社会開発調査部報告書

No. 42

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

## SUMMARY

JULY 1995



NTT INTERNATIONAL CORPORATION
NIPPON TELECOMMUNICATIONS CONSULTING CO., LTD.

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## 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. Sizuhiro 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

Hideaki KAMITSUMA
President and CEO
NTT International Corporation

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# OUTLINE OF THE FEASIBILITY STUDY

In this study, the Emergency Project was formulated which is intended to rehabilitate and improve the telecommunications network in the area of high demand density as well as important subscriber concentration inside the objective area while the Essential Project following the Emergency Project was formulated which will develop telecommunications network in the objective area.

## 1. Planning Period

In due consideration of the development progress in Cambodia having uncertainty in social and economical aspects, the planning period encompassed by the study is ten years from 1997 to 2007 to make the study firm in the light of realization.

## 2. Telephone Supply Target

Initial provision of telecommunications facilities will be made to meet the immediate requirement at the expected commissioning year for these exchange offices which are planned in the Study.

In the course of telephone provision, priorities were given to those applicants of administrative, public, industrial/business or commercial groups.

It is recommended that provisioning for further expansion be implemented every 5 years so as to avoid frequent expansion which may increase the total costs for expansion work over the long period.

(1) Local Exchange Office Area

Nine local exchange office areas were established in due consideration to demand density, administrative boundary and technical requirement of facilities.

(2) Demand Forecast

A macroscopic demand forecast based on population prospects and economic growth estimation and a microscopic demand forecast by field survey were carried out and the future demand of each exchange were forecasted.

(3) Project Formation

Exchanges have been divided into the following three groups and projects have been formulated taking into account the efficient service provisions and sound investment.

- First group : Central, West, Airport Exchange Office
- Second group : North, Charang Cham Reh, Takhumau, Chabar Ampou Exchange Office
- Third group : Prek Phnou, Russei Exchange

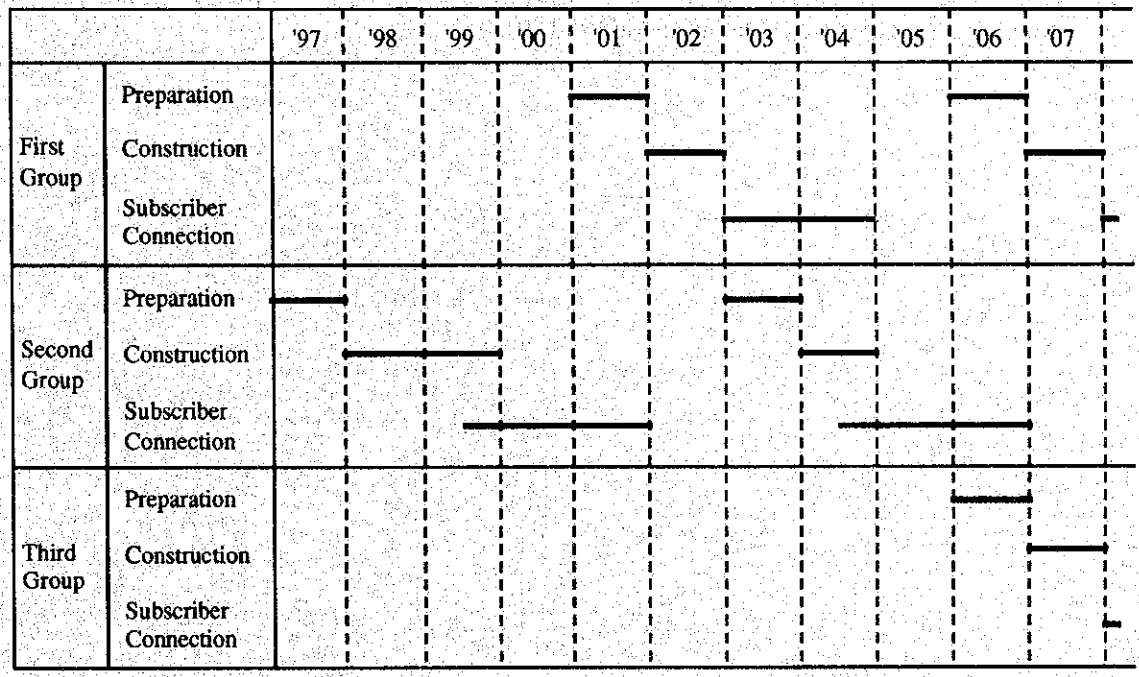
## 3. Emergency Project

The first group above is the exchange areas of the highest demand density among the study area and there are many important subscribers being concentrating. Therefore the group was selected as the Emergency Project. The scope of the project is, to construct three exchange offices, to install digital switching equipment to these exchange offices and transmission facilities connecting these exchange offices by optical fiber cable network and local cable network of these exchange office areas. The provision of telephone services to the waiting applicants belonging to the highest priority group outside these three exchange office areas and not covered by the existing network will be carried out by the radio subscriber system. the expansion of the telecommunications facilities of this group or exchanges will be included in the Essential Project.

The estimated cost of the project, under the condition that 100.21 Japanese Yen is equivalent to 1 US dollar, is about US$32.3 million consisting of US$29.9 million for the foreign portion and US$2.3 million for the local portion.

## 4. Essential Project

The second and third group and the expansion of the first group above are selected as the Emergency Project. The following figure shows the time schedule consisting of four stages of implementation of the Essential Project.




## 5. Operation and Maintenance Plan

Establishment of telephone office organization was proposed in order that the increment of the number of subscribers can easily be handled. The necessary number of staff for the operation and maintenance, tools and equipment and supporting system were determined and the importance of human resource development and counter measures for efficient work procedures were pointed out as well.

## 6. Project Evaluation

The FIRR (financial internal rate of return) for the feasibility study was calculated as 12.91% which shows high viability. To measure the economic benefits of the feasibility study, the idea of consumers' surplus is employed. The EIRR (economic internal rate of return) was estimated as 33.53%. This EIRR shows that economic contribution of the Project will be relatively high to Cambodia.

## 7. Recommendation

A recommendation of the government's responsibility to telecommunications development was pointed out and the necessity of establishing a development target, operation format and private participation dealing necessity of toll exchange, improvement of telephone charge collection, review of tariff system, operation and maintenance issue were recommended as well.

# CHAPTER 1 INTRODUCTION

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") have been prepared in the form of a Final Report, which is composed of the following;

(1) Summary
(2) Main Report
(3) Appendix

The report for the Emergency Project was prepared separately from the final report and submitted on February 1995.

The Study Team dispatched by Japan International Cooperation Agency (hereinafter referred to as "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 (hereinafter referred to as "the MPTC").

## 1.1 Background of the Study

At present, only approximately 10,000 telephone main lines are serving the population of 9.8 million, with around 90% of telephone subscribers being concentrated in Phnom Penh City, the capital of Cambodia. The telephone density of Cambodia is 0.12 per 100 inhabitants, which is very low. Even in Phnom Penh City, the telephone density is 1.4 per 100 inhabitants.

Most of the facilities for domestic communications were installed prior to 1970, so that they are now more than 25 years old. As a result, some have deteriorated and are not fully functional or are out of use. On top of this, the civil war from 1975 to 1979 destroyed and damaged most of the equipment, facilities and cables which were then in operation.

Under these circumstances, the Royal Government of Cambodia (hereinafter referred to as "the Government of Cambodia") requested the Government of Japan to conduct a feasibility study on telecommunications network for Phnom Penh City and its surrounding areas in Cambodia. In response to this request, the Government of Japan decided to dispatch a JICA Study Team for the execution of the Study.

1.2 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 the 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 develops the network in the same area.

1.3 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 $km^2$ in the southwestern corner of Indochina, bordered by Thailand to the west, by Laos to the north, by Viet Nam to the east, and the Gulf of Thailand to the south. Much of Cambodia's geography is dominated by large central plains, which cover about three-fourths of the total land area and by the Mekong River, which flows southward through the eastern part of the country.

### 2.2 Climate

Cambodia is a part of monsoon Asia and the tropical zone, with pronounced wet and dry seasons. A long dry season is between November and April. Rain falls mainly in May - June and around September - October.

### 2.3 Country's Condition

(1) Population size

The population of Cambodia is about 9.8 million people as of December, 1993. Almost 90% of the population lives around the Tonle Sap Lake, where the population density is about 50 per $km^2$. The Capital is Phnom Penh City with an increasing population of about 0.9 million people. The annual population growth rate is about 2.5% in general, 5% in Phnom Penh City.

(2) Administration

Cambodia is divided into 19 provinces and 2 municipalities. Provinces are further subdivided into 172 districts.

(3) Language

Khmer is the national language. French was used as an official language until about 1970. Recently, English has been prevalent. Other languages, including Vietnamese, Chinese (mainly Cantonese and Fukienese), and Thai are also spoken.

(4) Religion

Approximately 88% of the population belongs to Theravada Buddhism. Other religious groups include Catholicism, Protestantism, Islamicism and so on.

## 2.4 Economic Trends

Table 2.4-1 shows the key economic indicators of Cambodia from 1989 to 1993.

Table 2.4-1 The Key Economic Indicators of Cambodia for the Past Five Years (1989 - 1993)

| Year | | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|
| 1) Population | million | 8.4 | 8.6 | 8.8 | 9.0 | 9.8 |
| 2) GDP Total | Riel billion | 240.9 | 243.7 | 262.2 | 280.6 | 291.5 |
| Primary industries | | 125.9 | 127.4 | 135.9 | 138.5 | 135.6 |
| Secondary industries | | 37.1 | 36.3 | 39.6 | 45.7 | 52.6 |
| Tertiary industries | | 77.9 | 80.0 | 86.7 | 96.4 | 103.3 |
| 3) Real GDP Growth Rate | % | 3.5 | 1.2 | 7.6 | 7.0 | 3.9 |
| 4) Consumer price inflation | % | 60 | 142 | 197 | 75 | 114 |
| 5) Balance of trade | US$ million | - 90.7 | - 80.6 | - 188.1 | - 294.3 | - 283.4 |
| 6) Balance of payments on current account | US$ million | - 89 | - 50 | - 25 | -29 | - 41 |
| 7) External debt outstanding | US$ million | 1,423 | 1,557 | 1,603 | 1,552 | 1,552 |
| 8) Yearly average exchange rate | Riel : US$ | 223 | 537 | 856 | 1,521 | 2,822 |

Source: 1) - 4) National Institute of Statistics, Ministry of Planning / 5) - 6) Ministry of Commerce 7)Ministry of Economy and Finance / 8) UNDP & Asian Development Bank (ADB) Project, Department of Statistics (Data from 1989 to 1992), National Bank of Cambodia (Data in 1993)

## 2.5 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 for 1994 - 1995, Cambodia will need approximately US$1 billion for a two-year total investment budget. However, due to the low level of economical development, Cambodia is unable, by itself, 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 and to retain the exclusive right to enter into joint venture and business cooperation contracts in Cambodia.

In the MPTC, 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. As the feature of the MPTC's organization, the operating body in provinces outside Phnom Penh are under the control of the provincial authorities.

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

Based on a Business Cooperation Contract (hereinafter referred to as "BCC") and joint venture system, the MPTC conducts business in international telecommunications and cellular telephones jointly with foreign companies.

(1) International Telecommunications Service

Based on a BCC, the MPTC has been conducting international telecommunications business jointly with OTC International limited (hereinafter referred to as OTCI). The revenue on incoming calls after reduction of transit and original call goes 51% to the MPTC and 49% to OTCI.

(2) Public pay phones

The MPTC signed a contract with OTCI in February 1993 to install public pay phones after a one year market trial which was agreed to in November 1991. The contract says that OTCI is going to install up to 175 public pay phones by the year 2000.

(3) Cellular Telephone Service

Under the joint venture scheme in Cambodia, there are three private investors from Thailand and Malaysia in the cellular telephone service field and one from Thailand in the fixed telecommunications service field in operation.

(4) Paging Services

Three companies of Singapore, Hong Kong and Taiwan has established joint venture companies individually executing agreements with the MPTC. Around three hundred subscribers exist as of June 1995.

(5) Long-distance Call Services

A joint venture contract was made for operating long-distance call services by using ex-UNTAC network between the MPTC and PT. INDOSAT of Indonesia.

3.3 Telecommunications Development Plan

The telephone density of Cambodia is one of the lowest in the world. The telecommunications services in Phnom Penh are scant in quantity and are of poor quality. There is no national trunk network to allow direct dialing from the local networks. In order to improve these conditions, the MPTC has plans to implement the following 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.

(1) Installation of switching and outside plant to provide up to 20,000 lines in Phnom Penh
(2) Installation of switching and outside plant to provide up to 20,000 subscribers in provincial towns
(3) Provision of rural telecommunications service of at least one telephone to most of the district towns and villages
(4) Introduction of marine and coastal radio system with efficient shipping operation function and search and rescue capability
(5) Installation of national microwave trunk network to interconnect all provincial capitals with each other and Phnom Penh
(6) Installation of inter-regional microwave network within Indochina region

Technical Assistance consists of the following items:

(1) Training and human resource development
(2) Training center and course development
(3) Institutional support to the MPTC
(4) A master plan for telecommunications development of Cambodia (under implementation by UNDP/ITU)

3.4 Assistance by International Agencies

3.4.1 ITU and UNDP

ITU preliminary sector appraisal mission prepared situation analysis for the telecommunications sector of Cambodia in 1991. Consequently, in June 1993, Preparatory Assistance commenced its activities under the support of UNDP, and ITU Senior Advisor assigned to the MPTC. The Preparatory Assistance activities were to address priority requirements of the new Government of Cambodia and to identify longer term development needs of the sector.

UNDP Project of the Telecommunications Master Plan and Institutional Strengthening was signed on August 30, 1994 as described in 3.3.2 based on the results of the Preparatory Assistance activities.

3.4.2 Germany

German Kreditanstalt für Wiederaufbau (KfW; German Reconstruction Finance Cooperation) has proposed a plan to install a microwave radio system between Phnom Penh City and Battambang, and a Point to Multi-point rural telephone system covering the range from Phnom Penh to Battambang, which would accommodate subscribers in cities in between. In contrast, the MPTC plans to construct rural telecommunications facilities with priority given in Battambang, and to use the UNTAC satellite facilities as the transmission system between Phnom Penh and Battambang. The MPTC also wants to avoid the increase of the different type of exchanges, because three different types of digital exchanges will be introduced in Cambodia in the near future.

### 3.4.3 France

Recently an agreement was made between France and Cambodia. The agreement says that France plans to install a new exchange at a training center in Phnom Penh, a remote switching unit (RSU) in the MPTC Head Office to replace the Penta Conta exchange, and an optical fiber link from the training center to the MPTC head office.

# CHAPTER 4 PRESENT TELECOMMUNICATIONS SERVICES AND FACILITIES

## 4.1 Site Conditions

The conditions of the relevant sites are summarized in Table 4.1-1.

Table 4.1-1 Site Conditions in the Study Area

| Name of Site | Organization | Building | Tower | Facilities | Remarks |
|---|---|---|---|---|---|
| MPTC | The MPTC Head Office | 3 stories | Tripod guyed tower : 45 m above roof (approx. 60 m above ground) | Exchange<br>Transmission (Microwave, F/O)<br>Cellular telephone systems | |
| Training Center | Free space & the Training Center | Training center (2 stories) | - | - | Plan for the Central Exchange Office |
| Airport | Airport | Airport Control Tower<br>5 stories<br>(3F for the MPTC) | - | Satellite comm.<br>Transmission (microwave)<br>PABX<br>Cellular telephone systems<br>Public pay phone | |
| Hub Station | MPTC Hub Station | Trailer for facilities | tripod guyed tower : 63 m above ground | Satellite comm.<br>Transmission (microwave, UHF)<br>PABX | Former UNTAC station |
| Takhmau | Post & communications (Switching Center) | 3 stories | - | Exchange (SxS)<br>Transmission (microwave, VHF) | |
| Prek Phnou | Post & communications | 2 stories | - | - | |
| ITC (OTCI) | Earth Station for international call | 1 story | guyed pipe tower : 20 m above ground | Satellite comm.<br>Exchange<br>Transmission (microwave, F/O)<br>TV | Land, INTERSPUTNIK building and tower are owned by the MPTC |

Source : Information from the MPTC and result of survey

4.2 Network Structures

The telecommunications network in Phnom Penh and its surrounding areas is indicated Figure 4.2-1.

The telecommunications network has the following features in the study area:

(1) Subscriber Network in the Study Area

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) Junction Network in the Study Area

Currently, 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) Long Distance Network

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. This system will be renovated and used for public communications in the near future by joint venture.

(4) International Telecommunications Network

The international telecommunications network is being operated and maintained under BCC between the MPTC and OTCI. The exchange facilities for international calls are installed at the MPTC Head Office which is planned to be transferred to the International Telecommunications Center (hereinafter referred to as "ITC").
The approach link is connected between the MPTC Head Office and ITC by a optical fiber cable system with a microwave system as backup.

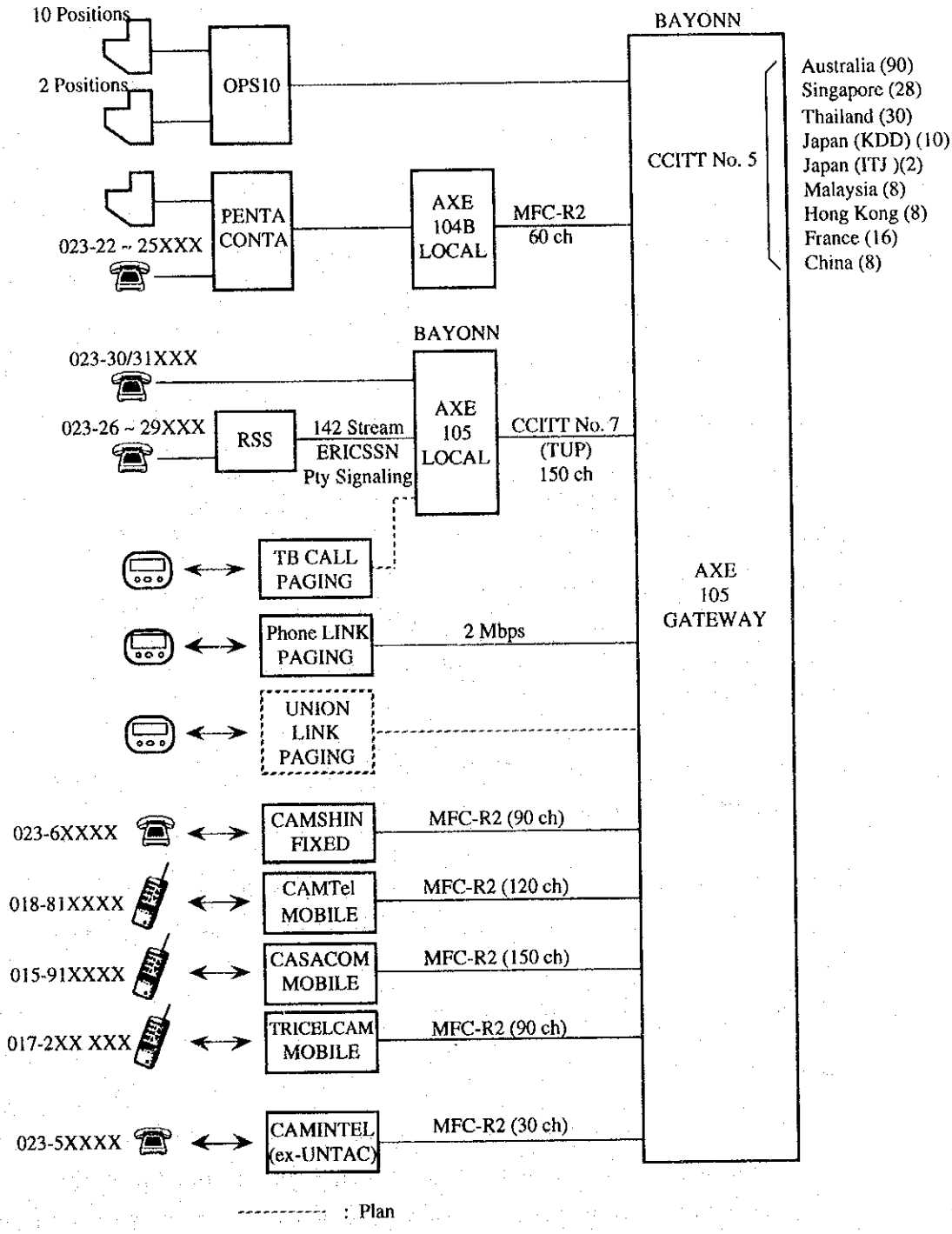



Figure 4.2-1 Network Structure in Phnom Penh City and its Surrounding Area

## 4.3 Telecommunications Services

### 4.3.1 Telephone Services

(1) Telephone Services in Phnom Penh

Presently, in Phnom Penh, the telephone services are provided by the MPTC with five foreign companies participating in a joint venture and BCC scheme.

Through 1993-1994, the transition of subscribers including cellular telephone services is as follows:

Table 4.3-1 Number of Telephone Subscribers

| Type of Telephone | | 1993 | October, 1994 |
|---|---|---|---|
| Ordinary Telephone | Penta Conta | 2,828 | 2,800 |
| | AXE 104 A, B | 624 | 1,900 |
| Cellular Telephone | | 4,810 | 9,200 |
| Total | | 8,262 | 13,900 |

Source: Information from the MPTC

The local exchange system (AXE 104/105) can be applied to IDD, and cross-bar (Penta Conta) Exchanges can not.

Presently the number of public pay phones is registered at 66 sets, and Phonecards ranging in value are available for 2,5, 20, 50 and 100 US$ each.

(2) Telephone Services in Surrounding Area

(a) Takhmau

Presently in Takhmau the local telephone services are supported with an out-dated exchange system (Oki step by step, manufactured in 1967).
The subscribers in the step by step exchange cannot make automatic dialing calls due to no trunk network. This system has 400 terminals with 140 subscribers. There are also some subscribers in Takhmau who are directly accommodated in Penta Conta and AXE 104 exchanges in the MPTC Head Office by the digital microwave link (one hop) with 30 channels (2 Mbps x 1 system).

(b) Airport

The MPTC telecommunication facilities such as PABX and microwave link with 2 Mbps digital multiplex equipment connecting to the MPTC Head Office are installed on third floor in Control Tower building together with OTCI PABX for public pay phone and CAMTel cellular telephone systems.

(c) Prek Phnou

Prek Phnou is an area with no telephones.

(3) Telephone Services in Provinces

The telecommunication services in provincial areas are limited due to aged exchange facilities, the capacity of which is only less than 4,000.

In other provincial areas the public telecommunications services are covered by means of VHF/HF transceivers.
The traffic including Telegram services is 50 times per day.

(4) International Telephone Service

The international telephone service is provided under the BCC between the MPTC and OTCI. The telecommunications facilities for the service are composed of the AXE 105 installed at the MPTC Head Office, optical fiber cable system between the MPTC Head Office and the ITC, and the INTELSAT. The 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, so the communications facilities such as the exchange, approach link and the earth station are now arranging and expanded under the BCC. The number of channels and the countries connected through the INTELSAT are shown below:

| Country | | Number of Channels |
|---|---|---|
| Australia | : | 90 channels |
| Thailand | : | 30 channels |
| Singapore | : | 28 channels |
| Japan (KDD) | : | 10 channels |
| Japan (ITJ) | : | 2 channels |
| Malaysia | : | 8 channels |
| Hong Kong | : | 8 channels |
| France | : | 16 channels |
| China | : | 8 channels |
| Total | : | 200 channels |

Source: As of June, 1995, Information from the OTCI

4.3.2 Cellular Telephone Services

The cellular telephone services are provided by the following four (4) joint venture companies with the MPTC in Cambodia.

At present, the number of subscribers accommodated in the cellular telephone systems is larger than that of cable systems, and is increasing significantly, by accommodating a high demand limited to those such as government authorities concerned, governmental offices, foreign embassies, business offices, hotels and restaurants, in spite of the charges and fees being higher than for cable systems.

Table 4.3-2 Service Status of Cellular Telephone Systems

| Items | CAMSHIN | CAMTel | CASACOM | TRICELCAM |
|---|---|---|---|---|
| Commencement of Service | August, 1993 | October, 1992 | November, 1992 | October, 1993 |
| Type of System | Fixed Cellular<br>450 / 800 MHz<br>(NOKIA) | AMPS<br>800 MHz<br>(MOTOROLA) | NMT<br>900 MHz<br>(NOKIA) | ETACS<br>800 MHz<br>(ERICSSON) |
| Service Area | Phnom Penh | Phnom Penh | Phnom Penh<br>Battambang<br>Kompong Cham<br>Siem Reap<br>Sihanoukville | Phnom Penh |
| No. of Base Stations | 2 | 2 | 6<br>(2 in Phnom Penh) | 3 |
| No. of Subscribers | 1,800 | 2,200 | 3,700 | 1,500 |
| Telephone Number | 6X-XXX | 018 81-XXXX | 015 91-XXXX | 017 20-XXXX |

Source: Information from the MPTC, * Data as of October, 1994

### 4.3.3 Telex Services

A telex network is connected to Sydney exchange system in Australia through the INTELSAT support.

There is little demand for Telex services in Phnom Penh. Furthermore registered users have only 39 lines including 16 incapable lines, which seem to have been left behind today's times.

Less than 15 telexes are sent or received at the MPTC per day. Accordingly, telex services in Phnom Penh are not so popular.

### 4.3.4 Paging Services

As of May 1995, two (2) joint venture companies are providing paging services in Phnom Penh. In addition to the above, a joint venture company with the MPTC is planned to provide paging service in near future.

The service conditions of the paging systems are shown in table 4.3-3:

Table 4.3-3 Conditions of Paging Services as of May, 1995

| Item | PHONE LINK | TB CALL | UNION LINK |
|---|---|---|---|
| Counterpart of joint venture with MPTC | STI (Singapore) | Twin Bridge (Taiwan) | Union Link (Hong Kong) |
| Service Commencement | 13 March, 1995 | 20 March, 1995 | under preparation |
| Radio Frequency | 170.025 MHz | 152.650 MHz | 152.925 MHz |
| Antenna Height | 27 m | 30 m | 40 m |
| Exchange Capacity | 5,000 | 10,000 | 30,000 |
| No. of Lines for services | 10 lines | tentatively 4 lines (10 lines in future) | 6 lines |
| Service Menu | Numeric Alphanumeric Voice Mail | Numeric Alphanumeric Voice Mail | Numeric Alphanumeric |
| Method of Connection | Automatic Operator | Automatic Operator | Automatic Operator |
| Radius of Service Area | approx. 30 km | approx. 30 km | approx. 30 km |
| No. of Subscribers as of 15 June, 1995 | 129 | 120 | - |

## 4.4 Telecommunications Facilities

### 4.4.1 Exchange Facilities

(1) Existent Exchange Facilities

Existent exchange facilities are shown in Table 4.4-1 excluding the facilities of UNTAC system.

(2) Exchange Facilities by OTCI

OTCI has installed an AXE 105 international exchange and AXE 105 subscriber exchange with 2,000 subscriber lines in the ITC, and an AXE 105 RSU with 3,000 subscriber lines in the MPTC Head Office.
The RSU in the MPTC accommodates the existent subscribers of AXE 104 A and AXE 104 B.

(3) Exchange Facilities to be Installed by France

France is planning to install an E10B exchange with 1,000 subscriber lines in the training center and RSU with 4,000 subscriber lines in the MPTC Head

Office in August 1995. The RSU in the MPTC will accommodate subscribers of Penta Conta exchange.

Table 4.4-1 Existing Facilities of Switch Systems as of June 1995

| Area Code | Province or City | City or Exchange Office | Function | Office Code | Type | Year | Capacity | Existing Lines |
|---|---|---|---|---|---|---|---|---|
| 2 | Phnom Penh | MPTC | INTS | | AXE105 | 1990 | | |
| | | MPTC | LS | 22,23 24,25 | PENTA CONTA | 1960 | 4,000 | 2,800 |
| | | MPTC | LS-RSU | 26, 27, 28, 29 | AXE-RSU | 1994 | 3,000 | 1,900 |
| | | MPTC | LS-RSU | | E10B-RSU | 1995 | 4,000 | PLANNING |
| | | ITC | INTS | | AXE105 | 1994 | | 200 ch |
| | | ITC | LS | | AXE105 | 1994 | 2,000 (5,000) | |
| | | TRAINING CENTRE | LS | | E10B | 1995 | 1,000 (6,000) | PLANNING |
| | KANDAL | TAKHMAU | LS | | OKI-SXS | 1990 | 400 | 140 Exchange was moved from P.P |
| | KAM.SPEU | KAM.SPEU OUDONG | LS | | MAGNET | 1982 | 100 | |
| 3 | TAKEO | TAKEO | LS | | MAGNET | 1982 | 150 | |
| | KAMPOT | KAMPOT | LS | | MAGNET | 1981 | 150 | |
| | SIHANOUKVILLE | SIHANOUKVILLE | LS | | PABX | 1982 | 100 | |
| | | SIHANOUKVILLE | LS | | MAGNET | | 100 | |
| | KAHKONG | KAHKONG | LS | | PABX | 1984 | 100 | |
| 4 | KAM.CHAM | KAM.CHAM | LS | | OKI-SXS | 1985 | 600 | |
| | PREY VENG | PREY VENG | LS | | MAGNET | 1981 | 150 | |
| | SVAY RIENG | SVAY RIENG | LS | | SEMIAUTO | 1983 | 200 | |
| | PURSAT | PURSAT | LS | | MAGNET | 1981 | 100 | |
| | BATTAMBANG | BATTAMBANG | LS | | OKI-SXS | 1986 | 1,000 | |
| | | PAILIN | | | | | | |
| | BANTAY MEAN | SISOPHON | | | | | | |
| 6 | KAM.THOM | KAM.THOM | LS | | PABX | 1981 | 100 | |
| | SIEM REAP | SIEM REAP | LS | | MAGNET | 1982 | 100 | |
| | | SAMRONG | | | | | | |
| 7 | KRATIE | KRATIE | LS | | MAGNET | 1982 | 100 | |
| | MONDU KIRI | SENMONROM | LS | | MAGNET | 1983 | 100 | |
| | STUNG TRENG | STUNG TRENG | LS | | MAGNET | 1982 | 100 | |
| | RATTANA KIRI | LUMPHAT | LS | | MAGNET | 1982 | 100 | |

Source: Information from the MPTC

Legend INTS: International Gateway Switch
LS: Local Switch
LS-RSU: Local Switch -Remote Switch Unit
Figure in brackets shows the total capacity including that of RSU

4.4.2 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 eleven (11) microwave links and three (3) optical fiber cable networks in Phnom Penh City and its surrounding area, that include the facilities of joint venture. The MPTC property is as follows:

Table 4.4-2 The MPTC Property

| Type of System | Link / Section | System Capacity |
|---|---|---|
| Microwave System | MPTC - Takhmau | 2 Mbps |
| | MPTC - Airport | 2 Mbps |
| | MPTC - ITC | 3 x 2 Mbps (not in use) |
| F/O Cable System | MPTC - Hub Station | 34 Mbps, 2 cores |
| | MPTC - ITC | 34 Mbps, 6 cores |

Source: Information from the MPTC

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

4.4.3 Outside Plant

(1) Outside Plant of Phnom Penh City

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 very much.

(a) Subscriber Network

i) Configuration of Subscriber Network

Figure 4.4-1 shows the subscriber network in Phnom Penh City composed of primary cable route, cabinets and distribution boxes.


Figure 4.4-1 Primary Cable Route

ii) Quality of Subscriber Network

The average number of faulty subscriber lines excluding the faults of telephone sets amount to 15~25 /day in dry seasons, and 25~55 /day in rainy seasons, i.e., the fault rate of the outside plant is about 13 faults/month/100 subscribers.

(b) Junction Cable

There are three transmission cables in Phnom Penh City and two of them have been installed between the MPTC Head Office and ITC along different routes. Another cable has been installed between the MPTC Head Office and the Hub Station of UNTAC system. These three cables are optical fiber cables with six-core single mode fibers.

(2) Outside Plant in Surrounding Area of Phnom Penh City

(a) Takhmau

The six aerial cables (total 212 pairs) have been installed directly from the MDF in the Takhmau Post Office. The total length of the primary cables is about 2.3 kilometers.

(b) Other Surrounding Area

There are no outside plants for telecommunications in the surrounding areas.

4.5 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) Domestic Telecommunications Operation and Maintenance

The domestic network consists mainly of the local network and the trunk network. It can be said that the current operation of the MPTC is concentrated in the local network in Phnom Penh City due to the destruction by civil war.

(2) International Telecommunications Operation and Maintenance

Currently, due to the technical problems in operation and maintenance, the INTERSPUTNIK earth station is not fully operated and most traffic goes through the INTELSAT network operated under the BCC between the MPTC and OTCI.

(3) Training Center

The MPTC has one training center in Phnom Penh named ENARPOSTEL (Training Center of Posts and Telecommunication) where 14 personnel work under a Principal.
The training center currently has two main courses, one for the certificate of BST, which is a three-year-course, and the other for the certificate of skilled worker, which is a two-year-course.

(4) Vehicles

For the purpose of maintaining telecommunications facilities, the MPTC currently possesses seven vehicles which are used by the section of outside plant installation and maintenance. MPTC staff belonging to other section uses their own motorcycles when they need to go out.

(5) Subscriber Connection

At present, due to the shortage of subscriber cable pairs available, the process becomes a complicated one.
From 1983 to 1993 the annual new subscriber connections were between two and three hundred.

(6) Subscriber Fault Repair

As is often the case in developing countries, Cambodia's telecommunications network faults mostly occur in the outside plant.
The lack of vacant pairs of subscriber cables in good condition sometimes causes incomplete repair of subscriber lines.

## 4.6 Telephone Facilities donated by UNTAC

A communications network was constructed to support the UNTAC activities in 1992 in Cambodia. After performing their duties, the leased facilities for the communications network were removed, and the remaining facilities (worth US$28.8 million) were donated to the Cambodian Government.

The major communications facilities donated by UNTAC are shown as follows:

Table 4.6-1 Telephone Facilities donated by UNTAC

| Telephone Facilities | Component (volume) | Present Conditions | Remarks |
|---|---|---|---|
| Satellite Communications System | Hub Station equipment (1)<br>DAMA controller (1)<br>PA equipment (1)<br>PABX (MD 110) (1+21)<br>Earth station equipment (21)<br>Engine generator (1+21) | for communications between Phnom Penh and provinces | |
| Microwave System | Microwave system (3 links) | Hub - Airforce<br>Hub - Kangaroos Station (not in use)<br>The MPTC - Toul Kork TV Station | |
| P-MP System | IRT 2000 (TRT)<br>Central station equipment (1)<br>Repeater station equipment (2)<br>Remote terminal station equipment (5 x 2) | not in use | |
| P-P System | Exicom SR310 (1 link) | Hub - CMAC (Cambodia Mine Actions Center) | |
| Cellular Telephone System | AMPS-800<br>Base station equipment<br>(1 station, 15 RF CH)<br>Exchange (1)<br>Subscriber terminals (350 sets) | not in use | |
| Mobile Radio System<br>(Trunk Line Mobile Radio System) | (TAIT)<br>Base station equipment<br>(1 station, 6 RF CH)<br>Subscriber terminals (89 sets) | for government communications | |

Source: Information from the MPTC

The above communications systems will be connected to PSTN with charging systems by the joint venture of the MPTC and PT. INDOSAT. The modification and relocation is now under way by the joint venture company which is named CAMINTEL.

## CHAPTER 5 DEMAND FORECAST

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

Since there are two different ways to obtain demand, the Study has two different results in Phnom Penh City as shown in Tables 5.1-3 and 5.2-1.

The evaluation of the results and descriptions of the demand used for the Study are shown as follows:

### 5.1 Macroscopic Demand Forecast for Telephones

#### (1) Result of National Demand Forecasts

Table 5.1-1 shows the calculation result produced herewith.

Table 5.1-1 National Demand Forecasts

| Year | GDP (M. US$) | Population (Thousand) | GDP per capita (US$) | Telephone Density | Demand |
|---|---|---|---|---|---|
| 1997 | 2,986.4 | 10,082 | 296 | 0.68 | 68,600 |
| 1999 | 3,451.1 | 10,488 | 329 | 0.76 | 79,600 |
| 2002 | 4,287.3 | 11,081 | 387 | 0.90 | 99,600 |
| 2004 | 4,954.5 | 11,479 | 432 | 1.01 | 115,700 |
| 2007 | 6,155.0 | 12,072 | 510 | 1.20 | 144,700 |

#### (2) Result of Demand Forecast for Phnom Penh Municipality

Following the demand forecast at a national level, the calculation result is allocated to Phnom Penh, the capital city as follows.

Table 5.1-2 Demand Forecasts in Phnom Penh Municipality

| Year | GDP per capita (US$) | Phnom Penh's Population (Thousands) | Demand | Phnom Penh's Telephone Density |
|---|---|---|---|---|
| 1997 | 296 | 1,016 | 22,200 | 2.19 |
| 1999 | 329 | 1,097 | 26,500 | 2.42 |
| 2002 | 387 | 1,241 | 35,800 | 2.88 |
| 2004 | 432 | 1,351 | 44,300 | 3.28 |
| 2007 | 510 | 1,538 | 62,000 | 4.03 |

(3) Demand Forecast inside Phnom Penh Municipality

Phnom Penh Municipality is divided into seven districts. The detailed demand diffusion in four of "Khan" is investigated by the field survey for below-mentioned microscopic demand forecast by the Study Team and the division of Phnom Penh Municipality's demand into three of "Srok" is calculated herewith.

Table 5.1-3 shows the demand inside Phnom Penh Municipality.

Table 5.1-3 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 |

(4) Demand Forecast of Prek Phnou and Takhmau

Table 5.1-4 shows future demand of Takhmau and Prek Phnou.

Table 5.1-4 Demand of Takhmau and Prek Phnou

| Year | Takhmau | Prek Phnou |
|---|---|---|
| 1997 | 1,000 | 80 |
| 2002 | 2,000 | 180 |
| 2007 | 4,000 | 420 |

5.2 Microscopic Demand Forecast for Telephones

The microscopic demand forecast adopted herewith is, described in detail later on, applied only to Phnom Penh city, as it is the method that is adequate to apply to urban area.

(1) Category of Property

The present category of property consisting of the properties of the equal telephone density is firstly confirmed by the Schematic Survey where future demand of each category of properties is estimated in line with macroscopic demand forecast results in Phnom Penh City.
Each category of property is defined following studies in other countries by the Study Team.

(2) Detailed Survey

By the detailed survey an area classification map was formulated.

Should the land area of a calculation unit, that is a street block, and the classification of the property in the calculation unit be determined by the field survey by the Study Team, the demand value is obtained corresponding to demand density defined beforehand.

(3) Calculation of Microscopic Demand Forecast

Calculation of Demand was made by totalizing demand value in the calculation unit in the Phnom Penh City. 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

In the course of the Study, the comparison between micro- and macrodemand forecast result was made by the Team and the Team came to the conclusion that the result could be similar. For the purpose of the Study, therefore the demand forecasted by macroscopic demand forecast is applied to the surrounding areas where microscopic demand forecast method is not adequate and the demand forecasted by microscopic demand forecast is applied to Phnom Penh City as local cable design requires the detailed demand diffusion that microscopic demand forecast can provide. The demands 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 which is produced by the cellular telephone density represented by the formula of

$$D = \frac{0.216}{1 + 1.23\, e^{-0.977(t - 1992)}}$$

Where D represents cellular telephone density and t means the year in question.

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

Referring to exchange locations studied in Chapter 8, the network structure for Phnom Penh and its surrounding areas was decided as shown in Figure 6.1-1.

This network is to be composed of final trunks and local exchanges are fully connected by direct trunks. Outgoing long distance calls (including international calls) and special service calls from local exchange subscribers are concentrated at the Central Exchange Office and then sent to their destinations. The loss probability of 0.01 will be applied for calculating the number of junction circuits.

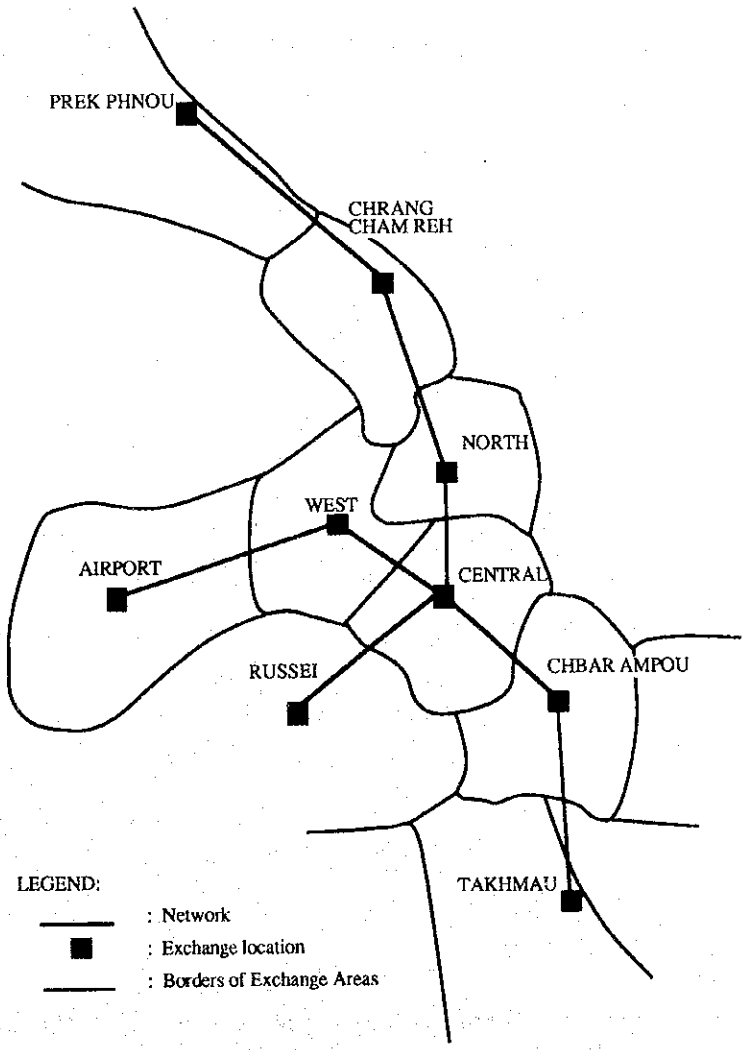



Figure 6.1-1 Network in Phnom Penh City and its Surrounding Areas

## 6.2 Numbering Plan

The proposed numbering plan for Phnom Penh and its surrounding area will be 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.

Considering the above principles, the telephone numbering for subscribers accommodated by newly installed exchanges in this area will be 023-NX-XXXX. Here, N; 2 ~ 9, X; 0 ~ 9.

Figure 6.2-1 shows proposed first digit number N of exchange code for new local exchange areas.

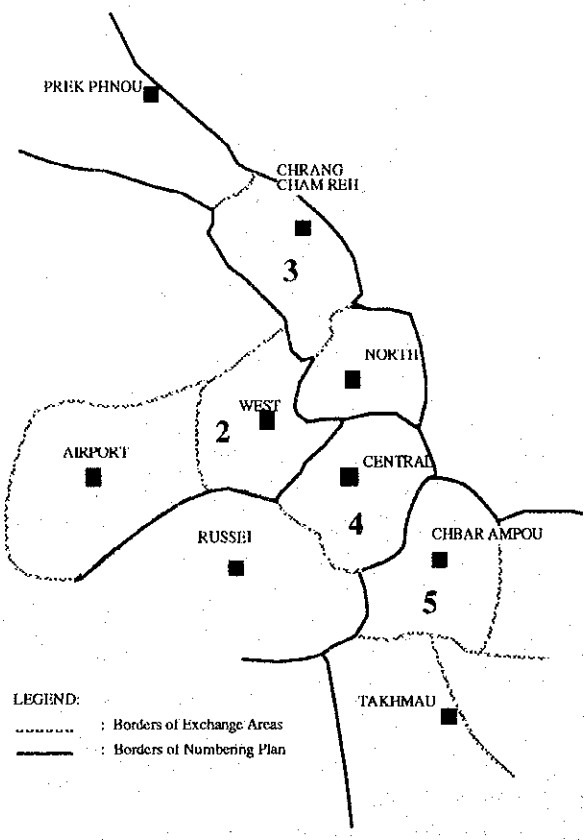



Figure 6.2-1 Numbering Plan in Phnom Penh City and its Surrounding Areas (The numbers represents the first digit number N of exchange code) 023-NX-XXXX

6.3 Signaling System

The CCITT CCS No. 7 is applied to the signaling system between digital exchanges. In the first stage of the introduction of digital exchange, an associated mode is used as the mode of signaling link as shown in Figure 6.3-1.

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

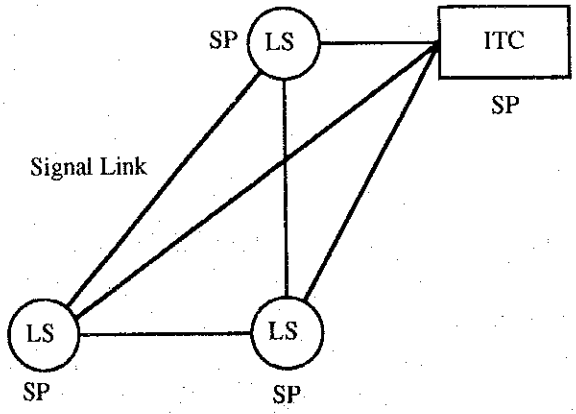



Figure 6.3-1 Signal Transfer Mode (associated mode) in Objective Area in the Emergency Project

In the future, a quasi-associated mode will be introduced and each Signal Point (SP) will belong to two Signal Transfer Points (STP) as shown in Figure 6.3-2.

In this Study, the quasi-associated mode will be applied to the Essential Project.

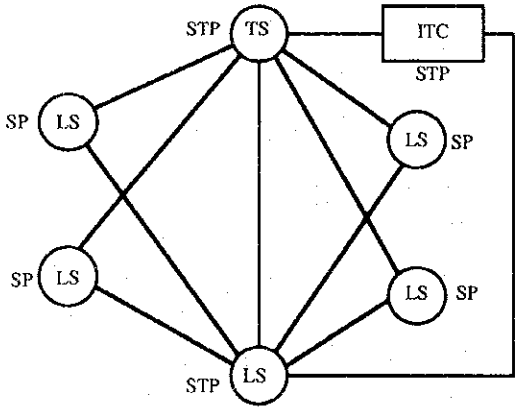



Figure 6.3-2 Signal Transfer Mode (quasi-associated mode) in Objective Area in the Future

## 6.4 Charging System

The present charging systems are shown in the following table.

Table 6.4-1 Present Charging Systems

| Category of Call | Charging System | Charging Point |
|---|---|---|
| Local call | *1 None | - |
| Long distance call | *2 None | - |
| International call | Automatic Message Accounting (AMA) System | Local Switch |

*1 Flat rate system *2 Per minute system

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

## 6.5 Synchronization Plan

For the telecommunication network of Cambodia, a master-slave synchronization method will be introduced. For the time being, the existing international exchange which has cesium oscillators with a stability of $10^{-12}$/life time will be the master exchange. Local exchanges to be introduced will be slave exchanges. Local exchanges will have oscillators with stability of $10^{-8}$/life time as back up oscillators in free run. RSU will have oscillators with stability of $10^{-6}$/life time as back up oscillators in free run. Master clock distribution network for the time being is shown in Figure 6.5-1.

When a new trunk exchange is introduced in Phnom Penh City, it will be a sub-master exchange and will have cesium oscillators with stability of $10^{-12}$/life time as back up oscillators. Master clock distribution network in the future is shown in Figure 6.5-2.

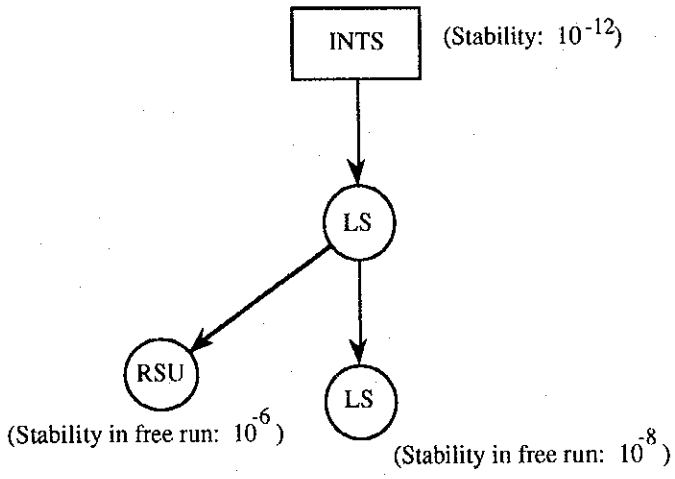



Figure 6.5-1 Master Clock Distribution Network for the Time Being

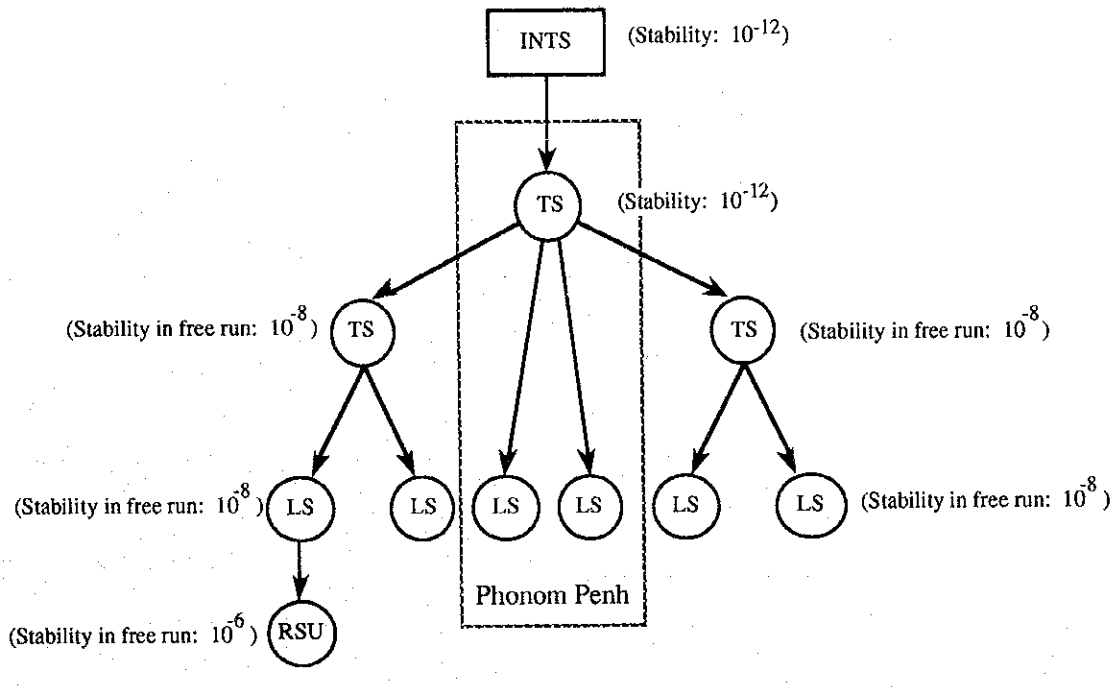



Figure 6.5-2 Master Clock Distribution Network in the Future

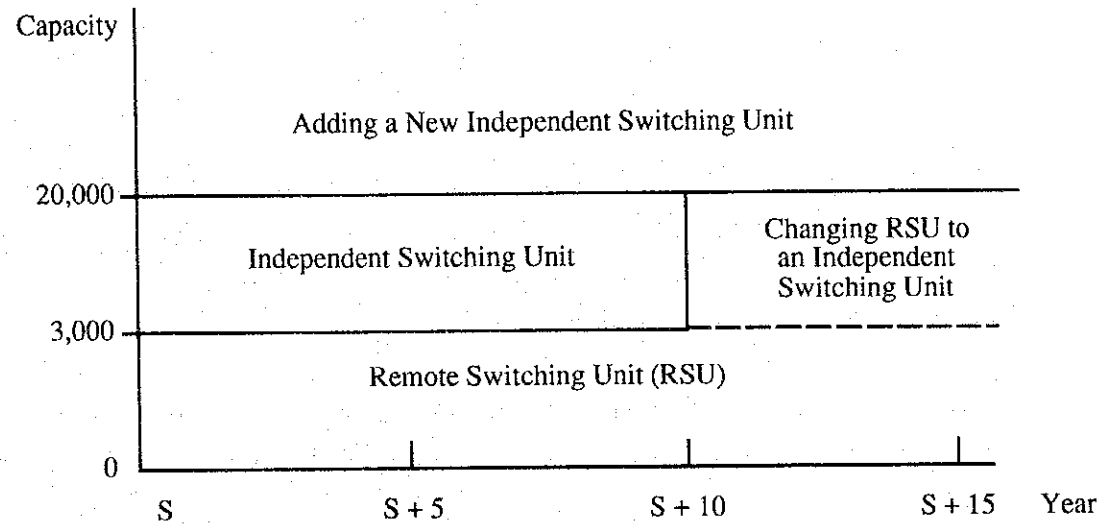
## 6.6 Technical Standard of Network Quality

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

Selection criteria of switching systems is shown in the Figure 7.1-1.




(1) In the case of establishing a remote switching unit, an independent switching unit to accommodate it is necessary in the same local area.

(2) If there is not an independent switching unit to accommodate RSU, an independent switching unit will be installed even though it has small exchange capacity.

Figure 7.1-1 Selection Criteria of Switching Systems

### 7.2 Transmission Network System

For the provision of the transmission system for the junction network in the Study, an optimum system should be selected considering not only the requirement to meet traffic density estimated in the year targeted, but also the requirement that it be an economical system for the whole network which takes into account the world technology trend.

7.2.1 Selection of System

A digital transmission system should be applied to the networks in the study area. The Synchronous Digital Hierarchy (SDH) system is to be introduced to the networks for the following reasons.

- SDH has been standardized and recommended by ITU-T as a worldwide unified digital hierarchy system in 1988, and approved by the World Telecommunication Standardization Conference (WTSC) in March, 1993.

- The Plesiochronous Digital Hierarchy (PDH) system might become globally obsolete telecommunications technology in the near future. Therefore, it is presumed that the equipment and materials for PDH will become difficult to obtain for maintenance and operation of the system.

- It is an advantage of SDH system that the management system for transmission networks utilizing either micro-wave links or optical fiber links, can be adopted easily.

- The system interface is unified as 155.52 Mb/s, and can connect with inter networks among other countries, so the multi-venderization of equipment is possible.

7.2.2 Interface of SDH

The interface of the SDH system in the Study is shown in Figure 7.2-1.

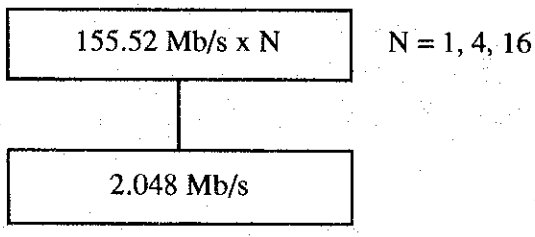



Figure 7.2-1 Interface for SDH

7.2.3 Selection of Transmission Network for the SDH System

The SDH system can be applied to the transmission network (media) utilizing either the micro-wave link or optical fiber link systems. Therefore, the optimum transmission network to be applied in the Study is determined by the cost comparison between the above 2 systems. The cost comparison was made for the 3 conceivable systems (media) in the Study, i.e., the digital micro-wave transmission system (155 Mb/s), the optical fiber system (155 Mb/s) and the optical fiber system (600 Mb/s), and the results are shown in the Figure 7.2-2. An applicable range for optimum systems given in the figure in terms of distance between the terminal exchanges and capacities to be transmitted as parameters.

In accordance with the cost comparison, the SDH system using optical fiber transmission system is an appropriate medium for the transmission network when the distance between exchanges is less than 20 km and when the capacity of transmission is less than 126 systems (calculated in terms of 2 Mb/s).

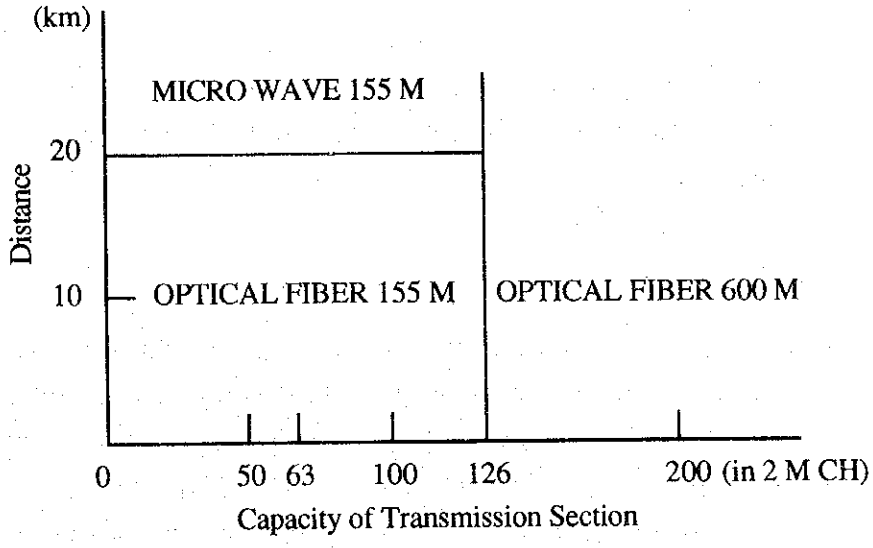



Figure 7.2-2 Standard of System Selection for SDH

7.3 Subscriber System

The subscriber system to be applied in the study areas is selected considering the following conditions:

(1) Request by Cambodian Side

The Cambodian side requests the application of the metallic cable system in the study areas due to the following reasons:

- To rehabilitate the cable subscriber network as a basic telephone service
- To avoid competition with the existent joint venture companies
- To provide affordable public services
- To manage the subscribers by the easiest means as far as possible
- To solve the difficulty of subscribers to get commercial power supply for terminals

(2) Required Service Menu

The subscriber system to be applied in the study areas requires only a basic service menu such as ordinary telephone functions and facsimile communications.

(3) Application Conditions

In the study areas, the conditions of the AC commercial power are very poor. If the radio subscriber systems are applied to the ordinary subscribers (not specific subscribers such as important subscribers), the provision of the power supply system is required. Besides, the cable subscriber system can be constructed easily due to little restriction in the study areas compared with the other countries.

From the above considerations, the metallic cable system is selected for subscriber systems in the study areas.

# CHAPTER 8 DEVELOPMENT STRATEGY

## 8.1 Demand Fulfillment Plan

The basic concept of this development strategy is shown in the following expression.

**To improve the services in both quantity and quality for supporting and enhancing the socio-economic activities of the area.**

In this plan, in accordance with the Investment Program, the penetration ratio of the greater Phnom Penh City will improve to more than 2 to 3 telephones per 100 inhabitants by the year 1997, and the following items will be completed during the 10 years from 1997 to the final target year 2007 of this project:

- 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

To realize the target, the following strategy will be applied to telephone supply and network development.

### 8.1.1 Telephone Supply Strategy

Based on the concept to support and enhance the socio-economic activities mentioned above, the telephone supply strategy categorizes all waiting applicants into five groups, priorized in the order as given: administrative group, public group, industrial / business group, commercial group and residential group. For the area within an exchange, the telephone lines are provided to all waiting applicants in accordance with the priority orders. For the area outside exchange areas, the subscriber radio system will be provided to the waiting applicants belonging to the highest priority group.

8.1.2 Provisioning Period

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

A provisioning plan is prepared in accordance with the telephone demand forecasted.

8.2.1 Exchange Area

Taking into consideration of telephone demand density, area size, boundary condition for big river, railway and administration, application of unigauge system using 0.4 mm conductor diameter cable and limitation of subscriber line loss 7 dB, an exchange office is the center of an exchange area within a radius of 3 Km. The greater Phnom Penh City has 3 exchange areas in the city and 6 exchange areas in the surrounding area. These exchange areas are shown in Figure 6.1-1.

8.2.2 Telephone Demand of Each Exchange

The telephone demand forecast for each exchange is shown in Table 8.2-1. All exchanges except North Exchange are proposed to be newly established and to cover respective area telephone demand. However, in consideration of future network in Cambodia, it is recommended to shift the location of existing North Exchange. The subscriber radio system will be applied for the high priority subscribers outside exchange areas, such as administrative offices, hospital / clinics, police station, organization offices to be subordinate to the government and / or non governmental organizations.

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1994 | 1,300 | 8,200 | 4,400 | 300 | 50 | 500 | 900 | 930 | 40 | 1,830 | 18,450 |
| 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

### 8.3.1 Telephone Network in the greater Phnom Penh City

The telephone network in this area will be realized in the year 2007 as shown in Figure 6.1-1 and the capacities for main equipment of each exchange office are listed in Table 8.3-1.

Table 8.3-1 Capacities of Main Equipment

| Exchange Office | Switching Unit | Exchange Capacity | MDF Termination | Transmission Media |
|---|---|---|---|---|
| NRT (MPTC) | LS | 3,600 lu. | 4,000 pairs | F/Optic |
| CNT | T/LS | 21,000 lu. | 24,800 pairs | ditto |
| Other Area | (incl. Central) | (100 lu.) | (-) | digital MAS |
| WST | LS | 15,000 lu. | 17,600 pairs | F/Optic |
| CCR | RSU | 1,300 lu. | 1,600 pairs | ditto |
| PPN | RSU | 500 lu. | 600 pairs | ditto |
| APT | RSU | 3,000 lu. | 3,600 pairs | ditto |
| TKM | LS | 4,800 lu. | 5,000 pairs | ditto |
| CAP | LS | 4,400 lu. | 4,600 pairs | ditto |
| PRS | RSU | 300 lu. | 350 pairs | ditto |
| Total | - | 54,000 lu. | 62,150 pairs | - |

Note: Host exchange of RSUs in Prek Phnou, Charang Cham Reh, and Russei exchanges is Central exchange,
Host exchange of RSU in Airport exchange is West exchange,
T/LS means Toll Local Switching,
F/Optics means optical fiber cable (junction cable system).

### 8.3.2 Project Implementation Plan

In order to realize the public telecommunications network in the year 2007, the implementation plan for the provision of facilities is established as shown in Table 8.3-2. The exchange offices planned for the objective area are divided into three groups by the priority order as follows:

Table 8.3-2 Project Implementation Plan

| | Essential Project | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1st | | 2nd | | 3rd | | 4th | | Total |
| Implementation Year | | | '00 ~ '02 | | | | '05 ~ '07 | | |
| Provision Year | | | '02 | | | | '07 | | |
| Central Exchange Office | | | 13,400 | 4,000 | | | 19,800 | 6,400 | 19,800 |
| West Exchange Office | | | 8,300 | 3,000 | | | 13,900 | 5,600 | 13,900 |
| Air Port Exchange Office | | | 1,400 | 800 | | | 2,900 | 1,500 | 2,900 |
| Implementation Year | '97 ~ '99 | | | | '02 ~ '04 | | | | |
| Provision Year | '99 | | | | '04 | | | | |
| North Exchange Office | 2,000 | | | | 3,300 | 1,300 | | | 3,300 |
| Charang Cham Rey Exchange Office | 600 | | | | 1,200 | 600 | | | 1,200 |
| Takhmau Exchange Office | 2,200 | | | | 4,300 | 2,100 | | | 4,300 |
| Chabar Ampou Exchange Office | 2,000 | | | | 4,000 | 2,000 | | | 4,000 |
| Implementation Year | | | | | | | '05 ~ '07 | | |
| Provision Year | | | | | | | '07 | | |
| Prek Phnou Exchange Office | | | | | | | 420 | | 420 |
| Russei Exchange Office | | | | | | | 240 | | 240 |
| Expansion Total | 6,800 | | 23,100 | 7,800 | 12,800 | 6,000 | 37,260 | 13,500 | 50,060 |
| Construction Period | 1st | | 2nd | | 3rd | | 4th | | |
| Year | 97 | 99 | 01 | | 03 | | 05 | 07 | |

**The First Priority Group** includes 3 exchange areas, i.e., Central Exchange Office area, West Exchange Office area, and the Airport Exchange Office area and the other areas to be covered by the subscriber radio system. The Emergency Project completed in the year 1997 is a main part of this group and 16,800 line units are planned to be installed under the Emergency Project. After the Emergency Project, it is desirable to establish more telephones for the existing exchanges every five years.

**The Second Priority Group** includes 4 exchange areas, i.e., 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 7,600 line units in the year 1999. For these 4 exchanges, more telephones will be established in the year 2004.

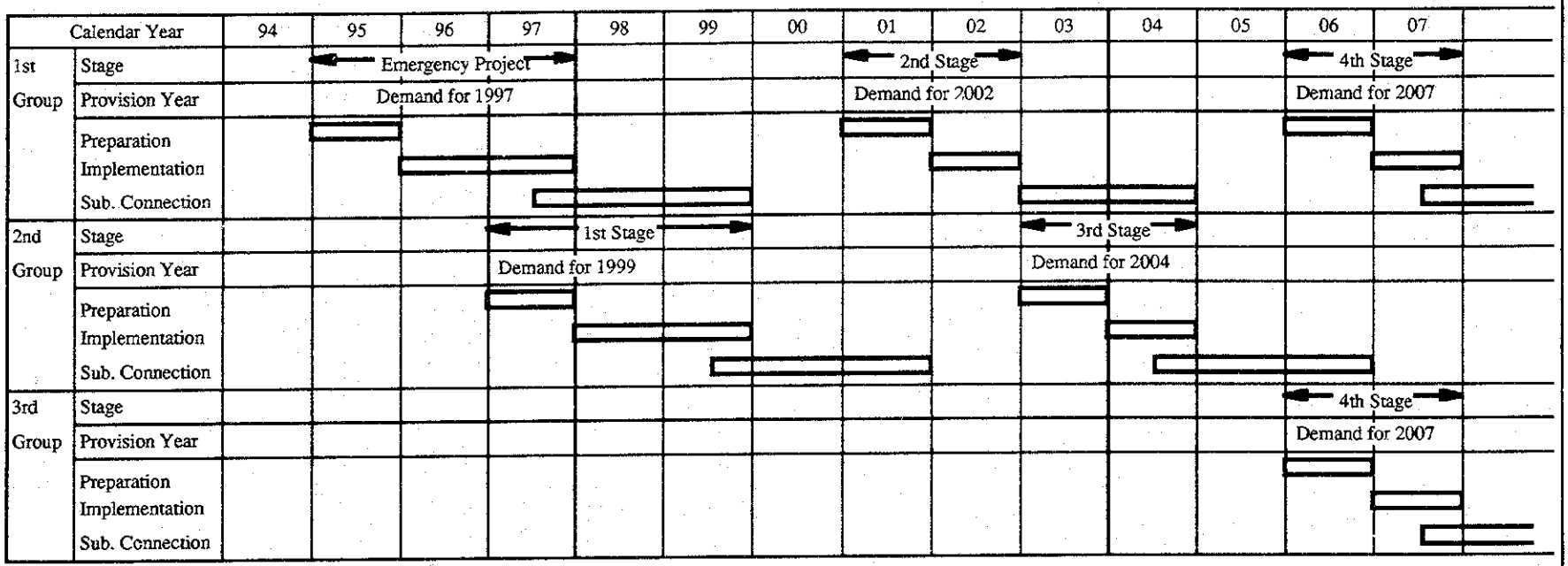
**The Third Priority Group** includes 2 exchange areas, i.e., Prek Phnou Exchange Office area and Russei Exchange Office area. This project plans to have provided 800 line units in 2007.

8.3.3 Project Implementation Schedule

The overall time schedule of the project implementation is shown in Table 8.3-3. The following preconditions are taken into consideration in formulating the time schedule and details are described in Chapter 12.

(1) Implementation of the Emergency Project is required urgently.
(2) The project implementation contractor should be selected by competitive bidding.
(3) Equipment and materials should be provided by the same contractor for all areas in the groups to ease operation and maintenance, and also to reduce cost required for spare units.
(4) Construction work should be carried out on turn-key basis by the contractor.
(5) MPTC will take responsibility for the connection work for subscriber lines including financial resources.

Table 8.3-3 Implementation Schedule




Note: Exchanges consisted in each group are as follows
1st Group - Central Exchange, West Exchange, Airport Exchange
2nd Group - North Exchange, C.C. Rey Exchange, Takhmau Exchange, C. Ampou Exchange
3rd Group - P. Phnou Exchange, P. Russei Exchange

## CHAPTER 9 TRAFFIC FORECAST AND CIRCUIT CALCULATION

This chapter is for obtaining the number of junction circuits among exchanges in Phnom Penh and it's surrounding area. For this purpose, the following items were studied one by one.

(1) Measurement of outgoing and incoming traffic of the existing digital exchanges
(2) Determination of average outgoing calling rate per subscriber
(3) Presumption on traffic volume per each local exchange
(4) Preparing traffic matrix
(5) Calculation of number of junction circuits among exchanges

### 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.

(1) Monday had the most heavy traffic.
(2) The busy hour was one hour between 10 to 11 o'clock in the morning.
(3) Outgoing calling rates by types of calls are as follows;
    (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

Local Traffic is distributed to each exchange. The result in 2007 of this local traffic distribution is shown in Table 9.2-1. As an assumption on preparing this table, the affinity rate among exchanges is equal and it is not affected by the distance between exchanges.

Table 9.2-1 Local Traffic Matrix in 2007

(erl)

| | 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 | |

## 9.3 Traffic between Host Exchanges and its RSUs

The Central Exchange Office has three RSUs, or C.C Reh, Prek Phnou and Russei. Table 9.3-1 shows the outgoing traffic from each RSU to Central Exchange Office. The West Exchange Office has the Airport RSU and the outgoing traffic from Airport RSU to the West exchange is 124 erl.

Table 9.3-1 Outgoing Traffic From RSUs to Central Exchange in 2007

(erl)

| CCR | PPN | RRS |
|---|---|---|
| 55 | 21 | 13 |

## 9.4 Circuit Calculation

### 9.4.1 Circuit Calculation Result for the Number of Junction Circuits

For the number of circuits required in the local networks, calculations are made for junctions, long distance networks and special service circuits according to categories of calls. In this study, the calculation used 0.01 as loss probability. The calculation result in 2007 is shown in Table 9.4-1.

Table 9.4-1 Number of Junction Circuits among Exchanges in 2007

(ch)

| | Local | | | | | | | Long Distance | Special Service |
|---|---|---|---|---|---|---|---|---|---|
| | CNT | WST | NRT | TKM | CAP | ITC#1 | ITC#2 | | |
| CNT | | 240 | 60 | 90 | 90 | 90 | 270 | 120 | 120 |
| WST | 240 | | 60 | 60 | 60 | 60 | 210 | 120 | 60 |
| NRT | 60 | 60 | | 30 | 30 | 30 | 60 | 60 | 60 |
| TKM | 90 | 60 | 30 | | 30 | 30 | 90 | 60 | 60 |
| CAP | 90 | 60 | 30 | 30 | | 30 | 60 | 60 | 60 |
| ITC#1 | 90 | 60 | 30 | 30 | 30 | | 90 | 60 | 60 |
| ITC#2 | 270 | 210 | 60 | 90 | 60 | 90 | | 120 | 60 |

9.4.2 Circuit Calculation Result for the Number of Circuits between Host Exchange Offices and its RSUs

The number of circuits between Central Exchange Office and its RSUs in 2007 is shown in Table 9.4-2 and the number of circuits between West Exchange Office and Airport RSU is 300 ch.

Table 9.4-2 Number of Circuits between Central Exchange Office and RSUs in 2007

| CCR | PPN | RRS |
|---|---|---|
| 180 ch | 120 ch | 60 ch |

# CHAPTER 10 TELECOMMUNICATIONS FACILITY PROVISION PLAN OF ESSENTIAL PROJECT

## 10.1 Exchange Facilities

The number of subscriber lines of new local exchanges for each facility provision year is shown in the Table 10.1-1.

Table 10.1-1 The Number of Subscriber Lines of New Local Exchanges

| Exchange Name | Year | | | | |
|---|---|---|---|---|---|
| | 1997 | 1999 | 2002 | 2004 | 2007 |
| Central | *1 9,600 | 10,600 | 13,400 | 15,200 | 19,800 |
| CNT | *2 10,000 | 10,000 | 14,000 | 14,000 | 21,000 |
| Airport | 600 | 900 | 1,400 | 1,900 | 2,900 |
| APT | 800 | 800 | 1,500 | 1,500 | 3,000 |
| C.C. Reh | 400 | 600 | 900 | 1,200 | 1,800 |
| CCR | | 800 | 800 | 1,300 | 1,300 |
| Prek Phnou | 80 | 120 | 180 | 260 | 420 |
| PPN | | | | | 500 |
| Russei | 60 | 70 | 110 | 150 | 240 |
| PRS | | | | | 300 |
| West | 5,300 | 5,900 | 8,300 | 10,000 | 13,900 |
| WST | 6,000 | 6,000 | 10,000 | 10,000 | 15,000 |
| North | 1,600 | 2,000 | 2,700 | 3,300 | 4,400 |
| NRT | | 2,200 | 2,200 | 3,600 | 3,600 |
| Takhmau | 1,700 | 2,200 | 3,300 | 4,300 | 6,700 |
| TKM | | 2,400 | 2,400 | 4,800 | 4,800 |
| C.Ampou | 1,500 | 2,000 | 3,000 | 4,000 | 6,200 |
| CAP | | 2,200 | 2,200 | 4,400 | 4,400 |
| AXE-105ls | | | | | |
| ITC#1 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| AXE-105int | | | | | |
| ITC#2 *3 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 |

Note: *1 : Demand *2 Number of telephone installations

*3 : Number of telephones in ITC#2 includes cellular networks to be connected to AXE105 int.

## 10.2 Transmission Facilities

In accordance with the description in 7.2, the transmission system for the project will be supported by the SDH system using optical fiber cables.

### 10.2.1 Capacity of Transmission Systems

The transmission system is planned based on the circuit calculation in Chapter 9.3 of four stages of implementation year by year.

Required capacity of the transmission system at each exchange office at the time of the implementation completion is summarized in Table 10.2-1.

Table 10.2-1 Required Transmission Capacity (1997 - 2007)

| Exchange Office | | '97 | '99 | '02 | '04 | '07 |
|---|---|---|---|---|---|---|
| Airport | (RSU) | 4 | 4 | 6 | 6 | 10 |
| West | (LS) | 32 | 38 | 48 | 54 | 66 |
| Central | (TLS) | 76 | 158 | 176 | 198 | 214 |
| North | (LS) | 0 | 22 | 24 | 28 | 32 |
| ITC | (LS/INT) | 48 | 68 | 74 | 78 | 80 |
| Russei | (RSU) | 0 | 0 | 0 | 0 | 2 |
| CH Ampou | (LS) | 0 | 36 | 38 | 46 | 50 |
| Takhmau | (LS) | 0 | 20 | 20 | 24 | 26 |
| C. C. Reh | (RSU) | 0 | 4 | 4 | 6 | 10 |
| Prek Phnou | (RSU) | 0 | 0 | 0 | 0 | 4 |
| Total Unit/2 Mbps | | 160 | 350 | 390 | 440 | 494 |

### 10.2.2 Cores of Optical Fiber Cable

Figure 10.2-1 shows the cable route for junction network, the number of cores and rough length of the optical fiber cables as of the final stage of the project, 2007.

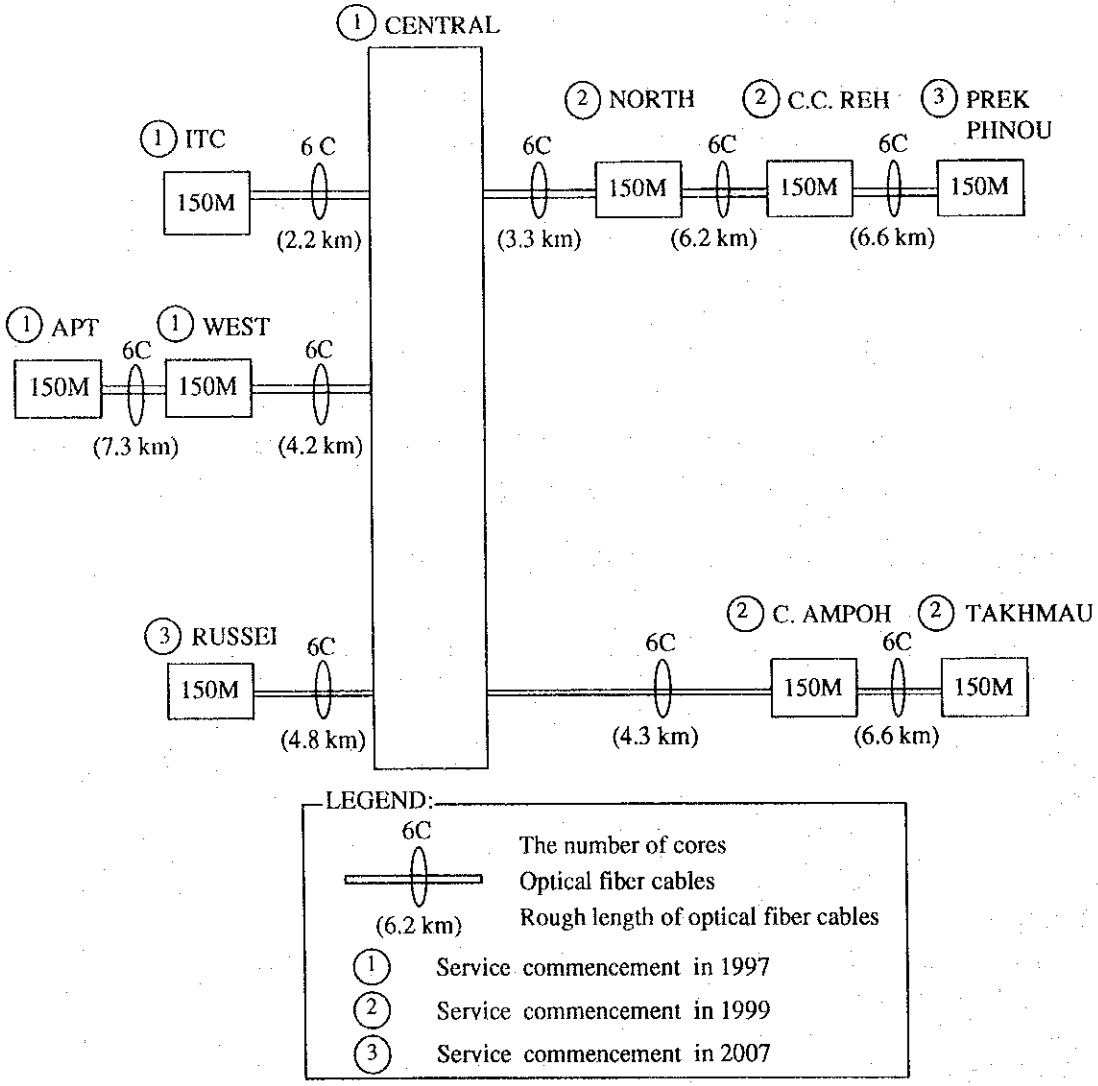



Figure 10.2-1 Cable Route of Junction Network

10.2.3 Network Management System

In order to facilitate the introduced SDH system's operation and maintenance, the network management system consisting of local management and central management systems will be adopted in both Projects.

(1) One portable local network management system will be provided in the Emergency Project and used to monitor the status of SDH operation, and change of SDH parameters.

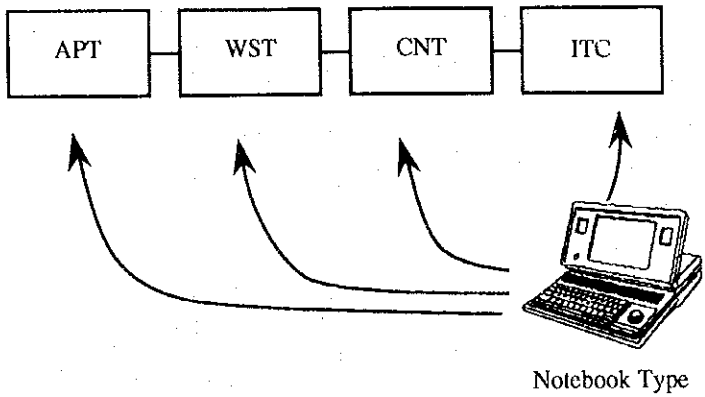



Figure 10.2-2 Configuration of Portable Local Network Management System

(2) The central network management system will be provided in the 1st stage of the Essential Project. This system which is a fixed type will be installed in Central Exchange Office, and can monitor the status of SDH system in all the exchange offices in operation and can change SDH parameters. The configuration of the network management system is shown in Figure 10.2-3. Major functions of the network management system are shown in Table 10.2-2.

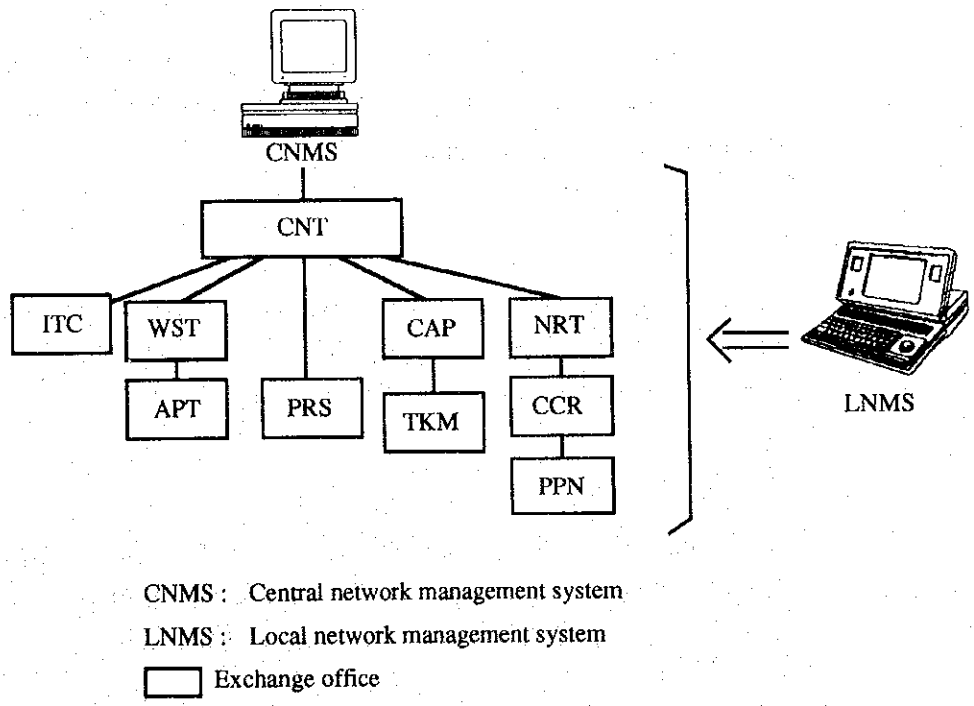



Figure 10.2-3 Configuration of Network Management System

Table 10.2-2 Function of Network Management System

| | Major Functions | Local | Central |
|---|---|---|---|
| 1 | Alarm and status monitor | x | x |
| 2 | Provisioning setting | x | x |
| 3 | Performance monitor | x | x |
| 4 | Control | x | x |
| 5 | Security | x | x |
| 6 | Configuration management | | x |
| 7 | Network route indication | | x |
| 8 | History data log | | x |

## 10.3 Outside Plant

### 10.3.1 Subscriber Network

(1) The Facility Provision Policy

(a) Subscriber Network System

The flexible distribution system will be applied to the subscriber network of the Essential Project. This system can provide cable pairs effectively to meet the fluctuation of demand.

(b) Primary Cable

Phnom Penh City suffers from floods frequently in the rainy season. Jelly filled cable is therefore applied to the primary cable which will prevent cable troubles caused by the infringement of water.

(c) Secondary Cable

The direct buried cable is applied for the secondary cable taking the request from the Cambodian side for the reliability of the cable into consideration. The cable is jelly filled and steel armored.

(d) Type of Cable

The electrical characteristics of cable and the number of the cable pairs used for the Essential Project are shown in Table 10.3-1 and Table 10.3-2 respectively.

Table 10.3-1 Electrical Characteristics

| Diameter (mm) | Direct Current Loop Resistance (Ω/km) | Transmission Loss (dB/km) |
|---|---|---|
| 0.4 | 148.0 | 1.84 |

Table 10.3-2 Number of the Cable Pairs

| Kind of Cable | Number of Pairs |
|---|---|
| Primary Cable | 400, 600, 800, 1000, 1200, 1300, 1400, 1600<br>1800, 2000, 2200, 2400 |
| Secondary Cable | 10, 20, 30, 50, 100, 200 |

(e) Civil Work

The number of duct lines will match the number of the primary cables to be installed for the Essential Project. In order to avoid digging up the road frequently, one duct line for maintenance (replacement of damaged cable) and one spare duct line for fluctuation of the demand are added.

(2) Major Work Volume

On the basis of the facility provision policy mentioned above, the major work volume of the subscriber network for the Essential Project is calculated. Summaries for the major work volume for each stage are shown in Table 10.3-3.

Table 10.3-3 Primary Cable Pairs for each Stage

| The Stage of the Project | Exchange Office | Primary Cable Pair |
|---|---|---|
| The First Stage (Provision Year: 1999) | North | 2,400 |
| | Charang Cham Reh | 800 |
| | Takhmau | 2,400 |
| | Chabar Ampou | 2,200 |
| The Second Stage (Provision Year: 2002) | Central | 4,800 |
| | West | 3,800 |
| | Airport | 1,000 |
| The Third Stage (Provision Year: 2004) | North | 1,600 |
| | Charang Cham Reh | 800 |
| | Takhmau | 2,600 |
| | Chabar Ampou | 2,400 |
| The Forth Stage (Provision Year: 2007) | Central | 8,000 |
| | West | 7,000 |
| | Airport | 1,800 |
| | Prek Phnou | 600 |
| | Russei | 350 |

### 10.3.2 Transmission Cable Facility

(1) Facility Provision Policy

Jelly filled single mode optical fiber cable is applied for the Essential Project.

The transmission cable will be laid directly under the ground, but will be installed into the duct in the section where the transmission cable route runs on the same route as the primary cable route of the subscriber network.

(2) Major Work Volume

The summary for the major work volume based on the facility provision policy mentioned above is shown in Table 10.3-4.

Table 10.3-4 Major Work Volume of the Transmission Cable

| Provision Year | Transmission Section | Cable Length (km) | Duct Section (km) | Buried Cable Section (km) | No. of Core |
|---|---|---|---|---|---|
| 1999 | Central - North | 3.3 | 3.3 | 0 | 6 |
| | North - C. Cham Reh | 6.2 | 2.2 | 4.0 | 6 |
| | Central - C. Ampou | 4.3 | 2.1 | 2.2 | 6 |
| | C. Ampou - Takhmau | 6.6 | 1.8 | 4.8 | 6 |
| 2007 | C. Cham Reh - P. Phnou | 6.6 | 0.8 | 5.8 | 6 |
| | Central - Russei | 4.3 | 0 | 4.3 | 6 |

10.3.3 Public Pay Phones

In principle, public pay phone terminals are installed along the sidewalk of main roads with 1,000 meters distances. Placement to be installed and the required number of public pay phone terminals by 2007 are shown in Table 10.3-5.

Table 10.3-5 Number of Necessary Public Pay Phone Terminals

| Locations | Number of Locations | Necessary Number of Terminals | Total |
|---|---|---|---|
| Along the Roads | 56 km | 1 terminal/km | 54 terminals |
| Big Markets | 3 sites | 20 terminals | 60 terminals |
| Small Markets | 8 sites | 5 terminals | 40 terminals |
| Big Hospitals | 15 sites | 3 terminals | 45 terminals |
| Bus Stations | 6 sites | 3 terminals | 18 terminals |
| Big Hotels | 20 sites | 3 terminals | 60 terminals |
| Railway Stations | 1 site | 3 terminals | 3 terminals |
| Pagodas | 30 sites | 1 terminal | 30 terminals |
| Ports | 1 site | 5 terminals | 5 terminals |
| City Halls, Theaters | 5 sites | 3 terminals | 15 terminals |
| Airport | 1 site | 30 terminals | 30 terminals |
| Total | | | 360 terminals |

At present there is an agreement between MPTC and OTCI which stipulates the installation of 175 public pay phone terminals by 2000. After completing the installation as specified in the agreement, 185 remaining public pay phone terminals to be installed at each above location will be performed.

They will be installed for each stage as shown in Table 10.3-6.

Table 10.3-6 The Number of Public Pay Phone Terminals for Each Stage

| Stage | Terminals to be Installed |
|---|---|
| The second stage (Provision Year: 2002) | 150 |
| The third stage (Provision Year: 2004) | 35 |

## 10.4 Power Supply System

### 10.4.1 Outline of Power Supply System

The power supply system at the exchange office is designed considering the accommodation plan of the telecommunications systems. The typical system diagram of the powers supply system at the telephone offices is indicated in Figure 10.4-1.

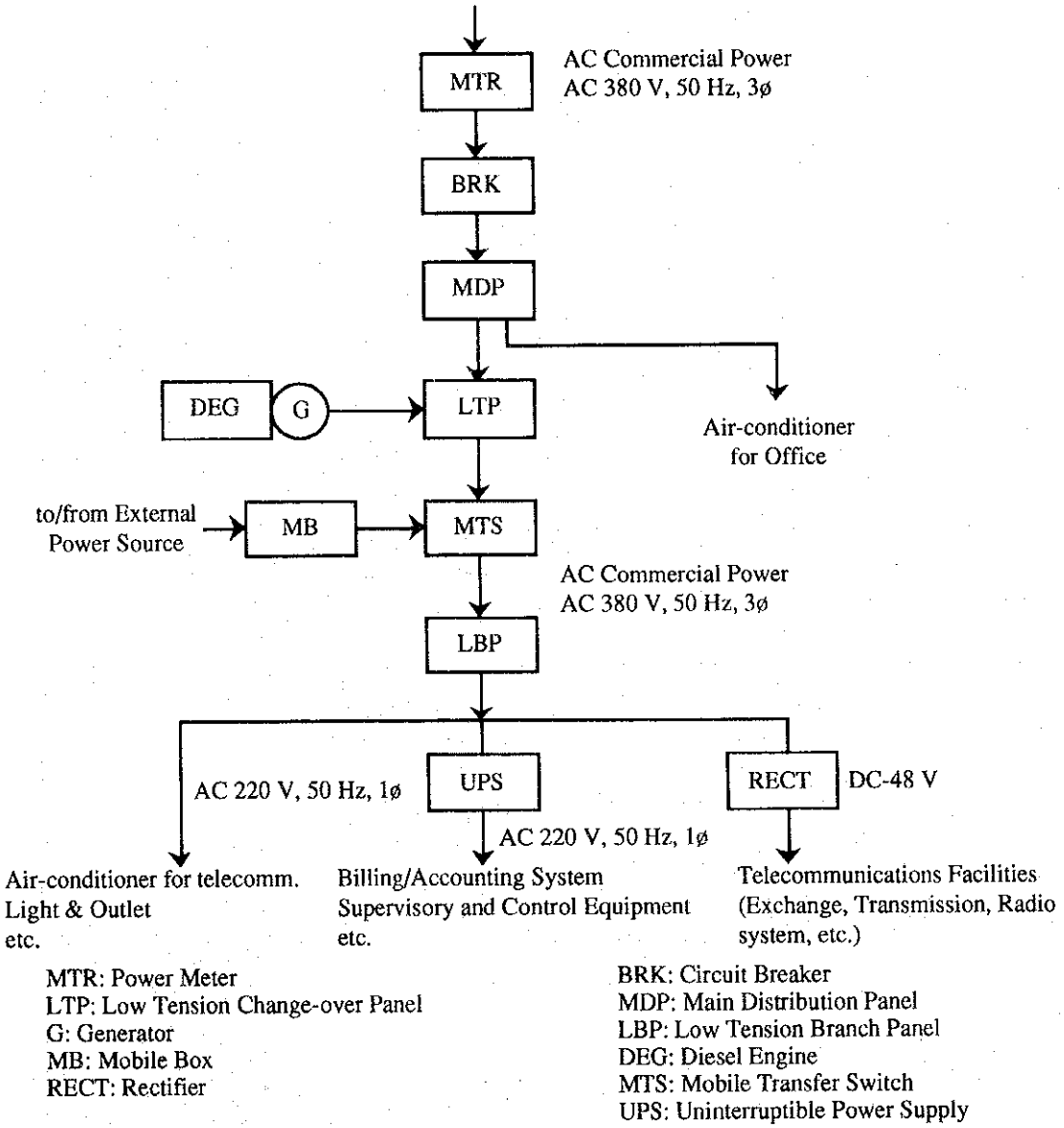



Figure 10.4-1 System Diagram of Power Supply System at the Exchange Office

The power supply systems at the Central, West and Airport Exchange Offices will be introduced under the Emergency Project.

### 10.4.2 Facility Provision Plan

Based on the introduction plan of telephone exchanges and power consumption at each office, the facility provision plan of the power supply systems is established as shown in Table 10.4-1.

Table 10.4-1 Facility Provision Plan of Power Supply system

| Exchange Office | 1st Stage (1999) | 2nd Stage (2002) | 3rd Stage (2004) | 4th Stage (2007) |
|---|---|---|---|---|
| Central | - | BATT: +5000 AH<br>RECT: +1500 A<br>MAINS:+120 KVA | - | BATT: +1000 AH<br>RECT: +300 A<br>MAINS:+20 KVA |
| West | - | BATT: +1000 AH<br>RECT: +200 A<br>MAINS:+15 KVA | - | RECT: +300 A<br>MAINS:+25 KVA |
| Airport | - | RECT: +100 A<br>MAINS:+10 KVA | - | BATT: +600 AH<br>RECT: +100 A<br>MAINS:+5 KVA |
| North | E/G: 60 KVA<br>BATT: 1000 AH<br>RECT: 300 A<br>UPS: 1 KVA<br>MAINS: 50 KVA | - | BATT: +1000 AH<br>RECT: +200 A<br>MAINS: +15 KVA | - |
| C. C. Reh | E/G: 50 KVA<br>BATT: 600 AH<br>RECT: 200 A<br>UPS: 1 KVA<br>MAINS: 40 KVA | - | BATT: +600AH<br>RECT: +200 A<br>MAINS:+15 KVA | - |
| Takhmau | E/G: 70 KVA<br>BATT: 1000 A<br>RECT: 400 A<br>UPS: 1 KVA<br>MAINS: 55 KVA | - | BATT: +1000 AH<br>RECT: +200 A<br>MAINS: +20 KVA | - |
| C. Ampou | E/G: 90 KVA<br>BATT: 2000 AH<br>RECT: 400 A<br>UPS: 1 KVA<br>MAINS: 55 KVA | - | RECT: +200 A<br>MAINS: + 20 KVA | - |
| Prek Phnou | – | – | – | E/G: 40 KVA<br>BATT: 300 AH<br>RECT: 200A<br>UPS: 1 KVA<br>MAINS: 40 KVA |
| Russei | – | – | – | E/G: 30 KVA<br>BATT: 300 AH<br>RECT: 200 A<br>UPS: 1 KVA<br>MAINS: 40 KVA |

Note *1 E/G: Engine Generator, BATT: Batteries, RECT: Rectifier, UPS: Uninterruptible Power Supply, MAINS: AC Mains, +: Equipment to be added
*2: Capacity of AC Mains means only the capacity for the contract with EDC.

## 10.5 Building

For the buildings for new exchange offices, total floor space of building is shown in the Table 10.5-1.

All the buildings are considered as newly constructed buildings.

Table 10.5-1 Total Floor Space of Buildings for New Exchange Office

| Exchange Name | Year | | | | |
|---|---|---|---|---|---|
| | 1997 | 1999 | 2002 | 2004 | 2007 |
| Central | 3,888 $m^2$ | 3,888 $m^2$ | 3,888 $m^2$ | 3,888 $m^2$ | 3,888 $m^2$ |
| Airport | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ |
| C.C. Reh | | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ |
| Prek Phnou | | | | | 36 $m^2$ |
| Russei | | | | | 36 $m^2$ |
| West | 216 $m^2$ | 216 $m^2$ | 216 $m^2$ | 216 $m^2$ | 216 $m^2$ |
| North | | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ |
| Takhmau | | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ |
| C.Ampou | | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ | 180 $m^2$ |

## CHAPTER 11 OPERATION AND MAINTENANCE PLAN

After the completion of the construction, the operation and maintenance plan will be established by the MPTC to cope with the increase of the number of new subscribers.

(1) For operation

- Plant record arrangement
- Subscriber arrangement
- Patrol
- New subscriber connection, desk and field work
- Procurement

(2) For maintenance

- Fault repair on site
- Workshop for repairing equipment/contract with local agent
- Manufactures' repair contract

### 11.1 Operation and Maintenance Body

An organization can operate and maintain those telephone offices established under the Essential Project together with those established under the Emergency Project in terms of telecommunications facilities. The main force will be stationed at the Central Exchange Office.

Given that the forecasted demand in 2007, will be around 50,000, the employees to operate and maintain all the equipment in each exchange office are centralized at night.

Concerning the operation and maintenance structure, it is determined that the operation and maintenance employees will be stationed during the daytime at exchange offices using the independent type exchange.

Meanwhile, the force for outside plant operation and maintenance formerly being stationed in the Central Exchange Office will be transferred to the below-mentioned outside plant maintenance center (OPMC).

Figure 11.1-1 shows the proposed telephone office organization as of the year 2007.

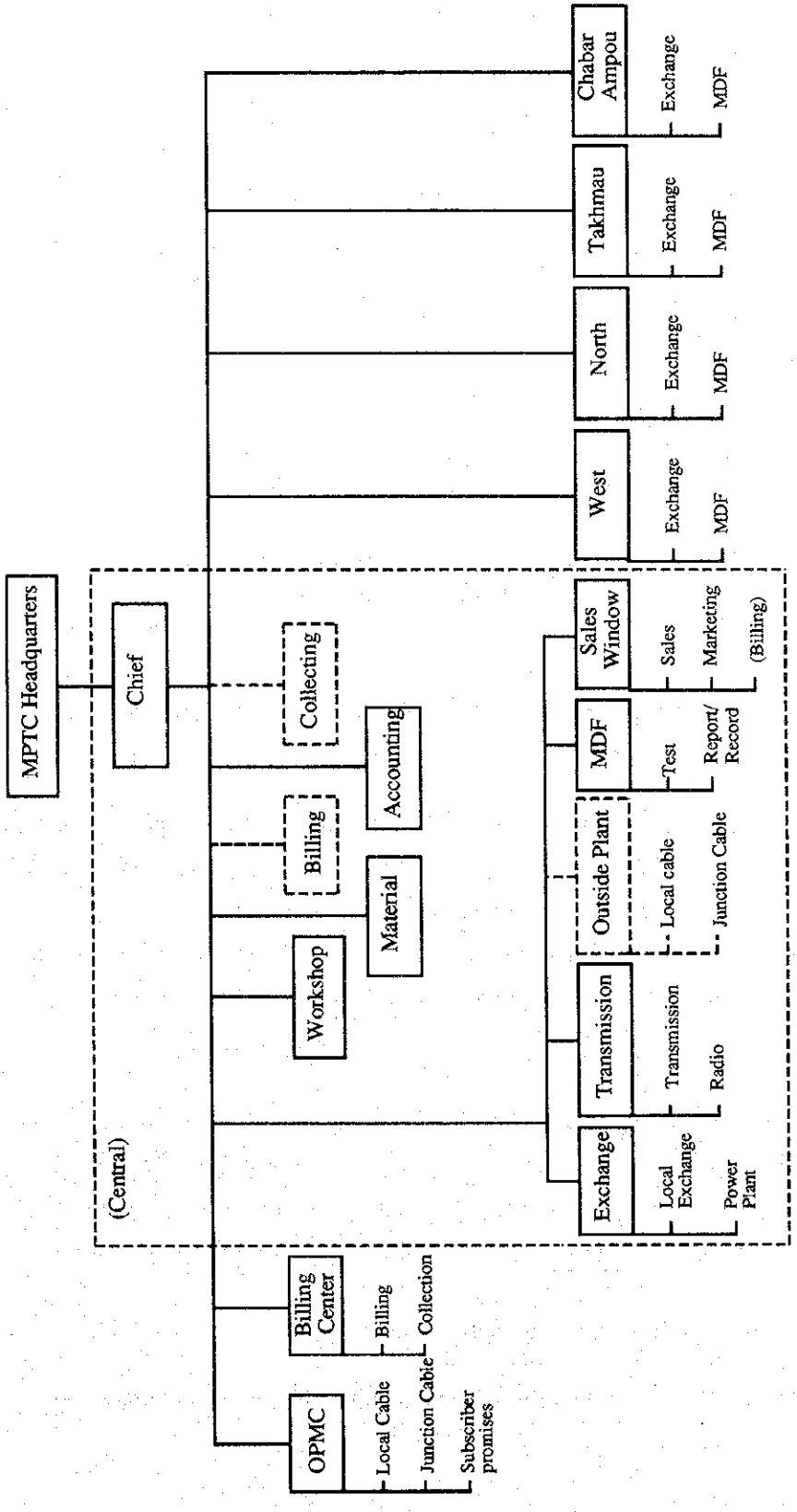



Figure 11.1-1 Proposed Telephone Office Organization as of 2007

11.2 Staffing

(1) Necessary number of employees

Figure 11.2-1 shows the assumption of number of employees.

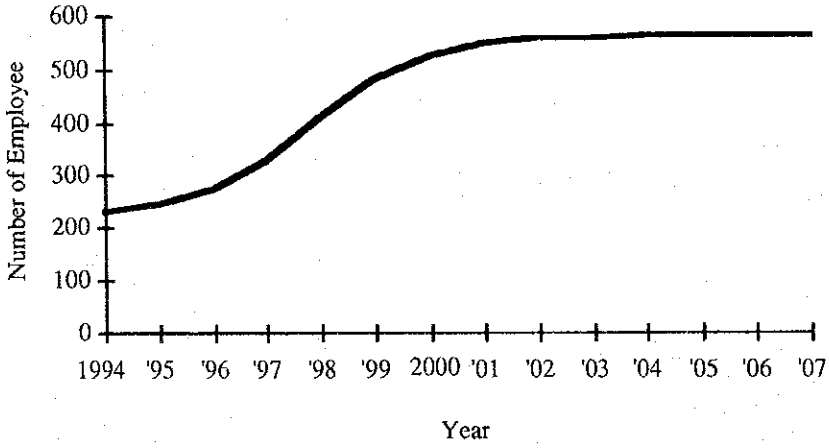



Figure 11.2-1 Number of Employees for Domestic Telecommunications Operation and Maintenance

- The efficiency in terms of the number of subscribers operated and maintained by an employee increases by 10 percent annually where 10 percent increment is estimated based on other countries experiences
- The saturation in the Figure 11.2-1 means the balance of the increase of work efficiency with the increment of the number of subscribers.

About one tenth of these employees are assumed to be administrative division. The personnel to be increased will be those doing desk work for subscribers' affairs and those of field work for outside plant. The number of employees in charge of inside plant are not so many due to technology renovation.

(2) Recruit and human resource development

The MPTC needs a recruitment plan and a human resource development plan.

11.3 Tools and Equipment for Operation and Maintenance

It will be necessary to keep the following tools and equipment for operation and maintenance work.

(1) Inside Plant

(a) Network management system

Regarding exchange equipment and transmission, the network management systems respectively are to be introduced under the scope of the Project to monitor, manage and control them from consoles at the same time of system construction. Operation and maintenance employees monitor the console which, in the case of trouble, indicates the position and situation of trouble instantly.

(b) Spare package

Necessary spare packages selected by the determination of both importance of the function and fault rate are provided by contractor(s) at the completion of the Project and kept by the MPTC.

When a fault occurs, following the diagnosis by the network management system, the deteriorated package(s) will be replaced by the spare package(s) and will be sent to the manufacture to be fixed.

(c) Vehicle

The vehicles for patrol and for dispatch of fault repair employees to unattended exchange offices is prepared under the Project.

(2) Outside Plant

As the outside plant group have to do their work outside exchange offices, vehicles having measuring equipment and/or tools necessary are provided under the Project.
Aspects required in the vehicle are, for example,

(a) Equipment and tools

i) measuring equipment;

- grounding measuring set and insulation tester for operation work
- buried cable locator and cable pair checker for maintenance work
- gas detector for common work

ii) working tools

- cable cutter for maintenance work
- manhole blower and submergible pump for common work

(b) Safety

- safety belt
- helmet
- facilities enclosing working site from third party

(c) Vehicle

- for patrol and light duty preventive as well as corrective maintenance work, van type vehicle with the capacity of 4 to 5 passengers and 500 kg payload
- for heavy duty preventive and corrective maintenance work, a truck with 1 to 2 ton capacity to carry cable drum and/or pole

Aspects which make desk work efficient will also be prepared within the scope of below-mentioned outside plant maintenance center.

- plant record management system which stores and proceeds records in terms of drawing of area wise spreading outside plant
- cable pair assignment sheets which record every terminal block number and cable pair number of each subscriber
- fault record/analysis system which controls each step of fault repairing work flow from complaint reception until repair work completion, analyzes the fault cause, location and situation to make suitable preventive measures in future

11.4 Supporting System

To operate the telecommunications facilities constructed under the project and in consideration of the MPTC's lack of experienced engineers, prompt human resource development plan preparation and prompt improvement of work efficiency are required.

To realize the above and sustain the project, the followings are to be recommended.

(1) Establishment of the following:

(a) New Training Center to be a center of human resource development

The MPTC needs not only construction of a training center building but also rehabilitation of the training program and reinforcement of the training center with practical training materials as well.

(b) Outside Plant Maintenance Center

It can be pointed out, referring to the operation conditions of other countries, that most of the faults of newly constructed telecommunications facilities will concentrate on outside plant, especially drop wire, indoor wire and telephone sets. This means, in the future, maintenance work force of the MPTC will have to mainly focus on that of outside plant and the MPTC may be required to prepare a special taskforce to meet such a situation from the two aspects of providing services of good quality to its customers and operating its services in a cost-conscious manner.

To operate and maintain outside plant in high quality with suitable cost, it is necessary to utilize the tools, equipment and manpower for corrective maintenance work which is the repair work promptly carried out in response to each subscribers' complaint and, adding to that, to promote preventive maintenance work utilizing the tools, equipment and manpower which rehabilitates outside plant prior to total deterioration and will prevent losses in corrective maintenance work to respond to each complaint randomly occurring in time and place.

In proportion with the increase of volume of facilities, the quantity of tools, vehicles and materials as well as number of employees will increase and the division will become a center having an individual premises and buildings. A maintenance area of around 20,000 subscribers will be the criterion establishing the center.

(c) Billing Center

A billing center having a more capable billing system than that installed in the Central Telephone Office under the Emergency Project and being able to communicate with customer service system will be required in line with the increase of the number of subscribers.

These three centers will be established in 1999 under the Project.

(2) Introduction of fellowship to send employees study abroad

It is required for MPTC that it will look for the funding and foreign counterpart who responds to MPTC's request. Long and short term planning, design and their execution, facilities management, maintenance plan and its implementation are, for example, required.

(3) Introduction of technical assistance as follows

(a) foreign experts for management

The government of Japan, in response to the MPTC's requirement, has a plan to dispatch a long-term expert. Some short-term experts for technical assistances to make MPTC operate and maintain new facilities with those technology firstly introduced are also required.

The MPTC needs to establish new guidelines for work structures and procedures for new subscriber connection work referring to other countries' experience to match the following two situations. One is that the annual increment of the number of subscribers becomes thousands under the Essential Projects. Two is that it can be said in general in developing countries that the considerably high percentage of fault of subscriber network is concentrated on that of outside plant especially that of dropwire, indoor wire and telephone set of which the reason has been clearly analyzed that incorrect installation itself and/or that poor installation quality causes deterioration in shorter term than the materials' lifetime. A short-term expert will also be required to prepare the said guideline.

(b) Junior volunteers for actual level of know-how transfer

In cooperation with the afore-said experts, junior volunteers will also be required to carry out the technical assistance for new work process in the MPTC to handle facilities constructed and subscribers connected to them as well.

## CHAPTER 12 IMPLEMENTATION PLAN

### 12.1 Policy of Implementation Plan

In order to carry out the Project smoothly and without any delays, the basic items to be considered are shown as follows.

#### 12.1.1 Construction on Turn Key Basis

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.

#### 12.1.2 Employment of Consultant

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.

#### 12.1.3 Establishment of Project Team

In order to coordinate management among the sections concerned, the MPTC should establish a project team which consists of the MPTC staff and consultant.

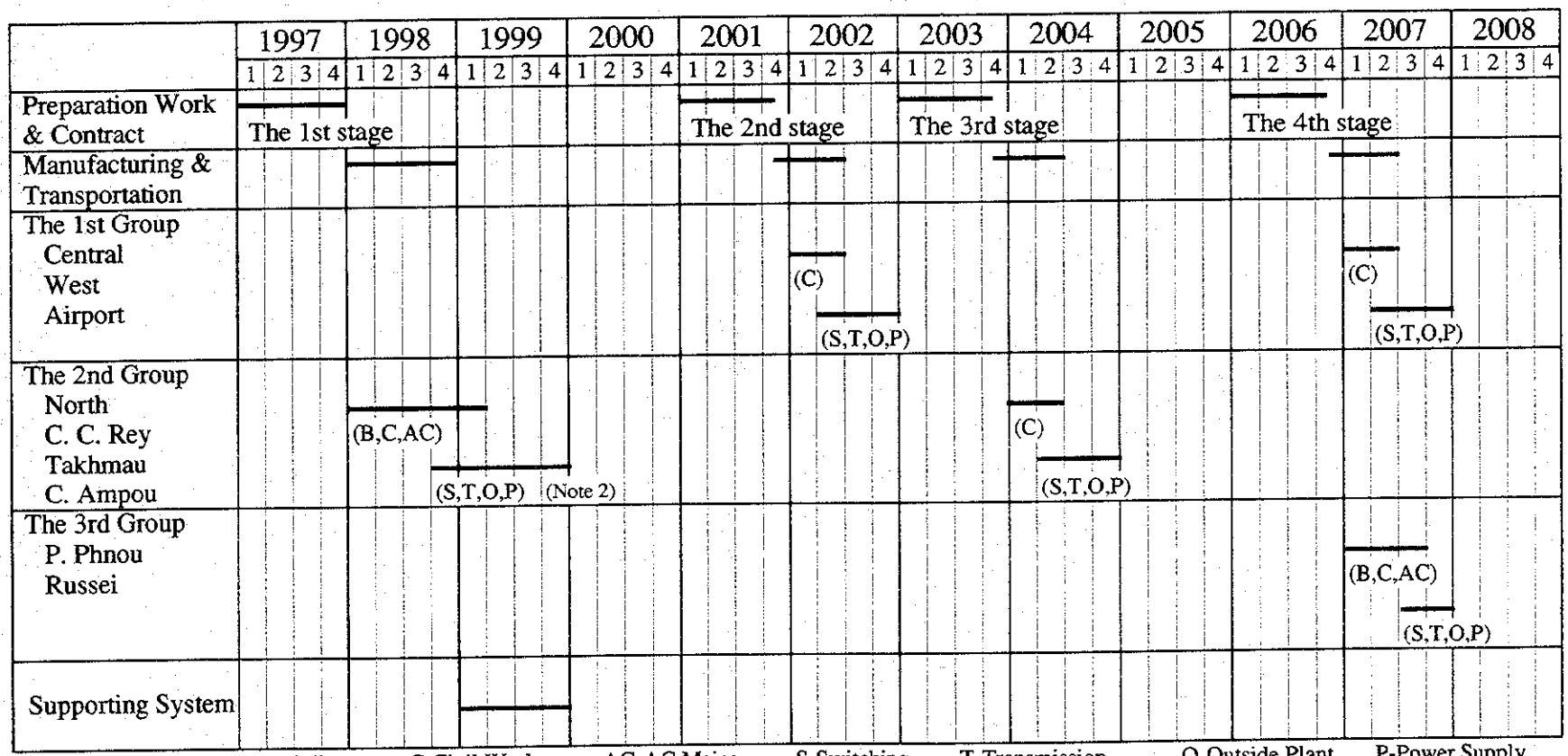
#### 12.1.4 Participation in Construction Work

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. The overall time schedule of the Essential Project implementation and the supporting system construction is shown in Table 12.2-1. As for the Emergency Project, the time schedule is shown in the Emergency Project part of the report.

Table 12.2-1 Implementation Schedule for the Essential Project




Note 1: B-Building C-Civil Work AC-AC Mains S-Switching T-Transmission O-Outside Plant P-Power Supply

Note 2: Installation of Transmission Facilities at ITC are included in the schedule for the first stage.

## CHAPTER 13 COST ESTIMATION

The investment cost of the Essential Project is estimated based on the telecommunications facility provision plan of the essential project in Chapter 10 of this report with the following conditions.

(1) US$ are used as domestic currency.

(2) The classification of procurement from abroad or domestics is shown in the following table.

| | Exchange, Transmission Power Plant | | Subscriber, & Junction Cable | | Building | |
|---|---|---|---|---|---|---|
| | Abroad | Domestic | Abroad | Domestic | Abroad | Domestic |
| Equipment & Materials | X | | X | X | X | X |
| Design & Installation | X | X | X | X | X | X |
| Training | X | | X | | - | - |

(3) The investment cost of the project is mentioned in Table 3-1 as US$.

(4) The cost of equipment and materials is C.I.F. (Cost, Insurance and Freight) of 1994.

(5) Rate of foreign exchange is shown below.

US$1 = ¥100.21

Table 13-1 Estimated Investment Cost

(1) Telecommunication Facilities

(US$1,000)

| Phase | I | | II | III | IV | |
|---|---|---|---|---|---|---|
| Constructed office: Number of subscriber line of exchange to be installed. | North : 2200<br>C.C. Reh : 800<br>Takhmau : 2400<br>C. Ampou : 2200 | | Central: 4000<br>West: 4000<br>Airport: 700 | North: 1400<br>C.C. Reh: 500<br>Takhmau: 2400<br>C. Ampou: 2200 | Central : 7000<br>West : 5000<br>Airport : 1500<br>P. Phnou : 500<br>P. Russei : 300 | |
| Item | 1998 | 1999 | 2002 | 2004 | 2006 | 2007 |
| (1) Equipment & Material | | | | | | |
| Subscriber cable | 1,351 | 900 | 2,649 | 2,179 | 0 | 4,741 |
| Junction cable | 0 | 75 | 0 | 0 | 0 | 42 |
| Exchange | 0 | 3,034 | 2,750 | 2,076 | 0 | 4,598 |
| Transmission | 0 | 665 | 9 | 24 | 8 | 156 |
| Power Plant | 0 | 198 | 34 | 14 | 0 | 96 |
| Subtotal = a | 1,351 | 4,872 | 5,442 | 4,293 | 8 | 9,633 |
| (2) Installation | | | | | | |
| Subscriber cable | 1,339 | 893 | 2,598 | 2,120 | 0 | 4,689 |
| Junction cable | 0 | 27 | 0 | 0 | 0 | 15 |
| Exchange | 0 | 152 | 138 | 104 | 0 | 230 |
| Transmission | 15 | 125 | 3 | 7 | 0 | 34 |
| Power Plant | 0 | 11 | 1 | 2 | 0 | 5 |
| Building | 3,189 | 0 | 0 | 0 | 0 | 108 |
| Common temporary office | 454 | 121 | 262 | 223 | 0 | 508 |
| Subtotal = b | 4,997 | 1,329 | 3,013 | 2,456 | 0 | 5,589 |
| (3) Training | | | | | | |
| Subscriber cable | 0 | 21 | 21 | 21 | 0 | 21 |
| Junction cable | 0 | 11 | 0 | 0 | 0 | 11 |
| Exchange | 0 | 61 | 6 | 42 | 0 | 92 |
| Transmission | 0 | 35 | 0 | 0 | 0 | 35 |
| Power Plant | 0 | 8 | 0 | 0 | 0 | 8 |
| Subtotal = c | 0 | 136 | 27 | 63 | 0 | 167 |
| (4) Management d = (a + b) x 0.1 | 635 | 620 | 846 | 675 | 1 | 1,522 |
| (5) Consultant e = (a + b) x 0.1 | 635 | 620 | 846 | 675 | 1 | 1,522 |
| (6) Physical Contingency f = (a+b+c+d+e) x 0.1 | 762 | 757 | 1,022 | 816 | 1 | 1,843 |
| Total (a + b + c + d + e + f) | 8,379 | 8,334 | 11,245 | 8,978 | 11 | 20,276 |

(2) Supporting System

Commencement year: 1999 (US$1,000)

| Item | Training Center | OPMC | Billing Center | Note |
|---|---|---|---|---|
| (1) Equipment & Material | 3,333 | 599 | 2,994 | |
| (2) Installation | 2,030 | 3,194 | 1,248 | |
| (3) Training | 67 | 200 | 60 | |
| (4) Management | 536 | 379 | 424 | = [(1) + (2)] x 0.1 |
| (5) Consultant | 536 | 379 | 424 | = [(1) + (2)] x 0.1 |
| (6) Physical Contingency | 650 | 475 | 515 | = [(1) + (2) + (3) + (4) + (5)] x 0.1 |
| Sub total | 7,152 | 5,226 | 5,665 | |
| Total | - | - | - | 18,043 |

## CHAPTER 14 PROJECT EVALUATION

### 14.1 Procedure

The Essential Project was evaluated by the following methods:

(1) Identifying premises and assumptions in the Essential Project
(2) Estimating capital expenditure and operation expenditure (cash outflow)
(3) Estimating operation revenue (cash inflow)
(4) Creating a cash flow table and calculating a financial internal rate of return (FIRR)
(5) Performing sensitivity analysis
(6) Estimating economic benefits and calculating the economic internal rate of return (EIRR)

### 14.2 Premises and Assumptions

The present tariff rate (1994) was used to estimate the revenue in the Essential Project. To estimate costs, the study team used the data of actual projects in Cambodia.
Project life is assumed to be 20 years. The salvage value of the equipment after the end of its service life is assumed to be nil. The effects of inflation were basically not considered. MPTC belongs to the government of Cambodia, MPTC does not pay taxes. In this analysis, working capital is estimated by the following equation.

$$K_i = E_i - E_{i-1}$$

$K_i$ = Working capital of the year of i
$E_i$ = Operating and maintenance cost of the year of i

### 14.3 Result of Financial Analysis

Table 14.3-1 is a revenue and expenditure statement summarizing the operating revenue, operating expenditure and capital costs of the project over its total life-span.

The project will have an internal rate of return of 12.91%.

Table 14.3-1 Cash Flow Table for the Calculation of FIRR of the Essential Project (Unit: US$)

| Year | Revenue per main line | Number of Subscribers (New) | Number of Subscribers (Cumulative) * Note1 | Subscription fee * Note2 | Telephone revenue | Total revenue [A] | Investment (Telecom) | Investment (Others) | Operation & Maintenance Cost | Working capital | Total expence [B] | Net inflow [A] - [B] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1998 | | | | | | | 8,379,147 | | | | 8,379,147 | -8,379,147 |
| 1999 | | | | | | | 8,332,375 | 18,025,990 | | | 26,358,365 | -26,358,365 |
| 2000 | 640 | 3,400 | 3,400 | 880,000 | 2,176,000 | 3,056,000 | | | 978,602 | 978,602 | 1,957,204 | 1,098,796 |
| 2001 | 640 | 3,400 | 6,800 | 1,360,000 | 4,352,000 | 5,712,000 | | | 1,139,276 | 160,674 | 1,299,950 | 4,412,050 |
| 2002 | | | 6,800 | | 4,352,000 | 4,352,000 | 11,245,137 | | 2,181,736 | 1,042,460 | 14,469,333 | -10,117,333 |
| 2003 | 939 | 3,800 | 10,600 | 1,520,000 | 7,920,200 | 9,440,200 | | | 2,615,851 | 434,115 | 3,049,966 | 6,390,234 |
| 2004 | 939 | 3,800 | 14,400 | 1,520,000 | 11,488,400 | 13,008,400 | 8,977,703 | | 3,627,906 | 1,012,055 | 13,617,664 | -609,264 |
| 2005 | 530 | 3,000 | 17,400 | 1,200,000 | 13,078,400 | 14,278,400 | | | 3,533,958 | -93,948 | 3,440,010 | 10,838,390 |
| 2006 | 530 | 3,000 | 20,400 | 1,200,000 | 14,668,400 | 15,868,400 | 10,538 | | 4,034,592 | 500,634 | 4,545,764 | 11,322,636 |
| 2007 | | | 20,400 | | 14,668,400 | 14,668,400 | 20,277,350 | | 3,932,307 | -102,285 | 24,107,372 | -9,438,972 |
| 2008 | 719 | 4,720 | 25,120 | 1,888,000 | 18,062,080 | 19,950,080 | | | 4,691,815 | 759,508 | 5,451,323 | 14,498,757 |
| 2009 | 719 | 4,720 | 29,840 | 1,888,000 | 21,455,760 | 23,343,760 | | | 5,246,615 | 554,800 | 5,801,415 | 17,542,345 |
| 2010 | 719 | 4,720 | a) 27,760 | 1,888,000 | 20,497,440 | 22,385,440 | | | 5,168,286 | -78,329 | 5,089,957 | 17,295,483 |
| 2011 | | | 27,760 | | 20,497,440 | 20,497,440 | | | 4,932,672 | -235,614 | 4,697,058 | 15,800,382 |
| 2012 | | | 27,760 | | 20,497,440 | 20,497,440 | | | 5,293,876 | 361,204 | 5,655,080 | 14,842,360 |
| 2013 | | | b) 20,160 | | 13,361,040 | 13,361,040 | | | 3,468,314 | -1,825,562 | 1,642,752 | 11,718,288 |
| 2014 | | | 20,160 | | 13,361,040 | 13,361,040 | | | 3,678,350 | 210,036 | 3,888,386 | 9,472,654 |
| 2015 | | | c) 14,160 | | 10,181,040 | 10,181,040 | | | 2,708,966 | -969,384 | 1,739,582 | 8,441,458 |
| 2016 | | | 14,160 | | 10,181,040 | 10,181,040 | | | 2,789,154 | 80,188 | 2,869,342 | 7,311,698 |
| 2017 | | | 14,160 | | 10,181,040 | 10,181,040 | | | 2,736,762 | -2,789,154 | -52,392 | 10,233,432 |
| | | | | | | | | | | | IRR = | 12.91% |

Note1 : a) The exchange which will be installed in 1999 will be removed in 2010 because of completion of its life.

b) The exchange which will be installed in 2002 will be removed in 2013 because of completion of its life.

c) The exchange which will be installed in 2004 will be removed in 2015 because of completion of its life.

Note2: US$400 per subscriber fixed

## 14.4 Sensitivity Analysis

The results of the sensitivity analysis are shown in Table 14.4-1.

Table 14.4-1 Results of Sensitivity Analysis (FIRR)

| Case | FIRR |
|---|---|
| The telephone revenues increase 2% every year | 13.34% |
| The telephone revenues increase 5% every year | 13.96% |
| The operation and maintenance costs increase 2% every year | 12.78% |
| The operation and maintenance costs increase 5% every year | 12.57% |

## 14.5 Economic Evaluation

In this section, economic benefits are quantified and the economic internal rate of return (EIRR) is calculated.

### (1) Economic Benefit

Economic benefit is the difference between the maximum willingness to pay of the users and the actual payment for the telephone use. This difference is called the "Consumers' surplus" in the field of economics.

### (2) Derivation of the Demand Function and Consumers' Surplus

The number of samples which are used in the multiple regression analysis is 221, and the total call charge per month of the 221 subscribers is US$213,731. From the result of the multiple regression analysis, the following equation was derived.

| | | | | | | |
|---|---|---|---|---|---|---|
| Log(T) | = | 1.003 | - | 0.676 Log(P) | + | 0.511 Log(Y) |
| | | (3.284)* | | (-9.140)* | | (14.527)* |

R = 0.719 The number of samples was 221. Figures in ( ) are T-value

"*" indicates a significance level of less than 0.5%

T = Average monthly number of calls per subscriber
P = Average call charges per call

Y = Average monthly income per subscriber in the originating areas
R = coefficient of determination

The following equations are derived from above equation.

$$P = e^{(1.003/0.676)} * T^{-1/0.676} * Y^{0.511/0.676} \quad \ldots\ldots (1)$$

From the equation (1), the consumer's surplus for the 221 subscribers was obtained as US$292,441.

Therefore, the amount of benefits which belongs to the consumers was US$506,172 and it was estimated at 2.37 times as large as the call charge.

## 14.6 Result of Economic Analysis

The economic internal rate of return (EIRR) is calculated using the following procedure.

(1) Identifying premises and Assumptions
(2) Estimating the Benefits
(3) Estimating the Cost
(4) Creating a Cash Flow Table
(5) Calculate the EIRR (Economic Internal Rate of Return)

### (1) Identifying Premises and Assumptions

The identifying premises and assumptions are the same as that of the financial analysis.

### (2) Calculatingthe EIRR

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. Table 14.6-1 shows the cash flow table for the EIRR.

Table 14.6-1 Cash Flow Table for the Calculation of EIRR of the Essential Project

(Unit: US$)

| Year | Revenue per main line | Number of Subscribers (New) | Number of Subscribers (Cumulative) * Note1 | Subscription fee * Note2 | Revenue(Tel) + Consumer's Surplus | Total revenue [A] | Investment (Telecom) | Investment (Others) | Operation & Maintenance Cost | Working capital | Total expence [B] | Net Economic Benefit [A]-[B] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1998 | | | | | | | 8,379,147 | | | | 8,379,147 | -8,379,147 |
| 1999 | | | | | | | 8,332,375 | 18,025,990 | | | 26,358,365 | -26,358,365 |
| 2000 | 640 | 3,400 | 3,400 | 880,000 | 5,157,120 | 6,037,120 | | | 978,602 | 978,602 | 1,957,204 | 4,079,916 |
| 2001 | 640 | 3,400 | 6,800 | 1,360,000 | 10,314,240 | 11,674,240 | | | 1,139,276 | 160,674 | 1,299,950 | 10,374,290 |
| 2002 | | | 6,800 | | 10,314,240 | 10,314,240 | 11,245,137 | | 2,181,736 | 1,042,460 | 14,469,333 | -4,155,093 |
| 2003 | 939 | 3,800 | 10,600 | 1,520,000 | 18,770,874 | 20,290,874 | | | 2,615,851 | 434,115 | 3,049,966 | 17,240,908 |
| 2004 | 939 | 3,800 | 14,400 | 1,520,000 | 27,227,508 | 28,747,508 | 8,977,703 | | 3,627,906 | 1,012,055 | 13,617,664 | 15,129,844 |
| 2005 | 530 | 3,000 | 17,400 | 1,200,000 | 30,995,808 | 32,195,808 | | | 3,533,958 | -93,948 | 3,440,010 | 28,755,798 |
| 2006 | 530 | 3,000 | 20,400 | 1,200,000 | 34,764,108 | 35,964,108 | 10,538 | | 4,034,592 | 500,634 | 4,545,764 | 31,418,344 |
| 2007 | | | 20,400 | | 34,764,108 | 34,764,108 | 20,277,350 | | 3,932,307 | -102,285 | 24,107,372 | 10,656,736 |
| 2008 | 719 | 4,720 | 25,120 | 1,888,000 | 42,807,130 | 44,695,130 | | | 4,691,815 | 759,508 | 5,451,323 | 39,243,807 |
| 2009 | 719 | 4,720 | 29,840 | 1,888,000 | 50,850,151 | 52,738,151 | | | 5,246,615 | 554,800 | 5,801,415 | 46,936,736 |
| 2010 | 719 | 4,720 | a) 27,760 | 1,888,000 | 48,578,933 | 50,466,933 | | | 5,168,286 | -78,329 | 5,089,957 | 45,376,976 |
| 2011 | | | 27,760 | | 48,578,933 | 48,578,933 | | | 4,932,672 | -235,614 | 4,697,058 | 43,881,875 |
| 2012 | | | 27,760 | | 48,578,933 | 48,578,933 | | | 5,293,876 | 361,204 | 5,655,080 | 42,923,853 |
| 2013 | | | b) 20,160 | | 31,665,665 | 31,665,665 | | | 3,468,314 | -1,825,562 | 1,642,752 | 30,022,913 |
| 2014 | | | 20,160 | | 31,665,665 | 31,665,665 | | | 3,678,350 | 210,036 | 3,888,386 | 27,777,279 |
| 2015 | | | c) 14,160 | | 24,129,065 | 24,129,065 | | | 2,708,966 | -969,384 | 1,739,582 | 22,389,483 |
| 2016 | | | 14,160 | | 24,129,065 | 24,129,065 | | | 2,789,154 | 80,188 | 2,869,342 | 21,259,723 |
| 2017 | | | 14,160 | | 24,129,065 | 24,129,065 | | | 2,736,762 | -2,789,154 | -52,392 | 24,181,457 |
| | | | | | | | | | | | IRR = | 33.53% |

Note1 : a) The exchange which will be installed in 1999 will be removed in 2010 because of completion of its life.

b) The exchange which will be installed in 2002 will be removed in 2013 because of completion of its life.

c) The exchange which will be installed in 2004 will be removed in 2015 because of completion of its life.

Note2: US$400 per subscriber fixed

14.7 Evaluation of the Project from the FIRR and EIRR Calculation

The FIRR of 12.91% is much higher than London Inter-Bank Offered Rate (LIBOR) of 6.25% (for one year; as of May 17). It shows that the project is more profitable than a bank deposit, and the project will be worth investing for MPTC.

On the other hand, the EIRR of 33.53% is also very high. The anticipated maximum payment by the telephone subscribers reaches 2.37 times as large as the actual payment, so, the project is expected to bring a great amount of economic benefit to the whole of the Cambodian social economy. The project is very significant from the point of not only the financial but also the socio-economic aspect.

# CHAPTER 15 RECOMMENDATION

## 15.1 Government's Responsibility

In classifying telecommunications services roughly, they are divided into basic telecommunications service and non basic telecommunications services. Although the definition of the basic telecommunications service differs from country to country, it is basically considered to mean a telecommunications service conveying information purely in which the content and message of the information sent and received are of an unchanged and unprocessed nature with regard to the telecommunications network or facilities used and of which terminals are used in common at offices, home and so on.

On the other hand, there exists the concept of universal service in the telecommunication field. This concept is used in many countries to mean some minimum level of telecommunications development in which the telecommunications service is supplied in good quality and available anywhere throughout the country with a reasonable price level. From this view, we can say that developed countries have achieved the universal service with the basic telecommunications service. In view of the impact of telecommunications on people's life, it is the responsibility of the government to achieve and sustain the universal service, regardless of it is whether in developed or developing countries. Therefore, it is the MPTC's responsibility to construct a national telecommunications network for the whole of the country as an authorized operating entity.

## 15.2 Necessity of Establishing a Development Target

What must be conducted presently for telecommunications development in Cambodia is not the provision of new services to specified customers for their satisfaction but the attempt to expand the basic telecommunications service throughout the country, what is called the achievement of universal service.

In reviewing the example of countries with success of telecommunications development throughout the whole of the country, we can see that they established the development target first and a medium and a long term development plans for the achievement of the target secondly and amended them if necessary. As a lesson from

other country's experiences, it is required that an appropriate target for the telecommunications development should be set up in Cambodia.

Such targets, for example, are:
- establishment of the national network and
- installation of at least one telephone in all cities towns and villages.

It is preferable that the targets to be established can be easily understood by the people and staff of the MPTC, as exemplified by the above. It is natural that the achievement of the targets will be the responsibility of the MPTC to the nation.

15.3 Alteration of Operation Format

(1) Establishment of Autonomy

What should be done with the highest priority by the government of Cambodia is to develop the basic telecommunications service to the whole of the country including rural areas. If private participation or privatization are employed under these circumstances, most investments would be concentrated in the lucrative areas and telecommunications markets and so-called cream-skimming would be generated. These matters would prevent the development of rural areas. Therefore, the government of Cambodia should neither employ private participation in the basic telecommunications market nor let the operating body of the MPTC be privatized. The MPTC should have a monopoly over the basic telecommunications market under the moderate control of the government for the well-balanced development until the value of telephone density will reach a certain level.

Because of the following reasons, however, we recommend that the management format of the operating body in the MPTC will be changed to be a public corporation/an autonomy with a self-accounting system, which has a monopoly over the basic telecommunications market, to smoothly supply the basic telecommunications service in good quality and with cheap price to the whole of the country.

- A direct government operation format such as the MPTC is not appropriate for steadily developing telecommunications business in terms of a long range

plan in response of the growth of telephone demand, because it is easily affected by politics and government intervention.

- The MPTC must pay all the revenue to the national treasury once, then it receives an annually required budget from the ministry of finance. The MPTC cannot establish a stable fund raising plan for the telecommunications development by itself on the basis of such budgetary system.
- Among the countries with per capita GDPs under $1,500 annually, public corporation formats achieved a higher telephone density ratio than direct government operation ones did.

(2) Organization in Provinces

The provincial organizations of the MPTC belong to the provincial government as well, they are prone to be loosely related to the headquarters. The issue with the highest priority for the MPTC is to smoothly provide basic telecommunications service to the whole of the country. In order to do that, the organizations in provinces must be ones in which the MPTC's policies can be made perfectly understood. Therefore, the double jurisdiction in which the MPTC's provincial organizations belong to both the provincial government and the MPTC's headquarters should be canceled and the provincial organizations of the MPTC should be completely internalized.

15.4 How private participation should be dealt with

Basic telecommunications service is very important for the general public, therefore it is the duty of the operator to supply it to the whole of the country including rural areas. For the development of the basic telecommunications service to the unprofitable areas, the operator must establish a cross subsidy mechanism in which the revenues accrued from profitable areas are invested into unprofitable ones.

The profitable fields in the basic telecommunications service of Cambodia are international telephone and long distance call markets and the profitable area is Phnom Penh city. However, since the international telephone service is provided under a BCC scheme, the long distance call service will be supplied under a joint venture scheme and the service in Phnom Penh city is provided under the competition between the MPTC and a joint venture company with WLL, some revenues which the MPTC should monopolize are taken up by the private companies. The above situation makes it difficult for the MPTC to set up the cross subsidy mechanism.

(1) As for the international telephone service, the MPTC should deal with the situation by newly installing its own facilities, and provide the service by itself. In addition, the MPTC should positively expand the service to the countries which have a large traffic demand. In order to realize this goal, the MPTC must study the following.
- the time when the new facilities are required
- preparation of funds for the new facilities
- security of know-how and technology regarding international telephone service during the validity of BCC

(2) Since the long distance call network composed of the facilities donated by ex-UNTAC take advantage of PABXs and a satellite, it seems to be transitional. In the future, it is necessary that the MPTC construct a genuine long distance call network with terrestrial transmission. After the construction of the new network, the network donated by ex-UNTAC will be disused. Therefore the MPTC should transfer this network to rural areas to urgently establish a national network, even though it may mean changing the terms and conditions of the contract for the joint venture scheme.

(3) The service utilizing the WLL system in Phnom Penh city should have been provided under the MPTC's responsibility. The MPTC should install the WLL system, and provide the service so as to ensure the benefit by itself as well as the international telephone service.

15.5 Necessity of Toll Exchange

The connections between networks of cellular telephone services and the MPTC's network are made through an international exchange operated under BCC scheme. The trunk network utilizing facilities donated by UNTAC, which will be operable in the near future, is expected to be connected with a local network in Phnom Penh through the international exchange as well. The international exchange plays a part in the domestic telecommunications service. This is because there is no toll exchange in Phnom Penh City.

In order for the MPTC to recover from such a situation, it is required to have its own toll exchange, which will be a nucleus of the telecommunications network, instead of

the international exchange. Once the MPTC has that, the domestic services via the international exchange at the moment can be supplied through the new toll exchange.

It is desirable that the MPTC will install the toll exchange at the Central Exchange Office which will be a nucleus of Cambodian telecommunications network.

15.6 Improvement of the Collection of Telephone Charges

The MPTC's collection of telephone charges is approximately 85%, a rate which we cannot say is very high. The MPTC must improve the telephone charge collection rate.

Methods for raising the telephone charge collection rate can broadly be divided into two. The first method is automatic withdrawal of telephone charges from customers' bank accounts and the second is the suspension of telephone use and the cancellation of telephone subscription contracts for customers who do not pay their telephone bills.

Regarding the second punishment, rather than applying the measures immediately, it is necessary to implement the measures in steps. For example, if a subscriber does not pay his charges even after the due date is past, he will be telephoned or sent a reminder. If the subscriber still dose not pay, he will be warned of telephone usage suspension, which will be implemented a few days later. If the customer further refuses to pay his charge, an investigative visit will be executed, and a warning will be issued that his telephone subscription contract will be canceled prior to cancellation of the subscription contract. In other words, measures such as confiscation of deposit money should be courageously taken.

15.7 Review of Tariff System

Table 15.7-1 shows the present tariff system in Cambodia which is the flat rate charge consisting of just monthly charge regardless of pulses. The flat rate is generally seen in the initial stage of telecommunications service operation development in other countries.

Table 15.7-1 Tariff System in Cambodia

| Basic Fee | Call Fee | | Remarks |
|---|---|---|---|
| Installation fee* | Local: free | | US$1 = R2,700 |
| Penta Conta: | Long distance: | per minute (Manual) | (R: Riel) |
| R60,000 ~ R100,000 + R20,000 | | | As of Jan. '95 |
| AXE: US$200 + R20,000 | Public Pay Phone: | US$0.2/min. (Local) | |
| (In the case of facsimile terminals, the price is doubled.) | | | |

Note: * The variation in installation fee of Penta Conta subscribers is subject to the distance from the MPTC Head Office.

Additional R20,000 for Penta Conta and US$200 + R20,000 for AXE means deposit charge.

As stated in preceding 15.4, the MPTC needs to secure the stable income through the format of an autonomy with a self-according system to develop the basic telecommunications service to the whole of the country including rural areas. Therefore the MPTC will, in future, have to review the tariff system as under.

- Application of a meter pulse system in local network
- Introduction of a rise in price in line with inflation on the condition that the rise does not affect the traffic volume

## 15.8 Operation and Maintenance

The Essential Project following the Emergency Project requires the MPTC to soundly operate and maintain the facilities constructed. The establishment of a new operation and maintenance structure and procedure to cope with a number of subscribers after completion of both the Emergency and the Essential Project is to be given the highest priority by the MPTC. Chapter 11 of this report proposes issues necessary for the new structure and procedure mentioned above.

- The establishment of a telephone office organization which is solely responsible for the facilities constructed under the Project as well as the structure for the operation and maintenance work in each exchange office apart from the Central Exchange Offices was recommended.
- The establishment of a new training center was recommended for the introduction of new technology, for urgent human resource development to fulfill manpower mobilization for the new operation and maintenance body and following the plan to

construct a new Central Exchange Office using the land of the existing training center.

- The establishment of an outside plant maintenance center where manpower, tools and equipment and materials are to be arranged to make outside plant works efficient.
- The establishment of a billing center for sound billing and charging as well as for the MPTC to win subscribers' confidence for invoice was recommended.
- Fellowship to promote human resource development was recommended.
- Technical assistance in order that the MPTC obtains the skills for operation and maintenance of newly introduced equipment was recommended.
- Introducing a suitable technical standard for the subscriber connection work and carrying out the work following the said technical standard were recommended. To assure suitable work procedures, obtaining technical assistance to introduce the said technical standard and obtaining field level technical assistance to upgrade the discipline were recommended.

It is again recommended that the execution of above proposals assure the MPTC to operate and maintain its facilities and the Study Team believes they are mandatory to the MPTC.

15.9 Radio Subscriber System

The Emergency Project currently formulated includes a radio subscriber system in order that the MPTC can provide telephone services to the important subscribers outside the exchange office areas under the said project to whom it is impossible for the MPTC to provide the services by cable. In connection with the establishment of new exchange offices under the Essential Project, it will be possible for the MPTC to provide the telecommunications services by the cable subscriber system to the subscriber having been provided the services by the radio subscriber system.

According to the current tariff system, there is no difference in charge between both systems so that the MPTC will have to advise the subscribers of the radio subscriber system to be transferred to the cable subscriber system. After the subscribers are transferred, the subscriber station equipment serving the subscriber should then be transferred to the areas where telecommunications service provision will not be available at the moment.

This should be managed and carried out by the MPTC in order that as many subscribers can take advantage of telecommunications services as possible and services by the radio subscriber system can complement the services provided by the facilities installed under the Essential Project.