an assessment of social and economic implications, and order of magnitude costs for Canada's complete withdrawal from the NANP, and the adoption of its own Country Code.

(4) A section devoted to activities in the U.S.A. concerned with developing an ISDN numbering plan, and Canadian industry participation in these activities. A brief history of the Bell Communications Research (Bellcore) ISDN Numbering Plan Forum (INF) and Canadian industry participation and contributions. A current report on the status of ISDN numbering plans in the U.S.A. and Canada, including the status of the recent appeal by Bellcore to T1S1 (Standards). Included will be a discussion of the influence of international requirements and regulations (CCITT Recommendations E.163 and E.164) on current and proposed U.S. and Canadian PSTN and ISDN numbering plans, and the plans to provide a Canadian ISDN compatible network at Time "T" (CCITT recommendation E.165).

(5) A description of the numbering plans currently used for Data Networks (DN's) in World Zone 1 in compliance with CCITT Recommendation X.2121, including Canada's current needs and anticipated future requirements, and how these may be affected by the needs of the U.S.A.

The report will meet all the requirements covered in the Statement of Work included as Appendix A in the request for Proposal. No changes to the Statement of Work are requested.

CCITT RECOMMENDATIONS
(PERTAINING TO NUMBERING PLANS)

Numbering conventions and standards for telecommunications interworking on a world-wide basis are established under international agreement by the International Telegraph and Telephone Consultative Committee (CCITT). This means that, in order to be able to interwork with other countries of the world, national numbering plans must conform to these international agreements, even if they conflict with some national needs.

The international conventions and standards are issued in a series of CCITT Recommendations and all existing or proposed numbering plans discussed in this document are reconciled with them. For this reason, the significant parts of the relevant Recommendations are reproduced herein for ease of reference. If additional information is required, the reader should refer to the full text of each Recommendation.

The numbers enclosed in brackets refer to the numerical index used in the actual CCITT Recommendation. Not all sections of the Recommendations have been reproduced in this addendum.

E.160 "DEFINITIONS RELATING TO NATIONAL AND INTERNATIONAL NUMBERING PLANS"

(2) Country Code - The combination of one, two, or three digits characterizing the called country.

(3) Trunk Prefix - A digit or combination of digits to be dialed by a calling subscriber making a call to a subscriber in his own country, but outside his own numbering area. It provides access to the automatic outgoing trunk equipment.

(4) Trunk Code - A digit or combination of digits (not including the trunk prefix) characterizing the called numbering area within a country (or group of countries, included in one numbering plan).

The trunk code has to be dialed before the called subscribers number where the calling and called subscribers are in different numbering areas.

The trunk code varies from one country to another and is composed of:

Either a regional code indicating the geographic zone to which the subscriber belongs and within which subscribers can call one another by their subscriber numbers, or a numbering area code followed by an exchange code when the directory entry of the called subscriber does not include the exchange code.

(5) Subscriber Number - The number to be dialed or called to reach a subscriber in the same local network or numbering area.

This number is the one usually listed in the directory against the name of the subscriber.

(6) National (Significant) Number - The number to be dialed following the trunk prefix to obtain a subscriber in the same country (or group of countries, included in one integrated numbering plan) but outside the same local network or numbering area.

Note: Where several countries are included in one integrated numbering plan, only the national (significant) number is to be dialed after the trunk prefix on calls from one of these countries to another.

E.163 "NUMBERING PLANS FOR THE INTERNATIONAL TELEPHONE SERVICES"

(1.2) Number Analysis

(1.2.1) The national numbering plan of a country should be such that an analysis of a minimum number of digits of the national (significant) number:

a) gives the most economical routing of incoming international traffic from various other countries.

b) indicates the charging area in those countries where there are several.

(1.2.2) In the case of a country with a two or three digit country code, not more than two digits of the national (significant) number should be analyzed for these purposes. In the case of a country with a one digit Country Code, not more than the three digits of the national (significant) number should be analyzed for these purposes.

(1.2.3) In the case where an integrated numbering plan covers a group of countries, the digit analysis specified in 1.2.2 should also determine the country of destination.

2) Limitation Of The Number Of Digits To Be Dialed By Subscribers

The number of digits to be dialed by subscribers in the automatic international service should not be more than 12 (excluding the international prefix). It is emphasized that this is the maximum number of digits and Administrations are invited to do their utmost to limit the digits to be dialed to the smallest possible number.

(2.2) National (significant) Number

The CCITT recommends that the number of digits of the national (significant) number should be equal to a maximum of 12 - n, where n is the number of digits in the Country Code.

(4.2) Country Code

(4.2.2a) The number of digits of the Country Code is one, two, or three according to the foreseeable telephonic and demographic development of the country concerned.

(4.2.2b) The nine digits from 1 to 9 have been allocated as the first digit of the Country Code. These digits define World Numbering Zones.

(4.5) Trunk Prefix

(4.5.1) The national (significant) number does not include the trunk prefix. Accordingly, in the international service, the trunk prefix of the country of destination must not be dialed.

E.164 "NUMBERING PLAN FOR THE ISDN ERA"

(3.1) General

The ISDN numbering and addressing principles are described in Recommendation I.330. The ISDN numbering plan will be based on and evolve from the existing numbering plans applicable to national and international public telephone networks.

Prefixes and other information concerned with identifying selection procedures or network service parameters (such as quality of service or transit delay) do not form part of the ISDN number.

(3.2) Structure of the International ISDN Number

The international ISDN number is composed of a variable field length of decimal digits arranged in specific code fields. The international ISDN number code fields are the Country Code and the national (significant) number.

The national (significant) number is used to select the destination subscriber. In selecting the destination subscriber, however, it may be necessary to select a destination network. To accomplish this selection, the national (significant) number code field comprises a National Destination Code (NDC) followed by the Subscriber Number.

The NDC field will be variable in length depending upon the requirements of the destination country.

Each NDC may have one of the following structures:

a) a Destination Network (DN) code, which can be used to select a destination network serving the destination subscriber;

b) a Trunk Code (TC), the format of which is defined in Recommendation E.160.

c) any combination of Destination Network (DN) code and Trunk Code (TC).

The NDCs of an administration may consist of any of the above structures.

Where appropriate, identification of an ISDN within the destination country shall be through the use of a national destination code (NDC) incorporated in the ISDN number.

The ISDN Number Structure is illustrated as:

COUNTRY CODE	NETWORK DESTINATION CODE	SUBSCRIBER NUMBER

```
|                |
|                |{------National significant number------------}|
|                                                                 |
|{---------------------National ISDN number----------------------}|
```

(3.3) Number Length

The international number may be of variable length. The maximum number length shall be 15 digits.

(3.4) Number Analysis

On international calls the number analysis performed at the originating country need not be more than the Country Code and:

- three digits of the National Significant Number (NSN) in the case of a country with a three digit Country Code.
- four digits of the National Significant Number (NSN) in the case of a country with a two digit Country Code.
- five digits of the National Significant Number (NSN) in the case of a country with a one digit Country Code.

(4) Number Allocation Principles

ISDN subscriber numbers may be allocated from the range of subscriber numbers available in the local ISDN exchange. These will be assigned to customers who subscribe only to the telephone service, customers with one or more data services and customers with a mixture of telephony and data services.

Subscribers with basic access should normally be allocated one unique number.

(9) **Address Information**

(9.2) Sub-addressing (network address extension)

Sub-addressing provides a separate additional addressing capacity outside the ISDN numbering plan but constitutes an intrinsic part of the ISDN addressing capabilities. One or more decimal digits up to a maximum 32 (provisionally) may follow the ISDN number and form the ISDN sub-address, which is transferred to the equipment at the subscriber's premises.

When required, the sub-address is sent by the calling party within the call set-up procedure and is passed transparently through the network as a separate entity from both the ISDN number and user-to-user information. Sub-address information is not processed within the public network.

E.165 "TIMETABLE FOR THE IMPLEMENTATION OF TIME 'T'"

(1) **Introduction**

Recommendation I.330 describes ISDN numbering and addressing principles, while Recommendation E.164 describes the numbering plan for the ISDN era. Recommendation E.164 also identifies the need for interworking arrangements between ISDN and present dedicated networks.

This recommendation sets a specific date (Time "T") after which all ISDNs can use the full capability of Recommendation E.164.

(2) **Application and Evolution of Time "T"**

ISDNs are expected to interwork with dedicated networks. However, due to the different addressing capabilities between the ISDN and existing Numbering Plans, some temporary constraints need to be imposed on the number length and digit analysis required to access the user network interfaces of the ISDNs before Time "T".

(2.1) <u>Numbering constraints before Time "T"</u>

- ISDNs interworking with dedicated networks:

To allow numbering plan interworking with dedicated networks before Time "T", an ISDN will not assign international E.164 numbers longer than 12 digits to its user network interfaces capable of receiving calls from dedicated networks.

In addition, for ISDNs and PSTNs, digit analysis, as defined in Recommendation E.163, will apply.

ISDNs which do not interwork with dedicated networks:

These ISDNs are allowed to assign user network interfaces according to the full capability of the Numbering Plan for the ISDN era. Digit analysis according to Recommendation E.164 may be required to access user network interfaces connected to these networks.

(2.2) <u>Evolution after Time "T"</u>

After Time "T", ISDNs and PSTNs can make full use of the capability of E.164 numbers to identify their user network interfaces and terminals respectively. In addition, for routing purposes, the ISDNs and PSTNs conforming to E.164 must be capable of analyzing the ISDN number to the extent required in recommendation E.164.

(3.0) <u>Date of Time "T"</u>

The date for Time "T" has been set to 31 December 1996 at 23h 59m Coordinated Universal Time (UTC).

(4.0) <u>Network requirements at Time "T"</u>

ISDNs and PSTNs supporting number length and digit analysis as described in Recommendation E.164, are said to be "E164-conforming" networks.

All ISDNs must be E.164 conforming networks. Functions associated with E.164 conforming networks are:

(a) for calls originated in its network, provision for carrying E.164 numbers up to 15 digits to interface networks;

(b) comparable treatment for transit calls;

(c) capability for conducting digit analysis for ISDNs and PSTNs as indicated in Recommendation E.164;

(d) screening to ensure that, taking into account agreements between the networks concerned, no transit calls are offered to non-conforming networks incapable of handling number length as defined in Recommendation E.164;

(e) provision of interim procedures, such as two stage selection, for internal network sources, eg. local exchanges, not equipped to handle 15 digits, so that all internal network sources can originate calls to all E.164 addresses.

X.121 "INTERNATIONAL NUMBERING PLAN FOR PUBLIC DATA NETWORKS"

(1.1) The international data number is to determine only the specific DTE/DCE interface and, in particular, to identify a country (or geographical area) and a network, if several data networks exist in the same country (or geographical area).

(2.2.3) All data network identification codes (DNIC) should consist of four digits. The first three digits should always identify a country (or geographical area) and could be regarded as a Data Country Code (DCC). The fourth, or network digit , should identify a specific data network in the country (or geographical area).

(2.2.4) Each country (or geographical area) should be assigned at least one three digit DCC. The DCC, in conjunction with the fourth digit, can identify up to 10 public data networks. The format for DNICs should be ZXXX where X denotes any digit from 0 (zero) through 9 (nine) and Z denotes any digit from 2 (two) through 7 (seven).

(2.2.5) The system of DNICs indicated will provide for 600 DCCs, and a theoretical maximum of 6000 DNICs.

(2.2.6) Should a country (or geographical area) have more than 10 public data networks, an additional DCC would be assigned to it.

610 NXX ADMINISTRATION/ASSIGNMENT GROUNDRULES

THE ADMINISTRATION AND ASSIGNMENT OF SAC 610 NXX CODES FOR USE BY NON-OTC PUBLIC ISDN PROVIDERS IN CANADA

Under the North American Numbering Plan (NANP), 610 is designated as a non-geographic NPA or Service Access Code (SAC) for Canada's exclusive use, and a quantity of SAC 610 NXX codes is used for TWX and Datalink services provided by the Canadian Operating Telephone Companies (OTCs).

With the concurrence of Bell Communications Research (Bellcore), the North American Numbering Plan (NANP) administrator; CNCP Telecommunications, Teleglobe Canada and Telecom Canada, on behalf of its member companies, have agreed to the use of SAC 610 NXX codes, not assigned TWX or Datalink services, to provide for numbering in non-Operating Telephone Company (non-OTC) public Integrated Services Digital Networks (ISDNs) in Canada.

CNCP Telecommunications, Teleglobe Canada, and Telecom Canada have agreed that NXX codes for non-OTC public ISDNs will be administered and assigned in accordance with the following groundrules.

ADMINISTRATION GROUNDRULES

1. An Administration Board (henceforth referred to as the Board) will oversee and adjudicate on all matters relating to the administration and assignment of 610 NXX codes to non-OTC public ISDN providers. In the main it is intended that the Board will function by means of verbal communications only and, will meet only if circumstances make it necessary.

2. Eligibility for representation on the Board will be confined initially to one representative from each of CNCP Telecommunications, Teleglobe Canada, and Telecom Canada. The Telecom Canada representative will be from the central staff organization and will represent all Telecom Canada Member and Associate Member Companies.

   The Telecom Canada member will act as a rapporteur for the Board in all matters and will receive all correspondence on behalf of the Board.

Applications for codes, and any other correspondence relating to the assignment of SAC 610 NXX codes for non-OTC public ISDNs, shall therefore be addressed to:

Telecom Canada
Director-Fundamental Planning
Floor 5
410 Laurier Avenue West
P.O. Box 2410, Station D
Ottawa, Ontario
Canada K1P 6H5

3. Any Canadian organization, which qualifies in the future as a user of SAC 610 NXX codes for non-OTC public ISDN purposes, will become eligible to nominate a member to serve on the Board.

4. The Board will arbitrate on all matters relating to the assignment and use of SAC 610 codes for non-OTC public ISDN purposes in a fair and equitable manner and in the interests of the overall Canadian communications industry. However, SAC 610 is an integral part of the NANP and NANP groundrules shall prevail in all decisions taken by the Board.

   All decisions taken by the Board will require the unanimous support of all Board members.

5. The Board has designated Telecom Canada as the assignment organization responsible for all recording and assignment activities associated with SAC 610 NXX codes for non-OTC public ISDN purposes.

   The assigning organization will not directly accept any applications for 610 NXX codes for non-OTC public ISDN purposes and will only assign such resources under the direction of the Board.

6. Users of 610 NXX codes for non-OTC public ISDN purposes will be confined to Canadian carriers authorized to own, operate or control transmission facilities that cross provincial or international boundaries and to any Canadian non-OTC public ISDN provider approved by the appropriate regulatory authority in the future.

   Applicants for these NXX codes must satisfy the Board that they are a qualified provider who intend to use the NXX codes in accordance with the groundrules set forth in this document.

7. Any applications for the assignment of SAC 610 NXX codes for non-OTC public ISDN purposes shall be submitted in writing to the Board for their approval. This approval will be required for both initial applications and for applications for additional codes, in order to establish whether or not the applicant is a qualified ISDN provider and/or how many NXXs the applicant may be assigned.

   The assigning organization is not authorized to rule on such matters and will only act on direction from the Board.

   It is expected that the Board will normally be able to provide a response to each request for codes within 60 days.

8. The Board must be satisfied that the quantity of NXX codes requested at any time is reasonable. This will include assurance that the code conservation requirement contained in the assigning groundrules will be complied with.

9. In cases where the code conservation groundrule requiring NXX code(s) to be placed in service within two years is not met, the Board will rule on what action is to be taken.

10. The Board may be called on to adjudicate on any matters relating to the assignment of 610 NXX codes to non-OTC public ISDN providers which are not covered by these groundrules. Any changes to these groundrules or redesignation of the assigning organization must be approved by the Board. The assigning organization must be informed promptly by the Board of any decisions which affect its functioning.

ASSIGNING GROUNDRULES

1. The organization responsible for the assigning and recording functions associated with 610 NXX codes for non-OTC public ISDN purposes (referred to in this document as the Assigning Organization) will be approved by the 610 NXX Administration Board (hereinafter referred to as the Board). Telecom Canada has been designated as the Assigning Organization.

2. NXX codes for non-OTC ISDN purposes shall be assigned from currently unassigned 610 NXX codes, limited only by the assigning groundrules contained in this document. The groundrules contained in this document must be strictly followed unless otherwise directed by the Board.

3. An up-to-date listing of both assigned and unassigned codes shall be maintained by the assignment organization at all times.

4. The Telecom Canada central staff organization shall not be required to disclose details of the NXX codes already assigned to TWX and Datalink services. Details of the assignment of such codes will be recorded separately from those used for non-OTC public ISDN purposes.

   Telecom Canada will release for re-use for other approved purposes all SAC 610 NXX codes which have been discontinued from TWX or Datalink service.

   At this time, the only other approved service is for non-OTC public ISDNs.

5. Recovered SAC 610 NXX codes, whether from TWX, Datalink or ISDN services will not be reassigned for at least six months unless there is a critical shortage of 610 NXX codes.

6. The Assigning Organization agrees to perform its function of assigning SAC 610 NXX codes for non-OTC public ISDN purposes in accordance with these groundrules, or specifically under the direction of the Board. It is not authorized to rule independently on any matters pertaining to these assignments.

7. In keeping with the Bellcore practice in regard to the assignment of NXX codes within SACs, non-OTC public ISDN providers may request specific NXX codes from SAC 610. If the requested NXX code(s) are available, the request will be met on a first-come-first-served basis. In the event of any disagreement, the postmark date of the original written application to the Board will prevail.

8. SAC 610 is an integral part of the NANP and as such, all 610 NXX assignments will follow established NANP groundrules and guidelines at all times.

   Specific NANP groundrules which will apply to SAC 610 NXX codes for public non-OTC ISDN purposes are:

   A) N11 format NXX codes will not be used.

      Explanation: Under the NANP all N11 codes are reserved for special purposes (e.g. 911,511 etc).

B) The following NXX codes are reserved throughout the NANP as "Special CO Codes" and will not be assigned under SAC 610.

<u>Explanation:</u> The NANP "Special CO Codes" are"

955	Toll Directory
950	Access to Interexchange Carriers under specific Exchange Access Arrangements
958	Plant Test
959	Plant Test
976	Information Delivery Services

C) NN0 format NXX codes will be assigned last.

<u>Explanation:</u> Throughout the NANP all 63 NN0 format NXX codes are assigned last (the 64th code, 950, is reserved as a special code) and in a specific order. This is done because when interchangeable NPA codes are introduced into the network the NN0 format codes will be assigned first, but in reverse order from the NN0 format CO codes. This will mean that ten digit telephone numbers having CO codes which are the same as NPA codes, will appear in the network gradually, in order to keep user confusion to a minimum.

D) NXX codes cannot be reserved for future use.

<u>Explanation:</u> For SAC 610 NXX code assignments for non-OTC public ISDN purposes, it has been agreed that an assigned NXX code must be brought into use to designate a working ISDN switching entity within two years. If the NXX code is not brought into use within two years, the assigning organization shall inform the Board, which will rule on the action to be taken, ie. grant an extension, or initiate steps to recover the code(s) in question.

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