BASIC DESIGN STUDY REPORT
ON
THE RURAL TELECOMMUNICATIONS NETWORK EXPANSION PROJECT
OF
THE KINGDOM OF NEPAL

JUNE 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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P R E F A C E

In response to a request from His Majesty's Government of the Kingdom of Nepal, the Government of Japan decided to conduct a basic design study on the Rural Telecommunications Network Expansion Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Nepal a study team headed by Mr. Kazuyoshi YAMAMOTO, Section Chief of International Cooperation Division, Communications Policy Bureau, Ministry of Posts and Telecommunications, from 27th November to 9th December 1990.

The team held discussions with the officials concerned of the His Majesty's Government of Nepal, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Nepal in order to discuss a draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of His Majesty's Government of the Kingdom of Nepal for their close cooperation extended to the team.

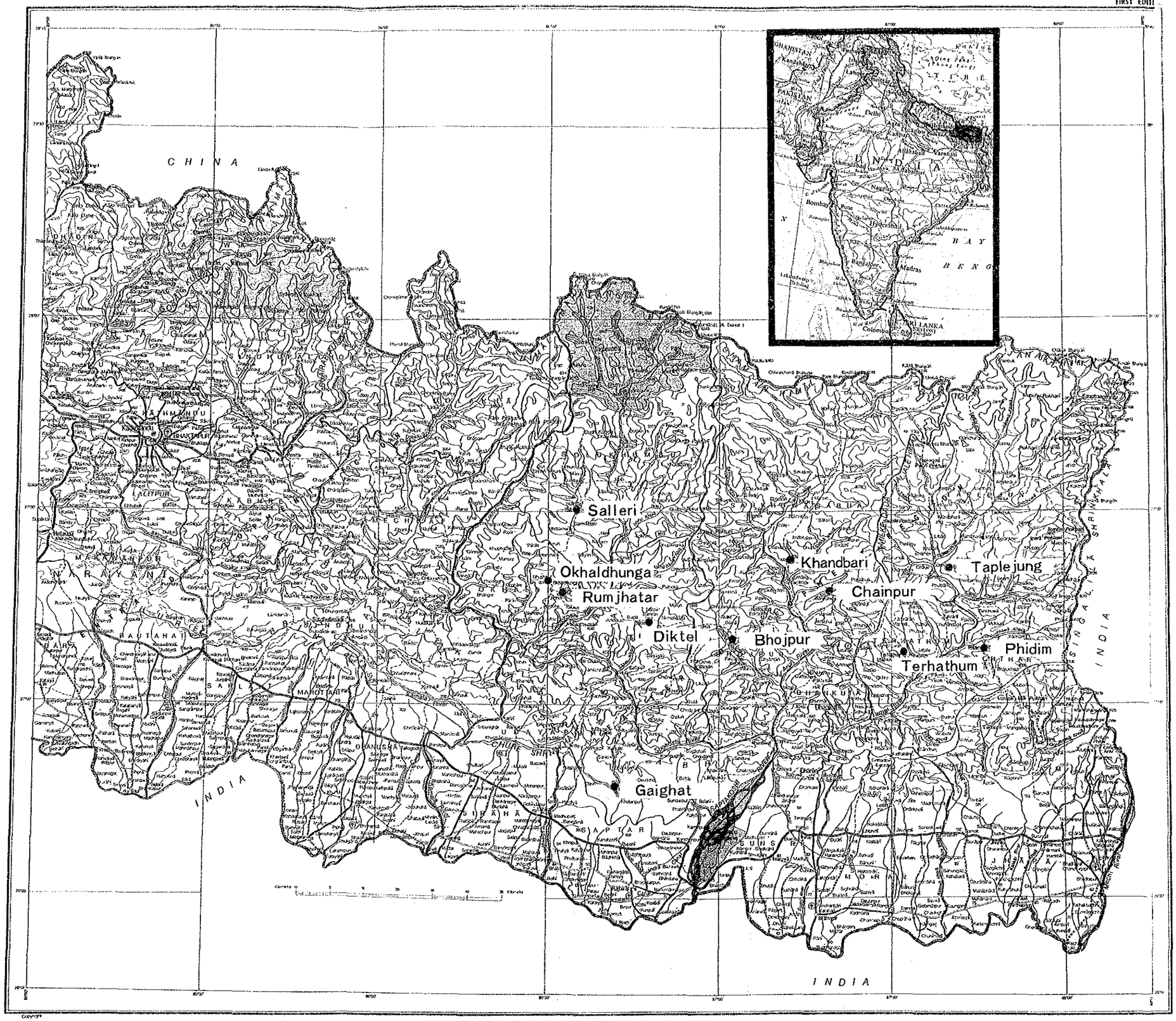
June 1991

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

KINGDOM OF NEPAL

FIRST EDITI



SUMMARY

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In the Kingdom of Nepal, telecommunications services started with the establishment of the Telecommunications Bureau in the Ministry of Communications (MOC) in 1960, rather late as compared with other countries. At first, HF radio links only were provided to connect zones, with no telephone exchange. The automatic telephone switching equipment had not been introduced until 1962. In 1976, the Nepal Telecommunications Corporation (NTC) was established to improve and develop the national telecommunications network.

NTC formulated the "Basic Plan for Telecommunications Network" in 1978 and, since then, has been promoting the expansion of the telecommunications network in accordance with this Plan. Even at present, however, advanced telecommunication system is available only in the Kathmandu and Pokhara valley and the major cities in the southern plain region of Terai. The geographical feature of this country, i.e., most of the land is mountainous, has made it difficult for NTC who has not so rich experience in telecommunications business to expand the facilities rapidly.

The current inadequate telecommunication service in Nepal is an obstacle to regional development, the most urgent subject to be achieved by His Majesty's Government. Administratively, it is also a problem to be solved urgently.

In 1982, His Majesty's Government requested the Japanese Government to extend the aid for improvement of the rural telecommunications network and, in answer to this request, the Japanese Government conducted the development survey from December 1982 to October 1983, and prepared the Rural Telecommunications Network Improvement Plan, comprising 4 phases. Out of them, Phase I and Phase II were implemented with the Japan's grant aid in fiscal years 1984 through 1987. Under these projects, 33 public call offices, 60 radio repeater stations, 50 radio hops, outside plant facilities of 53 Km in cable length, etc. were constructed. With these facilities, the rural telecommunications network in the Kingdom of Nepal has been remarkably upgraded, achieving the desired cooperation effect.

The current request from His Majesty's Government is for improvement of telecommunications network in 11 major cities in the eastern development region, the top priority area in Phase III and Phase IV.

In answer to this request, the Japanese Government decided to carry out the basic design study, and entrusted the study to JICA. Then, JICA dispatched the Basic Design Study Team to the Kingdom of Nepal from November 27 to December 28, 1990, for the field survey.

The Study Team held discussions with officials concerned of His Majesty's Government, and investigated the status quo of telecommunications networks in the Kingdom of Nepal, as well as social and economic conditions.

After returning to Japan, the Study Team examined and analyzed the contents of the request, based on the various data and information obtained through the field survey, and drew up the draft Study Report which covers the outline of the Project, basic design policy, implementation plan, etc. JICA dispatched the Study Team again to the Kingdom of Nepal from April 17 to April 26, 1991, for discussion with the officials concerned of His Majesty's Government to finalize the draft Report.

The outline of the Project, basic design policy and implementation plan are summarized in the following:

(1) Outline of the Project

1) Size of the facilities to be provided

Public Call Offices	11 sites
Transmission Facilities	23 stations
Outside Plant	11 cities
Power Plant	21 stations

2) Objective areas

-Mechi (02 zone)
Phidim, Taplejung.

-Koshi (02 zone)
Terhathum, Chainpur, Khandbari, Bhojpur.

-Sagarmatha (03 zone)
Gaighat, Diktel, Okhaldhunga, Rumjhatar, Salleri

(2) Basic Design Policy

1) Transmission Facilities

- Transmission system

2 GHz digital line-of-sight radio system will be installed.

- Transmission quality

Transmission quality should conform to the relevant CCITT and CCIR Recommendations and Reports.

- System configuration

Cold standby system will be adopted in order to minimize the power consumption.

- Transmission capacity

Transmission capacity of each route from Parent Exchange Office (PEO) to each public call office (PCO) in a district headquarter of the objective area is two 2Mbit/s (equivalent to 30 voice channels) systems, and in 2 cities which are not the district headquarter, namely, Chainpur and Rumjhatar, one system.

2) Outside Plant

- Aerial cable system will be adopted for the subscriber cables, and the capacity of the lead-in cables of each PCO should be enough for installation of 30 subscriber lines. The number of subscriber cables should be equivalent to the number of initial subscribers.

- For inter-office tie cables of PEOs, the underground cable system will be adopted, with the capacity corresponding to the transmission system capacity.

3) Power Plant

- For stations where commercial power supply is available, full floating system or combined system by solar battery and commercial power will be adopted.

- For stations where commercial power supply is not available, solar power system or combined system by solar battery and engine generator will be adopted.

4) Operation and Maintenance

Remote supervisory and control system will be introduced to make all the offices unattended except for PEO, and thereby minimize the operation/maintenance costs.

(3) Implementation Plan

1) Implementation Schedule

This project is divided into two (2) phases for implementation, in view of the geographical distribution of the objective sites, environmental conditions, and the scope and size of the works to be undertaken by His

Majesty's Government. For each Phase, the construction period is to be twelve (12) months after signing of the contract with the Contractor of each Phase. The period for detail design is to be three (3) months each.

(4) Project Evaluation

1) Effect of the Project Implementation

With the implemtnation of this Project, up-to-date direct distance dialling telephone service will become available not only for domestic communication but also for international communication, in the region where inhabitants have no access to communication service of any kind or only the outdated telegram service over an HF radio link is available.

2) Benefits from the Project Implementation

With the realization of the high quality direct dialling service, the government's administrative services will be remarkably improved and the emergency medial service will be upgraded. It will further facilitate the modernization of commodity distribution system, promotion of social and economic activities, increase of employment opportunities and public welfare.

As described in the foregoing, the materialization of this Project will contribute to not only the expansion of the telecommunications network in the Kingdom of Nepal but also the national economic development which His Majesty's Government is now vigorously proceeding with. It can be said, therefore, this Project is most suitable for the Japan's grant aid and can achieve cooperation effect.

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CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

His Majesty's Government, being aware of the urgency of the improvement of the rural telecommunications network as a most effective means for promoting the regional development which is currently the prime need of the country, as well as for upgrading the Government's administrative system, enhancing security, improving distribution system and medical services, etc., requested the Japanese Government to extend its aid for the "Basic Study for Rural Telecommunication Network Improvement" in 1982.

In answer to this request, the Japanese Government formulated the "Rural Telecommunications Network Improvement Plan", comprising 4 phases. Phase-I and Phase-II of the Plan were implemented with the Japan's grant aid in fiscal years 1985 through 1987.

The networks completed under Phase-I and Phase-II were put into service by NTC and their utilization by subscribers is daily increasing. The telephone service realized by these networks is highly appreciated by the inhabitants who, until that time, had been kept away from any communication service at all, or accessible only to the old type telegram service.

That is, significant benefit has been derived from the cooperation for Phase-I and Phase-II.

The current request from His Majesty's Government is for improvement and expansion of the rural telecommunications network in 11 cities in 3 zones, namely, Koshi, Mechi and Sagarmatha zones (which fall under the telephone area codes, 02 and 03) in the Eastern Development Region, the top priority area in Phase-III and Phase-IV of the Rural Telecommunications Network Improvement Plan.

The main items covered by the request are digital radio facilities and digital multiplex equipment, including associated antenna towers, outside plant and power plant.

In answer to this request, the Japanese Government decided to execute the basic design study for this plan, and the Japan International Cooperation Agency (JICA) dispatched the Basic Design Study Team headed by Mr. Kazuyoshi Yamamoto, Section Chief of International Cooperation Section, International Communication Policy Bureau, Ministry of Posts and Telecommunications, to the Kingdom of Nepal from November 27 to December 28, 1990. Basic Design Study Team members are listed in Annex-1.

The Basic Design Study Team discussed with the officials concerned of NTC the status quo of the existing telecommunications facilities and general conditions of the objective areas, including the current situation (size and progress) of the on-going telecommunications development plans. Field investigations were

also carried out in objective areas according to the itinerary given in Annex-3. NTC officials who joined the discussions, and the interviewees on the occasion of field investigations in the objective areas are listed in Annex-8.

On the basis of the above investigation findings and the analysis study carried out in Japan, JICA prepared the draft Basic Design Study Report and, to finalize this draft Report, dispatched the Report Explanation Team headed by Mr. Katsuichi Ito, Radio Station Inspector, Basic Trunk Section, Radio Wave Department, Telecommunication Bureau, Ministry of Posts and Telecommunications, to the Kingdom of Nepal from April 17 to April 26, 1991. This Basic Design Study Report on the Rural Telecommunications Network Expansion Project of the Kingdom of Nepal has been thus prepared. The minutes of discussions are given in Annex-5 and Annex-7.

CHAPTER 2 BACKGROUND OF THE PROJECT

CHAPTER 2 BACKGROUND OF THE PROJECT

2-1 Overview of the Kingdom of Nepal

2-1-1 General

The Kingdom of Nepal is a landlocked country which lies in South Asia, between China and India, two big countries in Asia. The Himalaya highlands on the north are bordered with the Tibetan autonomous region of China, and on the east, south and west, the country is bounded by India. It extends 885 km from east to west, and 145-240 km from north to south, with a total land area of 147,181km2.

Geographically, the country can be divided into three regions:

1) The Himalaya Highlands region, over 3,000 m in elevation

   This region occupies about 34% of the total national land area, and sparsely populated.

2) Hilly regions, from 900 m to 3,000 in elevation

   This region includes the foot of the Himalayas with forests leading to fertile basins (Kathmandu and Pokhara basins, etc.) and occupies about 49% of the total national land area, with 56% of the total population.

3) Terai region, less than 300 m in elevation

   The flat and fertile land of Terai is called the granary of Nepal, where agricultural productivity is highest in the country. About 40% of the population inhabit this area which occupies only about 17% of the national land area.

Under the national development plan, the country is divided into five (5) development regions, and administratively, into 14 zones consisting of 75 districts, as shown in Figure 2-1.

According to the censuses, 1971 and 1981, the annual population increase rate in Nepal was about 3%. After that, the population continued to increase at a slightly lowered rate of about 2.7%, probably exceeding 18,000,000 in 1990.

As for religion, about 90% of the population are Hindu, with 5% of Buddhists and 5% of others. That is, lying adjacent to India, Nepal is a Hindu Kingdom, and this fact certainly characterizes the country.

2-1-2 Industrial and Economic Conditions

The national economy of Nepal primarily depends upon agriculture. Some 90% of the population are engaged in agriculture which accounts for nearly 60% of the gross domestic products. Its productivity, however, is low. Main products are classified into two: food crops and cash crops. The former includes rice, wheat, corn, etc., and the latter, jute, tobacco, etc. No further expansion of agricultural land can be expected as the cultivation of mountain areas has now reached the limit. In recent years, annual yields of food crops remain on the same level, and the export of jute, the main cash crop, is decreasing.

In the industrial sector, major industries are those related to agriculture, i.e., jute processing, sugar and tobacco manufacturing. In addition, there are industries which are being encouraged for reducing imports, such as cotton goods and cement manufacturing, water bottling, etc.

Industrialization in Nepal is promoted, placing emphasis on the following three points:

1) To promote the production of the industrial sector so that it gets a larger share of the Gross Domestic Product.

2) To develop various fields of industry that can satisfy the fundamental needs of the people.

3) To increase employment opportunities and productivity.

To realize the above, the Government has embarked upon the development of the domestic products to be manufactured from domestic materials, aiming at the improvement of GDP. Emphasis is also placed on the promotion of the import substituting industries to promote domestic production of consumption goods, building materials, etc., raising funds from abroad where necessary.

2-2 Status Quo of Telecommunications

2-2-1 Organization and Management

Nepal Telecommunications Corporation (NTC) was established in 1976, with the recognition that expansion of telecommunication service is the most effective means for promotion of social and economic activities, as well as upgrading of public welfare. NTC is responsible for management and operation of domestic and international communications under the control of the Ministry of Communications (MOC). Organization of NTC is shown in Figure 2-2, and the number of personnel, in Table 2-1.

Table 2-1 Number of Personnel of NTC

Type	Number	Remarks
1) General Manager	1	
2) Deputy General Manager	4	
3) Manager Level (Technical)	12	
4) Manager Level (Non Technical)	5	
5) Executive Level (Technical)	35	
6) Executive Level (Non Technical)	16	
7) Engineer Level (Technical)	179	
8) Officer Level (Non Technical)	65	
9) Technician (Technical)	1,563	
10) Assistant (Non Technical)	650	
11) Others	967	
Total :	3,497	

2-2-2 Telecommunications Network

(1) In accordance with the Basic Plan for Telecommunications Network formulated in 1978, NTC has been promoting the improvement and expansion of the telecommunications in Nepal. The status quo of the existing facilities as of 1990 is presented in Table 2-2. The telephone exchanges number 43, with 72,590 terminals, of which 84% have been automatized. The number of telephone subscribers amounts to 54,195. (The latter falls short of the former due to the shortage of the subscriber cables.) In consequence, the telephone density as of 1990 is as low as 0.3 per 100 inhabitants on the national average. Particularly in the Eastern Region, the objective area of this Project, it is less than 0.1.

Table 2-2 Telephone Facilities

As of August, 1990

Items	(A) Whole Country	(B) Eastern Area Telecom Bureau 02 Zone	03 Zone	B/A (%)
Telephone exchanges	43	10	3	30.2
Automatic	36	8	1	25.8
Manual	7	2	2	57.1
Switching equipment	72,590 T	4,320 T	1,300 T	7.7
Automatic	71,600 T	4,000 T	1,000 T	7.0
Manual	990 T	320 T	300 T	62.6
Telephone subscribers	54,195	4,949	631	10.3
Waiting applicants	66,636	3,459	256	5.6
Telephone density	0.29 %	0.11 %	0.04	-
Population (thousand)	18,916	2,977	1,704	24.7

(2) Transmission Facilities

The backbone transmission route connecting major cities including Kathmandu has almost been digitalized, with digital switching equipment in each exchange. For the route from Kathmandu to Ilam in the objective area of this Project, digital radio system, NOKIA (Finland) made, has been introduced. (Figures 2-4 and 2-5 present transmission configuration.)

For other routes connecting medium and small sized cities, digital radio systems of medium/small capacity have been introduced, under the Japan's grant aid for the Rural Telecommunications Network Improvement Project, Phase-I and Phase-II, and also a Finland aid project. However, not all the zones and districts have been connected to this network.

(3) Telephone Switching Facilities

As of 1990, 43 exchanges are in operation, with a total capacity of 72,590 terminals. 98% of them have been automatized, and 74% of the automatic switching equipment are of digital system. E-10B made by ALCATEL, French, and System-12 made by BTM, Belgium, have been introduced.

Digital switching equipment in Rajbiraj, Biratnagar and Bhadrapur Parent Exchange Offices to which PCOs are connected under this Project is E-10B. Both-way connections are made by voice signals.

(4) Public Call Office (hereinafter referred to as PCO)

In 1981, public call offices (PCOs) were installed in administrative, commercial, agricultural and distribution centers in Nepal. Since then, NTC has been providing the minimum necessary public communication services, mainly telephone and telegram services, to these areas. Toll circuits from PCOs are, in principle, concentrated in higher ranking exchanges (hereinafter referred to as Parent Exchange Office or PEO), which undertake such functions as switching, connecting, and processing of meter pulses for billing, etc. As of 1989, the number of PCOs amounts to 56.

2-2-3 Situation of Rural Telecommunications Network after Implementation of Phase-I and Phase-II, and their Effects

In accordance with the Rural Telecommunications Network Improvement Plan, Phase-I and Phase-II Projects were implemented with the Japan's grant aids in fiscal years 1984 through 1987.

By these projects, a rural telecommunication network to cover the central region and the southern part of the western region of Nepal has been established, connecting 1 regional development bureau, 3 zonal headquarters, 23 district headquarters, and 6 commercial centers.

For maintenance of the system established by Phase-I and Phase-II Projects, NTC organized 7 maintenance centers, one for each of the 7 Regional Offices, i.e., 01: Kathmandu, 04: Janakapur, 05: Birganj, 06: Pokhara, 07: Bhairahawa, 08:Nepalgunj, and 09: Dhangadhi. These maintenance centers are in charge of the maintenance and supervision of PCOs and radio repeater stations in their respective areas.

7 NTC engineers underwent the training in maintenance at the factory of the equipment manufacturer for Phase-I and Phase-II in Japan. Further training of maintenance staff was conducted at Training Center in Kathmandu, in addition to the on-the-job

training during the construction period of Phase-I and Phase-II, with the abovementioned 7 engineers taking a leading part in it.

After completion of the construction work, trained personnel were stationed at 7 maintenance centers. Periodical tests, examination, inspection and troubleshooting are being carried out by these maintenance personnel. The facilities at each site are maintained in very good condition.

In case of a trouble in a remote area, maintenance personnel in the maintenance center concerned visits the trouble spot to replace the defective equipment with spare equipment. The defective equipment is delivered to Training Center (TTC) in Kathmandu and, after being repaired, sent back to the maintenance center.

The materialization of these Projects has brought about the telephone demand increase and, as the result, 6 PCOs out of the then installed 33 have recently been digitalized. Presently, these PCOs are making good profits with increased number of subscribers.

Table 2-3 presents the number of subscribers connected after the completion of the Projects. The feature of these projects lie in the fact that the telephone service was realized not only for domestic but also international communications in the area having no infrastructure at all, even road and power, nor any communication service. The network established significantly contributed to increasing efficiency in administrative service, encouraging economic activities through modernization of distribution system, upgrading the emergency medical service, etc. The desired cooperation effect has thus been achieved successfully.

2-2-4 International Cooperation for Telecommunication Sector

Major financial institutions and countries in the world, including Japan, France, Denmark, Finland, and IDA, have offered cooperation for materialization of telecommunications development plans formulated under up to the 7th National Development Five Year Plan in Nepal.

France and Denmark extended financial assistance for the improvement of switching systems, Finland for the digitalization of a backbone transmission network, and IDA for the digital multi access radio telephone systems (MARTS) to be introduced in 1991 through 1995. (Refer to Figure 2-6.)

2-3 Summary of Related Development Plans

2-3-1 National Development Plans

Since 1956, the 1st to 7th National Economic Development Five Year Plans have been implemented by His Majesty's Government. For the 1st and 2nd Five Year Plans, the budgets were merely 330 million and 600 million rupees, respectively, to cover only public works, that is, mainly for construction of such infrastructures as telecommunication, transportation, power supply, etc., with no long term prospects. Under the 3rd Five Year Plan, private sector was included for the first time, and under the 4th Five Year Plan, agriculture, irrigation, and farmland reform were added as the key objectives.

In and after the 5th Five Year Plan, the agriculture and forestry sector has been given priority over the thitherto first ranking telecommunication and transportation sector.

Main targets of the 7th Development Plan (1985-1990) were "acceleration of production increase", "creation of employment opportunities in high productivity industries", and "satisfaction of the public minimum." The largest allocation went to the agriculture sector, followed by forestry, mining and power. In raising fund, the private sector's share is becoming larger recently.

In any case of the past development plans, disbursements failed to be completed, after all. The GDP growth rate remained at 2-3% against the target rate of about 4%. Investments in development plans depend largely upon the external aids which account for more than two thirds of the necessary funds (71% in case of the 7th Five Year Plan).

All through the 1st to 7th National Economic Development Five Year Plans, rehabilitation of telecommunications network has been given high priority. Nevertheless, the telephone density as of May 1990, is as low as 0.22 per 100 inhabitants. Further rehabilitation and improvement is the pressing need of the moment.

The 8th National Economic Development Five Year Plan will be formulated and implemented by a new government to be established after the general election in 1991. In view of the recent slowdown in economy, continuous aids from abroad in large amounts will be indispensable for implementation of the 8th Five Year Plan.

2-3-2 Telecommunications Network Rehabilitation Plans

The Basic Plan for the Telecommunication Network in the Kingdom of Nepal was prepared in 1978 by a British consultant, Preece Cardew and Rider. Projects for the introduction of switching equipment and the construction of backbone analogue transmission lines were implemented, based on this Basic Plan.

In November, 1981, Asia-Pacific Telecommunication (APT) submitted the Basic Plan for the Rural Telecommunications Network in the Kingdom of Nepal (APT Report), after reviewing the above Basic Plan.

The APT Report recommended to introduce an advanced telecommunica-tion system to connect key locations, i.e., the capital (Kathmandu), 14 zone capitals, and 75 district capitals, aiming at the expansion of the telephone service and provision of non telephone services, such as telex, facsimile and data transmission. In other words, to realize the above, establishment of a large scale telecommunication network in the rural area was recommended.

It was, however, premature for His Majesty's Government to materialize this basic plan entirely at that time, and the Government requested the Japanese Government to carry out the feasibility study of a more realistic plan for telecommunication network improvement, based on the actual conditions in the Kingdom of Nepal.

In answer to this request, the Japanese Government formulated the Rural Telecommunication Network Improvement Plan as described in the preceding paragraph 2-2-3. Phase-I and Phase-II of this Plan were implemented in fiscal 1984 through 1987, with the Japan's grant aid.

2-4 Contents of the Request

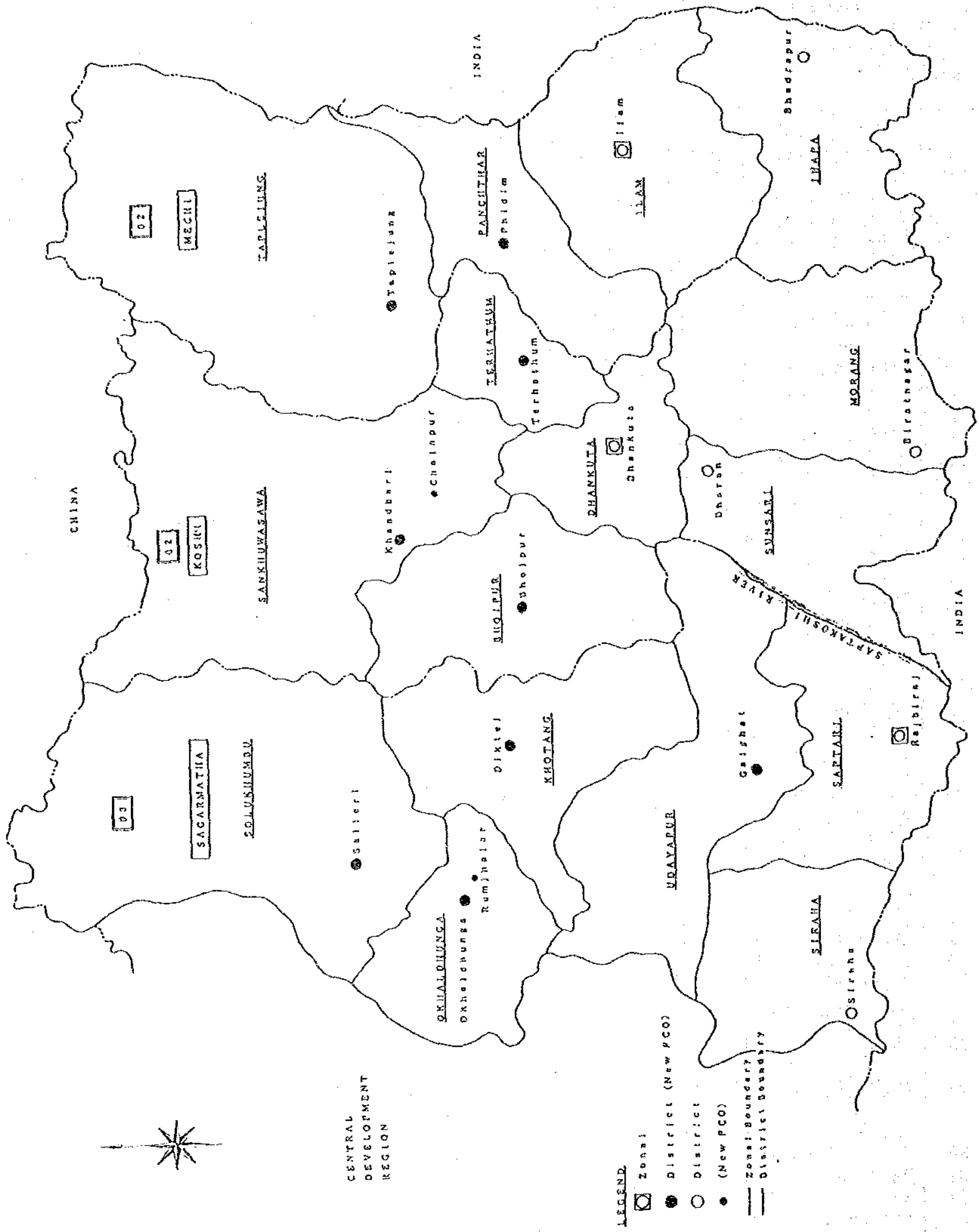
The request from His Majesty's Government in connection with the Rural Telecommunication Network Improvement Plan, this time, is the implementation of Phase-III and Phase-IV of the Plan, to follow Phase-I and Phase-II, which have already been materialized and put into operation.

The objective areas of Phase-III and Phase-IV of the Improvement Plan are 01, 02, 03, 06, 08 and 09 telephone zones, which cover almost the whole country, excluding only the central and southern regions. The feasibility study planned to install 38 toll public call offices in district capitals and commercial centers in these zones. Some of them, however, have already been materialized by other projects. Due to such change of the situation on the Nepal side, the request from His Majesty's Government is to cover 30 cities.

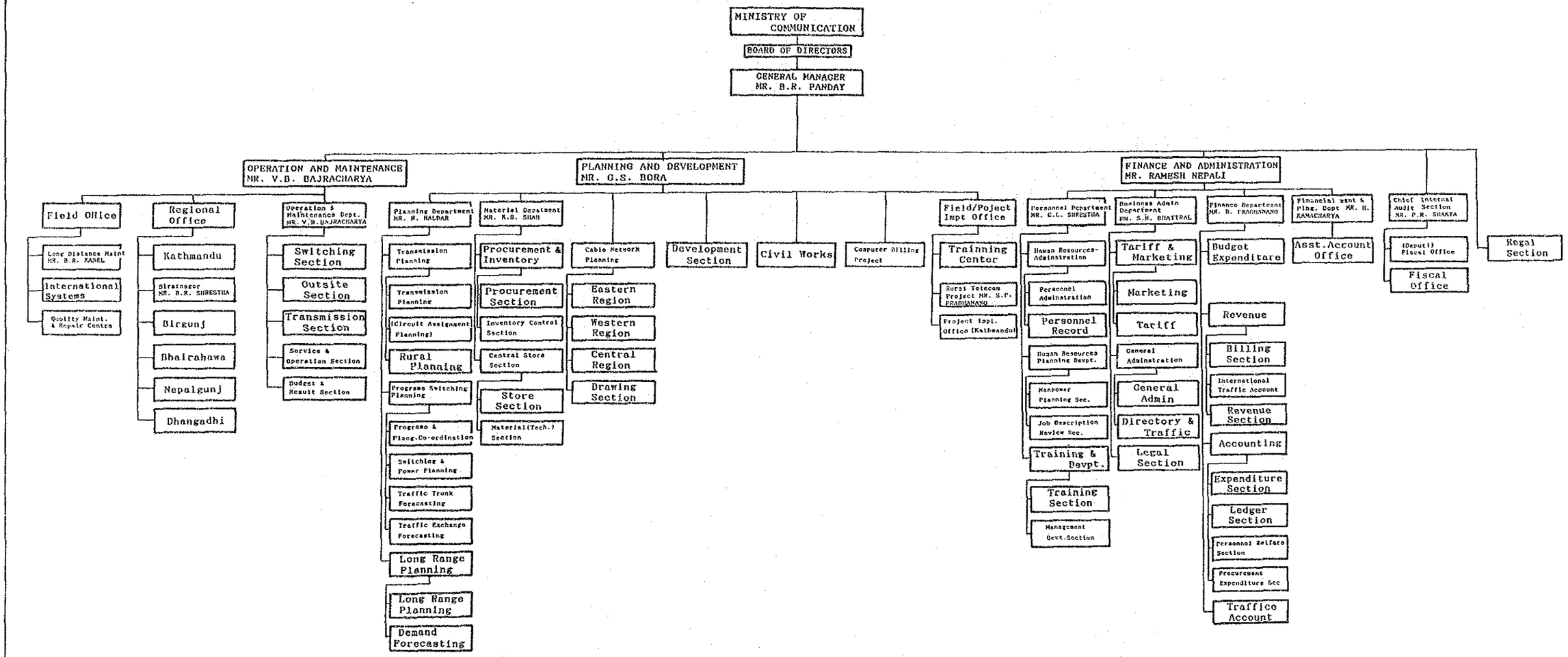
Table 2-3 Number of Subscribers Connected

Date: Feb. 1991

No.	Station Name	Initial No. of CCTS	Additional No. of CCTS	Total No. of CCTS	Total No. of Subscribers	Remarks
	01 Area					
1	Dhading	6	12	18	9	
2	Bidur	12	238	250	220	Converted to 250L RLU exchange
	04 Area					
3	SindhuliMadi	6	18	24	16	
4	Ramechhap	6	12	18	6	
5	Charikot	6	18	24	21	
	05 Area					
6	Simra	18	232	250	108	Converted to 250L RLU exchange
7	Kalaiya	6	244	250	234	
8	Gaur	6	194	200	6	100L Manual exchange operating
9	Bhimphedi	6	6	12	6	(with 121 subs.)
	06 Area					
10	Syangja	6	5	11	11	
11	Gorkha	8	14	22	22	
12	Bandipur	6	0	6	6	
13	Damauli	7	14	21	21	
14	Basishar	6	6	12	12	
15	Kusma	6	2	8	8	
16	Baglung	12	16	28	28	
17	Beni	6	5	11	11	
	07 Area					
18	Sandhikharka	6	6	12	11	
19	Parasi	6	18	24	23	
20	Tribeni	6	0	6	4	
21	Gulmi Tamghas	6	6	12	11	
	08 Area					
22	Tulsipur	6	244	250	220	Converted to 250L RLU exchange
23	Ghorahi	8	242	250	232	
24	Gularia	6	3	9	9	
25	Rajapur	6	0	6	6	
	09 Area					
26	Dhangadhi	6	1,994	2,000	1,249	Converted to 2000L independent exchange
27	Bhajani	4	0	4	4	
28	Tikapur	6	0	6	6	
29	Baitadi	6	0	6	6	
30	S.Doti/Dipayal	10	0	10	10	Converted to 250L RLU exchange
31	Dandeldhura	8	0	8	8	
32	Rajpur	6	0	6	6	100L Manual exchange
33	Darchula	6	0	6	6	
	Total	231	3,549	3,780	2,556	

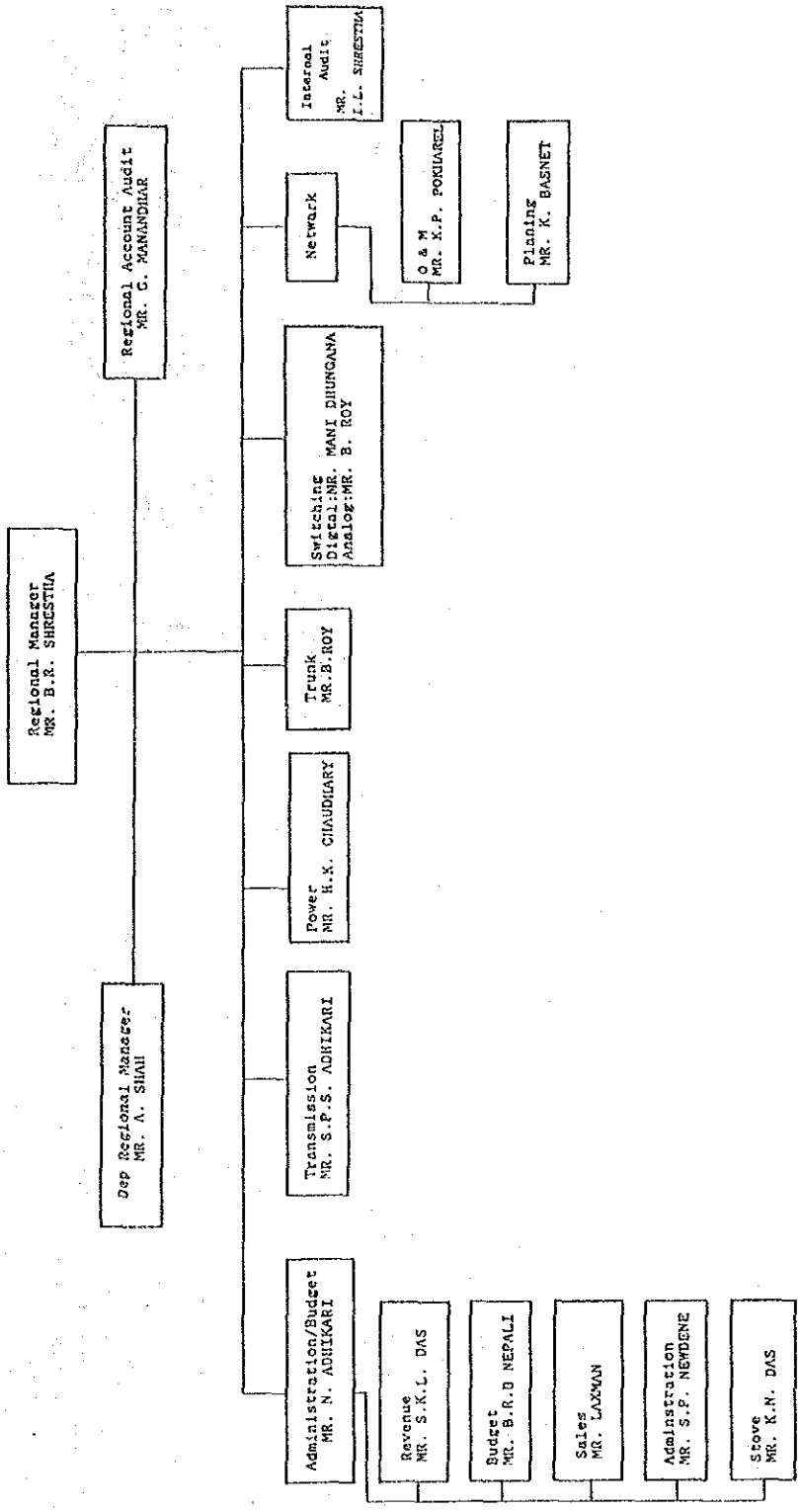


ADMINISTRATIVE ZONES AND DISTRICTS OF EASTERN DEVELOPMENT REGION	
SITE NAME	02, 03 AREA
SCALE :	FIGURE-2-1
UNIT :	

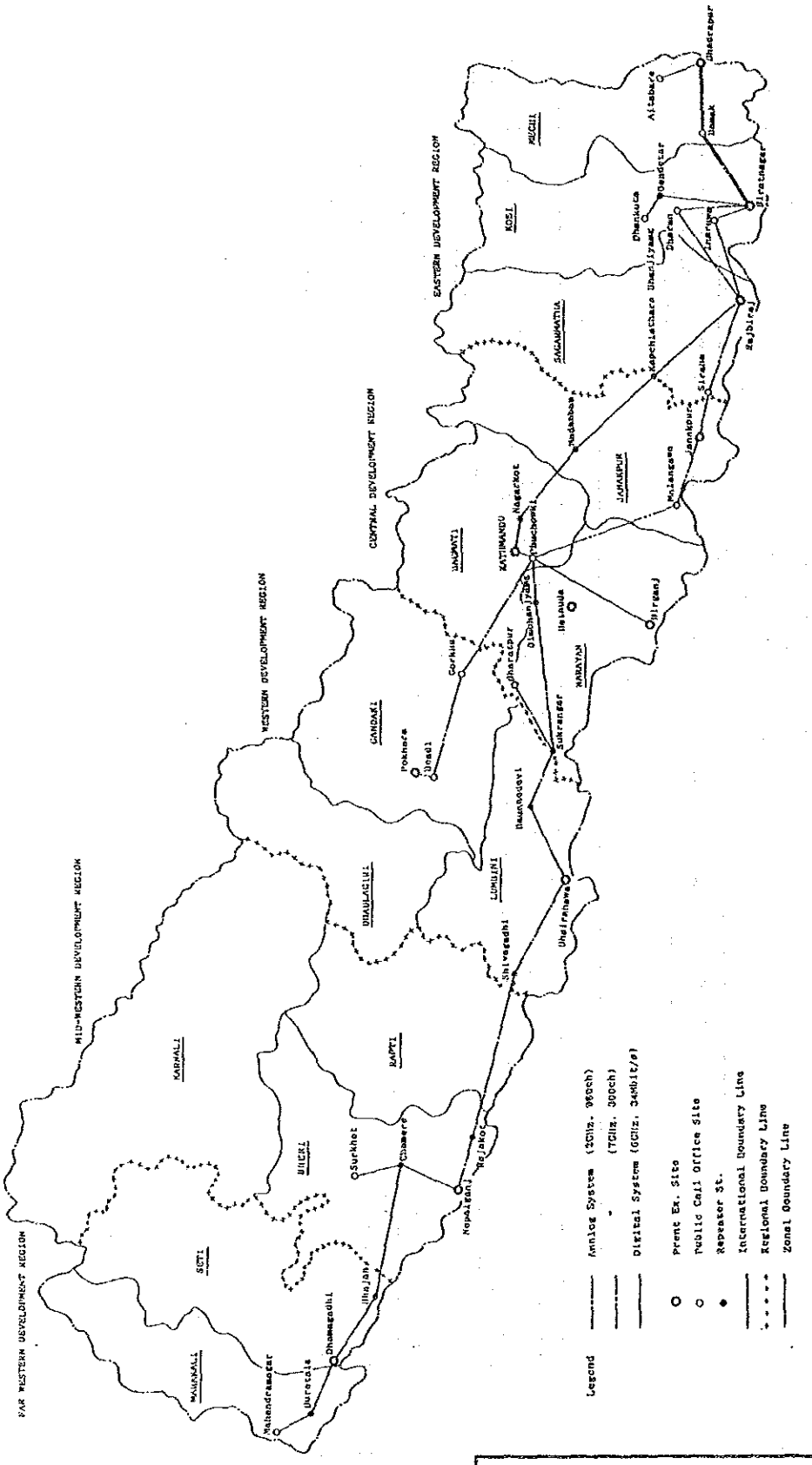


ORGANIZATION OF NEPAL TELECOMMUNICATIONS CORPORATION

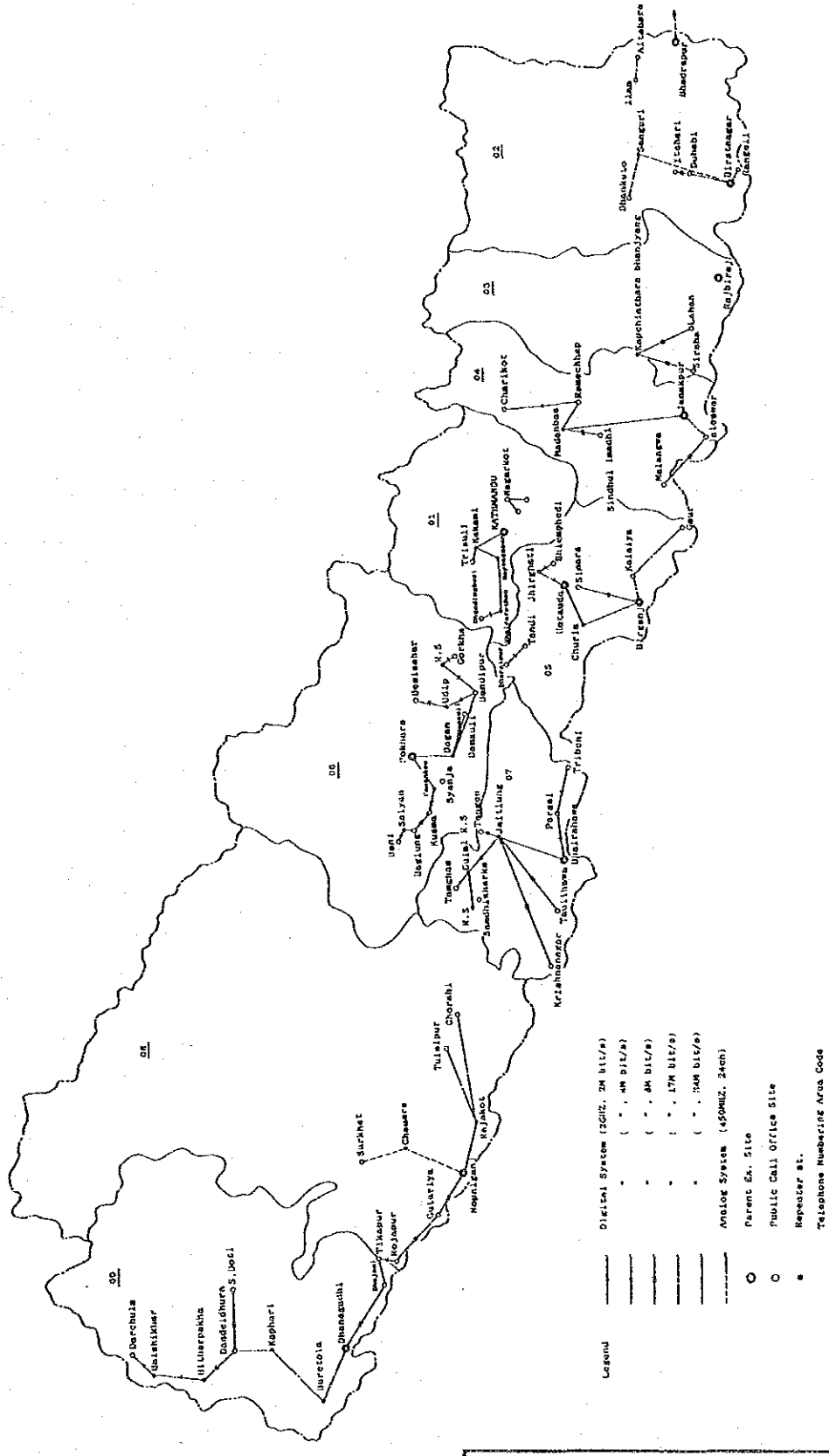
SITE NAME	
SCALE : —	FIGURE-2-2
UNIT : —	



ORGANIZATION OF EASTERN REGIONAL OFFICE	
SITE NAME	BIRATNAGOR
SCALE :	FIGURE-2-3
UNIT :	



EXISTING MAIN TRANSMISSION NETWORKS	
SITE NAME	
SCALE : —	FIGURE-2-4
UNIT : —	



EXISTING RURAL TRANSMISSION NETWORKS	
SITE NAME	
SCALE : —	FIGURE-2-5
UNIT : —	

CHAPTER 3 OUTLINE OF THE OBJECTIVE AREA

CHAPTER 3 OUTLINE OF THE OBJECTIVE AREA

3-1 Objective Areas

As mentioned previously, the Kingdom of Nepal consists of 5 development regions, i.e., Eastern, Central, Western, Mid-western, and Far Western Regions. The objective areas of this Project are 11 major cities in 9 districts of 3 zones, Mechi, Koshi and Sagarmatha, in the Eastern Development Region. Outline of each city is given below:

Cities	Population in District (thousand)	Population in City (thousand)	Governmental Offices, etc.	Schools, etc.	Remarks
Taplejung	152	11	25	12	District Headquarter
Phidim	194	5	20	2	-ditto-
Bhojpur	243	12	36	3	-ditto-
Chainpur	-	5	6	6	Commercial Center
Khandbari	163	7	32	7	District Headquarter
Terhathum	116	5	37	8	-ditto-
Diktel	268	8	36	5	-ditto-
Okhaldhunga	173	4	50	8	-ditto-
Gaighat	201	8	41	5	-ditto-
Salleri	111	6	32	6	-ditto-
Rumjhatar	-	6	15	3	Commercial Center

Source: NTC's Statistical Data

3-2 Outline of Social and Economic Infrastructure

The national industrial and economic conditions have already been outlined in Chapter 2. In this section is summarized the conditions of Eastern Development Region, the objective area of this Project.

(1) 3 zones composing the Eastern Development Region, i.e, Koshi, Mechi and Sagarmatha, are located in the Himalayan mountainous area, 1,000 - 3,000 m above the sea level, except for the Terai plain.

(2) Roads in this region are extremely poor. Only available transportation is a local bus linking Phidim and Gaighat. All the other cities are accessible only on foot, requiring several days. Particularly in Sagarmatha zone, cities are scattered at the foot of the Himalaya, and transport of goods by vehicle is not feasible.

(3) Industry in this mountainous area is agriculture by small-hold farmers. A number of small terraced fields are observed on the mountain slopes. Main crops are rice, millet, corn and tea. Woods in the mountains were lumbered to a large extent for fuel and, as the result, deforestation has developed considerably.

(4) In each city except Rumjhatar exists a PCO to provide HF radio system. Since only 5 frequencies are available for a whole nation, communication has to be of time-sharing system. It follows that communication time is limited and the service quality is extremely poor.

3-3 Natural Environment

Meteorologically, Nepal is divided into three areas:

1) Lowlands : Subtropical or tropical area, with the elevation of less than 1,200 m.

2) Mountainous area: Temperate area, with the elevation of 1,200 - 4,000 m.

3) Highlands : Area higher than the above.

There are two seasons in Nepal, dry and rainy; the former from June to October and the latter from November to May. A rainfall in the lowlands amounts to 2,500mm per year on an average, 1,800 mm in the mountainous area, and 1,270mm in the highlands and the south slope of the Himalaya. 80% of the rainfall is concentrated in the monsoon period starting in June and ending in September.

Sites for PCOs and radio repeater stations of this Project are located in the lowlands and mountainous area. Meteorological conditions at these sites vary considerably depending upon the locations which can broadly be classified into three: Terai area, hill area, and valley area. Consequently, the equipment and systems to be installed in these areas are designed, based on the data on their respective areas. Meteorological data (humidity, sunshine hours, velocity, temperature, rainfall, etc.) in Terai, valley and hill areas in 1983-1986 are shown in Table 3-1.

Table 3-1 Meteorological Data (1983 - 1986)

AREA	ELEMENTS		(MEAN)	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	YEAR	REMARK
TERAI Biratnagar	Av.Evaporation		(mm)														
	Av.Sunshine		(hrs.)	8.0	8.2	8.4	8.2	9.4	6.0	4.3	5.9	4.5	7.3	9.0	8.0	7.2	'85-'86
	Av.Wind		(km/hrs.)	5.5	7.0	8.3	10.1	9.3	8.7	8.0	6.4	5.2	4.8	4.1	4.0	6.8	'85-'86
	Av.Temperature		(℃)	15.8	17.9	23.6	27.2	27.6	29.1	28.4	29.5	27.9	26.1	21.7	17.5	24.3	
	Av.Precipitation		(mm)	9	7	12	40	217	299	568	194	322	102	3	11	1,780	
	Max.in 24 hrs.		(mm)	16	12	24	30	185	179	632	189	286	217	9	16	632	
	No.of rainy days in mm.	≧1.0	(days)	2	3	2	8	16	24	29	23	24	11	1	3	146	
		1.0- 9.9	(days)	1	2	2	4	7	11	10	13	9	4	1	1	65	
		10.0-24.9	(days)	1	1	0	3	5	3	6	6	9	4	0	2	40	
		25.0-49.9	(days)	0	0	0	1	2	5	7	3	3	2	0	0	23	
		50.0-99.9	(days)	0	0	0	0	2	4	4	1	3	0	0	0	14	
		≧100.0	(days)	0	0	0	0	0	1	2	0	0	1	0	0	4	
VALLEY Tarahara	Av.Evaporation		(mm)	1.4	2.8	4.7	6.6	6.4	5.4	4.1	4.6	3.7	3.2	2.6	2.1	4.0	'85-'86
	Av.Sunshine		(hrs.)	7.4	8.3	8.7	9.3	9.1	7.8	5.1	7.0	5.4	8.2	8.0	7.5	7.6	'85-'86
	Av.Wind		(km/hrs.)	3.0	3.7	6.2	8.4	7.4	7.8	8.0	5.2	5.8	4.3	3.6	3.9	5.6	'85-'86
	Av.Temperature		(℃)	15.4	17.2	22.5	26.0	27.1	28.9	28.4	29.1	27.3	25.4	21.3	17.3	23.8	
	Av.Precipitation		(mm)	11	8	4	45	191	340	621	218	377	148	6	27	1,994	
	Max.in 24 hrs.		(mm)	23	12	8	38	116	109	242	74	147	100	18	40	242	
	No.of rainy days in mm.	≧1.0	(days)	3	3	2	5	17	22	31	21	21	8	3	4	140	
		1.0- 9.9	(days)	1	1	1	5	5	8	9	11	12	5	2	3	63	
		10.0-24.9	(days)	2	2	1	0	7	5	6	4	3	1	1	0	32	
		25.0-49.9	(days)	0	0	0	0	3	4	9	2	3	1	0	1	23	
		50.0-99.9	(days)	0	0	0	0	1	4	5	2	3	1	0	0	16	
		≧100.0	(days)	0	0	0	0	1	1	2	2	0	0	0	0	6	
HILLS Okhaldhunga	Av.Evaporation		(mm)	1.7	2.4	5.4	6.1	5.3	3.8	2.8	3.3	2.7	2.7	2.4	2.0	3.4	'85-'86
	Av.Sunshine		(hrs.)	7.4	6.7	7.5	8.0	6.9	4.7	2.3	4.0	3.5	5.9	7.7	7.3	6.0	'85-'86
	Av.Wind		(km/hrs.)														
	Av.Temperature		(℃)	9.1	10.8	15.9	18.2	18.9	20.9	19.9	20.8	19.2	17.4	14.2	10.7	16.3	
	Av.Precipitation		(mm)	12	7	8	47	136	254	581	351	335	97	1	31	1,859	
	Max.in 24 hrs.		(mm)	19	9	15	17	55	68	93	67	132	58	3	41	132	
	No.of rainy days in mm.	≧1.0	(days)	3	2	3	11	19	25	31	32	27	14	1	5	173	
		1.0- 9.9	(days)	2	2	2	9	11	10	8	11	11	8	1	2	77	
		10.0-24.9	(days)	1	0	1	2	6	10	10	14	9	3	0	1	57	
		25.0-49.9	(days)	0	0	0	0	2	5	8	7	3	2	0	2	29	
		50.0-99.9	(days)	0	0	0	0	0	0	5	0	3	1	0	0	9	
		≧100.0	(days)	0	0	0	0	0	0	0	0	1	0	0	0	1	

3-4 Social Environment

The Eastern Region extends on the ground highest in the world, with huge peaks of the Himalaya on the north, and the Kanchenjunga ranges on the east along the border with India. Water from glaciers sweeps past deep valleys hollowed and, gathering water from mountain slopes, runs into the Rivers Sunkoshi, Dudhkoshi, Arun, Tamur, etc., and then finally joins on to the River Ganges after passing through the Terai plain southward.

A number of villages are scattered in the region thus consisting of mountains, valleys, and rivers. Roads run along rivers up to mountain tops and go down to passes and mountain foots, and thereby connect villages. The Terai plain which is bounded on the south by India is a center for transportation and industries, with large cities such as Janakpur, Biratnagar, Rajbiraj, etc.

(1) Transportation

Transportation network in Nepal consists of roadways and airways. In some part, railways and ropeways are available. Being a landlocked country bounded by China and India, export/import goods have to be transported through the territories of these countries. Nearly three quarters (3/4) of export goods to third countries are transported from Biratnagar to Calcutta for shipping, and about three quarters (3/4) of import goods from third countries are also landed at Calcutta and transported to Birganj. For transportation between Calcutta and Biratnagar or Birganj, railways or vehicles are utilized. In India, both broad- and narrow-gauge railways exist, and goods have to be re-loaded on the way, mostly at [Barauni], where severe congestion is observed recently. In addition, allocation of a car for reloading is not easy and requires much time. For the section between Calcutta and Birganj, transportation by truck is on the increase nowadays, and the poor roads constitute an obstacle to promotion of external trade.

In the Eastern Region, i.e., the objective areas (02 and 03 zones) of this Project, vehicles are available only in a limited district. Generally, goods have to be carried on foot from village to village.

For some districts in this region, road rehabilitation plans are being studied by His Majesty's Government. However, road construction in Nepal is not easy because of its topography which consists of ranges of mountains and hills and, therefore, requires a huge amount of investment. At present, materialization schedule has not been finalized yet. In the objective areas, the road from Kabre to Phidim (from west to

east) running through Diktel, Bhojpur and Dhankuta is included in the plan under study.

Out of 11 cities where PCOs are to be installed, only Gaighat and Phidim permit access by vehicle. Other 9 cities are accessible by airplane or on foot.

(2) Power Supply

Commercial power from a large capacity power plant is available in large towns, such as Rajbiraj and Biratnagar. However, the operation records of standby engine generators installed by subscribers for their own emergency use indicate more than 700 hours operation during half a year. Judging from this fact, satisfactory commercial power supply cannot be expected.

In other towns and villages in mountain areas, power is supplied from a small capacity hydro power plant only during night time. Or, even in case of 24-hour supply, available power is unstable with severe voltage fluctuation. The power system improvement plan envisaged by Nepal Electricity Authority includes the installation of the following in the objective area:

1) 33 kV Power Transmission Line between Anarmani and Ilam.

2) 26 MW Generator at Duhabi.

3) 33 kV Power Transmission Line between Lahan and Rajbiraj.

4) 33 kV Power Transmission Line between Lahan and Jharjhare.

5) 11 kV Power Transmission Line between Jharjhare and Gaighat.

(3) Water Supply and Drainage

Water supply and drainage are not complete in Nepal, except for major cities. In the objective areas of this Project, public water service is available but there is no water supply system for individual houses. Drainage is not available at all.

CHAPTER 4 OUTLINE OF THE PROJECT

CHAPTER 4 OUTLINE OF THE PROJECT

4-1 Objective

The objective of this Project is to realize the minimum necessary rehabilitation of the telephone network in 11 major cities in 3 zones, i.e., Koshi, Mechi and Sagarmatha, in the Eastern Development Region, in the Kingdom of Nepal, through installation of Public Call Offices (PCOs), including the provision of toll telephone services to important institutions in the area, such as governmental offices and public utility corporations.

4-2 Study and Examination on the Request

The request from His Majesty's Government this time was the provision of toll public call offices in 30 cities in 01, 02, 03, 06, 08 and 09 zones, as described in paragraph 2-4.

These zones spread over almost the whole country, mainly consisting of mountainous areas which are hard of access and, therefore, require expensive construction works, as compared with Phase-I and Phase-II Projects.

In view of the above and also in consideration of the amount of the grant aid to the Kingdom of Nepal in each fiscal year, as well as the intention of His Majesty's Government, the objective areas of the Basic Design Study to answer the above request was limited to 11 cities in 02 and 03 zones.

At present, a trunk transmission route is established over the digital radio circuit connecting Kathmandu with Ilam in 02 zone, via 3 Parent Exchange Offices (PEOs) in 03 and 02 zones, i.e., Rajbiraj, Biratnagar and Bhadrapur where digital switching equipment is installed.

Through the discussions with the officials concerned of NTC, it has been confirmed that the finalized request of His Majesty's Government is to extend a transmission route from the digitalized backbone transmission line to 11 cities in mountainous areas, connecting 11 toll public call offices with digital switching equipment in PEOs by 2GHz digital radio circuits.

4-2-1 Justification and Necessity of the Project

The objective 11 cities lie in mountainous areas where transportation facilities are hardly available. 9 cities out of 11 are district capitals and 2 are commercial and distribution centers.

Most of these cities are accessible only on foot. In addition, telecommunication facilities are extremely inadequate. That is, no telecommunication facilities are provided or only poor HF radio facilities are available.

Under such circumstances, installation of PCOs and DDD system toll telephone facilities for use by governmental and public utility institutions is an urgent necessity for the nation and therefore justifiable. The adoption of line-of-sight digital radio transmission system (2GHz) is reasonable in view of the compatibility with the existing trunk transmission line and digital switching equipment in PEOs, as well as with MARTS (digital multi access radio telephone system) which NTC is planning to introduce in the near future.

4-3 Project Description

4-3-1 Executing Agency

The executing agency for this Project is Nepal Telecommunications Corporation (NTC) of which organization chart is given in Figure 2-2. Main responsible departments and offices are:

Planning Department

Project Implementation Department and
Telecommunication Transmission Project

Operation & Maintenance Department and
Biratnagar Regional Office

Financial Management and Planning Department

4-3-2 Plan of Operation

(1) To install PCOs in 11 cities in Koshi, Mechi and Sagarmatha Zones for provision of toll public telephone network, including connection of important subscribers, such as governmental and public utility institutions.

(2) The portion to be covered by Japan's grant aid is the construction/installation of basic facilities, such digital transmission facilities, subscriber cables, and power plant.

(3) The Nepal side is held responsible for procurement of sites, construction of access roads, new office buildings and fences, remodelling of the existing buildings, and leading-in of commercial power, etc.

(4) The completed system is integrated into the existing network and its operation/maintenance is managed under the existing organization and system.

(5) Spare parts necessary for maintenance of the system for the time being after completion are procured within the framework of the grant aid.

4-3-3 Operation and Maintenance Plan

(1) Operation and Maintenance Organization

1) The network constructed under this Project is to be integrated into the national telecommunication network

integrated into the national telecommunication network and provide domestic and international services. Operation and maintenance after completion are executed by NTC.

2) The relevant departments of the current NTC organization will operate and maintain the respective facilities of the completed system as follows:

a) Transmission Department

Digital radio network (PEO-radio repeater station-PCO)

b) Outside Plant Department

Subscriber cables (PCO-Cable-Drop Wire-Telephone)

c) Power Supply Department

Power supply facilities (PEO,radio repeater station, PCO)

d) Maintenance Department

Antenna tower (PEO,radio repeater station,PCO)

(2) Operation and Maintenance Plan

Operation and maintenance works are generally classified into the following:

1) Maintenance of Facilities

a) Preventive Maintenance

Examination and test, inspection tour, preventive repair and replacement, etc.

b) Repair and Recovery

Repair and remedy of faults and defects, etc. and recovery of operation.

c) Administrative Management

Inventory, plant records, etc.

2) Operational Works

a) Facility operation

Facility operation, supervision and control.

b) System management

System management, particularly in respect of abnormal faults, etc.

3) Personnel and Equipment Management

a) Management of maintenance personnel

Manning schedule, personnel management, etc.

b) Training

On-the-job and class room training, etc.

c) Equipment management

Management of equipment and tools, measuring instruments, vehicles, etc.

A most effective and efficient organizational and manning scheme should be conceived taking into consideration all the above items, to ensure satisfactory operation and maintenance of the telephone network to be established in the Eastern Region under this Project.

(3) Operation and Maintenance of Telephone Network in the Eastern Region

1) Function of PEO

3 PEOs, Rajbiraj in 03 area, Biratnagar in 02 western area, and Bhadrapur in 02 eastern area, are to function as the maintenance center. PEOs are responsible for the operation and maintenance of unattended stations in their respective service areas.

Main works of each PEO are:

a) Supervision and control of the whole system in its maintenance coverage area by remote supervisory and control system.

b) Maintenance patrol to unattended stations.

c) Detection of faults, investigation of causes, and repair of faults.

2) Function of PCO

PCO usually undertakes only operational works consisting of the following:

a) Acceptance of subscription applications and allocation of the numbers (lines).

b) Collection of charges.

c) Telegram service.

d) Simple maintenance work, such as cleaning of solar cell surface, under the direction of PEO.

(4) Operation and Maintenance Personnel

1) At each PEO to function as the maintenance center, the undermentioned personnel will be stationed. The manpower mentioned below can be procured through the transposition of the present staff in the Eastern Regional office of NTC and NTC Headquarter.

a) Biratnagar Parent Exchange Office

- Transmission Dept.	...	Engineer	1
		Technicians	2
- Outside Plant Dept.	..	Technicians	4
- Power Plant Dept.	...	Technicians	2
- Maintenance Dept.	...	Technician	1

b) Rajbiraj Parent Exchange Office

- Transmission Dept.	...	Asst. Engineer	1
		Technicians	2
- Outside Plant Dept.	..	Technicians	4
- Power Plant Dept.	...	Technicians	2
- Maintenance Dept.	...	Technician	1

c) Bhadrapur Parent Exchange Office

- Transmission Dept.	...	Asst. Engineer	1
		Technician	1

- Outside Plant Dept. .. Technician 1

- Power Plant Dept. ... Technician 1

2) For each PCO, 3 operation personnel will be stationed. Therefore, for each existing PCO, 1 personnel is to be added, and for Rumjhatar PCO, 3 personnel.

The number of necessary personnel is summarized in Table 4-1.

Table 4-1. Number of Operation and Maintenance Personnel for Telecommunication Network in the Eastern Region

Office	Number of Offices	Maintenance			Operation
		Engineer	Asst.Eng.	Technician	
PCO	11	-	-	-	33
PEO	3	1	2	21	-
Total	14	1	2	21	33

(5) Operation and Maintenance Costs

The annual income and expenditure of NTC for five years, 1985-1989, are listed in Table 4-2.

Table 4-3 presents the operation and maintenance costs, i.e., personnel expenses and direct costs, for the telephone network to be constructed by this Project, which are estimated based on the necessary number of personnel given in Item (4) above. Direct costs include costs of building management and maintenance, fuel, etc., in addition to miscellaneous costs (office supplies for plant record keeping, etc.)

Table 4-2 Income and Expenditure

(Unit: 1,000,000 rupees)

	1989	1988	1987	1986	1985
Income					
Domestic service	246.2	159.2	110.1	61.1	48.8
International service	251.4	155.3	130.2	97.9	68.5
Others	18.8	17.0	10.1	10.0	10.5
Total :	516.4	331.5	250.4	169.0	127.8
Expenditure					
Operation costs	147.6	135.1	79.7	45.2	32.1
Personnel expenses	75.6	52.0	45.1	37.0	34.4
Others	197.6	109.0	88.7	79.2	52.4
Total :	420.8	296.1	213.5	161.4	118.9
Balance	95.6	35.4	36.9	7.6	8.9

Table 4-3 Operation and Maintenance Costs of Telephone Network in Eastern Region

	Rupees	Yen (thousand)	Remarks
Direct personnel expenses	1,170,000	5,464	See Note.
Direct costs	117,000	546	
Total :	1,287,000	6,010	

Note: Expenses of additional personnel (13 operation staff) to be required after completion of this Project, only.

4-4 Technical Cooperation

Phase-I and Phase-II Projects of the Rural Telecommunication Improvement Plan were implemented by Japan's grant aids and completed in 1987. Training equipment, tools and materials procured under these Projects are utilizable. Training of technical staff of NTC under this Project, therefore, can be conducted at NTC Training Center in Kathmandu, making use of these materials.

With respect to new technologies introduced under this Project to some extent, necessary training of NTC staff can be covered by the guidance on installation practices and equipment/facility operation mainly through on-the-job training.

CHAPTER 5 BASIC DESIGN

CHAPTER 5 BASIC DESIGN

5.1 Design Policy

This Project aims to construct the optimum regional telephone network in the objective area, in consideration of the natural, social and economic conditions, as well as the expected volume and features of subscribers' demands, ease of installation and operation/maintenance after completion, etc.

Design policies for this Project are:

(1) Consideration for Natural Environment

The objective area includes the Himalaya mountainous areas having the elevation of 1,000 m - 3,000 m above the sea level. This area also includes some district where a considerable scale of environmental disruption due to deforestation is seen.

In the Himalaya mountain areas exist Mt. Kanchenjunga (the third highest in the world) of the East Himalaya and a trekking route at the foot of Everest (Sagarmatha in Nepalese) mountains. For development of the tourist industry, the beautiful scenery and natural environment must be preserved.

In view of the above, consideration is given to the protection of natural environment in selecting the sites for radio repeater stations. The access road routes are so selected as to make them the shortest possible and the adoption of solar power system is considered as much as possible.

(2) Public call offices (PCOs) with no switching function are installed in 11 cities of administrative and agricultural/ commercial centers, to provide the minimum necessary public telecommunication service consisting mainly of toll telephone service and partly of telegram service, including the accommodation of governmental and public utility institutions.

(3) Toll circuits from PCOs are concentrated on their respective Parent Exchange Offices (PEOs), where switching, connecting and call metering (for charging) services are executed.

(4) Transmission Facilities

1) For transmission system, digital line-of-sight radio system (point-to-point system) is adopted. Frequency band to be used is 2 GHz band.

2) Transmission quality is in compliance with relevant CCITT and CCIR recommendations and reports.

3) As for system configuration, cold-standby system is adopted to minimize the power consumption and initial investment cost.

4) Transmission capacity of PCO is two 2Mbit/s systems, except for Chainpur and Rumjhatar, taking into account the introduction of MARTS to the mountainous areas as being planned by NTC. For Chainpur and Rumjhatar, one 2Mbit/s system is to be installed.

5) Supervisory remote control system is introduced to make all the stations unattended, except for PEOs, so as to minimize maintenance personnel.

(5) Outside Plant

1) Aerial cable system is adopted for subscriber cables in the service area of PCO. The number of lead-in cables to PCO should be enough for installation of 30 subscriber lines. The number of drop wires to subscribers should correspond to the number of initial subscribers.

2) In PEO, transmission facilities and switching facilities are installed apart. To connect these facilities, tie cable should be installed under the ground. The number of tie cables should correspond to the capacity of transmission system.

(6) Power Plant

1) At the station where commercial power is available, the following power system is adopted:

- Full-floating system power facilities (battery holding time: 8 hours)

- Solar battery/commercial power combined system (battery holding time: 5 days)

2) At the station where commercial power is not available, the following is adopted:

- Solar battery (battery holding time: 15 days)

- Solar battery/engine generator combined system (battery holding time: 5 days)

5-2 Study and Examination on Design Criteria

5-2-1 Transmission Facilities

(1) Radio Transmission Quality

1) Quality of digital radio transmission system is specified by bit error rate (BER).

Transmission quality should be in compliance with CCIR Rec. 594, and that between PEO and PCO should satisfy the following:

- BER should not exceed 1.12 x 10-7 for more than 0.4% of one month (unit for integral time: minute); and
- BER should not exceed 1 x 10-3 (unit for integral time: second) for more than 0.0061% of one month.

2) Fading occurrence probability should be calculated, based on the parameters applicable in North-west Europe given in CCIR Report 338.

(2) Antenna Height above the Ground

The antenna height above the ground should be calculated by the following equations, and whichever the higher should be adopted for this Project:

K = 4/3 with clearance coefficient U 0.6

K = 2/3 with clearance coefficient U 0.3

The minimum antenna height is set at 10 m, in consideration of nearby obstacles, such as buildings, trees, etc.

5-2-2 Outside Plant

(1) Installation Capacity

1) Subscriber cable

The capacity of lead-in cables to PCO should be 30 pairs and the minimum number of drop wires, 10 pairs.

2) The number of inter-office tie cables of PEOs should be as follows:

Biratnagar : 240 pairs
Bhadrapur : 120 pairs

Rajbiraj : 480 pairs

(2) Subscriber Cable Distribution Loss and D.C. Loop Resistance

Stipulations in NTC's Basic Telephone Network Plan should be observed.

1) Subscriber cable distribution loss: Standard 8 dB
Maximum 10 dB

Loss to be distributed to subscriber cables is the balance between the loss on the digital radio link and that on the tie cable.

2) D.C. Loop Resistance : Subscriber cable 1,500 ohms
Tie cable 1,200 ohms

(3) Cable Wiring and Cable Conductor Diameter

For cable wiring in PCO, the fixed wiring method presently adopted by NTC should apply. Conductor diameters of subscriber cables and tie cables should be as mentioned below, in consideration of the subscriber cable loss distribution and d.c. loop resistance mentioned above.

1) Subscriber cable : 0.4 or 0.9 mm, to be selected, based upon unigauge arrangement.
In case of SD wire, 0.9 mm.

2) Tie cable : 0.65 mm, so that as much loss as possible can be distributed to subscriber cables accommodated in PCO.

(4) Type of Cables

1) Subscriber cables

Aerial cable system to install cables on poles should be adopted because this system is easy to operate and maintain and flexible for future expansion. For aerial cable, the self-supporting type should be employed, because both installation and procurement of maintenance materials are easy. The number of cable pairs is twofold: 30 pairs and 10 pairs, with 2 pairs of SD wire.

2) Inter-office tie cable

Underground cables are to be adopted because the underground system is not easily suffer, as compared with other systems, from damages due to other construction

works (road, electricity, water, etc.). In case the existing underground conduit facilities are utilizable, polyethylene sheathed, foamed polyethylene insulated conduit cables, filled with jelly compound and dispensable with gas pressurization maintenance, should be used, in the unit type cable construction with pair twinning. If not utilizable, polyethylene double sheathed and foamed polyethylene insulated direct buried cable, filled with jelly compound, should be used, in the unit type cable construction with pair twinning.

(5) Poles

Poles for aerial cables should be steel pipe or fabricated steel plate poles. Steel pipes are applied to PCO accessible by vehicle, and fabricated steel plate poles, to PCO not accessible but on foot. Pole length should be 8.0 m in principle. Joint-use of existing power poles should be done as much as possible.

(6) Protection from Thunder Harm

Outside plant facilities should be equipped with the following to protect them from the damages due to thunder:

1) A protector should be installed at the cable end on the subscriber side, and a terminal strip with lightning rod should be installed at the cable end on PCO side.

2) At the splicing point of aerial cable and SD wire, on-pole protector should be provided.

3) In case the length of an SD wire connected with aerial cable exceeds 400 m, a forward lightning rod should be provided.

4) Aerial cable should be the aluminium sheathed.

5) An earthing device should be provided at each position where subscriber protector, on-pole protector or forward lightning rod is installed.

5-2-3 Power Plant

Depending on the availability of commercial power in the objective areas, the undermentioned 4 types of power plants are to be provided:

(1) Full-floating system when commercial power is available as the main power source

Power plant is composed of:

- Automatic voltage regulator
- Standby diesel engine generator
- Rectifying equipment
- Storage batteries

(2) Combined power supply system by solar battery and commercial power (Commercial power is used in night time only.)

Power plant is composed of:

- Rectifying equipment
- Storage batteries
- Solar batteries

(3) Combined power supply system by solar battery and diesel engine generator

Power plant is composed of:

- Diesel engine generator
- Rectifying equipment
- Storage batteries
- Solar batteries

(4) Solar battery power supply system (Solar batteries only are used as the primary power source.)

Power plant is composed of:

- Storage batteries
- Solar batteries
- Mobile engine generator and rectifying equipment for use by a plural number of stations

Design criteria of the equipment composing the above systems are:

1) Automatic voltage regulator (for full-floating system)

The capacity should cover the maximum load to equipment supplied under this Project only.

2) Standby diesel engine generator

a) Capacity

The capacity should cover the backup power supply to equipment provided under this Project only, not

covering the load for building power and lighting.

b) Construction

The construction shall be of dual standby system consisting of 2 units since more than 120 hours operation per month is expected.

c) Fuel tank

Assuming that engine generator is operated for 130 hours a month and fuel is replenished once three months, a main fuel tank for 400 hours operation and a day tank for 24 hours operation should be provided.

d) Environmental condition

Output of engine should be designed in consideration of the undermentioned environmental conditions:

- Altitude : Biratnagar less than 100 m
- Temperature: Biratnagar 36 C
- Humidity : Biratnagar 70 %

3) Diesel engine generator (combined system)

a) Capacity

Continuously operable, air-cooling type having a capacity suitable for running with the engine of 20 PS output (the minimum capacity in Japan), should be provided.

b) Operation hour

Operation of 60 hours per month (720 hours per year) should be taken into account in designing.

c) Fuel tank

Fuel replenishment is very difficult in rainy season due to poor road condition and, therefore, the replenishment is considered to be made once a year. Hence, a main fuel tank for 720 hours and a day tank for 8 hours should be provided.

d) Environmental conditions

Output of engine shall be designed in consideration of the undermentioned environmental conditions:

Altitude : Gaighat less than 200 m
Aitabare less than 2,000 m

Temperature:	Gaighat	35 C
	Aitabare	30 C
Humidity :	Gaighat	70 %
	Aitabare	80 %

4) Rectifying equipment (full floating system)

Rectifying equipment should consist of 2 units, working and standby. Each unit should have a capacity sufficient for power feeding to telecommunications load and for 20-hour rate charging of the batteries to be supplied.

5) Rectifying equipment (combined system by solar battery and commercial power)

Rectifying equipment should consist of 2 units, working and standby. Each unit should have a capacity of 2 times the power consumption by telecommunications facilities.

6) Rectifying equipment (combined system by solar battery and engine generator)

Rectifying equipment should consist of 2 units, working and standby. Each unit should have a capacity of more than 2 times the power consumption by telecommunications facilities. Capacity of diesel engine generator should be taken into account.

7) Storage batteries

Capacity should be calculated, based on the power consumption of telecommunication equipment and the undermentioned conditions:

a) Design temperature

The lowest temperature in the battery room in each area is assumed to be as follows:

- Terai area 10 C
- Valley area -5 C
- Hill area -10 C

b) Holding time

- Full floating system : 8 hours

To cover the time to clear troubles, e.g.

- Standby engine generator cannot start operation at the time of commercial power failure, because the generator happen to be

under overhauling for inspection, or the generator itself also fails.

- Rectifying equipment gets out of order, etc.

- Combined system : 5 days

Batteries are consumed through repetition of charge-discharge. Provided that the charge-discharge is repeated for about 10% of the capacity, the life of 3,500 cycles can be maintained. Hence, considering the approx. 10% charge-discharge per day, holding time of batteries is designed to be 5 days.

- Solar battery system : 15 days

In consideration of the continuous no-sunshine hours in rainy season or during a thick fog.

c) Number of storage battery banks

A storage battery is composed of 24 - 25 cells connected in series. If one of the cells becomes defective, whole the battery becomes inoperative. To enhance reliability, therefore, 2 banks of batteries are provided in principle, each having half the required capacity.

In determining the necessary number of banks, however, due attention should be paid to the fact that most of the sites for combined or solar power system require the transportation of equipment on foot by porter and, therefore, the maximum capacity of a battery is set at 900 AH, so as not to make the battery too heavy to carry.

8) Solar battery system

Capacity shall be calculated, based on the power consumption by telecommunication equipment, solar radiation data, and the undermentioned environmental conditions:

a) Solar radiation data

The same data as those for the previous projects are employed.

Table 5-1 Solar Radiation

Unit: langley (Cal/cm2)

Month	Terai Area	Valley Area	Hill Area
January	330	240	270
February	370	300	280
March	420	380	320
April	440	430	380
May	520	450	430
June	500	430	400
July	470	410	370
August	450	400	380
September	400	400	340
October	420	380	340
November	340	310	310
December	300	280	280

b) Number of solar battery arrays

The necessary number of arrays shall be calculated, based on the radiation at a proper angle calculated from the radiation on the horizontal level and the latitude at site, as well as the power consumption of telecommunication equipment, and the latest solar cell module to be adopted. In case of the combined system, it should also be taken into account in calculating the number of solar battery arrays that, for 2 hours a day, the power is supplied from the commercial power or diesel engine generator, and d.c. power supply and stored battery charging is carried out by rectifying equipment.

5-2-4 Terminal Equipment

All the telephone sets shall be of push button dial type. Quantity of initial installation is 3 telephones for PCOs and 4 telephones for important subscribers in each objective city.

5-2-5 Building Facilities

On the wall of the entrance to a power room and a radio room in a new office building and on the wall of a radio room, a cable inlet hole (for feeder and power cable) shall be provided at a height of 2.5 m above the floor.

2 pieces of pipes (1 for spare), approx. 50 mm in diameter, shall be installed on the wall of an MDF room as the inlet for subscriber cables.