CHAPTER 1

Introduction

CHAPTER 1 INTRODUCTION

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 area in the Kingdom of Cambodia (hereinafter referred to as "the Study"). Japan International Cooperation Agency (hereinafter referred to as "JICA"), which is an official agency responsible for the implementation of technical cooperation programs of the Government of Japan, dispatched a Preparatory Study Team on February 1994. The Cambodian side and the Japanese side agreed on the implementation of the Study.

The feasibility study team (hereinafter referred to as "the Team") began its work in September 1994 and prepared a progress report during the first visit in Cambodia. The progress report described mainly the present situation of telecommunications in Cambodia and how to rehabilitate the existing network of Phnom Penh, this being formulated as the Emergency Project. This was discussed between the Ministry of Posts and Telecommunications (hereinafter referred to as "the MPTC") and the Team on November 3, 1994 in Phnom Penh City. The contents of the progress report were approved by the MPTC and both parties compiled agreed matters into the minutes of meeting on November 5, 1994.

After the Team's return to Japan, an interim report was prepared describing mainly the Essential Project to follow the Emergency Project. The interim report was composed of two parts, namely a main part of the Study and the Emergency Project part. These were discussed with both parties during the second visit of the Team to Cambodia and approved by the MPTC. Both the parties signed the minutes of meeting on the interim report on January 27, 1995.

The Team prepared the draft final report by adding the following items to the interim report.

- Implementation Program of the Essential Project
- Financial and Economic Analyses of the Essential Project
- Operation and Maintenance Plan for facilities to be installed in the Essential Project
- Recommendations

The Emergency Project part has been kept separate from the draft final report.

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. After the war, the maintenance and operation of the equipment, facilities and cables were neglected for 4 years. Even now, well-trained engineers are so scarce that the equipment and facilities are not well maintained and cannot be repaired when they break down. At this moment, the installation of a new exchange, AXE 105 is under way. However, as there are no plans to replace the existing outside plants, inhabitants' needs for basic telephone services are not being satisfied.

Toll lines were in operation on the open-wire carrier system before the 1970s, but they were badly damaged and are not now operational. Only a wireless system is operable, connecting Phnom Penh City with some provincial cities.

Because of this situation in Phnom Penh City, three Thai companies and a Malaysian company, in the form of a joint venture with the MPTC, are now providing cellular phone services to 9,200 subscribers. However, these companies' services are very expensive and aimed at business use.

Under these circumstances, Cambodia needs the telecommunications network development which is indispensable to the social and economic development.

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.

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

1.3 Scope of the Study

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

(1) Collection and analysis of data / information

(a) Social and economic conditions and statistics
(b) National Development Plans
(c) Telecommunications Development Plan
(d) Previous studies for telecommunications
(e) Present status for telecommunications
(f) On-going / planned projects for telecommunications services
(g) Existing laws, regulations and technical standards related to telecommunications services
(h) Present situation of operation and management of telecommunications services
(i) Assignment of frequencies
(j) Other data / information related to the Study
(k) Local contractor and unit price
(l) Procedures for acquiring permission

(2) Field survey

(a) Social and economic conditions
(b) Existing telecommunications facilities and services
(c) Other surveys related to demand forecast and system design
(d) Sites where equipment / facilities will be installed
(e) Cable laying route
(f) Propagation path and service area

(3) Forecast

(a) Demand forecast
(b) Traffic forecast

(4) Confirmation of the project framework

(a) Target year
(b) Planning area
(c) Service level

(5) Fundamental telecommunications network plan

(a) Network structuring plan
(b) Numbering plan
(c) Signaling plan
(d) Charging plan
(e) Finding and formulation of the Project

(6) Feasibility study for the Project

(a) Facility improvement and expansion plan
  i) Switching system
  ii) Transmission system
  iii) Outside plant
  iv) Supporting facilities
(b) Operation and maintenance plan
(c) Institution, organization and management plan
(d) Cost estimation
(e) Evaluation for the Essential Project
  i) Financial evaluation
  ii) Economic and social evaluation
(f) Project implementation program

1.4 Organization of the Team

The work in Cambodia of the Study was carried out by the Team in close cooperation with counterparts in the MPTC, and a JICA Advisory Committee gave technical advice and guidance to the Team. The formation of the Team is shown in Figure 1.4-1.

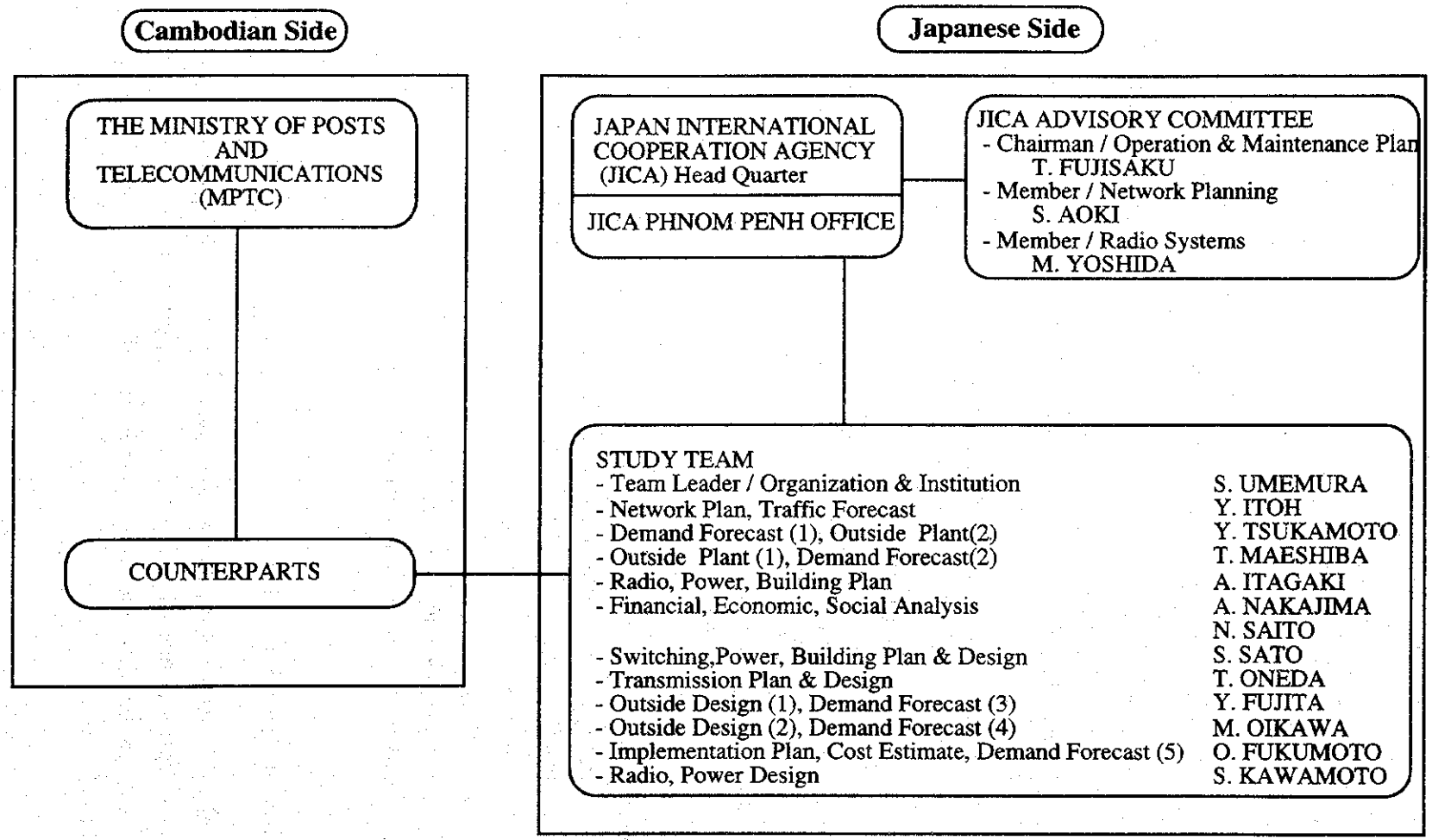


Figure 1.4-1 Formation of the Study

(1) JICA Advisory Committee

The JICA Advisory Committee provided the Team with advice and supervision for implementation of the Study. The members of the committee were as follows:

Name	Duty in Charge	Affiliated to
Mr. Tomohiro FUJISAKU	Chairman (Operation & Maintenance Plan)	Director for International Cooperation International Cooperation Division, International Affairs Department, Ministry of Posts and Telecommunications
Mr. Shigemaro AOKI	Member (Network Planning)	Senior Telecommunications Advisor Institute for International Cooperation, Japan International Cooperation Agency
Mr. Masato YOSHIDA	Member (Radio Systems)	Chief, Land Mobile Communications Division, Radio Department, Ministry of Posts and Telecommunications

(2) JICA Study Team

The names and duties in charge of the Team members are shown below:

Name	Duty in Charge
Mr. Shizuhiro UMEMURA	Team Leader, Organization & Institution
Mr. Yuichi ITOH	Network Plan, Traffic Forecast
Mr. Yoshihiko TSUKAMOTO	Demand Forecast (1), Outside Plant (2), Operation & Maintenance
Mr. Tetsu MAESHIBA	Outside Plant (1), Demand Forecast (2), Implementation Schedule
Mr. Akira ITAGAKI	Radio/Power Plant, Building Plan (2)
Mr. Akira NAKAJIMA Mr. Naomizu SAITO	Financial, Economic and Social Analysis
Mr. Sunao SATO	Switching/Power Plant & Design, Building Plan & Design (1)
Mr. Toshio ONEDA	Transmission Plan & Design, Network Development Plan
Mr. Yoshio FUJITA	Outside Plant Design (1), Demand Forecast (3)
Mr. Masayuki OIKAWA	Outside Plant Design (2), Demand Forecast (4)
Mr. Osamu FUKUMOTO	Implementation Plan, Cost Estimate, Demand Forecast (5)
Mr. Shunji KAWAMOTO	Radio & Power Plant Design

(3) MPTC Counterpart Team

The MPTC kindly assigned the counterpart personnel to each member as follows:

Counterpart	The Team Member
Mr. SAM Serey	Mr. Shizuhiro UMEMURA
Mr. KHAY Sokhon	Mr. Yuichi ITOH
Mr. NONG Thol	Mr. Yoshihiko TSUKAMOTO
Mr. OUNG Saroeun	Mr. Tetsu MAESHIBA
Mr. SEAR Nareth	Mr. Akira ITAGAKI
Mr. TRING Douma	Mr. Akira NAKAJIMA Mr. Naomizu SAITO
Mr. KIM Savang	Mr. Sunao SATO
Mr. HENG Each	Mr. Toshio ONEDA
Mr. RANG Chanrithy	Mr. Yoshio FUJITA
Mss. LORN Sakara	Mr. Masayuki OIKAWA
Mr. TIEV Tithia Kamol	Mr. Osamu FUKUMOTO
Mr. LAO Saroeun	Mr. Shunji KAWAMOTO

1.5 Schedule of the Study

The schedule of the Study is shown in Figure 1.5-1.

Work Item	Work Period	1994 9	10	11	12	1995 1	2	3	4	5	6	7
First Work in Cambodia	Explanation and Discussion of Inception Report	■										
	Data Collection, Analysis & Field Survey	■	■	■								
	Review & Survey of Demand	■	■	■								
	Selection of Emergency Project	■	■▲									
	Explanation of Progress Report			▲ P/R								
First Work in Japan	Demand Forecast			▭	▭							
	Traffic Forecast			▭	▭							
	Fundmental Network Plan				▭							
	Selection of Essential Projects for F/S				▭	▭						
	Establishment of Emergency Project			▭	▭	▭						
	Financial Analysis of Essential Projects				▭	▭						
	Preparation of Interim Report					▭						
Second Work in Cambodia	Explanation & Discussion of Interim Report					■ IT/R						
	Data Collection & Field Survey (Supplementary)						■					
Second Work in Japan	Finalization of Emergency Project						▭					
	Fundamental Network Plan								▭	▭		
	Study & Establishment of Essential Projects								▭	▭		
	Preparation of Draft Final Report									▭		
Third Work in Cambodia	Explanation & Discussion of Draft Final Report									■ DF/R		
Third Work in Japan	Preparation & Submission of Final Report											▭ F/R▲

■ Work in Cambodia

▭ Work in Japan

IC/R: Inception Report, P/R: Progress Report, IT/R: Interim Report

DF/R Draft Final Report, F/R: Final Report

Figure 1.5-1 Work Schedule

CHAPTER 2

Socio-economic Conditions

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. Low-lying, fertile, alluvial central plains surround Tonle Sap Lake, which is drained southeastward by the Tonle Sap River, to the Mekong River. The central plain which floods frequently spreads along the Mekong River and Tonle Sap Lake. The rich sediment deposited during the Mekong's annual wet season flooding has made for agricultural land of great fertility and the annual floods of the Mekong provide natural irrigation to numerous rice paddies. In the south-west, much of the area between the Gulf of Thailand and the Tonle Sap Lake is covered by a highland region formed by two distinct upland blocks, the Cardamom Mountains and the Elephant Mountains. About two - thirds of the total population lives in the central plains.

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. The heaviest precipitation is recorded along the coast, where it averages between 2,000 and 3,800 mm / year. In the central plains, annual precipitation is between 1,000 and 1,400 mm / year. The climate is favorable for natural vegetation and about three - fourths of Cambodia's land area is forested: deciduous forest and grasslands cover much of the eastern highlands, broadleaf evergreen forest cover the northern mountains, and mangrove forests are found on the coast. Weather conditions in Phnom Penh are shown in ATTACHMENT - 2.

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. Both of the municipalities, the Capital, Phnom Penh and Sihanoukville at the southwest shore, have their own extending area characteristics and specific international port. The main towns are Kompong-Cham, Battanbang, and Siemreap.

(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 group include Catholicism, Protestantism, Islamic and so on.

2.4 Economic Trends

(1) Outlook

Although Cambodia's economy has been recovering from the worst effects of the destruction in the 1970s, its productive capacity still remains below the levels achieved in the 1960s. In order to increase the economic efficiency, there have been major changes in politics towards developing a market economy in which the private sector has an important role. Farmers have been allowed to market their products since 1979. A local currency was reintroduced in 1980. Since 1985, Cambodia has been making efforts at moving to a market economy by pressing forward with privatization of national enterprises, price liberalization in some fields, and endorsement of private farmland. Individual rights to use land to own, sell and inherit houses were restored in 1989, and foreign investment was legalized in the same year.

Despite the above, Gross Domestic Product (hereinafter referred to as "GDP") per capita is estimated at only US$200 in 1992 by the World Bank (hereinafter referred to as "WB"), leaving Cambodia as one of the LLDCs. To improve the nation's financial strength, the Cambodian government is now planning to increase corporation tax, adopt a fixed property tax, and impose an income tax on those who have a monthly income of US$300 or more.

(2) Recent trends

Growth of GDP in 1993 was 3.9%, compared with 7% in 1992. Agriculture, which accounts for about 50% of the labor force, grew at 3.2% in 1993 compared with 1.9% in 1992. Industrial growth decreased from 15.4% in 1992 to 15.1% in 1993. Brick and ceramic tile production, engineering and repair activities, and food and beverage processing continued to expand rapidly. Construction activity, however, which had experienced boom conditions in the previous two years because of the demand for housing for personnel from the United Nations Transitional Authority for Cambodia (hereinafter referred to as "UNTAC"), suffered a major slump on their departure in 1993. For that reason too, growth in the services sector in 1993 was substantially lower at 7.2% compared with 11.2% in the previous year.

On the other hand, money is still flowing into Cambodia. The country is to receive $1 billion from Japan, Europe, and the US, over the next two years; of this, $300 million has already been supplied. Foreign firms are also looking for potential investments. Malaysian Air System invested in Royal Air Cambodia, which began operations in January 1995. Recently, no less than 160 corporations eager to invest in Cambodia participated in a formative meeting held in Bangkok, where investment possibilities ranging from a shoe-making factory to a tourist hotel were presented.

As mentioned above, the Cambodian economy grew at a rate of 3.9% in 1993, and is expected to achieve 7 or 8% growth in 1994. However, it will be necessary for a growth rate of 8% to be sustained for at least 10 years for Cambodia to regain the standard of living prevailing before the civil war. The key economic indicators of Cambodia for the past five years are shown in the Table 2.4-1.

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. The priorities of the Government of Cambodia in the rehabilitation and development process for the years 1994-1995 are based on four fundamental principles as follows;

(1) Macro-economic stability (privatization; move to a market economy; market-opening policies) and return to prewar economic levels.

(2) Human resource rehabilitation and development in conjunction with administrative reforms and improvement, and the setting up of a new legal framework.

(3) Rehabilitation and reconstruction of infrastructure. (Irrigation, electricity, waterworks, roads, etc.)

(4) Integration of the Cambodian economy into the world economy.

Lately, the economy has undergone a steady change. As mentioned in Table 2.4-1, after the growth rate of GDP in 1990 declined at 1.2%, GDP grew at a vigorous 7.6% in 1991 and 7.0% in 1992. GDP growth in 1993 is reported to be 3.9%. It is anticipated that with an improved economic policy framework and macro-economic stability, the growth rate will increase 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 as a two-year total investment budget. However, due to the low level of economic 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

CHAPTER 3 TELECOMMUNICATIONS SECTOR OUTLOOK

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.

3.1 Outline of Administrative Organization

In the MPTC, three Under Secretaries of State report to the Secretary of State; these Under Secretaries are in charge of international telecommunications, domestic telecommunications, and control of the general management including the postal service, respectively. The MPTC carries out all posts and telecommunications services such as management, supervision, and operations, with the exception of some business conducted in cooperation with foreign communication companies. 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. The present organization of the MPTC is shown in Figure 3.1-1. However, the MPTC has proposed its reorganization to the Government of Cambodia.

(1) The MPTC staffers

There are a total of 1,686 MPTC staffers as of October 1994, made up as follows:

(a)	Number of employees classified by task	Telecommunications	908
		Posts	567
		Administration	211
(b)	Number of employees classified by sex	Male	1,226
		Female	460
(c)	Number of employees classified by rank	Senior	76
		Middle	232
		Staff	1,011
		Others	155

(2) Working hours

- Monday - Friday AM 7:00 - 11:30 / PM 14:00 - 17:30
- Saturday AM 7:00 - 11:30

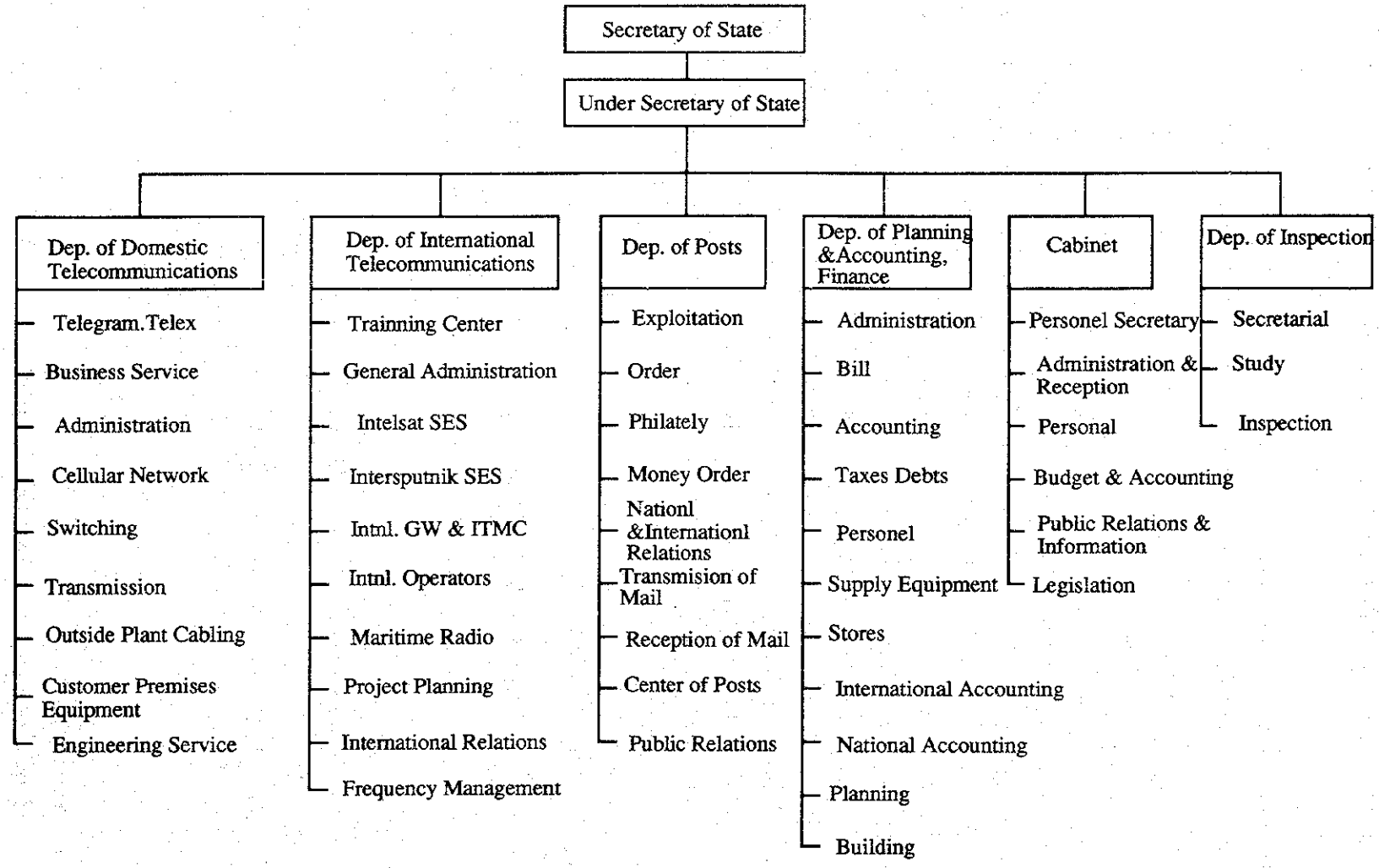


Figure 3.1-1 Organization of the MPTC

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.

3.2.1 Business Cooperation Contract

(1) International Telecommunications Service

In joint business under a BCC, a general commercial contract is adopted, so the rate of investment changes based on the contract conditions. Up to now, the MPTC has been conducting international telecommunications business jointly with OTC International limited (hereinafter referred to as OTCI). The following table shows the contents of the contract.

Table 3.2-1 Investment Ratio

Investment items	The MPTC	OTCI
Equipment	0%	100%
Land, Buildings	100%	0%
On-site costs (Electricity, etc.)	0%	100%

For international telecommunications, the revenue on incoming calls after reduction of transit and originating call goes 51% to the MPTC and 49% to OTCI; OTCI bears 49% of the cost of the leased satellite circuit. In the 2nd stage of the contract (Construction of a standard "A" earth station and 5,000-terminal LS), the MPTC investment in equipment, land, and buildings was 0%, and it will pay additional 12% of the revenue for international outgoing calls 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. Debit cards for pay phones are supplied to the MPTC by OTCI. OTCI receives 30% of the face value of all debit cards supplied by OTCI.

3.2.2 Joint Venture

(1) 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. Three private companies are in the process of supplying paging service. The terms and conditions are shown in Table 3.2-2.

Table 3.2-2 Terms and Conditions of the Joint Venture Contract for Cellular Telephone Service

Items	CAMTel	CASACOM (SAMART)	TRICELCAM	CAMSHIN
Service	Mobile Telephone	Mobile Telephone	Mobile Telephone	Fixed Wireless Telephone
Investment	UD$4 mil. invested by CP Group	UD$4 mil. invested by Samart	UD$4 mil. invested by TRI	UD$4 mil. invested by Shinawatra
Share Hold	30% owned by the MPTC 70% owned by CP Group	30% owned by the MPTC 70% owned by Samart	30% owned by the MPTC 70% owned by TRI	30% owned by the MPTC 70% owned by Shinawatra
Period of Contract	10 years	10 years	10 years	15 years
Tax	Liable for all taxes, but exempted from taxes of imported goods	Liable for all taxes, but exempted from taxes of imported goods	Liable for all taxes, but exempted from taxes of imported goods	Liable for all taxes, but exempted from taxes of imported goods
Building/Land	The MPTC leases	The MPTC leases	The MPTC leases	The MPTC leases
Board of Directors	2 members by the MPTC 3 members by CP Group	3 members by the MPTC 4 members by Samart	3 members by the MPTC 4 members by TRI	3 members by the MPTC 4 members by Shinawatra
Remarks				

(2) Paging Service

Three companies, Singapore Telcom International, Twin Bridge of Taiwan, and Union Link of Hong Kong has entered the sector establishing their joint venture companies individually executed the contract with the MPTC.

Now three joint venture companies provide pager services with around three hundred subscribers as of June 1995.

(3) Long-distance Call Services

A joint-venture contract establishing a joint venture company named CAMINTEL was made for operating long-distance call services by using ex-UNTAC network between the MPTC and PT. INDOSAT of Indonesia. Former dedicated network for UNTAC will be utilized as PSTN with charging system. The necessary work for starting operation is now under way by CAMINTEL.

3.3 Telecommunications Development Plan

As described in Chapter 1 above and detailed in Chapter 4 hereafter, 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 this situation, the MPTC has the following main goals:

(1) To replace or upgrade existing old telephone equipment in the country with modern facilities for switching, transmission and cabling.

(2) To increase the telephone density to at least 1 telephone per 100 people overall within the next five years.

(3) To provide a nation-wide trunk system using terrestrial microwave links or optical fiber cable systems.

(4) To introduce new telecommunications facilities within all provincial capitals and district centers.

(5) To improve the overall performance of the MPTC through the adoption of new structures and operating procedure.

(6) To develop, ratify and adopt new legislation, tariff procedures and operating practices.

(7) To have a rehabilitated training center suitably equipped with a long term training plan, courseware, instructors and equipment.

(8) To prepare and adopt a Master Plan as the basis for the next fifteen year development program.

3.3.1 The MPTC Programs for Rehabilitation and Development

The MPTC has a plan to implement the following infrastructure projects and technical assistance for 1994 to 1998. The funding for projects will be contributed by various means e.g. bilateral, WB, ADB, UNDP, ITU and so forth.

Infrastructure Projects are;

(1) Switching and Outside Plant in Phnom Penh

Development of switching and outside plant cabling in Phnom Penh and surrounding areas; to provide up to 20,000 lines in Phnom Penh with new local switching and cabling between 1994 and 1997.

(2) Switching and Cabling in Provincial Towns

To provide switching and outside plant cabling in all of the major cities of Cambodia to supplement the existing but extremely limited local facilities. Twenty one towns will require local exchanges, cabling and outside plants. Up to 20,000 subscribers will be supplied to meet the medium term needs.

(3) Rural Communications Systems

For the purposes of government administration and national security, rural and low density telecommunications services supported by public call office operations are to be of equal level with services provided in the major cities and Phnom Penh. The provision of low density rural service of at least one telephone to most of the district towns and villages is considered a reasonable target for the period from 1994 to 2000. These relatively low maintenance and operating cost systems provide high quality services in areas which offer low revenue return and are thus not attractive to private sector operators. However, services can be provided at lower cost to the subscriber than existing cellular telephone services now available in selected provincial areas of Cambodia. Three or four systems providing a total of 1,200 subscribers would be required.

(4) Marine and Coastal Radio

At the present time, Cambodia does not have a functional marine coastal radio and search and rescue capability. Reliance is placed on portable handheld units and marine radio is supplied through Ho Chi Minh City in Vietnam. The growth in marine traffic, shipping and coastal trade necessitates the building and operation of these systems. In addition there is a need to improve communication efficiency of the Mekong and Tonle Sap waterways. This requires the installation of a new

maritime VHF radio system in Phnom Penh along with a number of repeater stations along the waterways.

(5) National Microwave Trunk Network

To provide a long term solution to the requirements for a national transmission system, a terrestrial microwave network should be planned and eventually used to interconnect all provincial capitals with each other and Phnom Penh.
This will provide a high quality digital communications system for Cambodia supporting local, national and international telecommunications services. These facilities would gradually replace the newly acquired satellite communications system donated to Cambodia by the United Nations at the conclusion of the UNTAC operations. Two major microwave routes would be required, north/south and east/west.

(6) Inter Regional Microwave Network

The importance of establishing telecommunications links within the Indochina region is essential for the future economic development of Cambodia. Links should be established between Cambodia, Laos and Vietnam to provide lower cost services to these countries and to take advantage of the growth in telecommunications in these countries. Links to Thailand, Vietnam and Laos would also provide alternatives for the routing of international calls and provide the basis for improved economic and social relations between the countries.

Technical Assistance consists of the following ;

(1) Training, Human Resource Development, Technical Assistance

The technical assistance needs for the MPTC in telecommunications training and support are considerable. There are needs in virtually every area from technical to management. In addition, the low skill levels of the existing and incoming technicians is due to lack of higher education opportunities. This highlights the need of fellowships for engineers and technicians for overseas training and study trips.

(2) Training Center Development and Training Courses

The MPTC telecommunications training center in Phnom Penh is in a very poor state and lacks the most basic equipment for telecommunications services. In addition there is an absence of training materials, course ware and instruction materials. The building is in need of renovation for classrooms, workshops and residential facilities. The project would include upgrading, renovation and providing equipment and course materials.

(3) Institutional Support to the MPTC

Assistance in managerial improvement of a rapidly expanding telecommunications sector is required. Over the next three to four years, a program of improvement in financial management, accounting, planning and organization restructuring will be needed.

(4) A Master Plan for Telecommunications Development

Specification of the appropriate framework for the development of the telecommunications services in Cambodia is needed. This will cover a fifteen year period and would clarify technical aspects, financial requirements, national transmission systems, numbering plan, business plan, manpower requirements, organizational structure and project identification.

3.3.2 UNDP/ITU Project

The MPTC and UNDP/ITU instituted the project "Telecommunications Master Plan and Institutional Strengthening" to make a significant contribution to the improvement of the telecommunications sector in Cambodia at the end of August 1994. This project will contribute directly to the MPTC ability to autonomously plan, implement and manage the telecommunications sector, and is divided into two categories. One is to formulate the Telecommunications Master Plan, and the other is to analyze and improve the management, institutional strengthening and restructuring of the MPTC.

3.4 Financial Situation

Table 3.4-1 shows the revenues and expenditures of the MPTC for telecommunications business over the last three years (fiscal year: January – December).

Table 3.4-1 Revenues and Expenditures of the MPTC for Telecommunications Business from 1991 to 1993

(1,000 riels, US$1,000)

Year	Revenues	Expenditures
1991	Riel 1,208,100 (US$ 1,411)	Riel 898,200 (US$ 1,049)
1992	Riel 11,102,000 (US$ 7,299)	Riel 3,164,000 (US$ 2,080)
1993	Riel 63,495,000 (US$ 22,500)	Riel 16,932,000 (US$ 6,000)

Note: (1) Yearly average riel dollar exchange rate
1991; 856 riels / US$ 1992; 1,521 riels / US$ 1993; 2,822 riels / US$

(2) Financial data regarding revenues and expenditures of the MPTC up to 1990 does not include the international telecommunications services revenue, since international telecommunications services mainly started from 1991. Therefore, the data prior to 1991 is not valid for this financial evaluation.

(3) ( ): Equivalent value in US$

Itemized revenues and expenditures of the MPTC for telecommunications business in 1993 based on the data from the MPTC, are shown in Table 3.4-2.

Table 3.4-2 Itemized Revenues and Expenditures for the MPTC Telecommunications Business in 1993

(US$1,000)

Type	Revenues		Type	Expenditure	
International calls	18,817	(83.63%)	Labor costs	338	(5.63%)
Domestic calls	7	(0.03%)	Depreciation	96	(1.60%)
International FAX	1,165	(5.18%)	Expenses for goods	103	(1.71%)
TELEX	32	(0.14%)	Materials expenses	63	(1.05%)
International telegraph	7	(0.03%)	Supplies expenses	25	(0.42%)
Domestic telegraph	2	(0.01%)	Fuel expenses	63	(1.05%)
Phone rental (IDD)	621	(2.76%)	Power expenses	35	(0.59%)
Phone rental (non-IDD)	29	(0.13%)	Repair of large-scale fault	13	(0.21%)
Phone-card sales	1,649	(7.33%)	Repair expenses	2	(0.04%)
New installation & relocation	155	(0.69%)	Travel expenses	11	(0.19%)
Other services	16	(0.07%)	Insurance expenses	20	(0.34%)
			Satellite transponder rental	36	(0.59%)
			Settling expenses among International/other companies	76	(1.27%)
			International telecommunications revenue for OTCI	5,100	(84.99%)
			Indirect costs (OH)	18	(0.30%)
			Other costs	1	(0.02%)
Total	22,500	(100%)	Total	6,000	(100%)

3.5 Tariff System

3.5.1 Subscription Fee

The following fees are assessed when subscribing for a telephone (for a first subscription).

(1) Installation Fee

- Penta Conta subscriber (only for domestic use):

Zone No. 1 (within 1 km from MPTC Head Office)	;	60,000 riels
Zone No. 2 (more than 1 km and less than 2 km from MPTC Head Office)	;	80,000 riels
Zone No. 3 (more than 2 km from MPTC Head Office)	;	100,000 riels

(2) Dropwire Fee 150 riels / per meter (Actual cost)

(3) Deposit

Penta Conta subscriber	:	20,000 riels
AXE subscriber	:	US$200 + 20,000 riels

Fees (1) and (2) are required when subscribing; (3) is paid separately.

3.5.2 Monthly Telephone Rate

The monthly telephone rate for subscribers is divided into two categories. One is for subscribers accommodated in Penta Conta exchanges to whom IDD (International Direct Dialing) is unavailable and the other is for subscribers accommodated in AXE 104 exchanges to whom IDD is available. The rate is shown in Table 3.5-1.

Table 3.5-1 Monthly Telephone Rate

Penta Conta subscribers (Riel)		AXE 104 subscribers (US$)			
Telephone	Fax	Telephone		Fax	
Sub.'s own & Rental	Sub.'s own & Rental	Sub.'s own	Rental	Sub.'s own	Rental
2,400	2,400	20	30	40	60

3.5.3 Charge for Domestic Telecommunications

The charge for local calls is free, while the charge for long distance calls depends on minutes but not distance. The charge for long distance calls which is possible via a manual board is 3,000 riels per 3 minutes. The charge for public pay phone use in Phnom Penh is US$0.2 per minute. The charge for telegrams is 50 riels per word. Telexes are not used domestically.

3.5.4 Charge for International Telecommunications

(1) IDD Service

A per-minute system is used. The tariff is shown in Table 3.5-2.

Table 3.5-2 Tariff for International Calls (IDD)

(US$)

Outgoing	Telephone (per minute)	Fax (per minute)	Telegram (per word)	Telex (per minute)
Australia, Russia-13 states, Hungary, Bulgaria, Poland, & Czech	3.80 (3.00)	6.00	0.47	3.80
Thai	3.80 (3.00)	6.00	0.47	4.00
Vietnam, Laos, Hong Kong, Japan, New Zealand, Cuba	4.00 (3.20)	6.00	0.23	2.80
Asian Continent	4.50 (3.60)	6.00	0.63	4.90
European Continent, American Continent, African Continent & Oceanian Continent	4.80 (3.80)	7.00	0.68	5.65
Incoming	-	-	-	-

note: ( ) shows off peak phone rate from midnight of Friday to midnight of Sunday

(2) Operator Service

A per-minute system is used. The tariff is shown in Table 3.5-3.

Table 3.5-3 Tariff for International Calls through Operator

(US$)

Outgoing	Telephone (up to 3 min.)	Telephone (per minute after 1st 3 min.)
Australia, Russia-13 state, Hungary, Bulgaria, Poland, & Czecho	11.4	3.80
Thai	12.0	4.00
Vietnam, Laos, Hong Kong, Japan, New Zealand, Cuba	12.0	4.00
Asian Continent	13.50	4.50
European Continent, American Continent, African Continent & Oceanian Continent	15.90	5.30
Incoming	-	-

3.5.5 Relation of Payment Request and Collection

(1) Issuance of Bills

Penta Conta subscribers: Bills are issued every three months.
AXE subscribers: Bills are issued every month.
— Riels for domestic call rate / US dollars for international call rate

(2) Collection of Bills

Subscribers can pay the bills directly to the central office of the Ministry of Posts and Telecommunications, or through a bank account.

(a) An automatic-output schedule exchange of AXE104 digital is available for IDD subscribers.
(b) Hand printed rate schedule is available for crossbar exchange system subscribers.

Subscribers (including new ones) must pay telephone charges within 30 days after receiving a bill from the MPTC. If bills go unpaid even after the payment period expires, a reminder will be sent to delinquent subscribers. After receiving the reminder, the delinquent subscriber must pay telephone charges within 15 days. If he does not pay even after 15 days passed, a second reminder will be sent to him. If no payment is still forthcoming, the subscriber line is blocked. At the moment, the rate of collection of telephone call bills is about 85% in the MPTC.

3.6 Assistance by International Agencies

Though Cambodia received assistance from the Eastern bloc, mainly the former Soviet Union, from 1978 through the 1980s, assistance from these countries is no longer available.

Instead of the Eastern bloc's assistance, investments from abroad have been made to international telecommunications service by OTCI of Australia and the cellular telephone services by Thailand and Malaysia.

As part of foreign-assistance activities, ITU began to elaborate a fifteen year Telecommunications Master Plan and Institutional Strengthening in October 1994, France and Cambodia have agreed on the installation of the exchange in Phnom Penh City, and Germany plans to construct a transmission system between Phnom Penh City and Battambang.

3.6.1 ITU and UNDP

In terms of telecommunications project plans, UNDP formulated a study entitled "REPORT ON KAMPUCHEA NEEDS FOR ASSISTANCE" in 1989, which proposed needs of the Master Plan and the installation of a microwave system between Phnom Penh and Battambang.

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.

3.6.2 Development Plan of the WB and ADB

The WB announced "The Cambodia Agenda for Rehabilitation and Reconstruction" in May 1992. The Agenda suggested the construction of microwave systems of the south

and north route from Phnom Penh, and installation of 27,000 lines of exchange. No concrete action was taken afterward, however.

ADB has been in conference with Cambodia about assistance. In the conference, higher priority is being given to infrastructure areas such as roads, railways, airport construction, and maritime transport. As for the telecommunications sector, small investments may be made in training, building repair, and other areas.

3.6.3 Germany

German Kreditanstalt für Wiederaufbau (KfW; German Reconstruction Finance Cooperation) has suggested construction of a rural communications network (Point to Multi-point System (hereinafter referred to as P-MP System); 300 subscribers) in the Battambang area with grant aid of DM15 million (US$10 million). However, two problems have been identified; the absence of a node station for telecommunication links in Battambang, and the lack of a transmission system between Phnom Penh and Battambang.

KfW 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.

3.6.4 France

The French officials proposed the grant funds to improve telecommunications in the Siem Reap area and to install a new exchange in Phnom Penh City. 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. The system is scheduled to be in operation in August 1995.

CHAPTER 4

Present Telecommunications Services and Facilities

CHAPTER 4 PRESENT TELECOMMUNICATIONS SERVICES AND FACILITIES

4.1 Site Conditions

In Phnom Penh and its surrounding areas, the relevant sites to the Project such as the MPTC head office, and the post & communications offices have been surveyed and investigated as follows:

(1) Locations of Sites

The locations of the relevant sites, which were surveyed by the Study Team, are indicated in Figure 4.1-1.

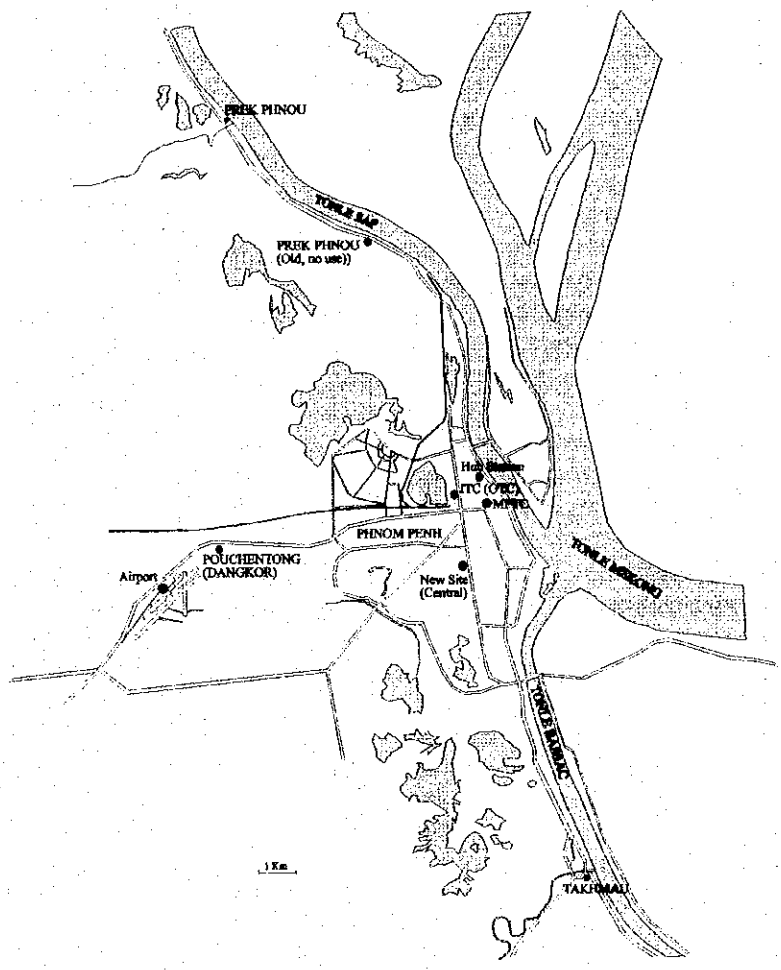


Figure 4.1-1 Locations of relevant Sites in Phnom Penh and Surrounding Areas

(2) Site Conditions

The conditions of the relevant sites are summarized in Table 4.1-1.
The drawings such as site layouts, floor layouts and tower loading conditions in the relevant sites are shown in ATTACHMENT-3.

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 Transmission (Microwave, F/O) Cellular telephone systems	
Training Center	Free space & the Training Center	Training center (2 stories)	-	-	Plan for the Central Exchange Office
Pouchentong (Dankor)	Post & Communications	2 stories (1F for the MPTC)	-	Transmission (VHF)	
Airport	Airport	Airport Control Tower 5 stories (3F for the MPTC)	-	Satellite comm. Transmission (microwave) PABX Cellular telephone systems Public pay phone	
Hub Station	MPTC Hub Station	Trailer for facilities	tripod guyed tower : 63 m above ground	Satellite comm. Transmission (microwave, UHF) PABX	Former UNTAC station
Takhmau	Post & communications (Exchange Center)	3 stories	-	Exchange (SxS) Transmission (microwave, VHF)	
Prek Phnou	Post & communications	2 stories	-	-	
Prek Phnou (old)	not in use	1 story	-	-	
ITC (OTCI)	Earth Station for international call	1 story	guyed pipe tower : 20 m above ground	Satellite comm. Exchange Transmission (microwave, F/O) 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 telecommunication 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. The conditions of the subscriber network, especially for the outside plant, are mentioned in clause 4.4.3.

(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. The details are mentioned in 4.4.1.

(3) Long Distance Network

The long distance network for public communications is provided by HF / VHF systems through a manual board (refer to 4.4.2).
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 the joint venture company of CAMINTEL (refer to 4.6).

(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 International Telecommunications Center (hereinafter referred to as "ITC").
The approach link is connected between the MPTC Head Office and ITC by an optical fiber cable system with a microwave system as backup.

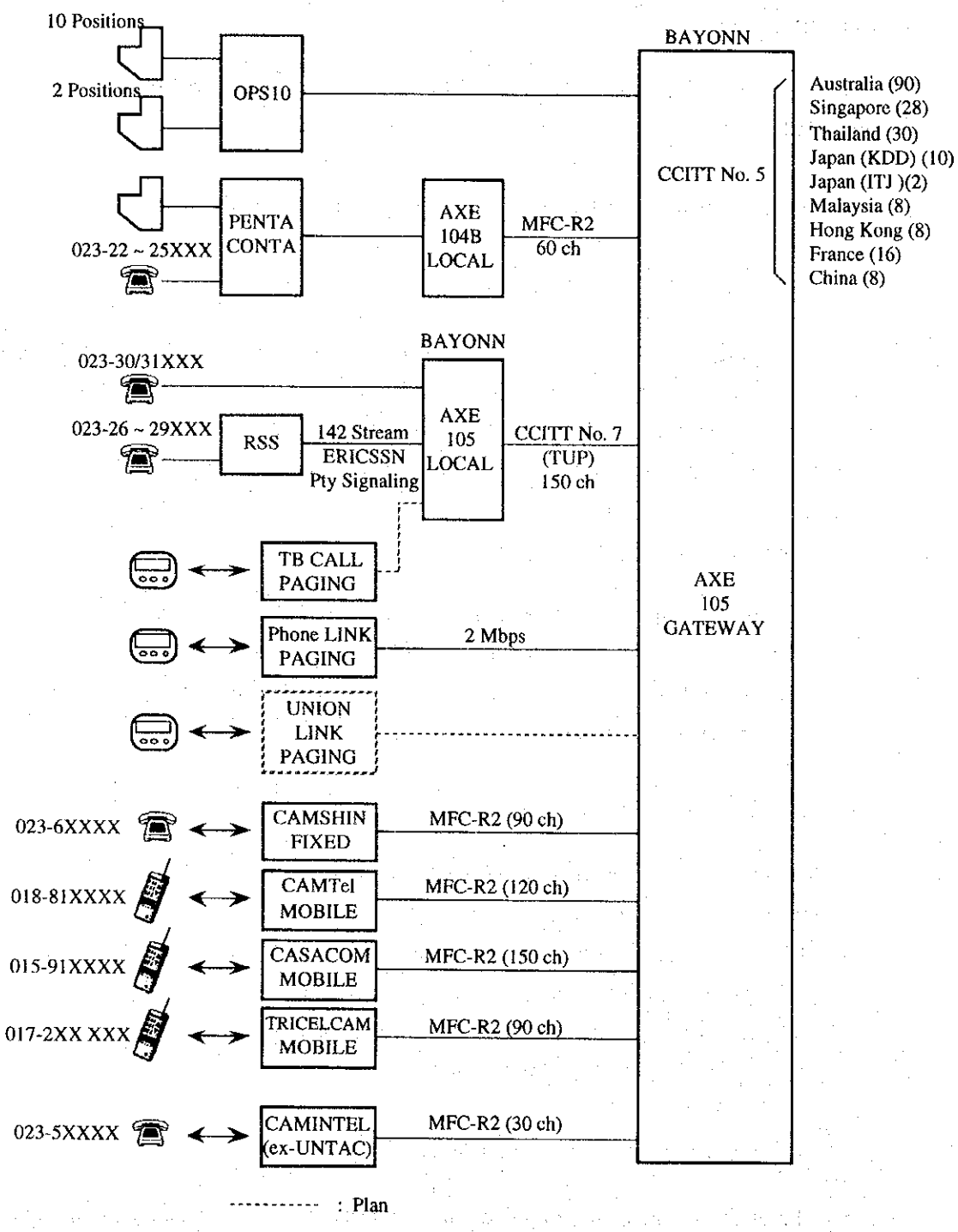


Figure 4.2-1 Network Structure in Phnom Penh City and its Surrounding Area

4.3 Telecommunications Services

4.3.1 Telephone Services

(1) Telephone Services in Phnom Penh

Presently, in Phnom Penh, the telephone services are supported with cross-bar exchange, digital exchange and cellular telephone systems. All systems which are managed/operated by the MPTC with five foreign companies participating in a joint venture and business cooperation contract scheme.

The telephone subscribers have been stated at about 3,000 before cellular telephone services were established in 1992.
Presently, there is a total of approximately 14,000 telephone subscribers, however, 10,000 of these are subscribers of cellular telephones.

Recently the MPTC has announced 20% reduction of international telecommunications services for off-peak on Saturdays and Sundays, which is subject to the trend of public opinion.

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

Table 4.3-1 Number of Subscribers for Telephone Services

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 in the MPTC Head Office separates handling form functions that digital exchange (AXE 104/105) can be applied to IDD, and cross-bar (Penta Conta) exchanges can not.

The inhabitants in Phnom Penh may understand the situation that the MPTC has a policy to expand the IDD calls in order to respond to the demand of customers.

MPTC has placed an order to OTCI for installing an important facility for locals, tourists and foreigners, therefore, the public pay phone services were commenced in 1993.

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

Table 4.3-2 Public Pay Phone Services

Category	No. of Sets
Important Facility	total 66 sets
Authorities Concerned	4
The MPTC/Post Office	11
Hotel/Restaurant	11
Airport	7
Hospital/Clinic	3
Bank/Business Firm	11
Education/Culture	3
Other service	16

Source: Information from the MPTC

(2) Telephone Services in Surrounding Area

(a) Takhmau

Takhmau post office is located 12 kilometers south of Phnom Penh City and takes about 20 minutes by car. All parts of national road Route-2 are connected by paved road. However, the road is not in good condition.

According to official data in Takhmau, the population is 43,000 and there are approximately 7,000 households.

The Post Office building, three-story with penthouse, has reached about 31 years of its existence.

Presently in Takhmau the local telephone services are supported with an out-dated exchange system (Oki step by step, manufactured in 1967), which has been moved from the MPTC head office three years ago, and installed there. 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.

On the other hand, there are some subscribers in Takhmau who are directly accommodated in Penta Conta and AXE 104 exchanges in the MPTC head office by the digital microwave (one hop) link with 30 channels (2 Mbps x 1 system).

(b) Airport

Pouchentong Airport is located 11 kilometers west of Phnom Penh City and takes about 20 minutes by car. All parts of national road Route-3 are connected by paved road.

The airport facility consists separately of Control Tower building and New Departure/Arrival Gates building.
A new post office is established in the departure lobby, but is still getting started. Also, the arrival gate is under construction.
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 post office is located 13 kilometers north of Phnom Penh City and takes about 25 minutes by car. All parts of national road Route-5 are connected by paved road. However the road is not in good condition.
According to the official data from Po Nhea Loeli district, the population is 8,300, and 1,240 households, but Prek Phnou is an area with no telephones.

(3) Telephone Services in Provinces

Administrative region in Cambodia consists of 19 provinces and 2 municipalities with 172 districts to be divided.
The telecommunication services in provincial areas are limited due to aged exchange facilities, the capacity of which is only less than 2,000.

In connection with public telecommunications for telephones and telegrams, the services in provincial areas are covered by means of HF transceivers with 8 frequency ranges.
There are two HF base stations in Phnom Penh which are located at the MPTC and Toul Svay Prey, and assigned communication services to the provinces of which the network in Cambodia is shown in Figure 4.3-1.
According to the customer data recently, the traffic including Telegram services is 50 times per day throughout the service time from 07:00 to 17:00.

As for VHF radio network in Cambodia, this system had been supported by the ex-Soviet Russian-made facilities in the past. Presently, however, VHF link is only maintained for Kampong Cham link.

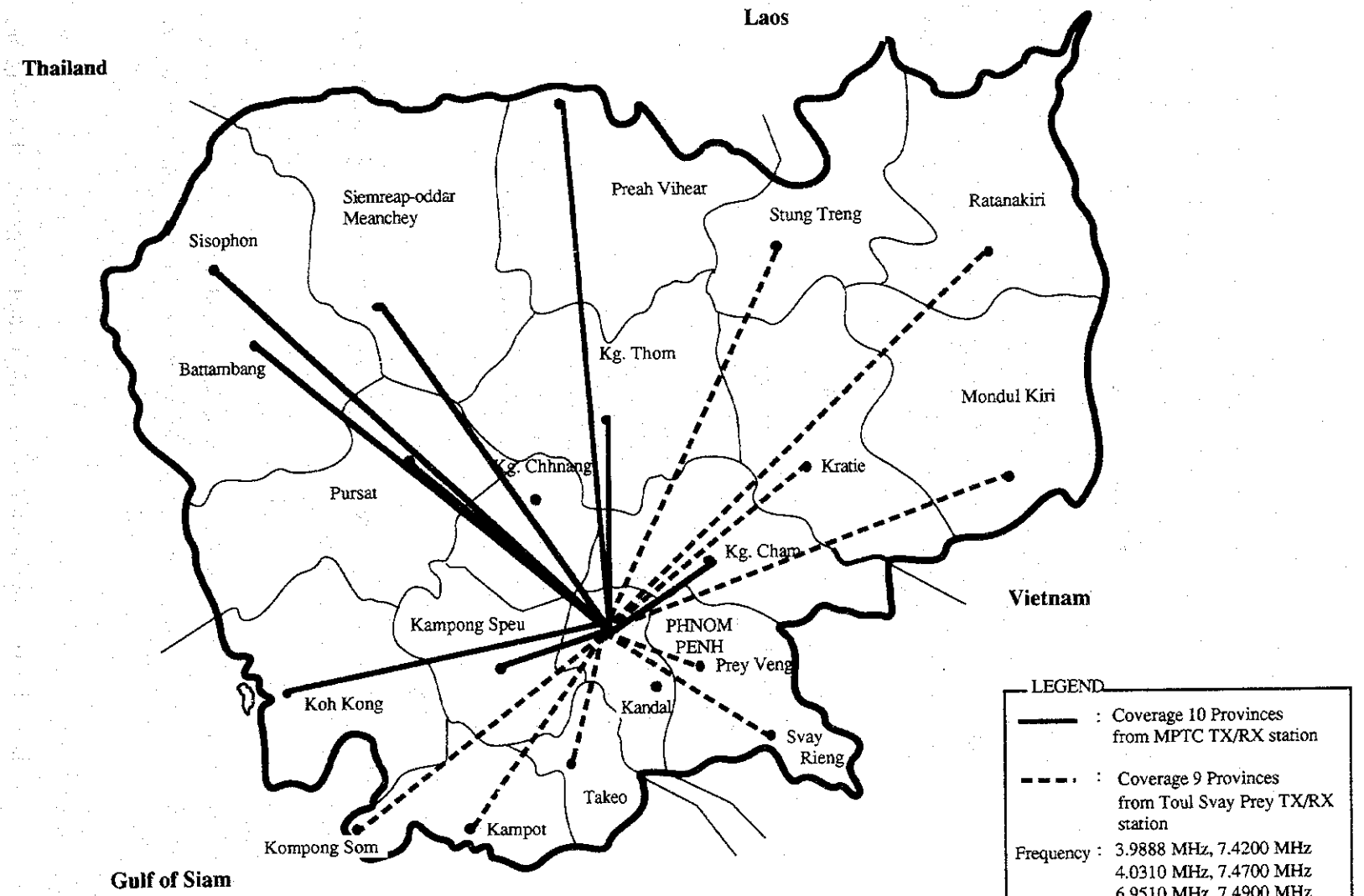


Figure 4.3-1 HF Radio Telephone/Telegraph Network in Cambodia

(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:

- CAMSHIN
  CAMSHIN is a joint venture company of the MPTC and SINAWATRA (Thailand), and has been providing cellular telephone services in Phnom Penh from August, 1993.

- CAMTel
  CAMTel is a joint venture company of the MPTC and CP group (Thailand), and commenced service in October, 1992 in Phnom Penh.

- CASACOM
  CASACOM is a joint venture company of the MPTC and SAMART (Thailand), and commenced service in Phnom Penh and four (4) provinces in November, 1992.

- TRICELCAM
  TRICELCAM is a joint venture company of the MPTC and Technology Resources Industries Brerhad (TRI, Malaysia), and has been providing a service in Phnom Penh from October, 1993.

At present, the number of subscribers accommodated in the cellular telephone systems is approximately 9,200 as of October, 1994; i.e., the number is larger than that of cable systems, and the number of subscribers 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 4.3-3 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 450 / 800 MHz (NOKIA)	AMPS 800 MHz (MOTOROLA)	NMT 900 MHz (NOKIA)	ETACS 800 MHz (ERICSSON)
Service Area	Phnom Penh	Phnom Penh	Phnom Penh Battambang Kompong Cham Siem Reap Sihanoukville	Phnom Penh
No. of Base Stations	2	2	6 (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

(1) Tariff System of Each Company

The tariff systems of the cellular telephone services are summarized as shown in Table 4.3-4.

Table 4.3-4 Tariff System of Cellular Telephone Services

Unit: US$

Items		CAMSHIN	CAMTel	CASACOM	TRICELCAM
Register Fee		160	950 - 2,550 *1	1,200	865 - 1,000 *1
Deposit		820	0	100	100
Monthly Charge		14	25	17	20
Local Call		0.15 / call	0.20 / min.	0.17 / min.	0.17 / min.
Local Long Distance Call		0.15 + 0.05/min.	-	-	-
Long Distance Call	Originating	*2	*2	1.30 / min.	*2
	Incoming	free	free	free	free
International Call	Originating (MPTC +)*3	0.2 / min.	0.2 / min.	0.2 / min. (from Phnom Penh) 1.3 / min. (from Province)	0.2 / min.
	Incoming	free	free	free	free

Source: Information from the MPTC

*1: Register fee depends on type of subscriber terminals.

*2: Connections between CASACOM and other cellular companies are not agreed, so the long distance call can not be provided by three cellular companies excluding CASACOM.

*3: International call charge is added to the charge of the MPTC.

*4: Data as of October, 1994

(2) Cellular Telephone Systems of Each Company

(a) CAMSHIN System

CAMSHIN system is different from the other three (3) cellular telephone systems, and is a kind of fixed cellular / Wireless Local Loop (WLL) systems. The subscriber terminal is fixed at customer premises with a power supply system (charger and batteries). This system uses the radio frequency 450 MHz and 800 MHz bands.

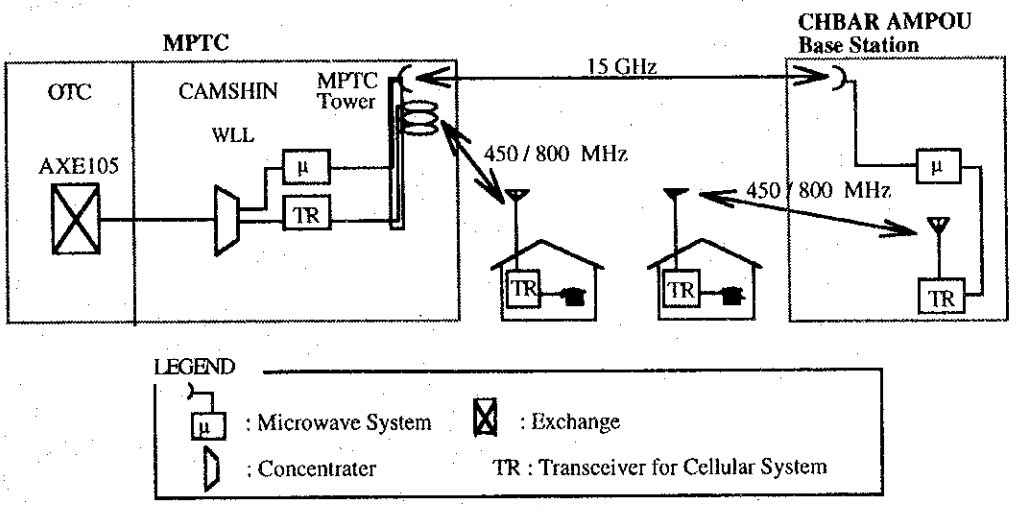


Figure 4.3-2 System Configuration of CAMSHIN System

(b) CAMTel System

CAMTel system applies the AMPS-800 system, and its service is provided by two (2) base stations in Phnom Penh.

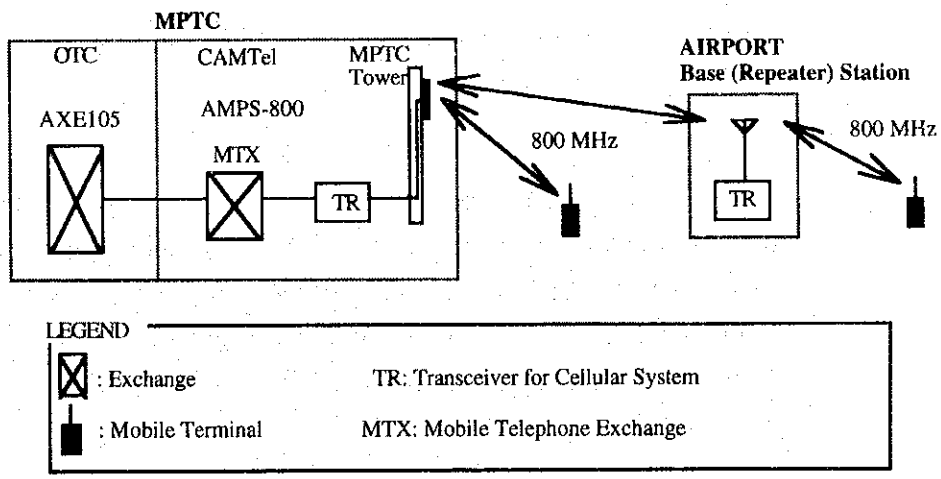


Figure 4.3-3 System Configuration of CAMTel System

(c) CASACOM System

CASACOM system applies NMT (Nordic Mobile Telephone System), and its service areas are not only in Phnom Penh, but also in 3 provinces (Battambang, Siem Reap, Kompong Cham, Sihanoukville). These base

stations are connected by terrestrial microwave systems in Phnom Penh and satellite communications systems between Phnom Penh and provinces.

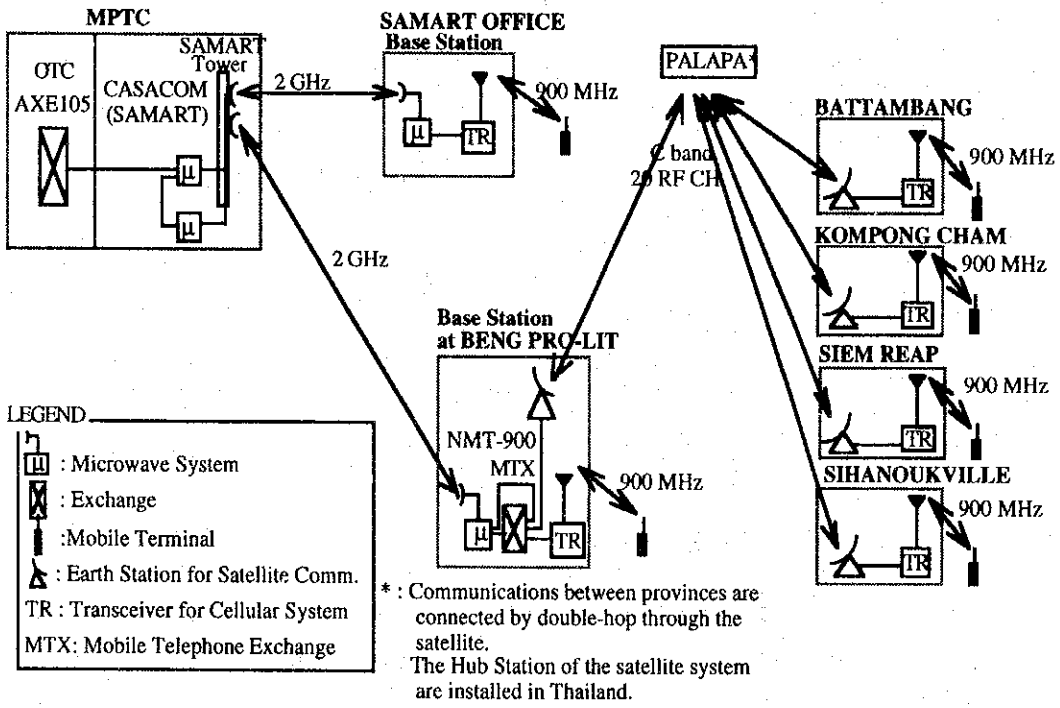


Figure 4.3-4 System Configuration of CASACOM System

(d) TRICELCAM System

TRICELCAM system applies ETACS, and its service areas are covered by 3 base stations in Phnom Penh. These base stations are connected to each other by the 8 GHz / 15 GHz microwave systems. The service area is approximately 15 Km x 15 Km in Phnom Penh.

TRICELCAM has a plan to expand the service areas in Sihanoukville and Kompong Cham.

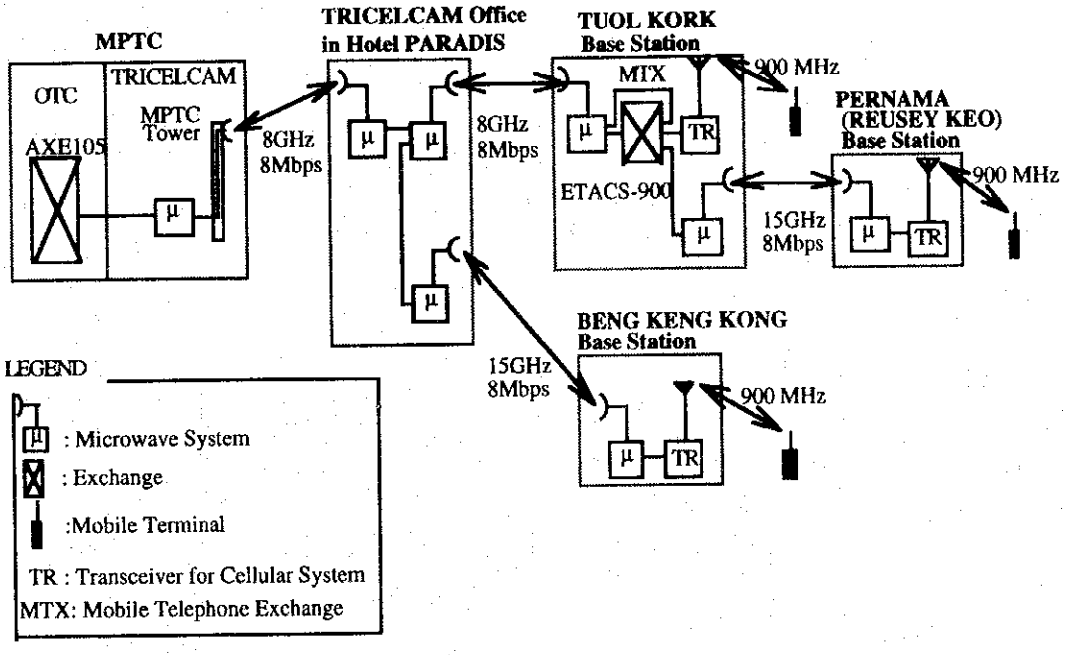


Figure 4.3-5 System Configuration of TRICELCAM System

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.

Presently a lot of telex machines are accommodated in the MPTC telex room. However, the greater part of machines could not be operated due to little demand and/or aged machines with no spare parts. In addition to the above, 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 MPTC is planned to provide paging service in near future.

The service conditions of the paging systems are shown in table 4.3-5:

Table 4.3-5 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 above ground	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
Service Area (Radius of Service Area)	Phnom Penh (approx. 30 km)	Phnom Penh (approx. 30 km)	Phnom Penh (approx. 30 km)
No. of Subscribers as of 15 June, 1995	129	120	-
Remarks		Concession and system were transferred from SOCITEL.	

As a typical paging system, the system configuration of TB CALL is shown in Figure 4.3-6:

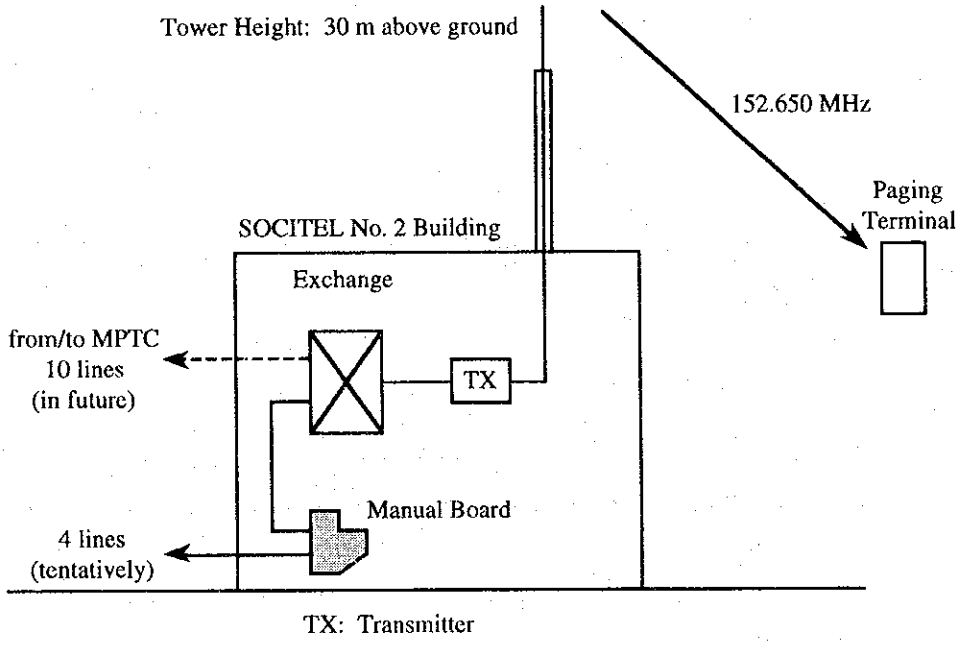


Figure 4.3-6 System Configuration of TB CALL Paging System

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 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.
Transition of exchange arrangement is described in Figure 4.4-1.

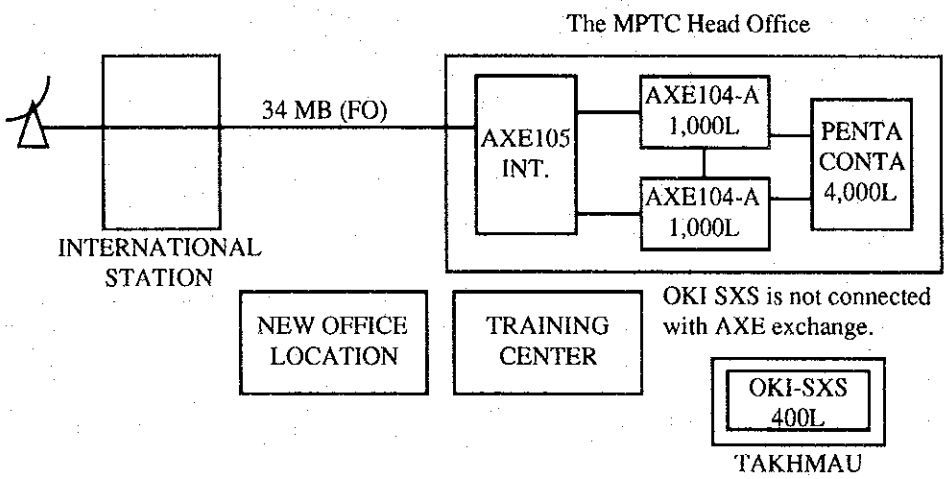
Table 4.4-1 Existing Facilities of Exchange Systems as of June 1995

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 PAILIN	LS		OKI-SXS	1986	1,000	
	BANTAY MEAN	SISOPHON						
6	KAM.THOM	KAM.THOM	LS		PABX	1981	100	
	SIEM REAP	SIEM REAP SAMRONG	LS		MAGNET	1982	100	
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	

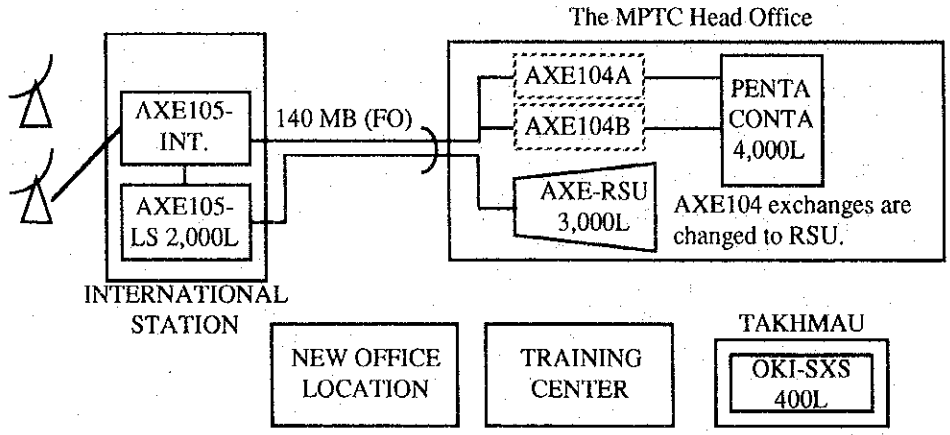
Source: Information from the MPTC

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

(1) As of 1st October 1994



(2) As of 1st April 1995



(3) After French grant project

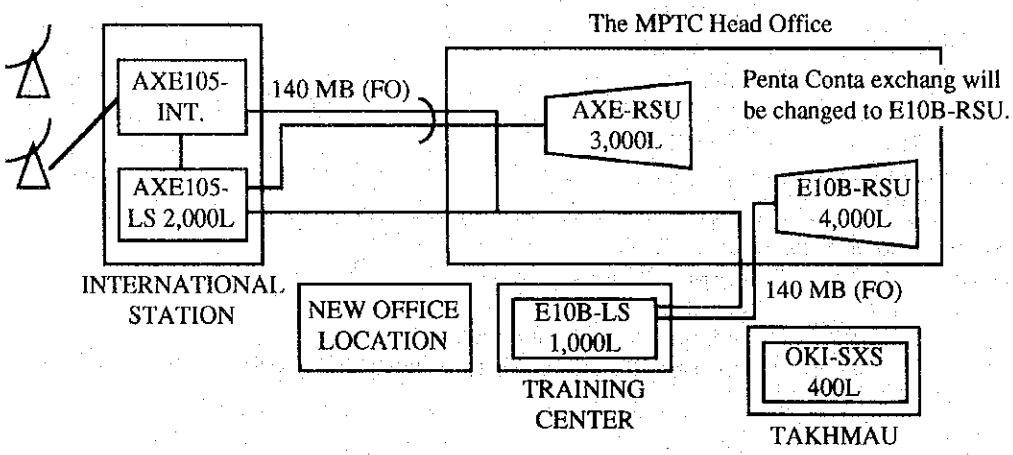


Figure 4.4-1 Transition of Exchange Arrangement in Phnom Penh

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.
Details of these situations are shown in Figure 4.4-2 and 4.4-3. However from the viewpoint of property against the MPTC, the environment of facilities such as room lighting, floor space and aged wiring including back-up system for AC / DC power supply (refer to ATTACHMENT-4) seems not to be in such good conditions as well as being small scaled transmission facilities. 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 (no use)
F/O Cable System	MPTC - Hub Station	34 Mbps, 2 cores
	MPTC - ITC	34 Mbps, 6 cores

Source: Information from the MPTC

As for most important facilities for international calls, OTCI is carrying out the installation work to set a transmission equipment and AC/DC power plant in the new building of ITC.
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. One of the cable lengths is about 2 km, and the other is 1.4 km. The initial stage of transmission capacity will be as follows.

Mobile	16 x 2 Mbps
RSS	10 x 2 Mbps
AXE 104 A	3 x 2 Mbps
AXE 104 B	3 x 2 Mbps
Private network	5 x 2 Mbps

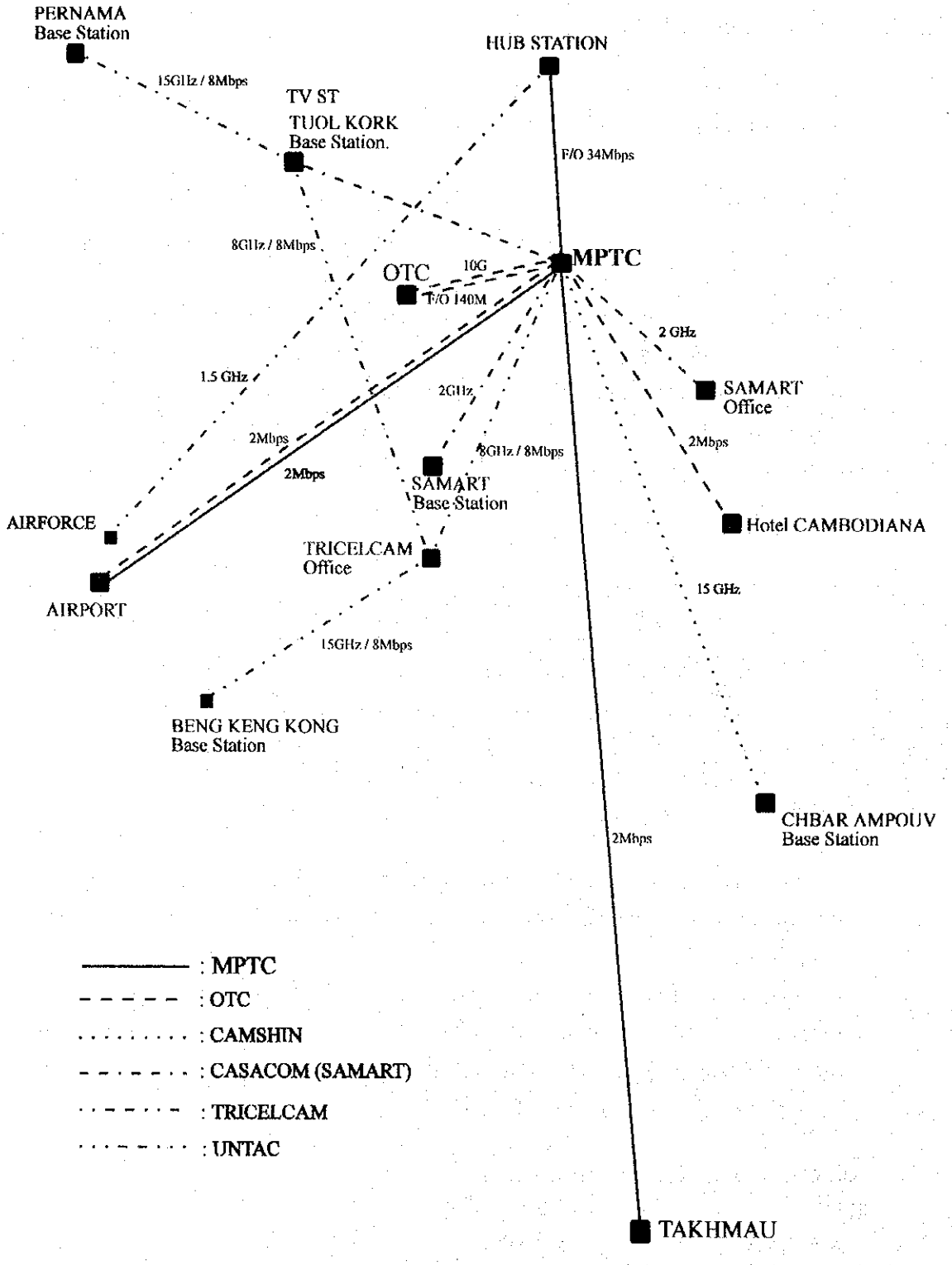


Figure 4.4-2 Microwave and Optical Fiber Routes in Phnom Penh

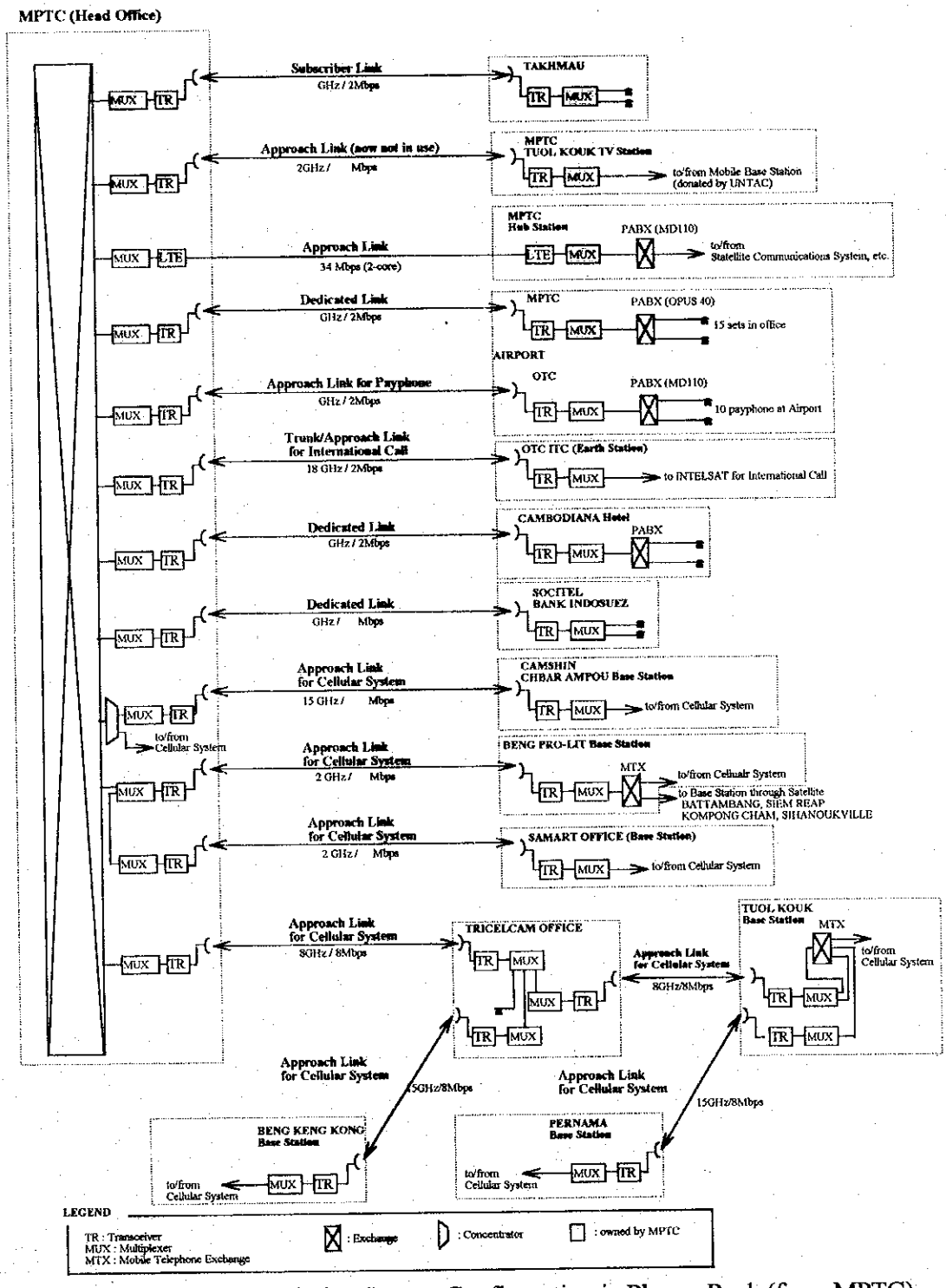


Figure 4.4-3 Transmission System Configuration in Phnom Penh (from MPTC)

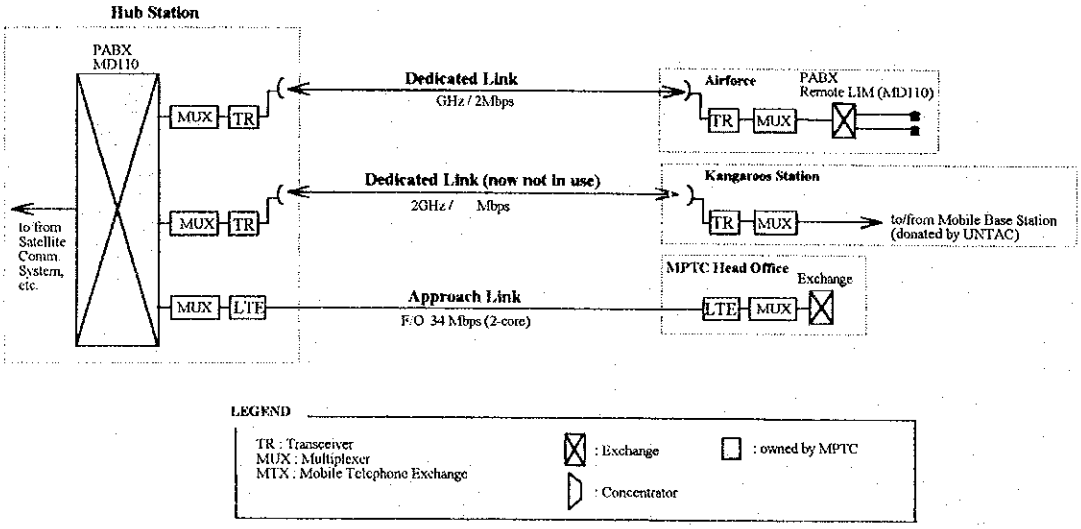


Figure 4.4-4 Transmission System Configuration in Phnom Penh (from Hub Station)

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) Cable for Subscriber Network

Direct buried cables are used for the primary cables and some part of the secondary cables, and aerial cables are used for the other part of secondary cables. Direct buried cables are lead sheath cable with paper insulation. Gas pressure systems are not installed in spite of the usage of paper insulation cable. In addition to the deterioration of the cable, this causes the increase of cable faults.

Aerial cables, which are polyethylene sheath cable with polyethylene insulation, are installed on old concrete telephone poles and electric poles. Aerial cables have also deteriorated and are installed in confusion together with many electric lines and many drop wires for telephones.

Table 4.4-3 shows the total length of the existing cable by types of cable.

Table 4.4-3 Total Length of Existing Cable

(km)

Direct Buried Cable	43.0
Aerial Cable	58.6
Total	101.6

Source: Information from the MPTC

Table 4.4-4 shows the installed cable length by year from 1990 to 1993. All installed cables are aerial cable, and these cables are assumed to be installed for the replacement of the damaged cables.

Table 4.4-4 Total Length of Installed Cable

(km)

1990	3.0
1991	2.0
1992	3.1
1993	7.7

Source: Information from the MPTC

(b) Civil Work

There is a underground cable vault just under the MDF room of the MPTC head office. Twenty six internal cables run from the MDF to the cable vault, and are integrated into sixteen direct buried cables. These cables go to the manholes installed close to the MPTC head office through the ducts on the both side of the cable vault.

The cable vault is full of cables and the ducts are fully occupied as well. It is difficult to install new ducts between the cable vault and the manhole outside.

Manholes in Phnom Penh City are simple brick box type and covered with concrete plates. During the field survey, many manholes marked with "1960" on the lid were found. Many concrete covers have broken off and the manholes which are filled with litter have been identified.

There were very few concrete troughs in some urban areas. These troughs are mainly used to protect cables under road crossings.

(c) Other Facilities

i) Drop Wire

As the installation of cables have been limited since 1970 and the number of defective conductors has increased because of the deterioration of the cable and the shortage of spare cables for maintenance, cable capacity is rather insufficient. Consequently, the long spans (500-900 meters) in which many drop wires are strung in confusion instead of aerial cables, and the aerial cable route is actually composed of multiple drop wires.

ii) Cabinet Box and Distribution Box

There are twelve cabinet boxes in Phnom Penh City and these are old and have deteriorated. We found connected cables, jumper wires and drop wires untidy in some cabinet boxes.

The distribution boxes are also old and have deteriorated. During the field survey, many active distribution boxes without cover have been seen. These distribution boxes were made in former East Germany, Cuba and France.

iii) Pole

The old concrete poles of six meters long have been installed along the streets mainly in the side walk. Some poles are leaning and several cracks are found in them.

(d) Subscriber Network

i) Configuration of Network

Though the primary cables are normally installed between exchange office and cabinet boxes, and the secondary cables are between cabinet boxes and distribution boxes, many drop wires have been installed from cabinet boxes to the subscribers.

There are many cables which have been installed from exchange office to the distribution boxes. This method is applied to the high demand density area for economical reasons, but this has been widely used in Phnom Penh City.

In addition to the deterioration of the facilities, the present condition mentioned above makes the subscriber network difficult to maintain.

There are twelve cabinets in Phnom Penh City now, and two of them are used as distribution boxes. Judging from the plant record of the MPTC, there are about 120 distribution boxes in Phnom Penh, but 50 distribution boxes are connected by working lines.

Figure 4.4-5 shows the primary cable route where only working cables run, and the cabinet boxes and the distribution boxes to which only working lines have been connected. From the cabinet boxes and the distribution boxes shown in the figure, the aerial cables and drop wires stretch in confusion for a long distance and cover all subscribers in Phnom Penh.

Source: Plant Record from MPTC

Note: Boxes to which working lines are connected, are shown

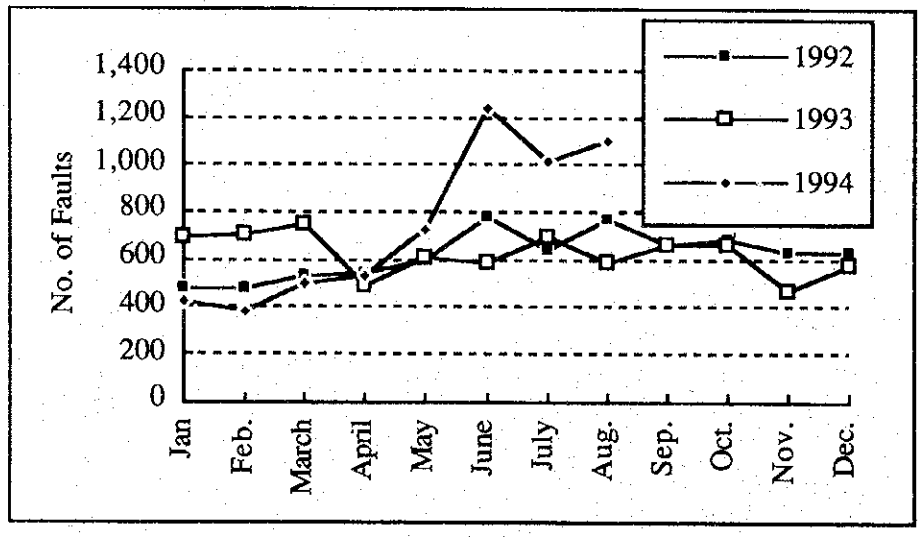
Number of pairs includes damaged lines

Figure 4.4-5 Primary Cable Route

ii) Quality of Subscriber Network

According to observation by the MPTC's staff, the average number of faulty subscriber lines amount to 15~25 /day in dry seasons, and 25~55 /day in rainy seasons.

As statistical data, the monthly number of faults in outside plant, for which repair orders have been issued to the outside plant section, is shown in Figure 4.4-6. These numbers do not include the faults of telephone sets.



Source: Information from the MPTC

Figure 4.4-6 Number of Faults for the Outside Plants

There seem to be many subscribers who do not complain of the telephone faults because the faults happen frequently. Therefore, it seems that there are many hidden faults in addition to the reported number of faults in the figure mentioned above.

The fault rate of the outside plant in Phnom Penh City, which is calculated using the above data is about 13 faults/month/100 subscribers. The value in Japan is about 0.12 faults/month/100 subscribers. This extreme difference of the fault rate between both countries comes from the existent subscriber cables whose service life has already past, and which have been deteriorating, obsolesced and lacking in maintenance, as well as the records of facilities not

being arranged sufficiently. Therefore, all existent subscriber cables must be replaced with new ones.

(e) 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 have been installed directly from the MDF in the first floor of the Takhmau Post Office, and through the second floor the cables run outside. The total pairs of the six cables amount to 212 pairs. 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.

4.5.1 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. The organization chart is shown in Table 3.1-1 in Chapter 3.

(1) Exchange

Exchange section operates and maintains AXE, Penta Conta, MD110 and the works in MDF.
In the MPTC's organization, the sub-section in charge of MDF works is called the Cable Record section which handles jumpering in MDF, measurement of the subscriber network and preparation of the measurement record, preparation of repair lists and repair order sheets to maintenance sections concerned.

(2) Transmission

Transmission section operates and maintains satellite communications system handed over by UNTAC, microwave equipment and VHF/UHF transceiver.

(3) Outside Plant

Outside plant operation and maintenance, from MDF up to distribution point, is covered by the Outside Plant Cabling section which consists of installation, maintenance, planning and drawing.

(4) Customer Premises Equipment

Customer Premises Equipment section covers PABX, telephone sets and facsimiles. The section also installs and maintains wiring of drop wire and house wire.

The staff belonging to the section are dispatched to do repairs in accordance with the repair order by the Cable Record section.

(5) Engineering Services

Engineering Services section operates and maintains the electric power plant of the exchange office. The section consists of Power Plant, Air Conditioner, Security Alarm, and Generator.

(6) Telegram/Telex

Telegram/Telex operation and maintenance consists of Record Keeping, Operation and Maintenance, and Correspondence.

(7) Business Services

Business Services section consists of customer services and Shop Center.

(8) Cellular Network

Cellular telephone services are operated under joint venture contracts between the MPTC and private investors. Private investors have their own operation and maintenance structure in their organization and carry out most of the operation and maintenance by themselves.

4.5.2 International Telecommunications Operation and Maintenance

International telecommunications network of the MPTC is divided into two way, namely, the INTELSAT network and the INTERSPUTNIK network.
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 business cooperation contract of the MPTC and OTCI.
As for the organization of the MPTC, the below-mentioned training center (ENARPOSTEL) is organized under the International Telecommunications Operation and Maintenance.

4.5.3 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. The former is for high-school graduates and the latter is for non-high school graduates.

There are four full time instructors at present. Those instructors specialize in telecommunications, radio (RF) and posts and are selected among the MPTC staff.

As of 1993, there are 83 trainees including 26 for telecommunications, 22 for radio (RF), and 35 for posts. 1,450 persons have already completed the course since the commencement of the center and have taken positions at the MPTC head office, the post offices in Phnom Penh and provincial cities, or at the training center (as instructors).

4.5.4 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. Among the seven vehicles, one is a ladder equipped truck, three are van type vehicles and the remaining is a pick up truck.

Due to an insufficient number of vehicles which are mainly assigned to the outside plant installation and maintenance section, MPTC staff belonging to other sections use their own motorcycles when they need to go out.

4.5.5 Subscriber Connection

The following chart shows the present work flow of new subscriber connections.

At present, due to the shortage of subscriber cable pairs available, the process shown below becomes a complicated one.

From 1983 to 1993 the annual new subscriber connections were between two and three hundred.

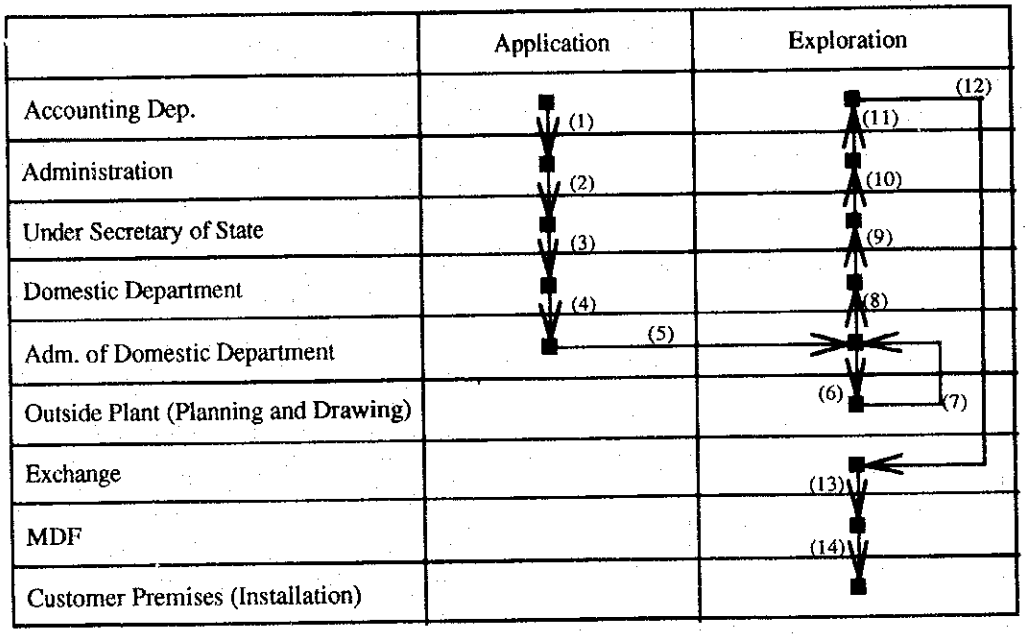


Figure 4.5-1 New Subscriber Connection Work Flow Chart

4.5.6 Subscriber Fault Repair

The following chart shows the current flow of fault repairing work.

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 because it is usual to solve trouble in a cable pair by changing the subscriber line to a good pair accommodated in the same cable as a troubling pair. The MPTC tentatively solves the situation by installing dropwire parallel to existing cable network.

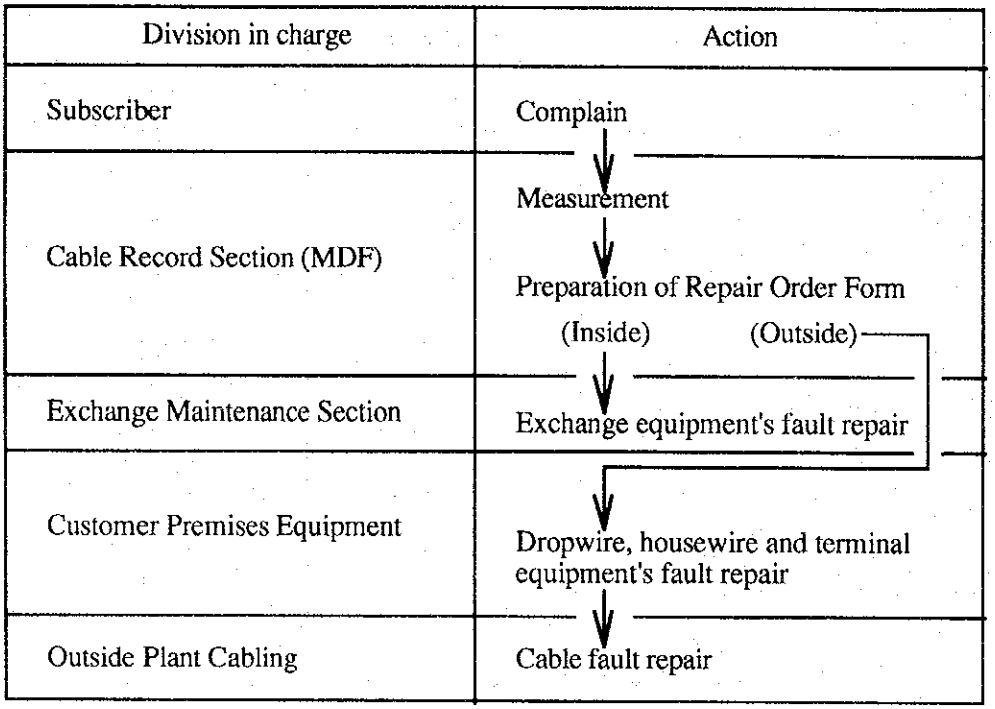


Figure 4.5-2 Fault Repair Work Flow Chart

Figure 4.4-6 shows number of fault occurred on outside plant in Phnom Penh in past years. As mentioned above, the data on outside plant fault can represent total fault of telecommunications network as the portion is particularly high.

As described in 4.4.3, the data of 13 fault/month/100 subscribers shows that a subscriber met around 1.5 outside plant faults in average per year or a subscriber met, in average, an outside plant fault every eight months.

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, UNTAC's main body of troops left Cambodia. Then the leased facilities for the communications network were removed, and the remaining facilities (worth US$15 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) DAMA controller (1) PA equipment (1) PABX (MD 110) (1+21) Earth station equipment (21) Engine generator (1+21)	for communications between Phnom Penh and provinces	
Microwave System	Microwave system (3 links)	Hub - Airforce Hub - Kangaroos Station (not in use) The MPTC - Toul Kork TV Station	
P-MP System	IRT 2000 (TRT) Central station equipment (1) Repeater station equipment (2) 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 Base station equipment (1 station, 15 RF CH) Exchange (1) Subscriber terminals (350 sets)	not in use	
Mobile Radio System (Trunk Line Mobile Radio System)	(TAIT) Base station equipment (1 station, 6 RF CH) Subscriber terminals (89 sets)	for government communications	

Source: Information from the MPTC

The above communications systems are at present being used in the following manner, however, the systems will be connected to PSTN with charging systems by the joint venture of the MPTC and INDOSAT (Indonesian company). The

modification and relocation is now under way by a joint venture company, which is named CAMINTEL.

4.6.1 Satellite Communications System

(1) System Features

The satellite communications system has the following features:

- Communications between Phnom Penh and provinces or between provinces (mainly used for government communications, and partially for public communications)
- Use for telephone and facsimile communications
- No charging system at present
  (charging performing by the MPTC's personnel watch)
- Communications between provinces are established by a double-hop.
- Power for the system in provincial area is supplied by an engine generator, so operation period is limited to 5 hours per day.
- Communications frequency is very high (about 3,000 times per day)

(2) System Configuration

The system configuration of the satellite communications system is indicated in Figure 4.6-1.

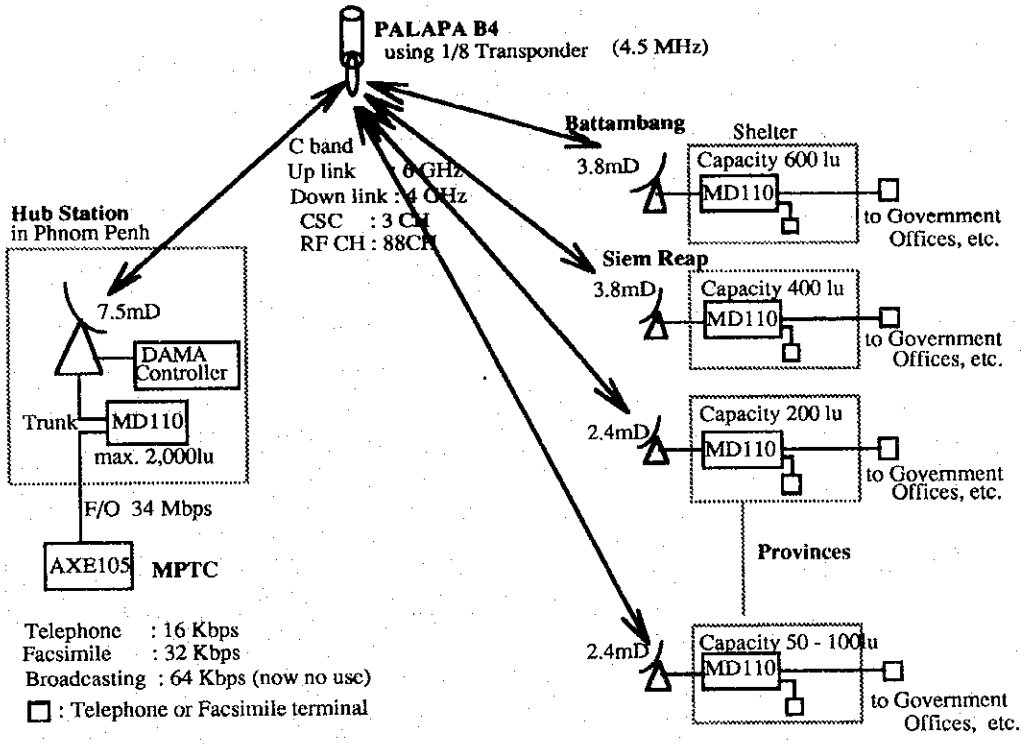


Figure 4.6-1 System Configuration of Satellite Communication System

Table 4.6-2 Satellite Communications System as of October, 1994

Site Name (Province)	Capacity of PABX (maximum)	DAMA Capacity (No. of Lines)	TX Power	Remarks
Phnom Penh	(2,000)	CSC : 3 CH F CH: 88 CH		
Phnom Penh				for training
Banteay Meanehey	(500)	7 (T: 5, F: 2)	10 W	in Sisaphon
Battambang	350 (750)	14 (T: 9, F: 5)	20 W	
Kampot	100 (250)	7 (T: 5, F: 2)	10 W	
Koh Kong	100 (250)	7 (T: 5, F: 2)	10 W	
Kompong Cham	150 (250)	9 (T: 5, F:4)	10 W	
Kompong Chnnang	100 (250)	7 (T: 5, F: 2)	10 W	
Kompong Speu	150 (250)	8 (T: 6, F: 2)	10 W	
Kompong Thom	100 (250)	7 (T: 5, F: 2)	10 W	
Kratie	150 (250)	3 (T:3, F: 1)	10 W	
Mondorukiri	100 (250)	7 (T:5, F: 2)	2 W	in Senmonorom
Prey Veng	100 (250)	7 (T:5, F: 2)	10 W	
Preh Vihea	100 (250)	7 (T: 5, F: 2)	10 W	in Tbeng meanchey
Pursat	100 (250)	7 (T: 5, F: 2)	10 W	
Rattanakiri				in Lom Phath
Siem Reap	180 (500)	8 (T: 6, F: 2)	10 W	
Sihanoukville	180 (250)	9 (T: 5, F: 4)	10 W	
Strung Treng	150 (250)	9 (T: 9, F: 0)	10 W	
Svay Rieng	100 (250)	7 (T: 5, F: 2)	10 W	
Takeo	100 (250)	7 (T: 5, F: 2)	10 W	
Other				

Source : Information from the MPTC

*1: Total number of earth stations excluding Hub Station is 21 sets, however, some equipment is out of order.

*2: The number of lines indicates that between an earth station and PABX.

T: Telephone line, F: Facsimile line

(3) Operation and Maintenance Conditions

The operation and maintenance of the system are being carried out by the MPTC and Indonesian staff under the UNDP assistance.

In most provincial areas, the operation of the system is limited to 5 hours per day, because the earth station in general uses an engine generator.

4.6.2 Microwave System

The following microwave systems were handed over to the MPTC from UNTAC.

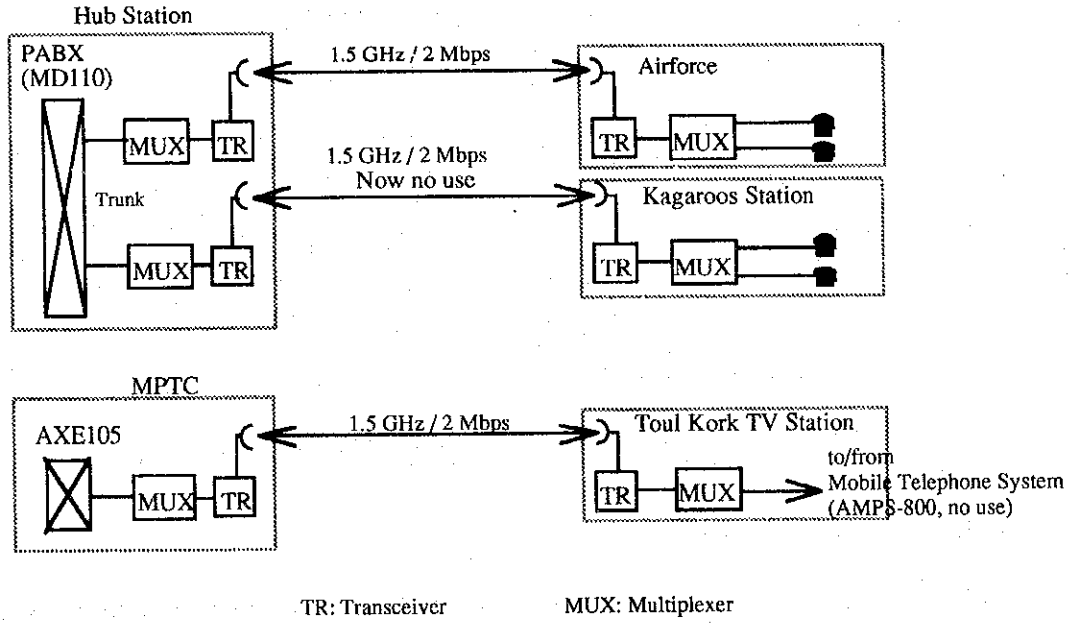


Figure 4.6-2 Microwave Systems donated by UNTAC

4.6.3 P-MP System

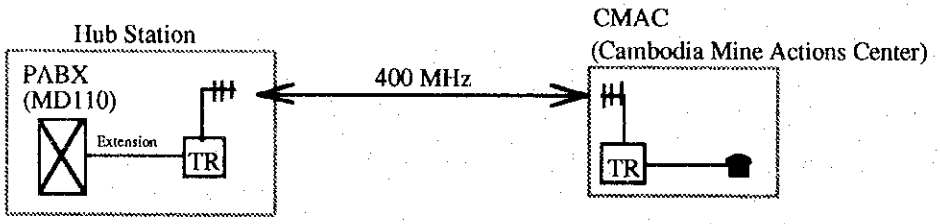
The following P-MP system was donated to the MPTC by UNTAC:

- Central station : 1 station in Hub Station
- Repeater station : 2 stations (in Takhmau and Prey Veng)
- Remote terminal station : 5 terminal stations per each cell

This model is IRT 2000 made by TRT (France), and using 1.5 GHz band, however this system is not presently used.

4.6.4 Point-to-Point System

As a Point-to-Point System (hereinafter referred to as "P-P system"), Exicom SR310 was also handed over to the MPTC from UNTAC. This system is used for the communications to Cambodia Mine Action Center (CMAC).

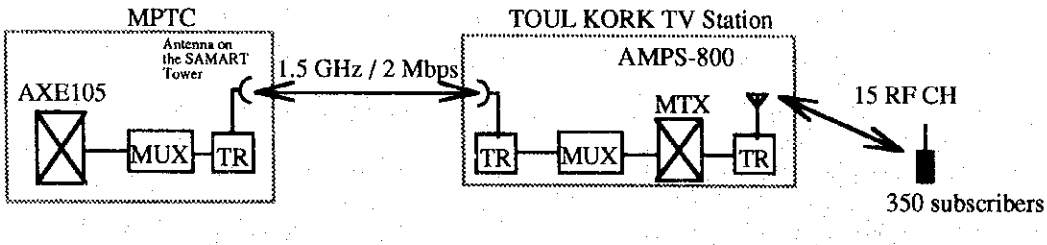


TR: Transceiver
TX (form Hub) : 420.825 MHz, RX : 410.825 MHz

Figure 4.6-3 System Configuration of P-P System

4.6.5 Cellular Telephone System

The cellular telephone system, which is AMPS-800 system and composed of 1 base station and 350 subscriber terminals, was donated to the MPTC by UNTAC. This system was connected with PSTN through a microwave system and assigned the telephone number of 013-21-xxxx. However, the power supply system is now out of order, so the system is not used.

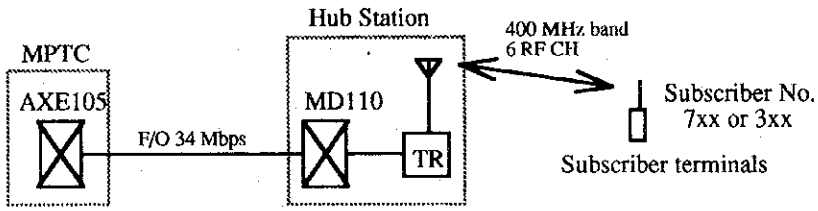


TR: Transceiver MUX: Multiplexer MTX: Mobile Telephone Exchange

Figure 4.6-4 Cellular Telephone System donated by UNTAC

4.6.6 Trunk Line Mobile Radio System

A trunk line mobile radio system (TLMRS) was also handed over to the MPTC from UNTAC. The system applies a two-frequency simplex operation and connects to PSTN with three digits' telephone number. This system is now used for governmental communications.



TR: Transceiver F/O: Optical Fiber System
TX : 415.575, 415.825, 416.075, 416.325, 416.575, 416.825 MHz
RX : 406.125 - 407.375 MHz

Figure 4.6-5 System Configuration of TLMRS

CHAPTER 5

Demand Forecast

CHAPTER 5 DEMAND FORECAST

5.1 Topdown and Bottomup 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.

The topdown forecasting method starts from forecasting national level demand then divides it into regional levels. The advantage of the method is, in short, that the method can be applied to any country in which local information is not available.
The bottomup forecasting method starts from forecasting the smallest unit of demand necessary for planning and designing. In the case of this Study, the necessarily smallest unit is the street block for subscriber cable network design. The merit of the method is that local characteristics variation and the current distribution of potential subscribers are obtained.

Since there are two different ways to obtain demand, the Study has two different results in Phnom Penh City as shown in Tables 5.2-8 and 5.3-3. Should the results of topdown and bottomup methods become unified, the column of "Phnom Penh" in the Table 5.2-8 which shows the result of a topdown method and the column of "Total" in the Table 5.3-3 which shows the result of a bottomup method must be the same because years and areas covered by them are strictly the same.

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

5.2 Macroscopic Demand Forecast for Telephones

5.2.1 ITU Model

Macroscopic demand forecast follows some of ITU's recommendations which standardize national telephone demand forecast by regression equation. Since the recommendations only show nation-wide demand calculation, the calculation results will be allocated to Phnom Penh City and its surrounding area by further assumption and calculations.

(1) National Demand Calculation Method

Following ITU recommendation, the national demand forecast is calculated by the exponential equation showing the correlation between demand density (number of telephone main lines per hundred population) and the level of the GDP per capita. The calculation makes it possible to forecast future telephone density at the national level by firstly projecting the GDP and population for future years.

The regression model showing the correlation between telephone demand density and GDP per capita is obtained by the least square method. Data on the calculation comes from world countries' current data of main line density per one hundred population and GDP per capita in United States dollar denomination which shows the trend of demand in every stage of development. Figure 5.2-1 shows the calculation result of the above-mentioned method based on the data collected for this study as shown in attachment.

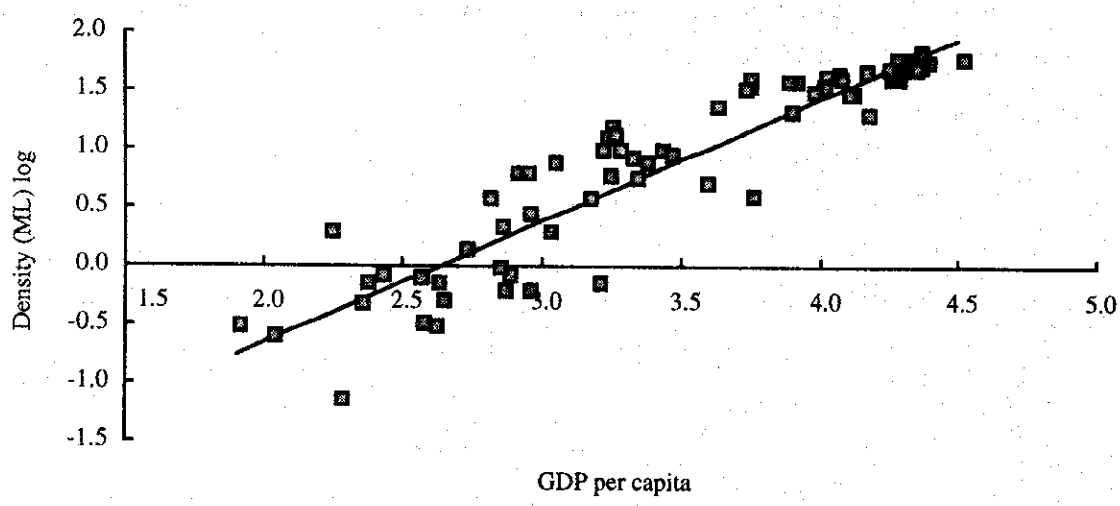


Figure 5.2-1 Main Line Density vs. GDP per capita

The following calculation result of the regression model is obtained by using the latest data analysis on 72 countries reported in the ITU Telecommunications Yearbook.

$Y = 0.001813X^{1.0416}$ (r=0.926) .....[1]

Where

Y : Main Line Density
X : GDP per capita (in US dollar)

(2) Big City Demand Calculation Method

Though it is usual to allocate the demand to the study area by dividing in proportion with expressed demand of the region which consists of the number of existing subscribers and the number of waiting applicants. In this case such an allocation is difficult because the current Cambodian condition easily gives the conclusion that suppressed demand is comparatively high in proportion to expressed demand and just considering expressed demand for the allocation may contain much error in calculation. Herewith suppressed demand represents the unknown potential subscribers that would demand a telephone if there was a realistic chance of it being provided in a reasonable time. When neglecting the factor and calculating only by expressed demand, more than 90 % of demand is concentrated in Phnom Penh which is the only city which has a telephone subscriber network.

To meet the conditions above, similar methods of estimation of national demand density recommended by ITU is introduced to this study which shows the relation between the ratio of big city's demand density per national demand density and GDP per capita.

The data collected for this Study concerning national demand and that of big city are shown in attachment.

Figure 5.2-2 shows the calculation result.

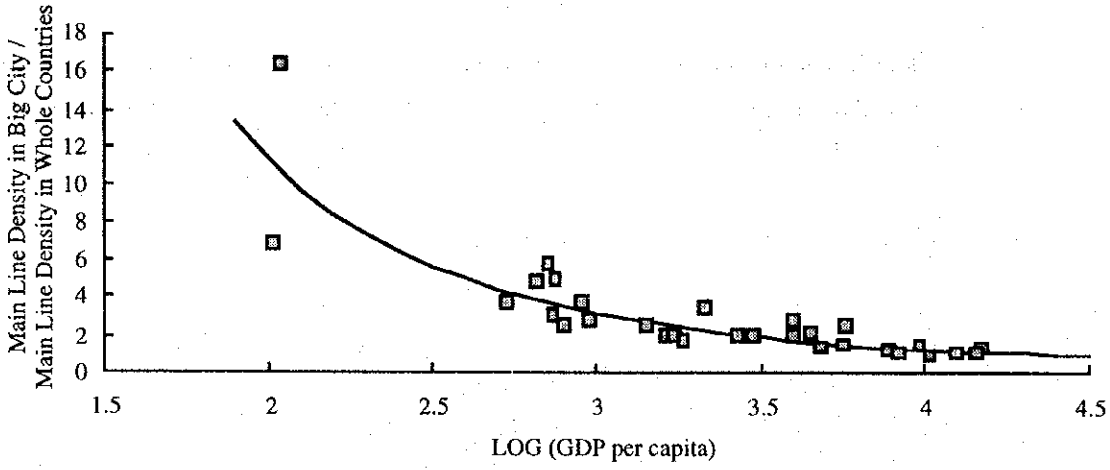


Figure 5.2-2 Main Line Density ratio of Big City vs. GDP per capita

The following calculation result on the regression model is obtained by the latest data analysis of those data in combination with ITU Telecommunications Yearbook and the World Telephone published by AT&T.

$$R = \frac{101.60}{(\mathrm{Log}_{10} X)^{3.1688}} \qquad (r = 0.908) \ldots\ldots\ldots\ldots [2]$$

R : Main Line Density in Big City/National Main Line Density
X : GDP per capita (in US dollar)

5.2.2 Forecast of Main Demand Factor Growth

(1) Population Forecast

(a) National Population

United Nation issues the "World Population Prospects" and its 1992 revision shows Cambodian population prospects as one of the countries. For this study, the prospects are used as the fundamental population estimation. This study follows the population growth rate in this "World Population Prospects" with 1992 population statistics collected by the Study Team.

Table 5.2-1 shows the populations used for the study. In this projection, Cambodian population will exceed ten million in 1997.

Table 5.2-1 National Population Projection

Year	1992	1997	2002	2007	2012
Population (Thousand Persons)	9,050	10,082	11,081	12,072	13,054
Growth Rate(percent)	2.72%	1.99%	1.78%	1.65%	1.65%

Source : World Population Prospects, the Study Teams estimation

(b) Population of Phnom Penh Municipality

Population in Phnom Penh Municipality is also not certain because of irregular residences. Some reports describe Phnom Penh Municipality as having a population of around 800,000 including irregular residences in 1991. For the purpose of demand calculation in Phnom Penh Municipality, this figure is applied. The growth ratio of population is around 4 % with yearly fluctuation which is calculated from the above-mentioned "World Population Prospects" which shows national population growth ratio and percentage of urban population.

Table 5.2-2 shows population projection in Phnom Penh Municipality.

Table 5.2-2 Population Projection in Phnom Penh Municipality

Year	1992	1997	2002	2007	2012
Population (Thousand persons)	835	1,016	1,241	1,538	1,903

Source : the Study Team's estimation

(c) Population of Districts in Phnom Penh Municipality

Considerable work had been carried out by the Master Plan Study Team of Water Supply by JICA in 1993 who investigated and concluded current and future population distribution in Phnom Penh Municipality. In this study, demand diffusion inside Phnom Penh Municipality follows the population distribution.

Phnom Penh Municipality is divided into seven districts. Four of them are called "Khan" in the central area and three of them are called "Srok" in the surrounding area. To divide the total Phnom Penh Municipality demands into these districts, populations in Table 5.2-2 are also divided into each district. Since the demand diffusion in four "Khan" areas are investigated in detail by the Study Team field survey, the detailed analysis

of these four "Khan"s is not needed separately from that of Phnom Penh City in Figure 5.2-3 which includes the total of those of the four "Khan"s.

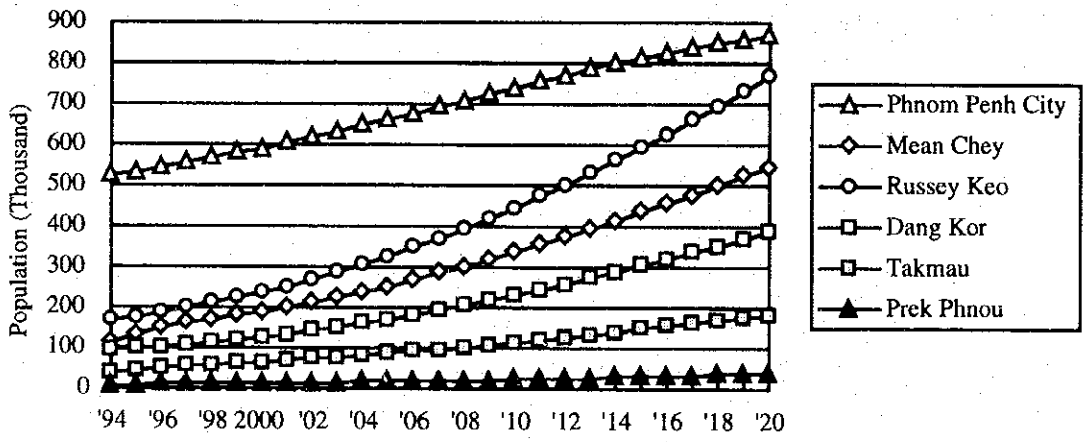


Figure 5.2-3 Population of Districts in Phnom Penh Municipality, Prek Phnou and Takhmau

(d) Population of Prek Phnou and Takhmau

Current Population statistics of the two districts of Prek Phnou and Takhmau which are next to Phnom Penh Municipality in the north and south respectively are available. Since the future projection is not available at present, the population growth rate of districts in Phnom Penh Municipality is applied. The population growth rate of Russey Keo which is the district adjacent to Prek Phnou is applied to Prek Phnou and that of Mean Chey which is the next district to Takhmau is applied to Takhmau. Figure 5.2-3 also shows the populations of these districts.

(2) Economic Growth Forecast

Cambodian official statements on economic indicators such as GDP are denominated in Cambodian currency, Riel. On the other hand, ITU recommendation of telephone demand calculation is based on GDP in United States Dollar denomination. It is necessary to estimate GDP growth in Unite States Dollar denomination. Some multilateral development agencies estimate current economic conditions of Cambodia. This Study uses ADB's calculation of GDP in United States Dollar denomination. Adding to the data, this study introduces a 7.5 percent growth rate in GDP which was concluded at the International Donor's Conference, ICORC, in March, 1994. Following the

past growth of south-east Asian countries, the high growth rate of economics is estimated to continue until 2007 then gradually fall to 5% in this Study.

Table 5.2-3 shows future GDP and GDP per capita estimated for this study.

Table 5.2-3 GDP and GDP per capita estimation

Year	1992	1997	2002	2007	2012
GDP (M. US$)	2,121.6	2,986.4	4,287.3	6,155.0	8,205.0
GDP per capita (US$)	234	296	387	510	629

Source : ADB, the Study Team's estimation

5.2.3 Result of Demand Forecast

(1) National Demand Forecasts

The data studied in 5.2.2 are applied to the macroscopic demand forecast model described in 5.2.1 and resulting in the national demand forecasts.
GDP in 5.2.2 is divided by population and GDP per capita is calculated. The GDP per capita is applied to the equation [1] of regression model in 5.2.1 and national telephone density is calculated. The density multiplied by population becomes national demand.

Table 5.2-4 shows the calculation result produced herewith.

Table 5.2-4 National Demand Forecasts

Year	GDP (M. US$)	Population (Thousand)	GDP per capita (US$)	Telephone Density	Demand
1994	2,403.9	9,473	254	0.58	54,900
1995	2,584.2	9,692	267	0.61	59,200
1996	2,778.0	9,885	281	0.64	63,700
1997	2,986.4	10,082	296	0.68	68,600
1998	3,210.4	10,283	312	0.72	73,900
1999	3,451.1	10,488	329	0.76	79,600
2000	3,709.9	10,697	347	0.80	85,800
2001	3,988.1	10,887	366	0.85	92,400
2002	4,287.3	11,081	387	0.90	99,600
2003	4,608.9	11,278	409	0.95	107,400
2004	4,954.5	11,479	432	1.01	115,700
2005	5,326.2	11,683	456	1.07	124,600
2006	5,725.6	11,876	482	1.13	134,200
2007	6,155.0	12,072	510	1.20	144,700
2008	6,579.8	12,271	536	1.26	154,900
2009	7,000.9	12,473	561	1.32	165,100
2010	7,413.9	12,679	585	1.38	175,300
2011	7,814.2	12,865	607	1.44	184,800
2012	8,205.0	13,054	629	1.49	194,600

(2) 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.

Phnom Penh Municipality's telephone density is calculated by national telephone density multiplied by the calculation result of the equation [2] of regression model in 5.2.1 which indicates the multiplication factor of big city's telephone density in line with national development described by GDP per capita. The calculated Phnom Penh Municipality's density multiplied by population becomes Phnom Penh Municipality's demand.

Table 5.2-5 Demand Forecasts in Phnom Penh Municipality

Year	GDP per capita (US$)	Phnom Penh's Population (Thousands)	Demand	Phnom Penh's Telephone Density
1994	254	904	17,400	1.92
1995	267	940	18,800	2.00
1996	281	978	20,400	2.09
1997	296	1,016	22,200	2.19
1998	312	1,056	24,300	2.30
1999	329	1,097	26,500	2.42
2000	347	1,140	29,100	2.56
2001	366	1,189	32,200	2.71
2002	387	1,241	35,800	2.88
2003	409	1,295	39,800	3.07
2004	432	1,351	44,300	3.28
2005	456	1,410	49,500	3.51
2006	482	1,472	55,400	3.76
2007	510	1,538	62,000	4.03
2008	536	1,607	69,300	4.31
2009	561	1,678	77,100	4.59
2010	585	1,753	85,500	4.88
2011	607	1,826	94,100	5.15
2012	629	1,903	103,400	5.43

(3) Demand Forecast inside Phnom Penh Municipality

As stated in 5.2.2 (1) (c), Phnom Penh Municipality is divided into seven districts. The detailed demand diffusion in four of "Khan" is investigated by the field survey by the Study Team and the division of Phnom Penh Municipality's demand into three of "Srok" is calculated based on afore-mentioned population distribution in Phnom Penh Municipality.

In such a case telephone densities of "Khan" and "Srok" are considered different, now and in the future. As an official city plan is not available, the Study Team estimates the difference based on experience in other countries by referring to Cambodian national telephone density and that of Phnom Penh Municipality calculated in 5.2.1 in combination.

Table 5.2-6 and Figure 5.2-4 shows the demand inside Phnom Penh Municipality.

Table 5.2-6 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
2012	50,300	17,500	23,500	12,100	103,400

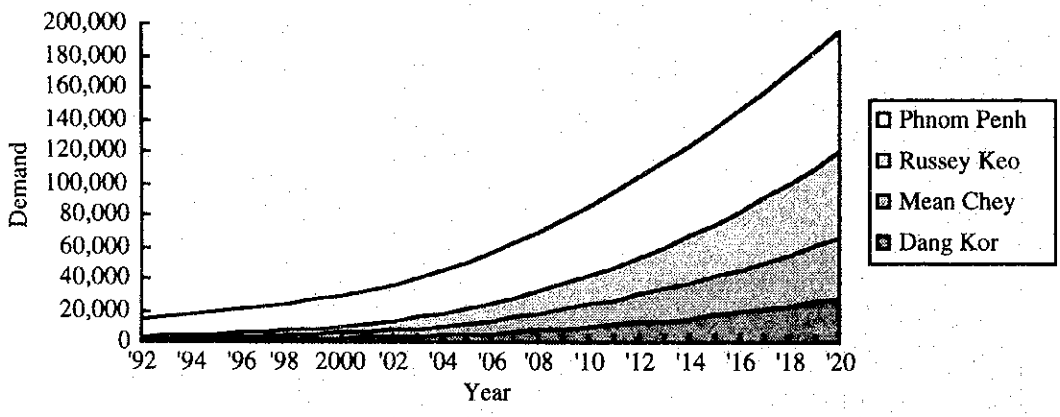


Figure 5.2-4 Demand inside Phnom Penh Municipality

(4) Demand Forecast of Prek Phnou and Takhmau

Following the calculation of districts in Phnom Penh Municipality, the Study Team estimates the telephone demand density by referring to that of the adjacent districts, Mean Chey for Takhmau and Russey Keo for Prek Phnou.

The telephone density is multiplied by the population projected and the demand of the year is calculated.

Table 5.2-7 and Figure 5.2-5 shows future demand of Takhmau and Prek Phnou.

Table 5.2-7 Demand of Takhmau and Prek Phnou

Year	Takhmau	Prek Phnou
1997	1,000	80
2002	2,000	180
2007	4,000	420
2012	7,300	860

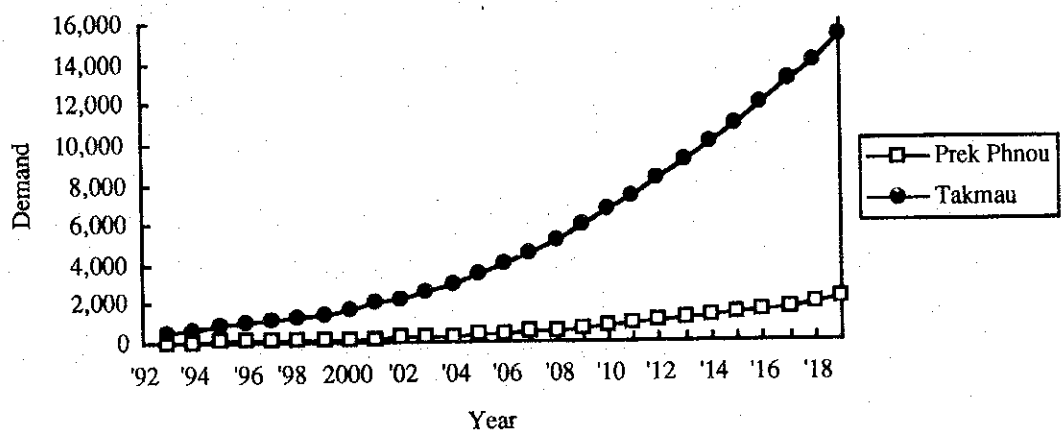


Figure 5.2-5 Demand Forecast of Takhmau and Prek Phnou

The demands in Tables 5.2-4, 5.2-5, 5.2-6, and 5.2-7, Figure 5.2-4 and 5.2-5 represents the number of telephones that would be required to satisfy the demand as opposed to the actual number installed.

5.3 Microscopic Demand Forecast for Telephones

The microscopic demand forecast adopted herewith, described in detail later on, is applied only to Phnom Penh city, as it is difficult to apply to rural areas.

The present category of property 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.

5.3.1 Basic Data Collection

Prior to the field survey, some city maps as basic data were collected. The scaled city map, even though it was made in the 70s, correctly shows the street blocks of Phnom Penh City.
The accuracy of scale was also verified by the Study Team in the below-mentioned Schematic Survey.

The Existing cable network plan and data concerning existing subscriber distribution are also collected from the MPTC, but all the facts indicate that this data is not useful for the study because the existing network has been deteriorating and the existing subscriber location does not depend on subscribers' dispersion but on cable availability.

5.3.2 Schematic Survey

Before the detailed field survey, a schematic survey was carried out to verify the assumption of the telephone penetration factor to be applied to each category of property. The factor is defined as the ratio of the total main line connection to a property. In calculations and field survey, a certain area of calculation unit which is the street block where similar classification of property are assembled is introduced and the factor has been determined on this street block basis.

Schematic survey was made on a sampling basis by the Study Team. After picking the typical area of each category of property, the Study Team checked the street block's characteristics to calculate the average number of property per unit area and to

assume the average number of telephone main line connection to each category of property.

The penetration factor in each classification of property is, after detailed survey, rechecked by macroscopic demand forecast and adjusted whenever necessary.

Table 5.3-1 and Table 5.3-2 shows the factor and classifications of property used in this Study.

Table 5.3-1 Penetration Factors

(Number of mainlines per property)

Class of Property		1994	1999	2004	2009
R1	Residential Area 1	0.4 - 0.6	0.5 - 0.7	0.6 - 0.9	1.0 - 1.4
R2	Residential Area 2	0.1 - 0.3	0.2 - 0.4	0.3 - 0.5	0.5 - 0.8
R3	Residential Area 3	0.0	0.0	0.0	0.0
S1	Big Shopping Area	0.5 - 0.7	0.5 - 0.8	0.8 - 1.2	1.2 - 1.8
S2	Shopping Center Area	0.0 - 0.3	0.1 - 0.5	0.5 - 0.9	0.8 -1.2
H1	Big Hotel	10	15	20	20
GR	Government Office	5	10	15	20
OT	Other Building	5	5	5	5
SP	Special Area	X	X	X	X

Table 5.3-2 Classification of Property

Division of Area		Type	Brief Description of Applicable Area/Property	*1	*2
Equal Density Area	Residential Area	R-1	An Area of high class residences having largely divided sites	667	15
		R-2	An Area of medium class residences	400	25
		R-3	No demand residence area	25	400
	Commercial Area	S-1	A big shopping district or a big shop-lined street	333	30
		S-2	A small to medium sized shop-lined street or in the shopping center building	167	60
Individual Survey	Miscellaneous	H-1	Big Hotel(more than 50 rooms), Big Hospital, Complex Business Office	each	plotting
		GR	Government Office (Ministry Office, Police, Hospital (except big hospital), Fire station, Embassy)	each	plotting
		OT	Other Office (School, Factory, Hotel(middle), Bank, Newspaper, Broadcast, Museum, N.G.O.)	each	plotting
		SP	Without above mentioned plotted properties, Property which needs demand calculation in especial	each	plotting

*1 : average area of the promises
*2 : average number of the promises per hectare

5.3.3 Detailed Survey

Detailed Survey consists of field survey, area classification which follows the calculation unit of property examined in schematic survey, and projection of area classification results on a city map. By this means, an area classification map was formulated.

The Study Team went, in cooperation with it's counterpart team, to most streets in Phnom Penh City, even if they seemed to be lanes, which border street blocks to catch the characteristics of afore-mentioned calculation unit.
Demand diffusion in Phnom Penh City then is calculated by calculation unit basis. The land area of a street block is also calculated by the map study. 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 of the schematic survey result.

5.3.4 Calculation of Microscopic Demand Forecast

Calculation of Demand was made by totalizing demand value in the calculation unit in the Phnom Penh City. Table 5.3-3 shows the result of the Microscopic Demand Forecast in the central area of Phnom Penh Municipality. In the course of this calculation, the Study Team assessed the result through comparison with the Macroscopic Demand Forecast result in 5.2 and came to the conclusion that the result could be applied to the Study.

Table 5.3-3 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

5.4 Demand for the Study

For the purpose of the Study, following the determinants on the previous page, the demand forecasted by topdown forecasting method, macroscopic demand forecast, is applied to the surrounding areas consisting of Mean Chey, Russey Keo, Dang Kor, Takhmau and Prek Phnou where microscopic demand forecast method is not adequate and the demand forecasted by bottomup forecasting method, microscopic demand forecast is applied to Phnom Penh City consisting of Toul Kork, 7 January, Kon Penh and Chamcarmon as the result was considered available for the Study and local cable design requires the detailed demand diffusion that just microscopic demand forecast can provide. The demands used for the Study are summarized in Table 5.4-1.

Table 5.4-1 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

5.5 Other Telecommunications Services

5.5.1 Cellular Telephone Services

(1) Current Situation of Cellular Telephone Services

As stated in 4.3.2 above, there are around 9.2 thousand cellular telephone subscribers in Cambodia.

It is said that there are two trends of cellular telephone growth. One is that of developed countries where the customers are satisfied with ordinary telephone service provisions and need advanced functions of cellular telephone services. The other is that of developing countries where the provision of plain ordinary telephone services (hereinafter referred to as POTS) runs short and some customers who need ordinary telephone services bear the cost of cellular telephone services.

(2) Demand Forecast

(a) Penetration in other countries

Figure 5.5-1 shows the cellular telephone penetrations in other countries.

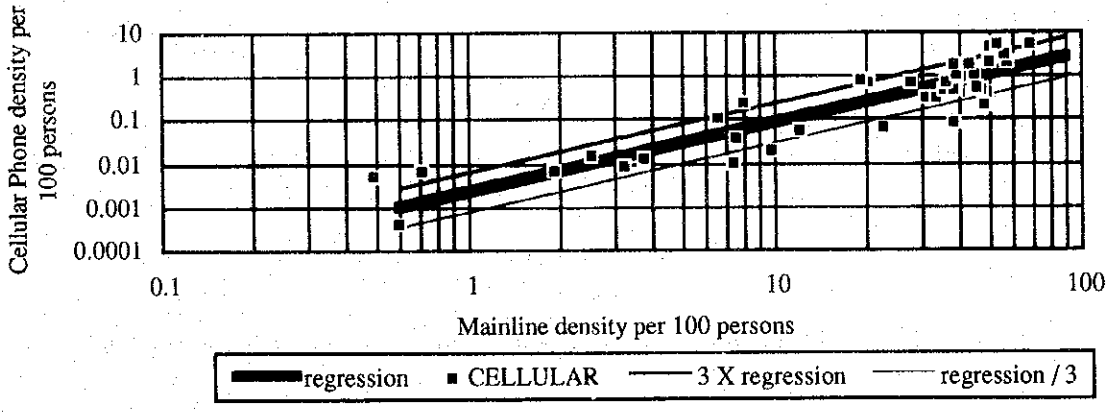


Figure 5.5-1 Cellular Telephone Penetration vs. POTS Penetration

The three lines in the above graph shows average growth tendency and its at three times rapid growth and at one third rapid growth. Most of these countries' cellular telephones penetration can be described with these three lines. This means in a country where cellular telephone penetration rapid

growth is at the maximum, the growth ratio can be estimated as three times as rapid as that of world average growth.

The rapid case above can be described by the following formula :

$D = 0.00819X^{1.524}$ ..... [3]

Where

D : Cellular Telephone Density per 100 persons
X : POTS Density per 100 persons

(b) Calculation by World Model

By the formula [3] above and demand forecasts results in 5.2 hereinabove, the following result can be obtained.
Figure 5.5-2 shows the above calculation result in comparison with current conditions.

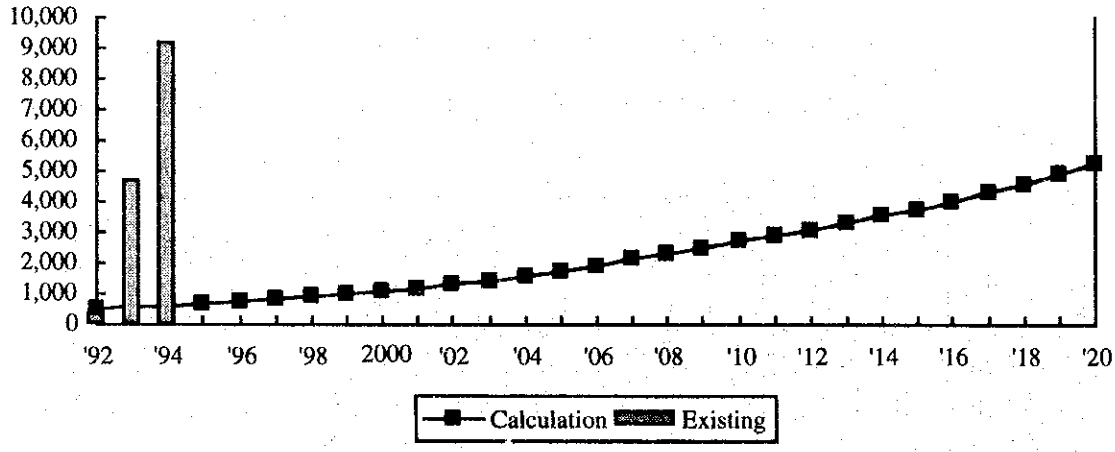


Figure 5.5-2 Demand Forecast of Cellular Telephone Services and Existing Customers

Figure 5.5-2 shows Cambodian conditions, that is, the rapid growth tendency in the world is far lower than that of Cambodia. Taking into consideration the situation in developing countries' regarding cellular telephone subscribers, most of the cellular telephone subscribers in Cambodia are also those who need POTS but use cellular telephone services.

(c) Logistic Model

Figure 5.5-3 and Table 5.5-1 shows a future demand forecast of cellular telephone services in Cambodia which is produced by the cellular telephone density per hundred population 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.

The calculation was made based on the following assumptions:

i) that current rapid increment of number of customers will continue for years and will reach a certain saturation point.,

ii) that the above saturation will be the result of present rapid growth caused by lack of POTS and once the year of saturation comes, the number of customer will gradually increase in line with the trend similar to other countries.,

iii) that saturation level and saturation year is not exactly defined at the beginning of simulation, but saturation level is defined as less than 0.3 per 100 population of which the definition follows national telephone density in 5.2.3 above.,

iv) that logistic model shown below is a widely known formula which simulates natural tendency well, so it will be used herein.

$$D = \frac{K}{1 + a \times e^{-bt}}$$

Where

D : density
K : Saturation Level
a, b : constant

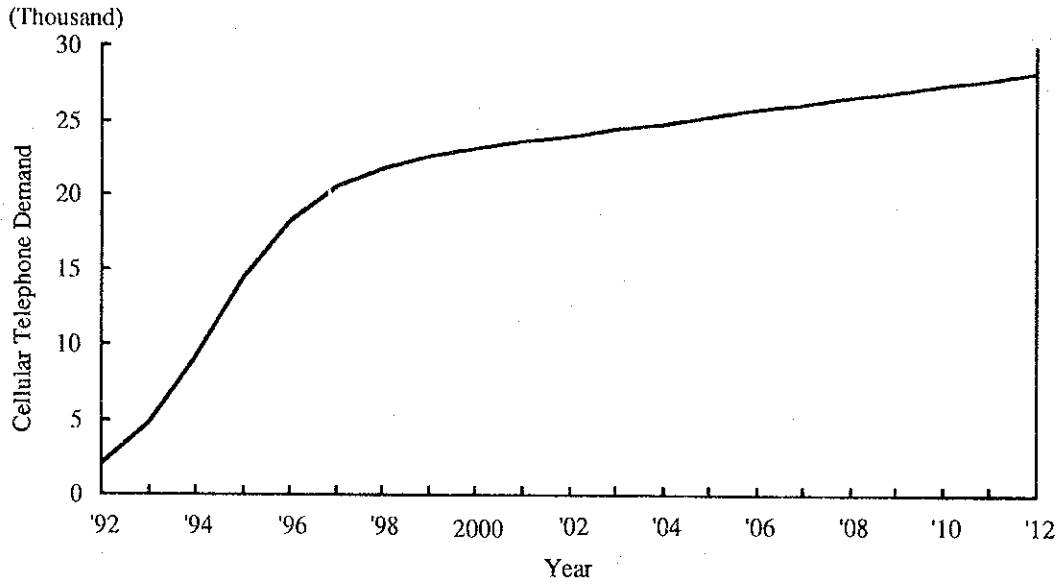


Figure 5.5-3 Cellular Telephone Demand

Table 5.5-1 Cellular Telephone Demand Estimation

Year	Density	Demand
1997	0.203	20,000
2002	0.216	24,000
2007	0.216	26,000
2012	0.216	28,000

CHAPTER 6

Fundamental Network Plan

CHAPTER 6 FUNDAMENTAL NETWORK PLAN

6.1 Network Structure

Although proposing a national network plan for the whole of Cambodia is out of scope in the Study, general views of a fundamental network hierarchy and national network configuration are comprehended to get a proper network plan in Phnom Penh City and its surrounding areas.

Telecommunications network structures are created to satisfy routing and transmission requirements in the most economical way for particular types of technology, each with its own cost characteristics.

A long distance network connects different local areas. This type of network is usually hierarchical with one, two or three levels depending on the number of local areas and the total traffic carried in the network.

(1) Network Hierarchy

An optimum hierarchy of the national telecommunications network depends upon the area of a country and the number of local exchanges in the country. Cambodia has an area of about 181,000 square kilometers. In order to estimate the total number of local exchanges to be installed in Cambodia, this area of Cambodia is divided by local exchange areas which have an average radius of 7 kilometers. According to this procedure, the number of total local exchanges in Cambodia is forecasted to be 1,180. By using the Figure 6.1-1 three hierarchical network is selected as an optimum option for Cambodia. Figure 6.1-2 shows the proposed network hierarchy of Cambodia.

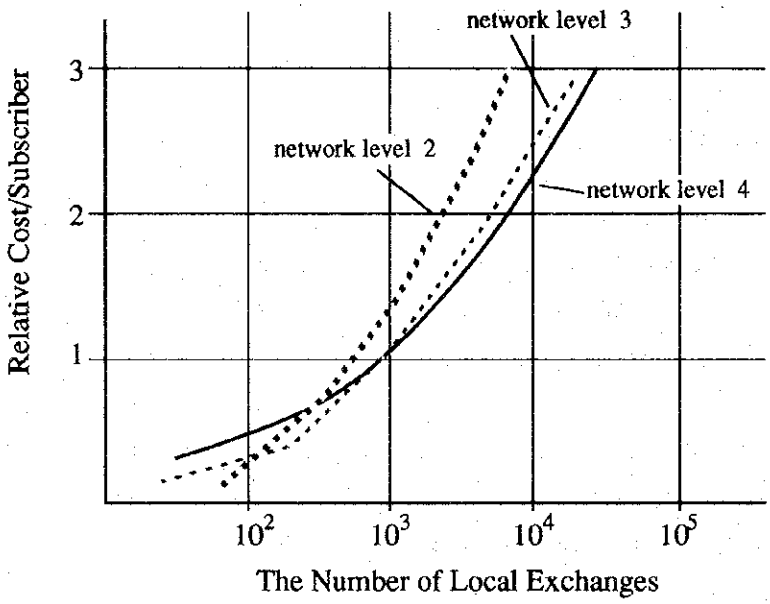


Figure 6.1-1 Selection for Optimum Hierarchy Level Network

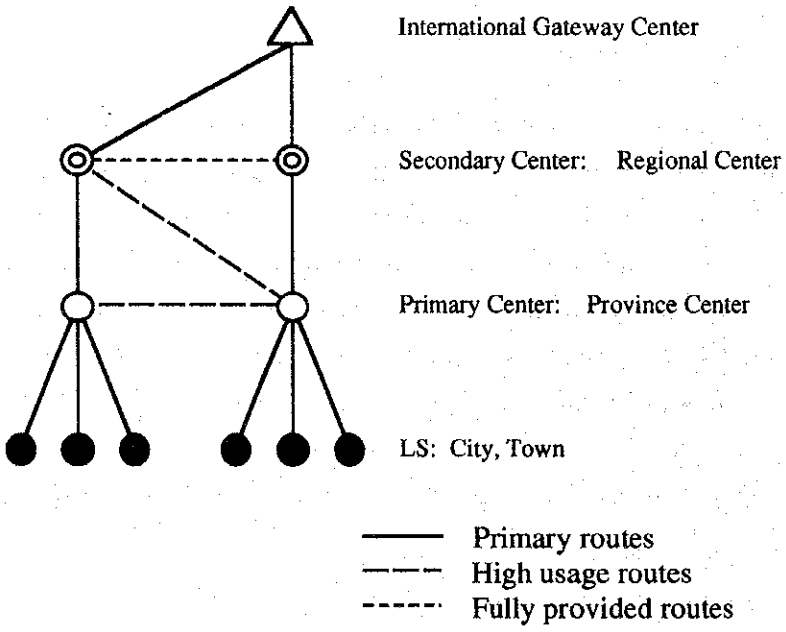


Figure 6.1-2 Network Hierarchy

(2) Network Configuration for Phnom Penh and its Surrounding Areas

Referring to exchange locations studied in Chapter 8, the network configuration for Phnom Penh and its surrounding areas is shown Figure 6.1-3.

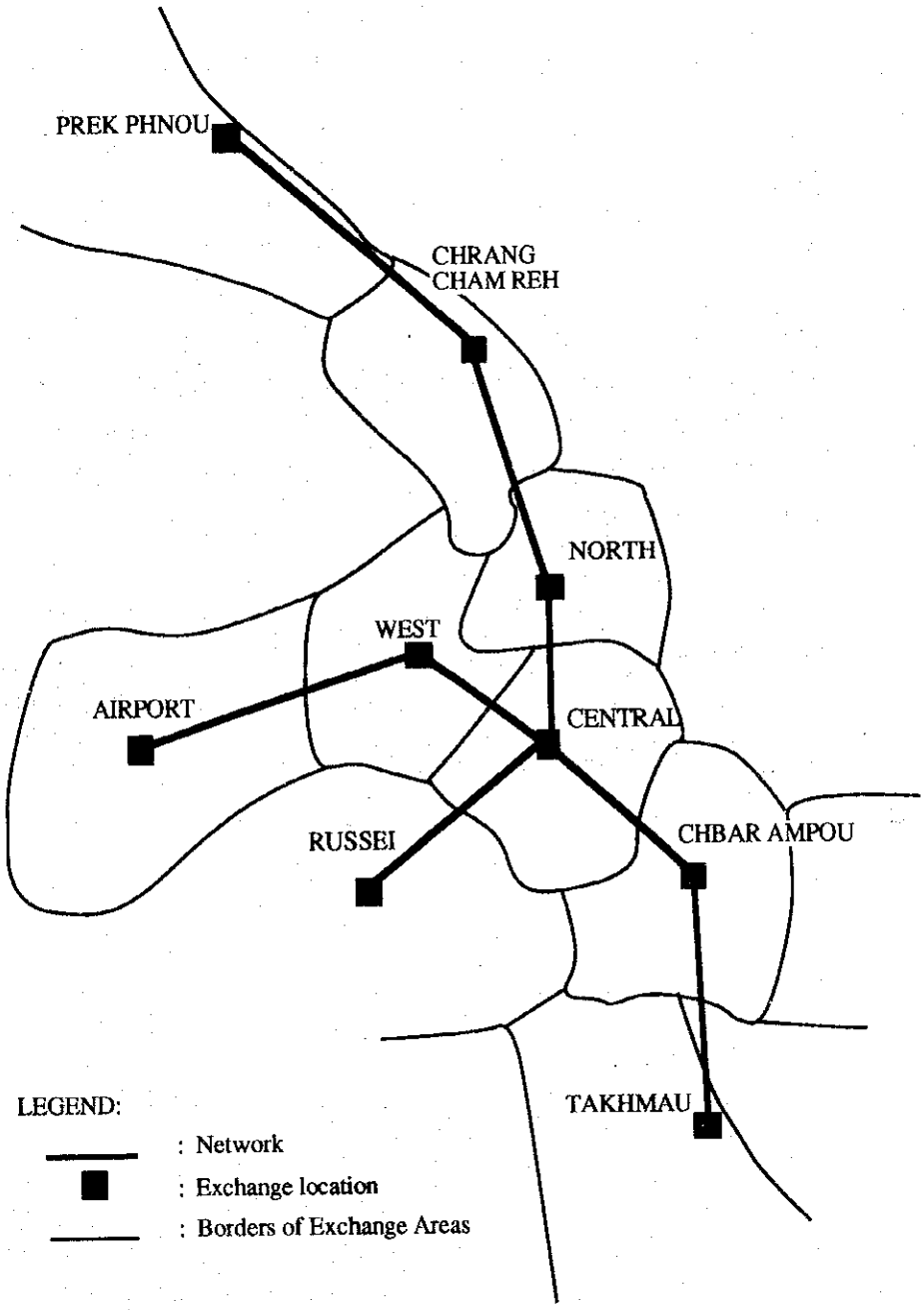


Figure 6.1-3 Network in Phnom Penh City and its Surrounding Areas

6.2 Routing Plan in Phnom Penh City and its Surrounding Area

(1) The local exchanges will have only final trunks to other exchange and the overflow calls become lost calls.

(2) Local exchanges in the same area are fully connected by direct trunks. (a full mesh structure)

(3) Outgoing long distance calls (including international calls) from local exchange subscribers will be concentrated at the Central Exchange Office and then sent to other long distance offices or the international exchange according to their destination. In this case, the loss probability of 0.01 will be applied for calculating the number of circuits.

(4) Outgoing special service calls from local exchange subscribers are also concentrated to the Central Exchange Office and connected to operator boards or equipment according to their destination. The loss probability of 0.01 will be applied for calculating the number of circuits.