

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF POSTS AND TELECOMMUNICATIONS

THE KINGDOM OF CAMBODIA

**THE FEASIBILITY STUDY  
ON  
TELECOMMUNICATIONS NETWORK  
FOR  
PHNOM PENH CITY AND ITS SURROUNDING AREA  
IN  
THE KINGDOM OF CAMBODIA**

**MAIN REPORT**

**JULY 1995**

**NTT INTERNATIONAL CORPORATION  
NIPPON TELECOMMUNICATIONS CONSULTING CO., LTD.**

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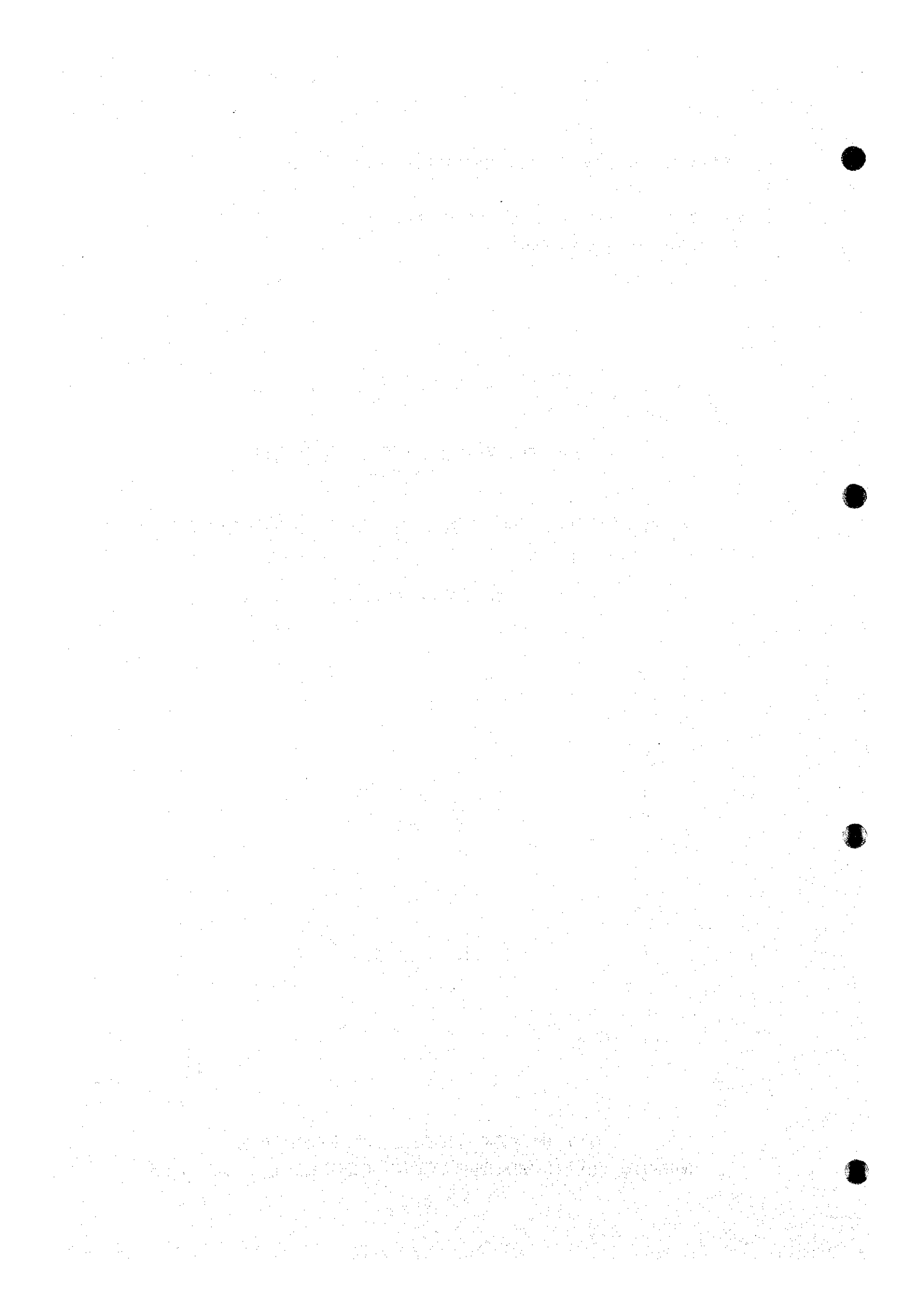
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**Abbreviation of Exchange Offices**

ART	:	Airport Exchange Office
CAP	:	Chabar Ampou Exchange Office
CCR	:	Charang Cham Reh Exchange Office
CNT	:	Central Exchange Office
INTS	:	International Gateway Switch
ITC	:	International Telecommunications Center
NRT	:	North Exchange Office
PPN	:	Prek Phnou Exchange Office
PRS	:	Russei Exchange Office
TKM	:	Takhmau Exchange Office
WST	:	West Exchange Office

**Abbreviation**

AC	:	Alternating Current
ADB	:	Asian Development Bank
AMA	:	Automatic Message Accounting
AMPS	:	Advanced Mobile Phone System/Service
BATT	:	Batteries
BCC	:	Business Cooperation Contract
BHN	:	Basic Human Needs
CEPT	:	European Conference of Postal and Telecommunications Administrations
CIF	:	Cost, Insurance and Freight
CMAC	:	Cambodia Mine Action Center
CNMS	:	Central Network Management System
DAMA	:	Demand Assignment Multiple Access
DC	:	Direct Current
DDF	:	Digital Distribution Frame
DP	:	Distribution Point
E/G	:	Engine Generator
EDC	:	Electricité du Cambodge
EIRR	:	Economic Internal Rate of Return
ENARPOSTEL	:	Training Center of Posts and Telecommunication
ETACS	:	Extended Total Access Communication System
F/O Cable	:	Fiber Optic (Optical Fiber) Cable
FIRR	:	Financial Internal Rate of Return
GDP	:	Gross Domestic Product
HF	:	High Frequency Band
HRX	:	Hypothetical Reference Connection
ICORC	:	the International Donor's Conference
IDD	:	International Direct Dialing
ISC	:	International Switching Center
ISDN	:	Integrated Services Digital Network
ISUP	:	ISDN Service User Part
ITC	:	International Telecommunication Center
ITU	:	International Telecommunication Union
JICA	:	Japan International Cooperation Agency
KFW	:	German Reconstruction Finance Cooperation
LBP	:	Low Tension Branch Panel
LE	:	Local Exchange

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LNMS	:	Local Network Management System
LS	:	Local Switch
LTP	:	Low Tension Change-over Panel
MAS	:	Multiple Access System
MB	:	Mobile Box
MDF	:	Main Distribution Frame
MDP	:	Main Distribution Panel
MPTC	:	Ministry of Posts and Telecommunications
MTS	:	Mobile Transfer Switch
NGO	:	Non Governmental Organizations
NMT	:	Nordic Mobile Telephone
OJT	:	On the Job Training
OPMC	:	Outside Plant Maintenance Center
OTCI	:	OTC International limited
P-MP System	:	Point-to-Multipoint System
P-P System	:	Point-to-Point System
PA	:	Pre-Assignment
PABX	:	Private Automatic Branch Exchange
PC	:	Primary Center
PDH	:	Plesiochronous Digital Hierarchy
POTS	:	Plain Ordinary Telephone Service
PRP	:	Low Tension Power Receiving Panel
PSTN	:	Public Switched Telephone Network
PVC	:	Polyvinyl Chloride
RECT	:	Rectifier
RSS	:	Remote Subscriber Switch
RSU	:	Remote Switching Unit
SC	:	Secondary Center
SDH	:	Synchronous Digital Hierarchy
SP	:	Signal Point
STP	:	Signal Transfer Points
TC	:	Tertiary Center
TLMRS	:	Trunk Line Mobile Radio System
TS	:	Toll Switch
UHF	:	Ultra High Frequency Band
UNDP	:	United Nations Development Programme
UNTAC	:	United Nations Transitional Authority for Cambodia
UPS	:	Uninterruptible Power Supply
VHF	:	Very High Frequency Band

## JICA

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WB : World Bank  
WLL : Wireless Local Loop  
WTSC : the World Telecommunication Standardization Conference



## PREFACE

In response to a request from the Royal Government of the Kingdom of Cambodia, the Government of Japan decided to conduct a feasibility study on Telecommunications Network for Phnom Penh City and its surrounding area in the Kingdom of Cambodia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Cambodia a study team headed by Mr. Sizuhiko UMEMURA, NTT International Corporation, three times between September 1994 and May 1995.

The team held discussions with the officials concerned of the Royal Government of the Kingdom of Cambodia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made 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 the Royal Government of the Kingdom of Cambodia for their close cooperation extended to the team.

August 1995



Kimio FUJITA  
President  
Japan International Cooperation Agency

July 1995

Mr. Kimio FUJITA  
President  
Japan International Cooperation Agency

### Letter of Transmittal

We are pleased to submit to you the report on a feasibility study on telecommunications network for Phnom Penh City and its surrounding area in the Kingdom of Cambodia.

This study was conducted by NTT International Corporation in association with Nippon Telecommunications Consulting Co., Ltd. under contracts to JICA, during the period of September 1994 to July 1995. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Cambodia, and formulated the Emergency Project which is intended to rehabilitate and improve the telecommunications situation in Phnom Penh and its surrounding areas as quickly as possible. We formulated the most appropriate fundamental telecommunications network plan of the objective area up to the year 2007, then formulated the Essential Project following the Emergency Project which will develop the network in the same area. The study report includes network and facility provision plans, operation and maintenance plan, implementation plan, cost estimation and project evaluation, and recommendations.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, and other authorities concerned of the Government of Japan. We would also like to express our gratitude to the officials concerned of the MPTC, other related agencies of the Royal Government of Cambodia, the JICA Cambodia Office, and the Embassy of Japan in Cambodia for their cooperation and assistance throughout our study.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,



Hideaki KAMITSUMA  
President and CEO  
NTT International Corporation

## **Summary**



**SUMMARY****CHAPTER 1 INTRODUCTION**

The Study Team for "A feasibility study on telecommunications network for Phnom Penh City and its surrounding area in the Kingdom of Cambodia" (hereinafter referred to as "the Study") dispatched by Japan International Cooperation Agency (JICA) carried out work during the period from September 1994 to June 1995. The Study has been carried out in close cooperation with counterparts in the Ministry of Posts and Telecommunications (MPTC).

The report represents the feasibility study performed by the Study Team during the above period.

**1.1 Objectives of the Study**

The objective of the study was to prepare a report which will be a basis to formulate two projects for development and rehabilitation of telecommunication network in Phnom Penh City and its surrounding areas in the Kingdom of Cambodia (hereinafter referred to as "Cambodia"). One is the Emergency Project which is intended to rehabilitate and improve the telecommunications situation in Phnom Penh City and its surrounding areas as quickly as possible. The other is the Essential Project following the Emergency Project, which will develop the network in the same area.

The report for the Emergency Project was prepared separately from this final report of the feasibility study, and submitted on February 1995.

**1.2 Scope of the Study**

In order to achieve the objectives mentioned above, the Study will cover the following main items:

- (1) Collection and analysis of data / information
- (2) Field survey

- (3) Demand and traffic forecast
- (4) Confirmation of the project framework
- (5) Fundamental telecommunications network plan
- (6) Feasibility study on the Project

## CHAPTER 2      Socio-Economic Conditions

### 2.1      Location and Geographic Features

Cambodia occupies a compact territory covering 181,035 km<sup>2</sup> in the southwestern corner of Indochina, bordered by Thailand to the west, Laos to the north, Viet Nam to the east, and the Gulf of Thailand to the south. Cambodia is a part of monsoon Asia and the tropical zone, and has pronounced wet and dry seasons.

The population of Cambodia is about 9.8 million people. Almost 90% of the population lives around the Tonle Sap Lake. The Capital is Phnom Penh City with an increasing population of about 0.9 million people. Khmer is the national language.

### 2.2      Economic Trends

Gross Domestic Product (GDP) per capita is estimated at only US\$200 in 1992 by World Bank, leaving Cambodia as one of the LLDCs.

Real GDP grow by 3.5%, 1.2%, 7.6%, 7.0% and 3.9% in the five years from 1989 through 1993 inclusive, while population grow by 8.4%, 8.6%, 8.8%, 9.0% and 9.8% over the same period.

### 2.3      National Development Plan

The Ministry of Planning has formulated a "National Development Two Year Plan (1994 - 1995)" in 1993. Lately, the economy has undergone a steady change, and the anticipated growth rate increasing to 7.5% in 1994 and 8% in 1995. In order to achieve these growth rates, Cambodia needs about US\$1 billion for a two-year investment budget. However, Cambodia is unable to generate the necessary domestic savings to finance infrastructure investment. Therefore the Government of Cambodia

expects that revenue will come principally from foreign aid, with domestic resources contributing 30%.

## CHAPTER 3 TELECOMMUNICATIONS SECTOR OUTLOOK

### 3.1 Outline of Administrative Organization

The MPTC is the sole responsible and authorized body to supply telecommunications services. Three Under Secretaries of State report to the Secretary of State; the Under Secretaries are in charge of international telecommunications, domestic telecommunications, and control of the general management including the postal service, respectively. The MPTC functions both as a regulatory body and an operating one.

### 3.2 Joint Business of the MPTC and Foreign Companies

- (1) Based on a Business Cooperation Contract (BCC) the MPTC has been conducting international telecommunications business and public pay phones installation jointly with OTC International limited (OTCI).
- (2) Under the joint venture scheme, there are three private investors in the cellular telephone service, one in the fixed telecommunications service, three in the paging service and one in the long-distance call service.

### 3.3 Telecommunications Development Plan

The MPTC has plans to implement infrastructure projects and technical assistance. The funding for the plans will be contributed by various means e.g. bilateral, WB, ADB, UNDP, ITU and so forth.

### 3.4 Assistance by International Agencies

- (1) Preparatory Assistance commenced its activities under the support of UNDP, and ITU Senior Advisor assigned to the MPTC. UNDP Project of the Telecommunications Master Plan and Institutional Strengthening was signed on August 30, 1994.

- (2) German Kreditanstalt für Wiederaufbau (KfW) has proposed a plan to install a microwave system between Phnom Penh and Battambang and a rural telephone system which would accommodate subscribers in cities in between.
- (3) Recently France and Cambodia agreed on France's plans to install a new exchange, a remote switching unit, and an optical fiber link in Phnom Penh.

## CHAPTER 4 PRESENT TELECOMMUNICATIONS SERVICES AND FACILITIES

### 4.1 Network Structures

- (1) The local telecommunications facilities for the subscriber network in the study area is not sufficient in quantity. In addition, the existent subscriber network is aged and of poor quality.
- (2) Exchanges for local and international calls are installed only in the MPTC Head Office, so no junction network exists in this area. However, there are some projects under way to install exchanges in Phnom Penh.
- (3) The long distance network for public communications is provided by HF / VHF systems through a manual board. On the other hand, the dedicated network between governmental offices is provided by a satellite communications system.
- (4) The international telecommunications network is being operated and maintained under BCC. The exchange facilities for international calls are installed at the MPTC Head Office which is planned to be transferred to the International Telecommunications Center (ITC).  
The approach link is connected between the MPTC Head Office and ITC by an optical fiber cable system with a microwave system as backup.

### 4.2 Telecommunications Services

- (1) The MPTC provides about 4,700 telephone main lines in Phnom Penh, of which 1,900 telephones are available for International Direct Dialing (IDD). Four joint



venture companies provide 9,200 cellular telephones in the same city. The number of public pay phones is registered at 66 sets.

An out-dated exchange system with 140 subscribers is in use in Takhmau. These subscribers cannot use automatic dialing, except for those subscribers who are directly accommodated in exchanges in the MPTC Head Office by the digital microwave link.

The MPTC telecommunication facilities connecting to the MPTC Head Office are installed in the control tower building at the International Airport together with PABX for public pay phone and CAMTel cellular telephone systems.

Other surrounding areas, including Prek Phnou, have no telephone service.

- (2) The international telecommunications service can be applied to the IDD through the digital exchange. The traffic volume of the international calls is increasing rapidly and the number of countries with which communication is possible is expanded. International circuits through INTELSAT are connected to Australia, Thailand, Singapore, Japan, Malaysia, Hong Kong, France and China.
- (3) Four joint venture companies with about 9,700 subscribers are now providing services. The number of subscribers of the cellular telephone systems is larger than that of cable systems, and is increasing significantly, accommodating a high demand, in spite of the charges and fees being higher than for cable systems.
- (4) At telex network is connected to Sydney exchange system in Australia through the INTELSAT support with little demand for Telex services in Phnom Penh. Less than 15 telexes are sent or received at the MPTC per day.

#### 4.3 Telecommunications Facilities

##### 4.3.1 Exchange Facilities

- (1) Existent exchange facilities in Phnom Penh are below-mentioned exchanges installed by OTCI and Penta Conta LS with 4,000 subscriber lines.
- (2) OTCI has installed an AXE 105 international exchange and AXE 105 subscriber exchange with 2,000 subscriber lines, and an AXE 105 RSU with 3,000 subscriber lines.

- (3) France is planning to install an E10B exchange with 1,000 subscriber lines, and an RSU with 4,000 subscriber lines.

#### 4.3.2 Transmission Facilities

The MPTC transmission facilities are classified roughly into microwave system, optical fiber cable system and HF Transceiver System.

Presently the major facilities consist of Microwave System of MPTC - Takhmau, MPTC - Airport, MPTC - ITC links and F/O cable System of MPTC - Hub Station, MPTC - ITC links.

The optical fiber cable for 140 Mbps single mode / 6-core loop is paying out into a new duct in the sidewalk as the trunk network between the MPTC and ITC.

#### 4.3.3 Outside Plant

- (1) In Cambodia, most of the outside plants are located in Phnom Penh City and are very old, having been installed 25 to 55 years ago and have deteriorated.  
There are 43.0 Km direct buried cables and 58.6 km aerial cables in total.
- (2) There are three transmission cables of six-core single mode optical fiber cable in Phnom Penh City; two are between the MPTC Head Office and ITC along different routes, the other being between the MPTC Head Office and the Hub Station of UNTAC system.
- (3) The six aerial cables (total 212 pairs) of 2.3 km of total primary cable length have been installed directly from the MDF in the Takhmau Post Office.  
There are no outside plants for telecommunications in the surrounding areas.

#### 4.4 Operation and Maintenance

The MPTC operates postal services, international telecommunications services and domestic telecommunications services. The MPTC operates its telecommunications services both independently and under BCC and/or through joint ventures.

- (1) It can be said that the current operation of the MPTC is concentrated on the local network in Phnom Penh City due to the destruction by civil war.

- (2) Currently, most international traffic goes through the INTELSAT network operated under the BCC between the MPTC and OTCI.
- (3) The MPTC has one training center in Phnom Penh named ENARPOSTEL. The training center currently has two main courses - one a three-year-course, and the other a two-year-course.

## CHAPTER 5 DEMAND FORECAST

Two separate methods have been selected to forecast the demand for telephones. The first is a macroscopic demand forecast and the second is a microscopic demand forecast.

### 5.1 Macroscopic Demand Forecast for Telephone

The following tables summarize the results of the macroscopic demand forecast.

Table 5.1-1 Macroscopic Demand Forecast for the whole of Cambodia and Phnom Penh Municipality

Year	National Demand	National Density	Phnom Penh's Demand	Phnom Penh's Density
1997	68,600	0.68	22,200	2.19
1999	79,600	0.76	26,500	2.42
2002	99,600	0.90	35,800	2.88
2004	115,700	1.01	44,300	3.28
2007	144,700	1.20	62,000	4.03

Table 5.1-2 Telephone Demand diffusion in Phnom Penh Municipality

Year	Phnom Penh (4 Khans)	Srok			Total
		Mean Chey	Russey Keo	Dang Kor	
1997	15,500	2,300	2,900	1,500	22,200
2002	22,600	4,500	5,700	3,000	35,800
2007	34,400	9,300	12,000	6,300	62,000

## 5.2 Microscopic Demand Forecast for Telephones

The microscopic demand forecast adopted herewith is applied only to Phnom Penh city, as it is the method that is adequate to apply to urban areas. The demand forecast is carried out by field survey.

Table 5.2-1 shows the result of the Microscopic Demand Forecast in the central area of Phnom Penh Municipality.

Table 5.2-1 Microscopic Demand Forecast in the Central Area of Phnom Penh Municipality

Year	Toul Kork	7 January	Don Penh	Chamcarmon	Total
1997	3,300	2,400	5,500	4,600	15,800
2002	5,300	3,300	7,900	6,500	23,000
2007	8,800	4,800	11,800	9,700	35,100

## 5.3 Demand for the Study

For the purpose of the Study, the macroscopic demand forecast is applied to the areas surrounding Phnom Penh and the microscopic demand forecast is applied to Phnom Penh City itself. The demand used for the Study are summarized in Table 5.3-1.

Table 5.3-1 Demand for the Study

Year	Phnom Penh	Mean Chey	Russey Keo	Dang Kor	Takhmau	Prek Phnou	Total
1997	15,800	2,300	2,900	1,500	1,000	80	23,580
2002	23,000	4,500	5,700	3,000	2,000	180	38,380
2007	35,100	9,300	12,000	6,300	4,000	420	67,120

## 5.4 Other Telecommunications Services

### 5.4.1 Cellular Telephone Services

Table 5.4-1 shows a future demand forecast of cellular telephone services in Cambodia.

Table 5.4-1 Cellular Telephone Demand Estimation

Year	Density	Demand
1997	0.203	20,000
2002	0.216	24,000
2007	0.216	26,000

## CHAPTER 6 FUNDAMENTAL NETWORK PLAN

### 6.1 Network Structure and Routing Plan

A telecommunications network linking nine exchange offices will be established. This network is to be composed of final trunks and local exchanges will be fully connected by direct trunks. Outgoing long distance calls, international calls and special service calls will be concentrated at the Central Exchange Office and then sent to their destinations.

### 6.2 Numbering Plan

A numbering plan was set up with the following principles:

- (1) The area code is composed of 2 digits.
- (2) The exchange code is composed of 2 digits.
- (3) The subscriber's numbering is composed of 4 digits.

### 6.3 Signaling System

The CCITT CCS No. 7 will be applied to the signaling system between digital exchanges.

In this Study, the associated mode will be applied to the Emergency Project and the quasi-associated mode will be applied to the Essential Project. The Telephone User Part (TUP) will be applied as the User Part.

### 6.4 Charging System

In this Study, the present charging systems will be used.

### 6.5 Synchronization Plan

- (1) A master-slave synchronization method will be introduced. For the time being, the existing international exchange which has cesium oscillators will be the master exchange.
- (2) When a new trunk exchange is introduced in Phnom Penh City, it will be a sub-master exchange and will have cesium oscillators as back up oscillators.

### 6.6 Technical Standard of Network Quality

In order to design an appropriate network, the design work should be done so as to satisfy each target value of the connection performance, the transmission performance and the availability performance for the network.

## CHAPTER 7 SYSTEM SELECTION

### 7.1 Switching System

An exchange of 3,000 subscriber lines or more is to be an independent switching unit having up to 20,000 subscriber lines. Where the criterion of 20,000 subscriber lines is exceeded, a new independent switching unit will be added. An exchange of less than 3,000 subscriber lines is to be a remote switching unit.

### 7.2 Transmission Network System

- (1) The Synchronous Digital Hierarchy (SDH) system is to be introduced to the networks on the basis of cost effectiveness, maintainability, interface connecting with inter networks and the multi-venderization of equipment.
- (2) The SDH system using optical fiber transmission system is an appropriate medium for the transmission network. Cost comparison was made for the selection of optimum systems in terms of distance between the terminal exchanges and capacities to be transmitted.



### 7.3 Subscriber System

- (1) The subscriber system to be applied in the study areas was selected considering the conditions of "Request by Cambodian Side", "Required Service Menu" and "Application Conditions."
- (2) From the above considerations, the metallic cable system was selected for subscriber systems in the study areas.

## **CHAPTER 8 DEVELOPMENT STRATEGY**

### 8.1 Demand Fulfillment Plan

In accordance with the Investment Program, the penetration ratio of Phnom Penh City will improve to more than 2 telephones per 100 inhabitants by the year 1997, and the following shall be completed during the 10 years from 1997 to the final target year 2007:

- To provide a digitized network
  - To provide sufficient capacity of facilities to meet the telephone demand in 2007
  - To provide a network in which the function of the trunk network can be added in the future
- (1) The telephone supply strategy categorizes all waiting applicants into five groups, prioritized in the order as given: administrative group, public group, industrial / business group, commercial group and residential group.
  - (2) For areas outside exchange areas, telephone lines are provided to all waiting applicants belonging to the highest priority group.
  - (3) It is recommended that provisioning for further expansion be implemented every 5 years, so as to avoid frequent expansion which may increase total costs for expansion work.

## 8.2 Provisioning Plan

- (1) A provisioning plan was prepared in accordance with the telephone demand forecasted.
- (2) Three exchange areas in Phnom Penh City and six exchange areas in the surrounding area of a radius of 3 Km were set up taking into consideration telephone demand density, area size, boundary condition, and technical requirements for subscriber cable network.
- (3) The telephone demand forecast for each exchange is shown in Table 8.2-1.

Table 8.2-1 Telephone Demand (Exchange base)

Exchange Name	North (MPTC)	Central	West	Charang Cham Reh	Prek Phnou	Airport	Takhmau	Chabar Ampou	Russei	Other Areas	Total
1997	1,600	9,600	5,300	400	80	600	1,700	1,500	60	2,740	23,580
2002	2,700	13,400	8,300	900	180	1,400	3,300	3,000	110	5,090	38,380
2004	3,300	15,200	10,000	1,200	260	1,900	4,300	4,000	150	5,490	45,800
2007	4,400	19,800	13,900	1,800	420	2,900	6,700	6,200	240	10,760	67,120

## 8.3 Project Formation

Exchanges have been divided into three groups of priority. The First Group consists of Central Exchange Office area, West Exchange Office area, and the Airport Exchange Office area. 15,500 telephones are planned to be installed under the Emergency Project, to be completed in the year 1997. Expansion works will be scheduled for every five years thereafter. The Second Priority Group consists of North Exchange Office area, Charang Cham Reh Exchange Office area, Takhmau Exchange Office area and Chabar Ampou Exchange Office area. This project plans to have provided 6,800 telephones in the year 1999. Expansion works will be carried out in the year 2004. The Third Group consists of Prek Phnou Exchange Office area and Russei Exchange Office area. This project plans to have provided 660 telephones in 2007.



## CHAPTER 9 TRAFFIC FORECAST AND CIRCUIT CALCULATION

### 9.1 Determination of average outgoing calling rate per subscriber

From traffic measurement of the existing exchanges and the analysis of the measurement results, the following data was obtained.

- (a) Local Calling Rate ; 0.040 erl
- (b) Long Distance Calling Rate ; 0.002 erl
- (c) Special Service Calling Rate ; 0.001 erl

### 9.2 Local Traffic Distribution Matrix

The result in 2007 of this local traffic distribution is shown in Table 9.2-1.

Table 9.2-1 Local Traffic Matrix in 2007

	CNT	WST	NRT	TKM	CAP	ITC#1	ITC#2
CNT		211	42	56	52	59	234
WST	211		33	44	40	46	183
NRT	42	33		9	8	9	37
TKM	56	44	9		11	12	49
CAP	52	40	8	11		11	45
ITC#1	59	46	9	12	11		51
ITC#2	234	183	37	49	45	51	

## CHAPTER 10 TELECOMMUNICATIONS FACILITY PROVISION PLAN OF ESSENTIAL PROJECT

### 10.1 Exchange Facilities

- (1) The number of subscriber lines of new local exchanges installed will be, 7,600 in 1999, 8,700 in 2002, 6,500 in 2004 and 14,300 in the year 2007.
- (2) The exchanges installed are to be digital exchange equipment and the percentage of digitized system will be 100% after the Project.

### 10.2 Transmission Facilities

- (1) The transmission system for the project will be supported by the SDH system using optical fiber cables.
- (2) In order to facilitate the introduced SDH system's operation and maintenance, a network management system consisting of local management and central management systems will be adopted.

### 10.3 Outside Plant

- (1) The number of primary cable pairs installed will be, 7,800 in 1999, 9,600 in 2002, 7,400 in 2004 and 17,750 in the year 2007.
- (2) The number of sections of junction cables will be, 4 in 1999 and 2 in the year 2007.
- (3) The installation of 150 public pay phone terminals in the year 2002 and 35 terminals in the year 2004, following completion of installation of terminals as specified in the agreement between MPTC and OTCI, will be performed.

### 10.4 Power Supply System

Engine generators, batteries, rectifiers, and main panels are to be installed to match the power consumption of telecommunications facilities in each stage.

### 10.5 Building

Four exchange office buildings of total floor space of 720 m<sup>2</sup> will be constructed in 1999.

## CHAPTER 11 OPERATION AND MAINTENANCE PLAN

- (1) An organization for operating and maintaining the facilities constructed under the project is proposed as follows:

- (a) The main force will be stationed at the Central Exchange Office.
  - (b) The employees to operate and maintain all the equipment in each exchange office will be centralized at night.
  - (c) The operation and maintenance employees will be stationed during the daytime at exchange offices using the independent type exchange.
  - (d) The force for outside plant operation and maintenance will be transferred to the outside plant maintenance center.
- (2) The number of employees required for the operation and maintenance was estimated based on number of subscribers and efficiency of employees in terms of number of subscriber per employee.
- (3) The recommended tools and equipment necessary for operation and maintenance and supporting systems are as follows:
- (a) Network management system for exchange and transmission equipment
  - (b) Spare package for exchange, transmission equipment and power plant
  - (c) Plant record management system, cable pair assignment sheets and fault record/analysis system for measures reinforcing operation and maintenance work
  - (d) Establishment of training center, outside plant maintenance center and billing center
  - (e) Introduction of technical assistance

## **CHAPTER 12 IMPLEMENTATION PLAN**

### **12.1 Policy of Implementation Plan**

- (1) Construction work is to be carried out on a turn key basis in order to promote the various types of construction work which are related to each other in an efficient and economical manner, and to complete the Project successfully.
- (2) An experienced consultant will be employed and will perform the preparation of the tender document, tender evaluation, installation supervision, inspection work, etc. in cooperation with the MPTC staff.

- (3) In order to coordinate management among the sections concerned, the MPTC should establish a project team which consists of the MPTC staff and consultant.
- (4) Operation and maintenance staff of the MPTC will participate in the construction work to acquire the necessary knowledge for the operation and maintenance of the systems to be constructed.

12.2 Implementation Schedule

The Essential Project will be divided into 4 stages and executed stage by stage, taking into consideration the demand trends up to 2007 and the even distribution of construction work volume.

CHAPTER 13 COST ESTIMATION

The investment cost of the Essential Project is summarized as follows;

(1) Telecommunication Facilities

(US\$1,000)

Phase	I		II	III	IV	
	1998	1999	2002	2004	2006	2007
Constructed office: Number of subscriber line per exchange	North : 2200 C.C. Reh : 800 Takhmau : 2400 C. Ampou : 2200		Central: 1400 West: 4000 Airport: 700	North: 1400 C.C. Reh: 800 Takhmau: 2400 C. Ampou: 2200	Central : 7000 West : 5000 Airport : 1500 P. Phnou : 500 P. Russei : 300	
Investment cost	8,379	8,334	11,245	8,978	11	20,276

(2) Supporting Facilities

(US\$1,000)

Item	Training Center	OPMC	Billing Center	Note
Sub total	7,152	5,226	5,665	
Investment cost	-	-	-	18,043

**CHAPTER 14 PROJECT EVALUATION**

- (1) The Essential Project was evaluated by the following methods:
  - (a) Identifying premises and assumptions in the Essential Project
  - (b) Estimating capital expenditure and operation expenditure (cash outflow)
  - (c) Estimating operation revenue (cash inflow)
  - (d) Creating a cash flow table and calculating a financial internal rate of return (FIRR)
  - (e) Performing sensitivity analysis
  - (f) Estimating economic benefits and calculating the economic internal rate of return (EIRR)
- (2) Result of the FIRR calculation is that the project will have an internal rate of return of 12.91%.
- (3) A sensitivity analysis was made which set assumptions on the fluctuation ranges of increase of revenue and operation and maintenance costs.
- (4) The result of the calculation shows that the EIRR is 33.53%. In other words, considerable economic benefit can be anticipated to result from the implementation of the Project.

**CHAPTER 15 RECOMMENDATION**

This report represents the results of a feasibility on telecommunications network for Phnom Penh City and its surrounding area in the Kingdom of Cambodia.

A project consisting four stages was formulated by the study. With regard to the realization of the project as well as development of telecommunications services in Cambodia, the following recommendations are presented herewith.

- (1) Government's Responsibility
- (2) Necessity of Establishing a Development Target

- (3) Alteration of Operation Format
  - (a) Establishment of Autonomy
  - (b) Organization in Provinces
  
- (4) How private participation should be dealt with
  - (a) As for the international telephone service
  - (b) The long distance call network composed of the facilities donated by ex-UNTAC
  - (c) The service utilizing the WLL system in Phnom Penh city
  
- (5) Necessity of Toll Exchange
  
- (6) Improvement of the Collection of Telephone Charges
  
- (7) Review of Tariff System
  
- (8) Operation and Maintenance
  
- (9) Radio Subscriber System