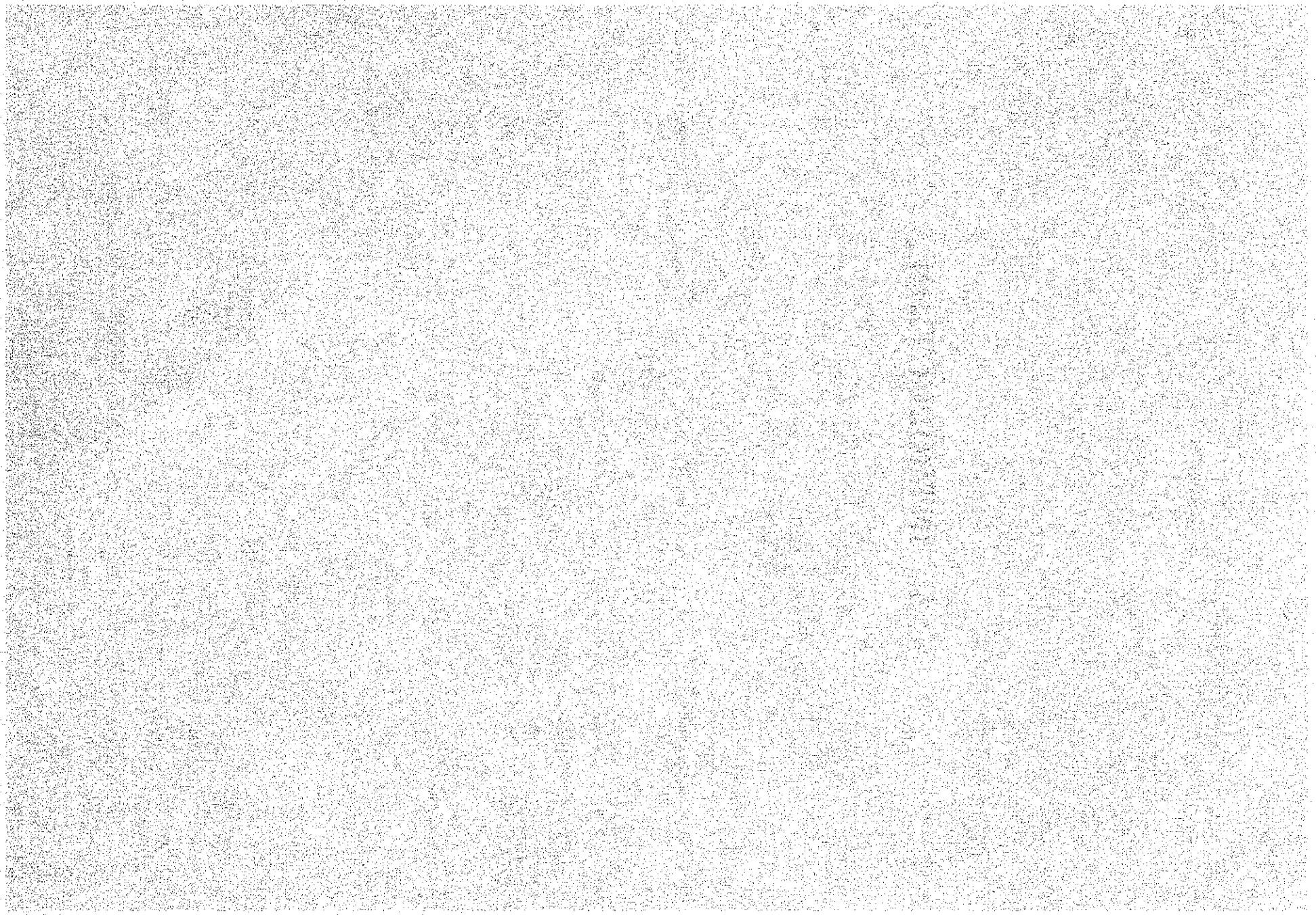
I . INTRODUCTION



I. INTRODUCTION

1-1 Background

His Majesty's Government of Nepal, cognizant of the importance of telecommunication services as a means of most effective contribution to the development of society and economy, as well as the enhancement of public welfare, established the Nepal Telecommunications Corporation (NTC) in 1976 and, in accordance with the Basic Plan for the Telecommunication Network formulated by NTC, has been promoting the improvement and expansion of the national telecommunication network.

Nevertheless, NTC itself still remains in its infancy and lacks capability to perform its role successfully. This fact, plus the specific topographic environment of the country, i.e., nearly 80% of the national territories being occupied by the mountainous regions, proves to be impedimental to the desirable development of telecommunication network. Only in Kathmandu, the capital city, and Pokhara located in the central valley and in part of main cities in the southern plain region of Terai, the modern telecommunication network is established.

In almost all the remaining areas of the country, the old fashioned High Frequency radio communication system (HF radio system) is the sole means of communication. Some of those areas do not have even the HF radio system in operation.

Such underdeveloped telecommunication services cannot but be a serious drawback to the promotion of rural development, the top priority policy plank of His Majesty's Government of Nepal. From the viewpoints of administration and social security also, the implication is no less serious.

To remedy the situation, His Majesty's Government of Nepal, with the assistance of Asia-Pacific Telecommunity, drew up the Basic Plan for the Rural Telecommunications Network in the Kingdom of Nepal. And, for implementation of this basic plan, His Majesty's Government of Nepal approached the Government of Japan, requesting technical cooperation.

In response to this request, the Government of Japan decided to carry out the feasibility study as part of overseas technical cooperation. The Japan International Cooperation Agency (JICA) as an executive organ of overseas technical cooperation dispatched a preliminary survey team, headed by Mr. Fukushi KITAHARA, to the Kingdom of Nepal in September 1982.

In the Kingdom of Nepal, the preliminary survey team exchanged views with the government organizations concerned of that country, and made arrangements for the main survey to follow, covering the basic requirements, such as the scope of survey and the survey period and itinerary. On September 23, 1982, the Scope of Work was finalized and exchanged between the preliminary survey team and NTC as a Government of Nepal organization in charge of telecommunication operations.

The feasibility study carried out, this time, is based on the above Scope of Work.

1-2 Objective and Scope of Survey

The current feasibility study is to probe into technical and economic feasibilities of the rural telecommunications network improvement and expansion plan covering the whole Kingdom of Nepal, from a long term viewpoint up to the year 2000. (The year 2000 is 15 years ahead, on the assumption that the implementation of the plan begins in 1985.)

The scope of survey is basically as shown in the attachment to Minutes exchanged between the preliminary survey team and NTC. However, the finally determined scope of survey is modified to some extent, based on the field survey findings and the result of joint study with NTC.

1-3 Study Team Organization and Study Phases

1-3-1 Study Team Organization

The feasibility study team, this time, was organized as under.

Name	Duty	Place of Employment
Fukushi KITAHARA	Administration (Leader)	Minister's Secretariat, Ministry of Posts & Telecommunications
Shigeyuki FUJIMURA	Radio Engineering	International Division, Nippon Telegraph & Telephone Public Corporation
Naoji HIRAI	Switching Engineering	Ditto
Masao TAKAHASHI	Outside Plant Engineering	Ditto
Seishin OJIMA	Site Selection	Radio Regulatory Bureau, Ministry of Posts & Telecommunications
Akihisa YAMAKOSHI	Ditto	Ditto
Isao IIMURA	Transmission Engineering	Nippon Telecommunications Consulting Co., Ltd.
Shozo ISHIJIMA	Radio Engineering	Ditto
Tadashi KOGAWA	Outside Plant Engineering	Ditto
Nobuo NAKAJIMA	Switching Engineering	Ditto
Mikio SOMA	Economic Evaluation	Nippon Telecommunications Consulting Co., Ltd.
Mitsutoshi KIKUCHI	Coordination	Japan International Cooperation Agency
Minoru TATEMATSU	Ditto	Ditto

1-3-2 Work Schedule

The feasibility study was carried out, divided into four phases. This arrangement was based on the work schedule as shown in the Scope of Work which the preliminary survey team had concluded with NTC of Nepal.

(1) Phase 1: Preliminary Work in Japan

The preliminary work in Japan consisted of the study of data collected by the preliminary survey team, the study in outline of the transmission paths by topographic maps, the formulation of field survey guidelines, and the inception report making.

(2) Phase 2: Field Survey

The field survey was carried out during December 9, 1982 through February 26, 1983. Main work items were:

a) Presentation to NTC, with explanation and discussion where necessary, of the inception report and the result of preliminary work in Japan.

b) Hearing of views from the organizations concerned with respect to the current project, and collection of related data.

c) Field survey of areas concerned, as well as collection of related data and information.

d) Shaping up of field survey results, as well as analysis and study of collected data and information.

e) Establishment of basic philosophy whereby to make feasibility study of the project, as well as discussion and confirmation of such basic philosophy.

f) Interim report making and presentation to NTC with explanation where necessary, as well as witnessing of interim report contents in the form of Minutes. (The Minutes bears signatures under date of February 22, 1983.)

(3) Phase 3: Draft Final Report Making and Presentation with Necessary Explanation

Based on field survey findings, the draft final report was made in Japan. The presentation thereof to NTC, with explanation where necessary, took place in Nepal during August 20 through August 29, 1983.

(4) Phase 4: Shaping-up and Presentation of Final Report

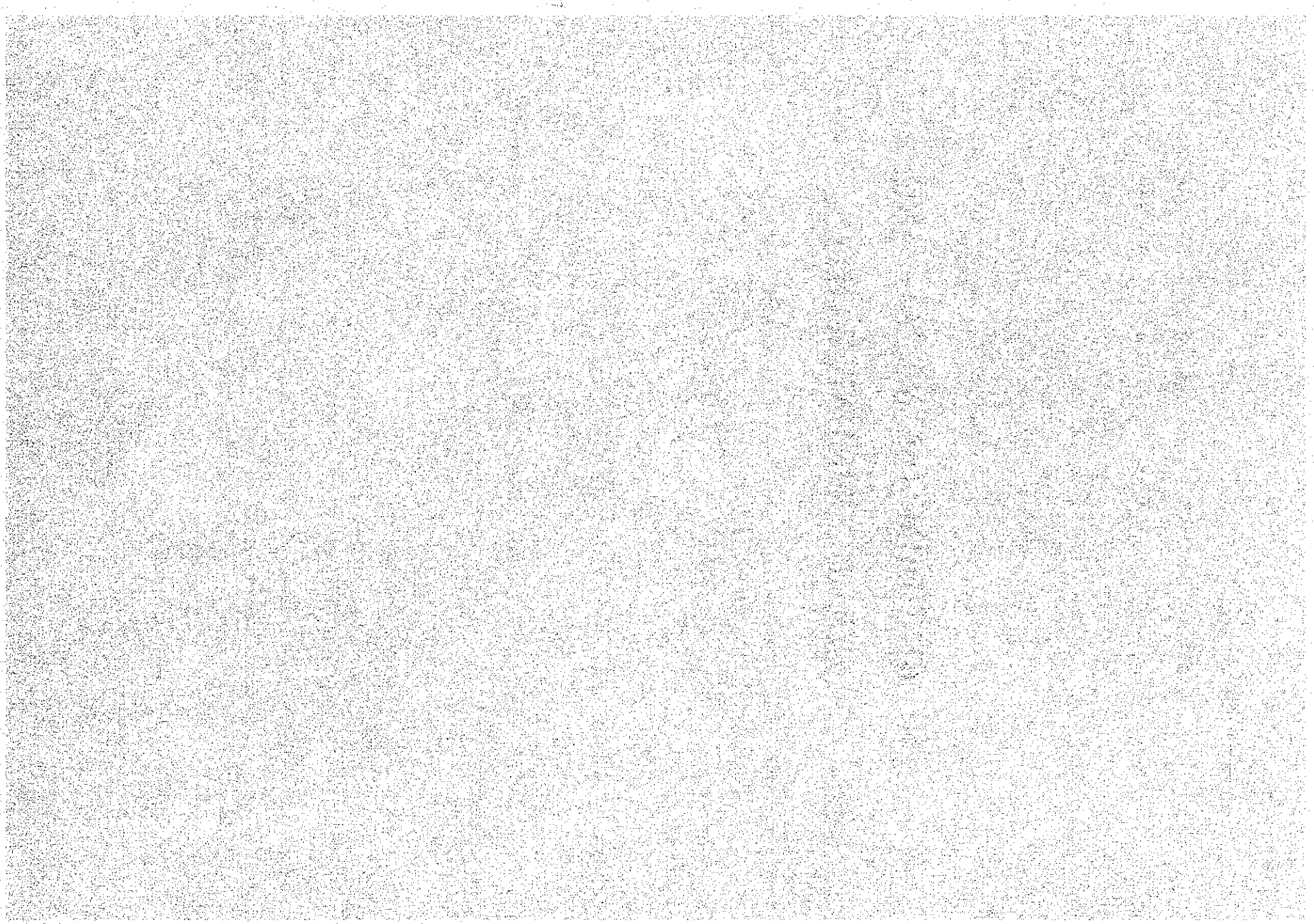
The final report of feasibility study, with NTC comments on the draft final report taken into consideration, was shaped up in Japan and sent to His Majesty's Government of Nepal on October, 1983. With this, the feasibility study work was completed.

1-3-3 Competent Authority in Nepal and Personnel in Charge

The authority that requested the feasibility study and assumes responsibility for implementation of the project concerned is the Nepal Telecommunications Corporation (NTC). The personnel of NTC who directly took part in the current feasibility study, including the Counterparts, are as under:

Name	Position
Mr. Ram Prasad Sharma	General Manager
Mr. Bhoop Raj Pandey	Deputy General Manager
Mr. Gajendra Shingh Bora	Chief Engineer
Mr. Ramesh Nepali	Business Manager
Mr. B.R. Pradhananga	Financial Controller
Mr. Chet Prasad Bhattarai	Executive Engineer
Mr. Bhesh Raj Kanel	Executive Engineer
Mr. Anoop Ranjan Bhattarai	Assistant Executive Engineer
Mr. Gyanendra Man Vaidya	Assistant Executive Engineer
Mr. Hari Gopal Shrestha	Assistant Executive Engineer
Mr. Yagya Bhadur Karki	Commercial Officer

II. KINGDOM OF NEPAL AND TELECOMMUNICATIONS



II. KINGDOM OF NEPAL AND TELECOMMUNICATIONS

2-1 Overview

The Kingdom of Nepal is a land-locked country located in South Asia, with its eastern, southern and western limits bordering with the India and having the national boundary with the Autonomous Region of Tibet of the People's Republic of China on the north. The whole country extends 885 km from east to west and 145 - 240 km from north to south, with an area of 140,797 km^2. The population of Nepal numbers approximately 15 million.

From the demographic and geographic viewpoints, the country can be divided into three main regions. (Refer to Figure 2-1.) The three regions are:

(1) The Trans-Himalayan region with an elevation of more than 3,000 m, composed of snowy mountains and glaciers including the world's highest Mt. Everest (elevation above sea level: 8,848 m).

This region occupies nearly 34% of the total national territories and is sparsely populated.

(2) The Middle region with an elevation of 900 m to 3,000 m, composed of the Himalayas piedmont with long slopes and green woodlands followed by the fertile valleys including Kathmandu and Pokhara.

This region occupies nearly 44% of the total national territories and about 56% of the total population.

(3) The flat and fertile Terai region with an elevation of 300 m or less, separated from the Middle region by the Mahabharat and Siwalik Heights.

This region is the richest in agricultural productivity so that it is called the granary of Nepal. This region measures only 50 - 80 km wide from north to south and extends not more than 600 km from east to west. Out of the total population, upwards of 40% inhabit this region.

In the national development plan, the country is divided into five development regions and, from the administrative viewpoint, into 14 zones that comprise 75 districts. (Refer to Figure 2-2.)

His Majesty's Government of Nepal is presently promoting the Sixth Five-Year (1980-1985) National Development Plan. This five-year plan is mainly intended to improve productivity, increase employment, and eliminate inequilibrium between urban and rural areas. Therefore, major emphasis is placed on improvement and expansion of infrastructures of all kinds, including telecommunication services, in the rural areas.

Key economic indices of the Kingdom of Nepal appear in Table 2-1.

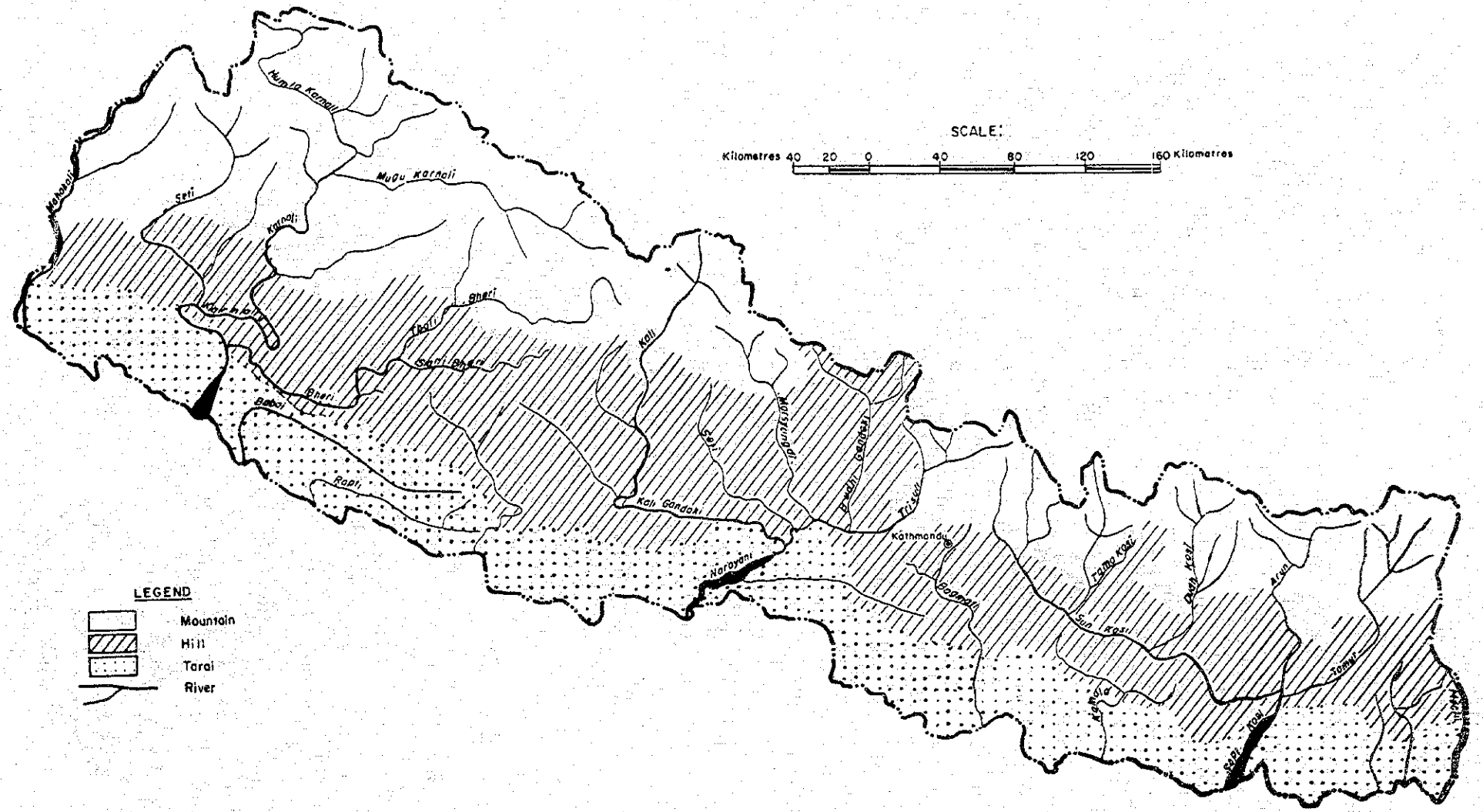


Figure 2-1 Geography of Nepal

Figure 2-2 Development Regions, Administrative Zones and Districts of Nepal

Table 2-1 Key Economic Indices at Nepal

Item \ Year	1978	1979	1980
Population (Thousand)	13,625	13,963	14,288
GNP (Million US$)	1,580	1,840	1,980
Per Capita GNP (US$)	120	130	140
Exports (Million US$)	68	87	97
Exports to Japan (Million US$)	6	9	8
Imports (Million US$)	215	274	345
Imports from Japan (Million US$)	36	24	43
Foreign Reserves (Million US$)	147	164	189
Balance of Foreign Liabilities (Million US$)	87	123	177
Debt Service Ratio (%)	1.4	1.4	1.5

Sources: IMB-IFS, IMF-DOT, World Bank

2-2 Situation of Telecommunication Services

2-2-1 History

The historical background of telecommunication operations in the Kingdom of Nepal is as under:

1960: The Telecommunications Department was established in the Ministry of Transport and Communications. As of 1960, only one manual telephone exchange existed in the country. HF radio system was the main means of contact between main cities and between local centers.

1962: The first automatic switching system with capacity of 1,000 line units was introduced in Kathmandu. Then followed the establishment of manual exchange with capacity of 300 line units in Biratnagar.

1976: The Nepal Telecommunications Corporation (NTC) was established. This was to promote the development, as well as the improvement and expansion, of national telecommunication network.

1978: The Basic Plan for the Telecommunication Network was formulated by NTC. Using this Basic Plan as a guideline, the national telecommunication network improvement and expansion have been carried out up to the present.

2-2-2 Organization of NTC

NTC is a public corporation under the control of the Ministry of Communications. The organizational chart is given in Figure 2-3. The staff personnel number is about 2,000 at present.

2-2-3 Existing State of Telecommunication Facilities

Telecommunication facilities in the Kingdom of Nepal as of the end of 1982 are summarized below.

- Number of main telephones (Waiting applicants)	13,248 (31,185)
- Number of telephone sets	14,066
- Number of telephone exchanges (Capacity)	23 (15,580 line units)
XB type automatic exchanges	4 (11,000 line units)
Common battery type manual exchanges	16 (4,500 line units)
Magneto type manual exchanges	3 (80 line units)
- International satellite communication earth station	1
- HF radio stations	82
- Number of toll circuits	180
- Number of international telephone circuits	40
- Number of international telex circuits	22
- Annual total of telegraphs	
Domestic telegraphs	294,000
International telegraphs	57,000

Telephone exchange locations including new establishments and expansions by the on-going Third Telecommunication Development Programme (1979 - 1983) Plan of NTC and the existing state of backbone transmission network mainly composed of microwave system appear in Figure 2-4 and Figure 2-5, respectively. As seen in these illustrations, the areas where the

switching system and the transmission network are established are extremely limited. Such areas only comprise Kathmandu, the capital city, and Pokhara, as well as the southern Terai region.

In the whole national territories of the Kingdom of Nepal, a total of 80 Regional Centers, Zonal Centers and District Centers exist. Out of these centers, those having the switching system and transmission system introduced number only 19. The remaining 61 centers (76%) are only equipped with the outdated HF radio systems. And such HF radio system is merely for telegraph service. Furthermore, the radio frequency allocations in different parts of the country consist of not more than five pairs of frequencies so that the time sharing operation applies to the use of radio frequencies by the telegraph offices. That is to say, each telegraph office can use the allocated radio frequencies for limited hours only.

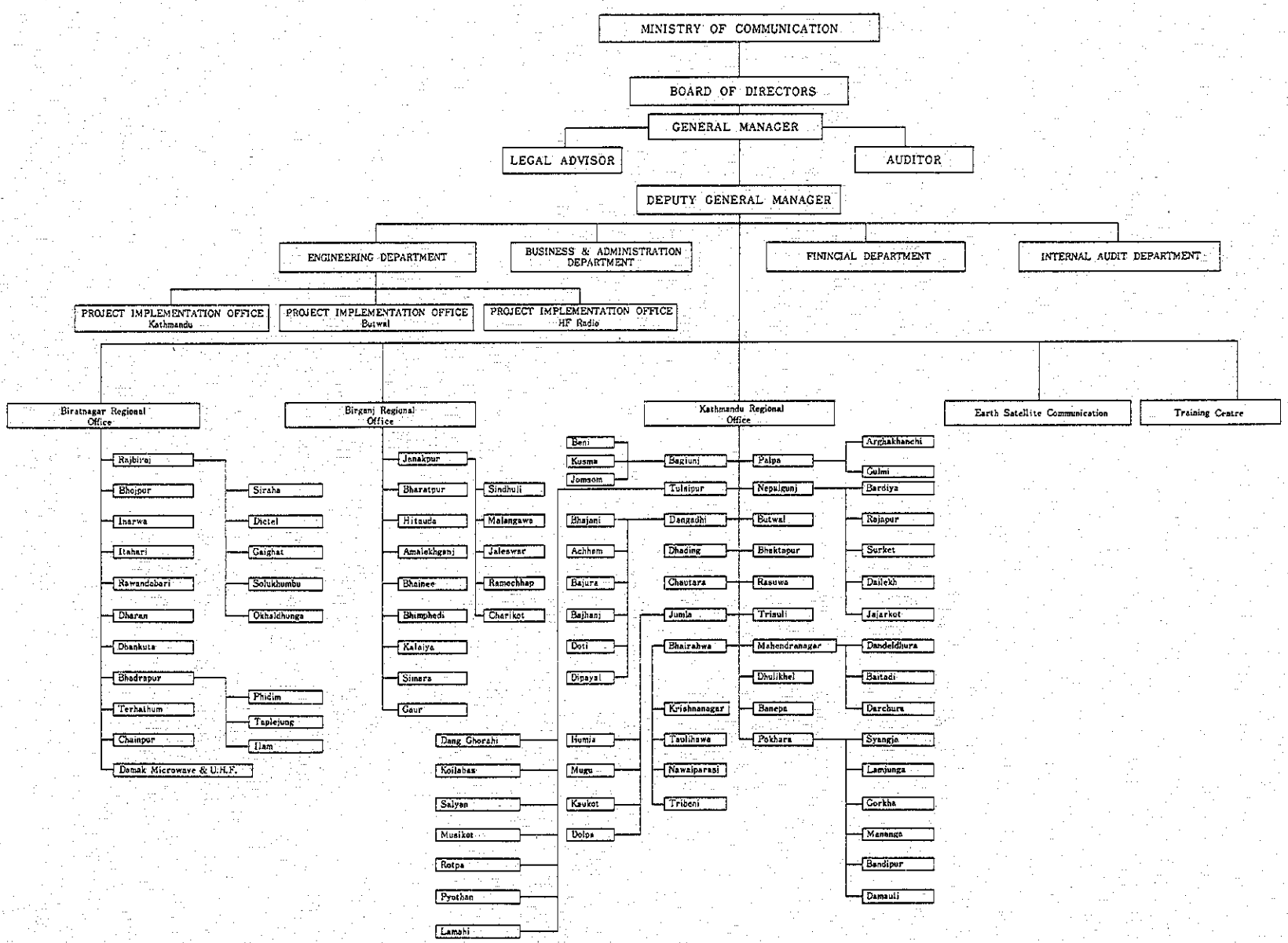


Figure 2-3 Organization of Nepal Telecommunications Corporation

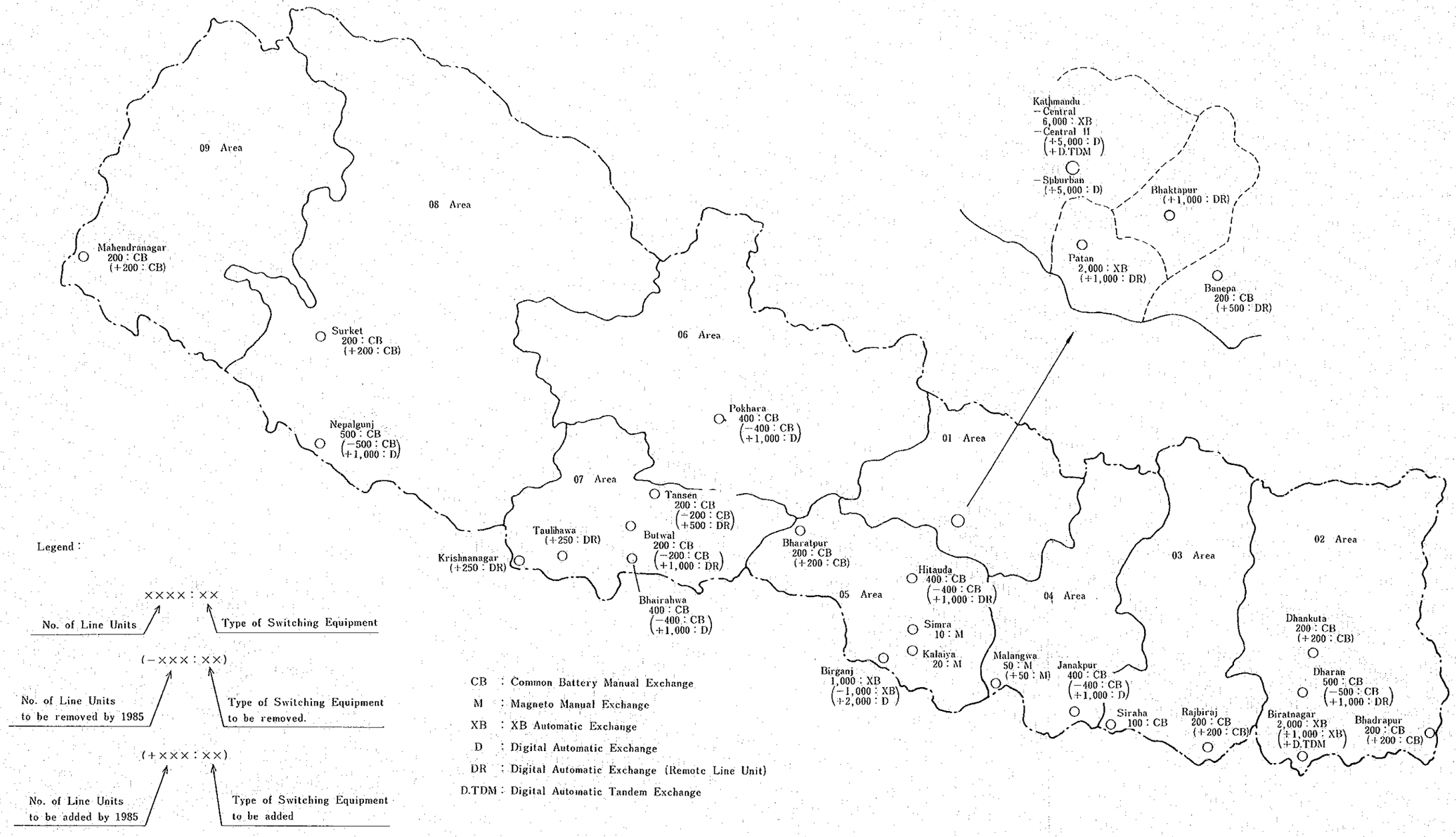


Figure 2-4 Existing Telephone Exchanges in Nepal

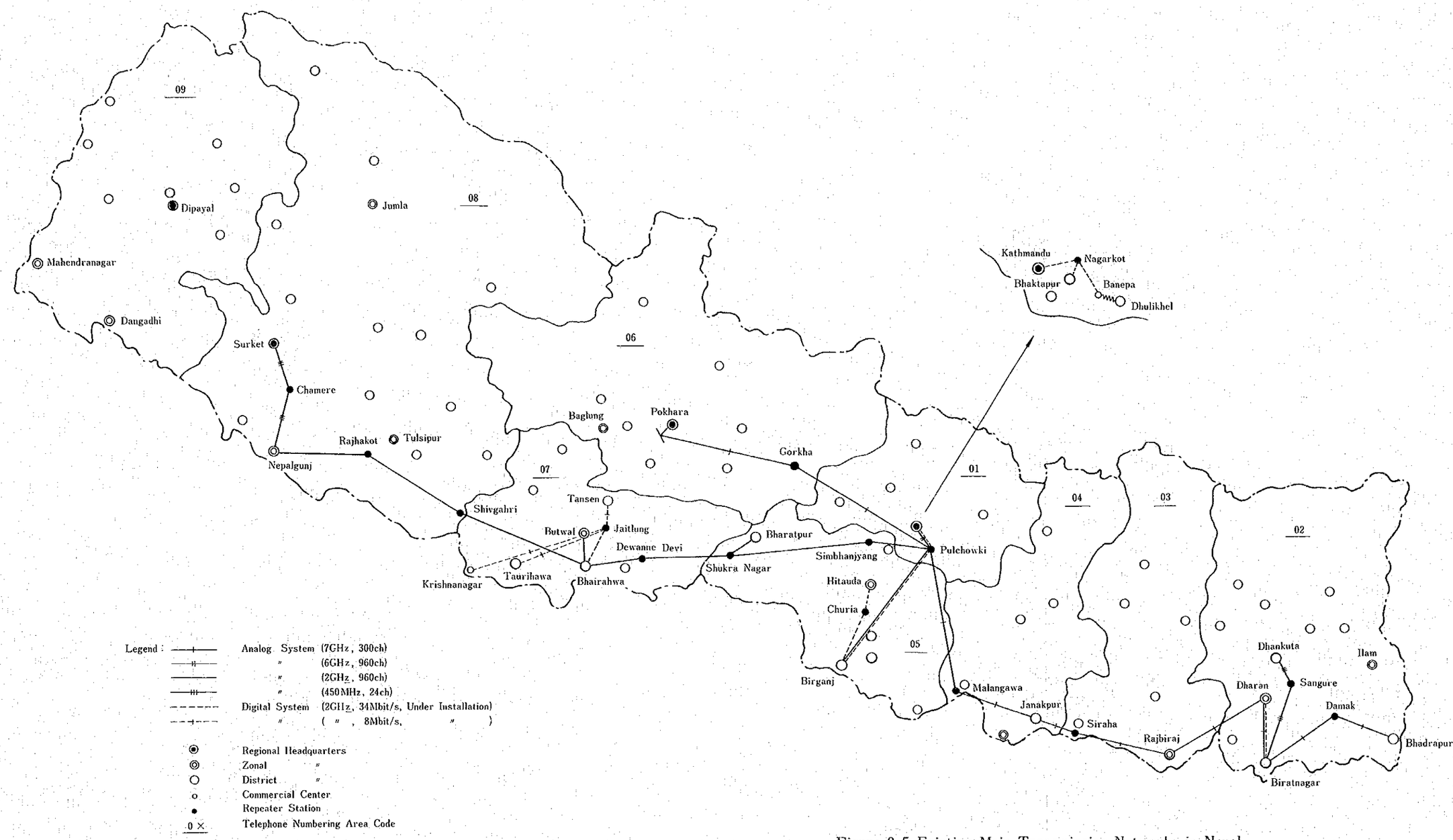
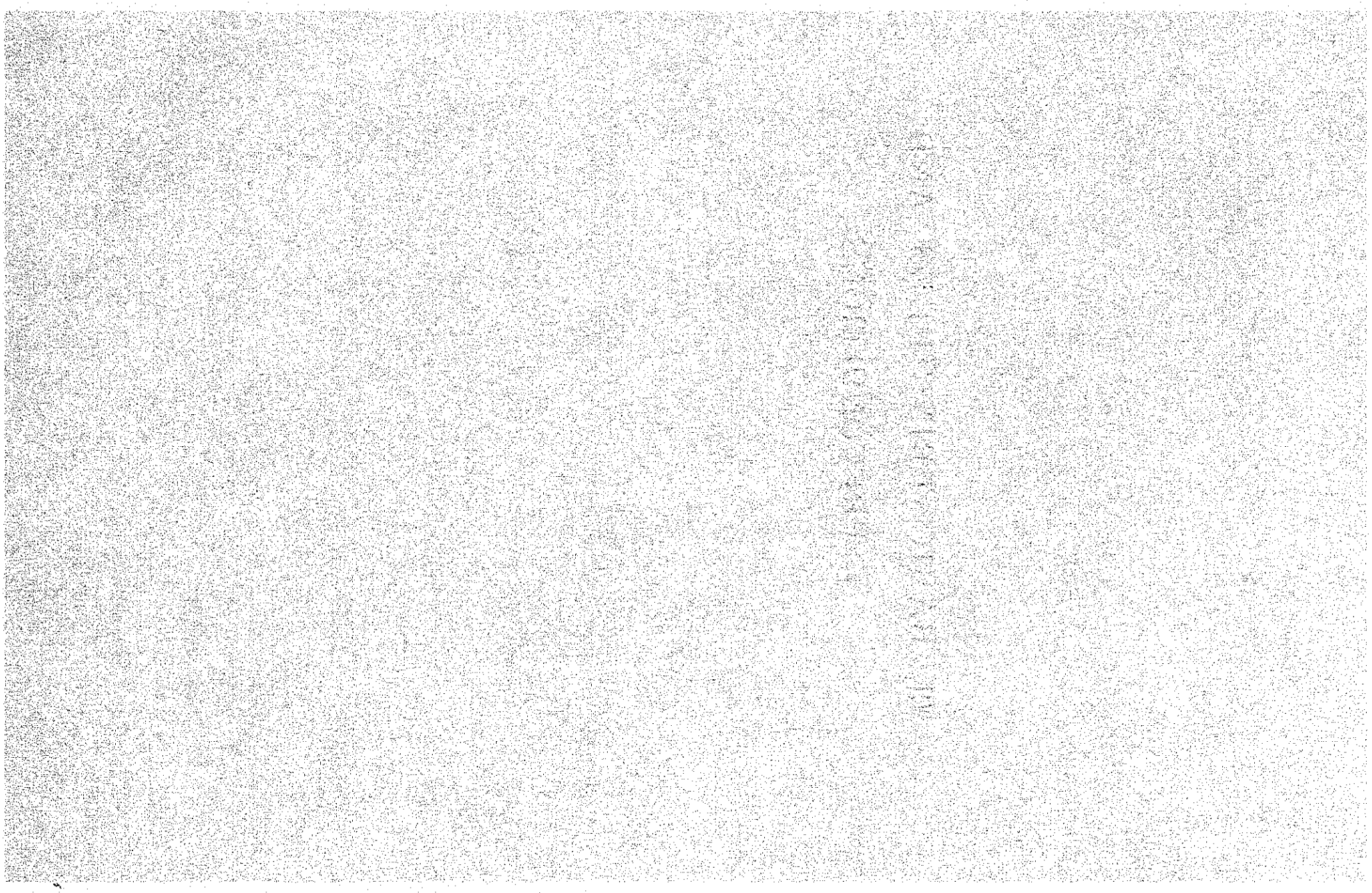


Figure 2-5 Existing Main Transmission Networks in Nepal

III. BASIC PRINCIPLES AND PRECONDITIONS



III. BASIC PRINCIPLES AND PRECONDITIONS

3-1 Basic Principles

In the Kingdom of Nepal, there still are areas where only the outdated HF radio system is available and areas where even such HF radio system is not available. The feasibility study, this time, is for introducing a high quality and stable, hence reliable, telecommunication network in those areas, or, more precisely, in the administrative centers and in the agricultural and commercial/industrial centers in those areas, and, by so doing, contributing to the development of society and economy, as well as the improvement of public welfare, in those rural areas which His Majesty's Government of Nepal intends to realize.

However, the formulation of plan to introduce an up-to-date telecommunication network in such rural areas must be preceded by the careful study of specific social and industrial structures of the Kingdom of Nepal, i.e., the fact that up to 93% of the total population are engaged in agriculture and the annual income level per capita is as low as 140 U.S. dollars.

Generally, the telephone diffusion rate is to improve through the development stages shown in Table 3-1. When the existing state of telecommunications in the Kingdom of Nepal is assessed by those development stages, the safe assumption is that the telecommunications in that country have just entered into the primary expansion stage. In the aforementioned rural areas where the current feasibility study applies, the telecommunications can still be considered to remain in the initiatory stage.

When introducing the telecommunication network in such early development stage areas, political consideration is required in the form of establishing facilities in the necessary minimum commensurate with the national development plan, instead of merely improving the telephone diffusion rate, because the telephone demand among the general public is presumed to be extremely small. In other words, top priority should be given to the provision of telecommunication services to government organizations and public establishments. In this case, the communication traffic of such government organizations and public establishments will almost completely be that of central or higher ranking organizations and establishments whereas the local communication traffic in the rural areas where the service is to be introduced will be practically nil. This fact must be duly considered in the network plan formulation.

From the foregoing viewpoint, the basic principles of the network plan formulation are determined as under:

(1) To create public call offices in the administrative centers, as well as the agricultural and commercial/ industrial centers, so as to provide public communication services, mostly telephone and telegraph services, in the necessary minimum and, at the same time, carry out telephone services to government organizations and public establishments.

    For the immediate future, public call offices are to provide toll communication service only, without performing local communication service.

(2) To introduce telephone switching facilities exceptionally at such places that assume special importance in rural development plans and where the development is expected in the future with the population increasing.

(3) To have toll circuits from public call offices concentrated in the highest ranking telephone offices in hierarchy, and to have switching and metering performed in those telephone offices.

In the telephone office hierarchy, the whole territories of Nepal are divided into nine areas, and in each area one primary switching center is established. Toll circuits from public call offices are to be concentrated, area by area, in the primary switching center. (The primary switching center is hereafter called the parent exchange.)

3-2 Preconditions

In the telecommunication network plan formulation, several preconditions are used, besides the basic principles described in the preceding paragraph. The preconditions are as under.

3-2-1 Objective Sites

The objective sites of the feasibility study, this time, are the administrative centers and the correspondingly important agricultural and commercial/industrial centers where the modern telecommunication network is not yet introduced.

The undermentioned sites are excluded from the objective sites, based on the result of consultation with NTC.

(1) Sites located near the existing backbone transmission network, where the service is easily available from the existing network. (These sites number five.)

(2) Sites located in the Trans-Himalayan region, where the introduction of communication facilities is extremely difficult both technically and economically at the present state of development. (These sites number three.)

The finally selected objective sites are identified in Table 3-2.

3-2-2 Application of Digital System

The telecommunication network digitalization is now the worldwide trend. NTC, for its part, has decided for network digitalization, beginning with its third telecommunication development programme (1979-1983).

Thus, in the feasibility study, this time, the precondition of network planning is to apply digital switching and transmission systems.

For the transmission system to be adopted, comparative study is to be made for line-of-sight UHF and SHF systems and the optimum system is to be selected out of these two systems.

Systems worth comparative study include (1) line-of-sight UHF and SHF systems, (2) tropospheric scattering over-the-horizon radio system, and (3) domestic satellite communication system. The reasons why the line-of-sight UHF and SHF systems alone are taken up for comparative study are as under:

(1) Over-the-horizon (O/H) system is still in the R&D stage even among the developed countries. Cases where the O/H system is put into practice are few.

(2) The domestic satellite communication system requires a huge amount of financial investment. Furthermore, the development of this system for practical purpose by in-house technology is extremely difficult for Nepal at the present stage. Although a satellite for domestic satellite communication is scheduled to be launched by India during 1983, the conditions for its utilization including the transponder lease tariff are not yet decided definitely.

(3) Both the O/H system and the satellite system, at the present moment, require by far larger scale facilities and greater capacity power supply than the line-of-sight UHF and SHF systems. Hence, neither of the former can be aptly used in Nepal, a country where the infrastructures, especialy the road network and power supply system, are not fully developed. This holds true not only technically but economically also.

3-2-3 NTC's Basic Plan

The Nepal Telecommunications Corporation (NTC) formulated the Basic Plan for the Telecommunication Network as guideline and objective of national telecommunication network planning in 1978. This Basic Plan consists of:

(1) Switching Plan

(2) Numbering Plan

(3) Charging Plan

(4) Transmission Plan

All these unit plans constitute the basic requirements in telecommunication network planning. Thus, in the feasibility study, this time, also, the rural telecommunication network plan for the Kingdom of Nepal is to be formulated in conformity with NTC's Basic Plan, in principle.

Meanwhile, NTC is presently engaged in the partial revision of its numbering plan pursuant to the change in administrative zones in the country. NTC is also studying the transmission plan modification in preparation for the introduction of digital system. However, since such revision and modification do not vitally influence the network planning according to the feasibility study findings, NTC's Basic Plan in its existing form is to be used, this time.

The contents of NTC's Basic Plan as it presently is can be summarized as under:

(1) Switching Plan

a) Office Hierarchy

The office hierarchy for telephone exchanges in the Kingdom of Nepal is presented in Figure 3-1. International Switching Center (ISC) and Main Switching Center (MSC) are established in Kathmandu, and Primary Switching Center (PSC) is established in each closed numbering area. (For PSC, refer to Paragraph (2) Numbering Plan, Sub-paragraph c).) Secondary Switching Center (SSC) is to be established where necessary in consideration of traffic flow.

b) Network Formation

Network among switching centers is to be star network for the immediate future. Sometime in the future, in consideration of traffic volume, the complex mesh-star network is to be introduced.

(2) Numbering Plan

a) National, International Trunk Access Codes

- National trunk access code: "0"
- International trunk access code: "00"

b) Numbering Formation

- National subscriber number:

  (Area code) + (Exchange code) + (Subscriber number) is 7 digits

- Special service code: 1XY (X, Y = 0 - 9)

c) Area Codes

	Administrative Zone	PSC
"1"	Bagmati Zone	Kathmandu
"2X"	Mechi & Koshi Zones	Biratnagar
"3X"	Sagarmatha Zone	Rajbiraj
"4X"	Janakpur Zone	Janakpur
"5X"	Narayani Zone	Birganj
"6X"	Gandaki & Dhaulagiri Zones	Pokhara
"7X"	Lumbini Zone	Bhairahwa
"8X"	Bheri & Rapti Zones	Nepalgunj
"9X"	Seti, Karnali & Mahakali Zones	Dangadhi

where, "X" = 2 - 9

(3) Transmission Plan

a) National Reference Equivalent

- Sending reference equivalent: 21 dB
- Receiving reference equivalent: 12 dB

b) Transmission Loss Distribution

- Subscriber's line: 8 dB
  (Long distance subscriber's line: 10 dB)
- Between LE & SSC : 5 dB
- Between SSC & PSC: 0.5 dB
- Between PSC & MSC: 0.5 dB

(4) Switching System

At present, manual and automatic switching systems are used. However, in the future, automatic switching system will be the sole switching system.

When automatic switching system is adopted, grade of service for provision of trunk is to be 0.2%.

(5) Signalling System

a) Information Signal

For the existing switching system, DP signalling system is to be used. For the switching system to be newly introduced, R2-MFC signalling system is to be adopted.

b) Supervisory Signal

Loop, E&M or digital signalling system, whichever best suited for transmission route facilities, is to be used.

(6) Charging System

a) Charging on Local Call

Call meter is provided for each subscriber and is stepped one unit for each local call made.

b) Charging on Toll Call

Detailed call recording is made in the primary switching center (PSC).

c) Charging System at Public Call Office

The call meter is to be installed for charging calls.

Table 3-1 Telephone Development Stages

Initiating Stage	In this stage, telephone is provided in military establishments, police and government agencies for the purpose of communication and liaison mainly in military and political fields. Telephone demand forecast using a model formula is almost useless in this stage and counting of the number of agencies requiring telephone service or determination of the number of telephone lines from a political point of view is more practical.
Primary Expansion Stage	In general, the convenience of telephone in business sector is beginning to be recognized but the need for household telephone is not recognized so greatly. Telephone density is very low but the convenience of telephone is recognized gradually in proportion to the increase of telephone installed. By time series, the number of telephone subscribers often shows a tendency of increasing in geometrical progression.
Latter Expansion Stage	The convenience of household telephone is widely recognized and demand for household telephone increases sharply. This stage covers a period from the time when the demand for household telephone comes close to the demand to the time when a majority of households are provided with telephone. By time series, there is a possibility of demand generation for exceeding the geometrical progression. In this stage, it is desirable to make separate demand forecast for business telephone and household telephone.
Popularization Stage	Business telephone has been diffused sufficiently and most of additional installations are for household telephone. Generation of stable demands is expected until a majority of households are provided with telephone.
Popularized Stage	Both business telephone and household telephone have been diffused sufficiently as a whole. Even in this stage, telephone demand for new business establishments or households can be expected. However, the sales effort on the part of telephone enterprise to develop a new demand, through introduction of new systems which make telephone more convenient to use and a new type of services, is indispensable for the growth of the business.

Table 3-2 (1/2) Objective Sites

Area	Parent Exchange Site	Independent Exchange Site	Public Call Office Site	
			Administrative Center	Commercial Center
01	Kathmandu (Central II)		Chautara Dhading Dhunche Bidur (Trisuli) *1	Panchkhal Nagarkot *2 Helambu Zinc Mining Town
02	Biratnagar		Terhathum Bhojpur Khandbari	Chainpur
	Bhadrapur		Ilam Phidim Taplejung Jhapa	Aitabare
03	Rajbiraj		Gaighat Okhaldhunga Diktel Salleri	Namche Bazar Rumjhatar
04	Janakpur		Sindhuli Madi Ramechhap Charikot	
05	Birganj	Kalaiya *3	Gaur	Simra *4
	Hitauda		Bhimphedi	
06	Pokhara		Kusma Baglung Beni Jomsom Damauli Gorkha Syangja Besishar Chame	Bandipur

Table 3-2 (2/2) Objective Sites

Area	Parent Exchange Site	Independent Exchange Site	Public Call Office Site	
			Administrative Center	Commercial Center
07	Bhairahwa		Gulmi Tamghas Shandhikharkha Parasi	Tribeni
08	Nepalgunj	Tulsipur Ghorahi	Dailekh Kalikot Jumla Gularia Jajarkot Musikot Gadhawa Pyuthan Libanggaon Salyan	Rajapur Koilabas
09	Dangadhi	S. Doti (Dipayal) *5	Mangalsen Martadi Dandeldhura Baitadi Darchula Chainpur	Bhajani Tikapur

Remarks:

*1 Trisuli will be treated as the same local area of Bidur and four telephone sets are required at initial stage.

*2 Equipment housing for public call office will be installed at Nagarkot apart from this project.

*3 Digital exchange will be installed at Kalaiya apart from this project.

*4 At least fifteen telephone sets are required for Simra PCO site at initial stage.

*5 Dipayal will be treated as the same local area of S. Doti.

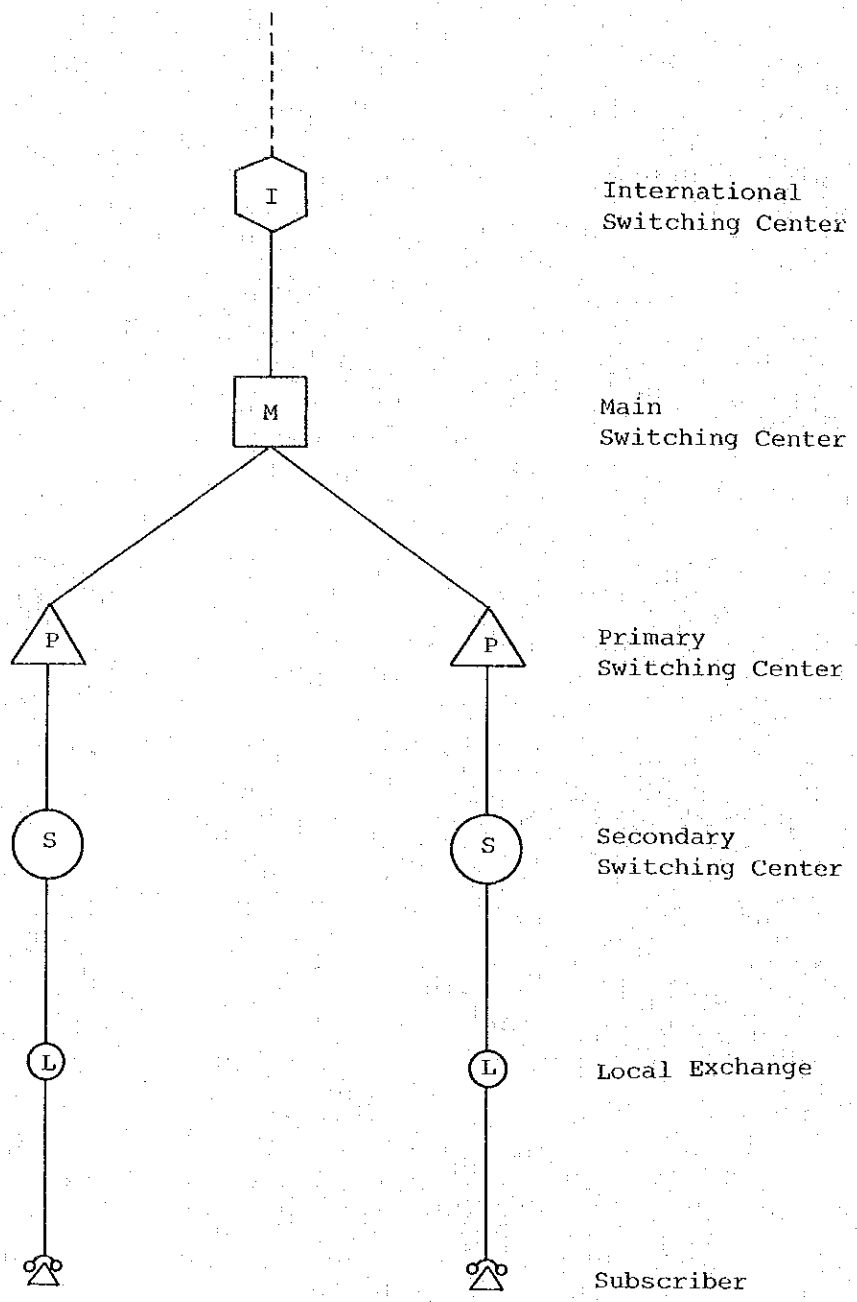


Figure 3-1 Telephone Exchange Office Hierarchy