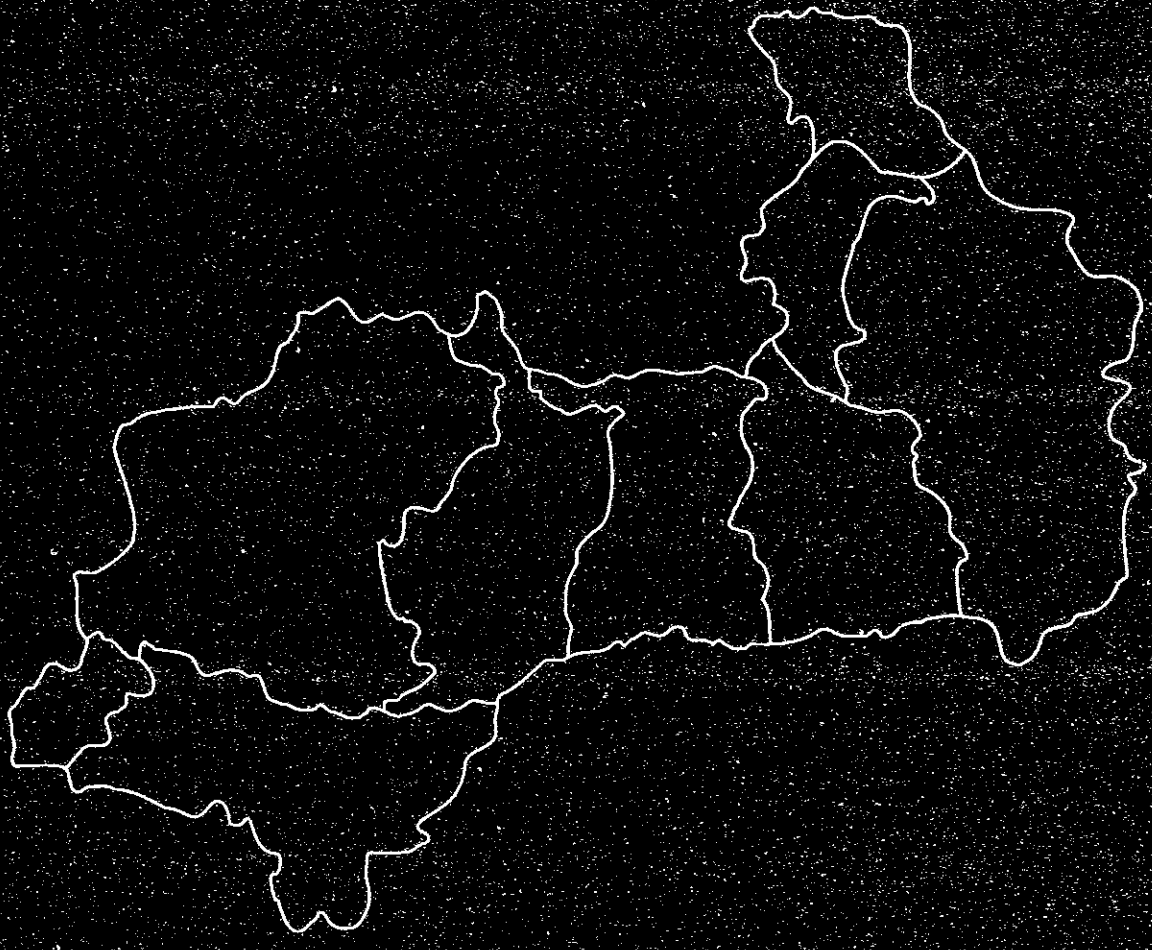
JAPAN INTERNATIONAL COOPERATION AGENCY

THE GOVERNMENT OF THE KINGDOM OF THAILAND
NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD

THE STUDY ON THE REGIONAL DEVELOPMENT PLAN FOR THE LOWER NORTHEAST AND THE UPPER EAST REGIONS IN THE KINGDOM OF THAILAND

FINAL REPORT



8. Telecommunications

September, 1993

NIPPON KOEI CO., LTD.

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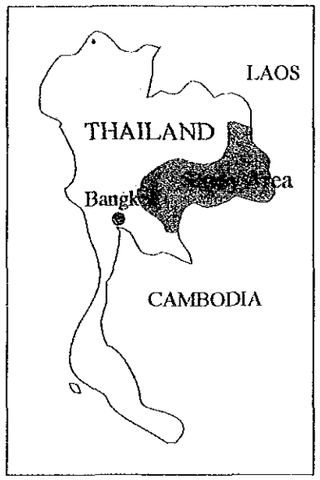

LEGEND

- International Boundary
- Provincial Boundary
- 202 National Highway (Number)
- Railway
- Airport
- National Park
- Major Tourism Attraction
- Major City (Population)
  - 100,000~500,000
  - 50,000~100,000
  - 25,000~ 50,000
  - 10,000~ 25,000

N

SCALE

0 6.5 32.5 65.0

km

Laos

Khon Kaen

Bua Yai

Huai Huat

Mukdahan

Savannakhet

Mukdahan

Yasothon

Amnat Charoen

Pha Taem

Ubon Ratchatani

Si Sa Ket

Warin Chamrap

Phibun Mangsahan

Kaeng Tana

Chon Mek Border Point

Det Udom

Satuk

Buri Ram

Phimai

Nakhon Ratchasima (Khorat)

Sung Noen

Sikhiu

Dan Kwian

Pak Tong Chai

Surin

Prasart Kamphaeng Yai

Kantralak

Phu Chong Nayoi

Khao Phra Viharn

Bangkok Metropolitan Region

Pak Chong

Chok Chai

Nang Rong

Prakhon Chai

Prasat

Phanom Rung

Muang Tam

Khao Yai

Wang Takrai N.P.

Tha Plan

Nakhon Nayok

Prachin Buri

Kabin Buri

Sa Kaeo

Aranyaprathet

Eastern Seaboard

Phnom Penh

Cambodia

Note : Basic elements of this map composition were derived from the Geographic Information System (GIS) Database developed in the study.

Location Map of Study Area

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Abbreviations

AAT	Airports Authority of Thailand [MOTC]
ADB	Asian Development Bank
AED	Agricultural Extension Department [MOAC]
BAAC	Bank for Agriculture and Agricultural Cooperatives [MOF]
BMA	Bangkok Metropolitan Area
BMR	Bangkok Metropolitan Region
BOB	Bureau of the Budget [OPM]
BOI	Board of Investment [OPM]
BOT	Bank of Thailand
CAO	Changwat Administration Organization [MOIT]
CAT	Communication Authority of Thailand [MOTC]
CATV	Cable Television
CCIR	International Radio Consultative Committee
CDD	Community Development Department [MOIT]
COLONETR	Computerized Local Network Record System
CPD	Cooperatives Promotion Department [MOAC]
CRDP	Coordinating Committee for the Royal Development Projects
DAMA	Demand Assigned Multi Access
DFPOT	Dairy Farming Promotion Organization of Thailand [MOAC]
DOA	Department of Aviation [MOTC]
DOH	Department of Highways [MOTC]
DOLA	Department of Local Administration [MOIT]
DRCS	Digital Radio Concentrator System
DRDC	District Rural (or Regional) Development Committee
DTEC	Department of Technical and Economic Cooperation [OPM]
EGAT	Electricity Generating Authority of Thailand [OPM]
EMS	Express Mail Service
ESBC	Eastern Seaboard Committee [NESDB]
ERTAT	Expressway and Rapid Transit Authority of Thailand [MOIT]
ETOT	Express Transportation Organization of Thailand [MOTC]
FIO	Forest Industry Organization [MOAC]
GCST	Government Cold Storage Organization [MOAC]
IEAT	Industrial Estate Authority of Thailand [MOID]
IFCT	Industrial Finance Corporation of Thailand
IODC	International Operator Direct Connection
IPD	Industry Promotion Department [MOID]
ISDN	Integrated Services Digital Network
ITD	Internal Trade Department [MOC]
ITFS	International Toll Free Telephone Service
JICA	Japan International Cooperation Agency
JPPCC	Joint Public / Private Consultative Committee [BOI]
LAN	Local Area Network
LDD	Livestock Development Department [MOAC]
LNE-UE	Lower Northeast - Upper East
LTD	Land Transport Department [MOTC]
MASS	Multiple Access Subscriber System
MOAC	Ministry of Agriculture and Cooperatives
MO	Marketing Organization [MOIT]
MOC	Ministry of Commerce
MOD	Ministry of Defence

MOE	Ministry of Education
MOF	Ministry of Finance
MOFF	Marketing Organization for Farmers [MOAC]
MOID	Ministry of Industry
MOIT	Ministry of Interior
MOPH	Ministry of Public Health
MOTC	Ministry of Transport and Communications
MOUA	Ministry of University Affairs
MS	Mobile Station
MSTE	Ministry of Science, Technology and Environment
MTX	Mobile Telephone Exchange
NEB	National Environment Board [MSTE]
NESDB	National Economic and Social Development Board [OPM]
NESDC	National Economic and Social Development Committee
NHA	National Housing Authority [MOIT]
NRDC	National Rural (or Regional) Development Committee
NTT	Nippon Telegraph and Telephone Company
OARD	Office of Accelerated Rural Development [MOIT]
OCSC	Office of the Civil Service Commission [OPM]
OECF	Overseas Economic Cooperation Fund (Japan)
OPM	Office of Prime Minister
OPP	Office of Policy and Planning [MOIT]
PDA	Provincial Development Committee
PEA	Provincial Electricity Authority [MOIT]
PRDC	Provincial Regional Development Committee
PRDCC	Provincial Rural (or Regional) Development Coordination Center
PTD	Post and Telegraph Department
PWA	Provincial Waterworks Authority [MOIT]
PWD	Public Works Department [MOIT]
PWO	Public Warehouse Organization [MOC]
QPSK	Quadrature Phase Shift Keying
RBS	Radio Base Station
RF	Radio Frequency
RFD	Royal Forest Department [MOAC]
RID	Royal Irrigation Department [MOAC]
SNRDC	Office of the Secretary to the National Rural (or Regional) Development Committee
SPC	Store Program Control
SRT	State Railway of Thailand [MOTC]
TAT	Tourism Authority of Thailand [OPM]
TCPD	Town and Country Planning Department [MOIT]
TDMA	Time Division Multiple Access
TOT	Telephone Organization of Thailand [MOTC]
TRDC	Tambon Rural Development Committee
TS	Transmission Links
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organization
USAID	United State Agency for International Development
VAN	Value Added Network
VSAT	Very Small Aperture Terminals

Abbreviation of Measures

Length

mm	=	millimeter
m	=	meter
km	=	kilometer

Area

ha	=	hectare
km^2	=	square kilometer

Volume

l	=	lit = litre
m^3	=	cubic meter
MCM	=	million cubic meter

Weight

mg	=	milligram
g	=	gram
kg	=	kilogram
t	=	ton = MT = metric ton

Time

sec	=	second
hr	=	hour
d	=	day
yr	=	year

Money

US$	=	U.S. dollar
B	=	Baht

Energy

kcal	=	kilocalorie
J	=	joule
MJ	=	megajoule
HP	=	horsepower
TOE	=	tons of oil equivalent
kW	=	kilowatt
MW	=	megawatt
kWh	=	kilowatt-hour
GWh	=	gigawatt-hour

Others

%	=	percent
°	=	degree
'	=	minute
°C	=	degree Celsius
cap.	=	capita
md	=	man-day
mil.	=	million
no.	=	number
pers.	=	person
PCU	=	passenger car unit
ppb	=	parts per billion

Unit Conversions

1 rai	=	0.16 hectare

CHAPTER 1

EXISTING CONDITIONS FOR TELECOMMUNICATIONS

1.1 Present Telecommunication Policies and Institutions

1.1.1 Overview

Telecommunication services in Thailand are provided by two state enterprises: the Telephone Organization of Thailand (TOT) mainly dealing with domestic communication services, and the Communications Authority of Thailand (CAT) most providing international communication services.

TOT has responsibility to provide domestic telephone and related services. Its network includes over 200 exchanges, many of which are store program control (SPC) digital systems, serving more than half a million subscribers nationwide. TOT also serves the business communities with telebanking services, televideotext and other advanced services.

CAT provides domestic and international postal and telecommunication services including postal banking, telegraphy, mobile telephone, telex, VHF radio, facsimile and paging services. It is also responsible for international telephone link via satellite and submarine cables, and marine radio telegraphy services.

1.1.2 Related institutions

The Government involvement in the telecommunications sector is through the Ministry of Transport and Communications (MOTC) and the Post and Telegraph Department (PTD) of MOTC.

MOTC initiates, coordinates, supervises and controls national transport and communication administrative and development policies through nine department and 12 state enterprises.

PTD controls, regulates and coordinates national postal and telecommunication administration, plans and policies. It is also responsible for the authorization to install, possess and operate radio communication stations, both by governmental agencies and private entities, as well as the issuance of licenses to operating personnel.

1.1.3 Policy framework for telecommunications

The Government has formulated development strategy for telecommunication in the Seventh Five Year Plan. The following constitute the general framework for the telecommunications development according to the Plan:

(a) Expanding telephone services to satisfy all the requests for services by the end of the Seventh Plan period;

(b) Increasing the ratio of phone numbers to no less than 10 per 100 population by the end of the Seventh Plan;

(c) Upgrading a quality of domestic and international communications services to attain international standards; and

(d) Setting up an integrated services digital network (ISDN) utilizing the digital system to respond to business needs and support enhancement of the international competitiveness of the Thai economy;

1.2 Telecommunication Services in Thailand

1.2.1 Services by TOT

TOT seems to have been consistently upgrading its services following the rapid development of communications technology worldwide. Its services now encompass the following.

Public telephone service

TOT is responsible for serving the public by installing public telephones in key locations. Four types of public telephones are offered: viz. local public telephones installed indoors, local public telephones installed outdoors, long distance public telephones installed outdoors, and rural long distance public telephones installed in remote rural areas where local telephone services are not available.

Public mobile telephone service on trains

The State Railway of Thailand (SRT), in collaboration with the TOT, initiated on November 1, 1989 a new service called "Public Mobile Telephones" on trains. The first phase now is in service in the northern and northeastern routes. This service includes local and international calls.

Cellular mobile telephone

Since the first provision of the cellular mobile telephone in July 1986, the number of subscribers has been increasing rapidly. Although the service area is limited at present, expansion has been worked out along the main communications routes of the Country.

DataNet

DataNet is the data transmitting service between computers as an on-line system. DataNet can transmit both computer data and voice signals at the same time via the same cable pairs and immediate service is available for DataNet on the user's application.

Public card phone

A public card telephone enables telephone users who frequently and regularly use public telephones to do so without carrying a handful of coins or facing difficulties in exchanging coins. This service is also a solution to the problem of multisized coins and the prevention of ill-purposed people who steal coins in the telephone booths as well. The service is available both for domestic and international calls.

Phonelink and pagephone service

The digital display paging system or Phonelink service is a rapid, prompt and most advanced device, enable to communicate to all areas nationwide where the long distance telephone is available. These two services, Phonelink and Pagephone, are conceded to private companies. The Pagephone service had been started after the service of Phonelink. One can call to pagers through telephone lines.

Telepoint

Telepoint is a telecommunications services by portable telephone. It is the basic wireless-telephone technology which communicates by radio signal between base station and each portable telephone. Telepoint users can however use it only within a 200-meter radius of the telepoint service symbols generally posted in public areas.

Videotex

Videotex enables two-way communications between senders who can select the required information, such as business service information, product prices, weather forecast, and educational information.

Toll free call "088" service

This allows users to make long distance calls without having to pay; the charge of calls is paid by call receivers. The service however is available only in the metropolitan telecommunication area at a moment.

1.2.2 Services by CAT

CAT provides domestic and international public communications services such as postal, monetary, telecommunications, and other related businesses as outlined below.

Postal service

It is the basic service that is the most inexpensive and essential to the public. CAT intends to expand the service network to cover all towns and villages.

Monetary service

The service consists of domestic telegraph money order, international telegraph money order and postcheck services.

Telecommunications service

International telephone service is the primary service offered by CAT. This enables global communications through the use of satellite and submarine cable systems.

Executive Telecard International is the latest service, most efficient and cost-effective for overseas telecommunications. The card meets in particular business people's need for fast and reliable service and it can be used in more than 30 countries worldwide in 1993. It's simple to use; the card contains an identity code that is operable on any

full touch tone telephone. Convenience is afforded with payment made upon issue of a monthly statement from the card holder's bank account.

CAT provides both domestic and international telex service. It is operated through the global telex network that makes it efficient and worldwide. The volume of telex service tends to decrease due to the expansion of facsimile services. CAT offers many types of radio communication service, satellite relay service of television pictures and facsimile service.

Other supplementary services

CAT also provides the following supplementary services:

- Sale of packaging material,
- Sale of air bubble film,
- Postcheck service,
- International EMS pick-up service,
- Telecommunications credit card,
- Payment services for international calls via bank account,
- International toll free telephone service (ITFS),
- International operator direct connection (IODC) service, and
- Cellular radio communication service.

1.2.3 Distribution of services

Basic statistics on telephone service are summarized in Table 1.1. Of the total main telephone stations, 70% are concentrated in Bangkok. The North region ranks second with 7.7% share followed by the Northeast and the South.

Telephone density with respect to the number of main telephone stations is by far the highest in Bangkok and its vicinities with 108 main stations per 1,000 population. This density is 16 in the East, 12 in the West and the South, 10 in the Central, 9 in the North and only 4 in the Northeast. The national average is 24 per 1,000 population.

1.2.4 Planned and on-going projects and services

To expand and improve the existing telecommunication services in the Country, TOT and CAT as well as PTD have been planning and implementing several projects and services. More important ones are enumerated below.

TOT

- Urgent telephone expansion project (1989-1992)
- Common base radio telephone service
- Optical fiber submarine cable project
- Optical fiber cable along rail way plan
- Rural long distance public telephone project (1992-1996)
- Computerized local network records system (COLONETR)
- DataNet
- Cellular 900
- Domestic satellite telecommunication

CAT

- Expansion project of postal and telegraph service (Phase 6)
- Expansion project of cellular radio communication area
- Establishment project of SPC II international telephone exchange
- Optical fiber submarine cable project (Phase 1)
- Acquisition plan of additional optical fiber submarine cable circuit
- Implementation project of INMARSAT mobile communication system
- Teleport project at Laem Chabang and Map Ta Phut

PTD

- Plan to establish Thailand as the regional center of telecommunication services for South-East Asia
- Reservation for the orbit of THAISAT satellite
- Project to survey degrees of needs for channels of satellite signals in domestic communications
- Survey project to evaluate the management of post and telegraph services in rural Thailand
- Project to establish a radiocommunication training center
- Project to establish the system of automatic monitoring and radio direction finding with remote control in the Bangkok metropolis
- Project to measure the strengths of radio and television signals
- Project to set up a data bank of all terrain altitudes in Thailand
- Project to utilize computer in radio frequency management
- Research project to expand the postal network in the rural areas befitting their economic status
- Project to establish the radiocommunication test and standard laboratory
- Project to survey the needs for postal services of the private business sector in Bangkok
- Project to develop the working efficiency of monitoring officers of the Post and Telegraph Department

1.3 Telecommunication Services in LNE-UE Regions

Present telecommunications network in the Study Area are provided and operated by TOT and CAT. The regions are covered by two systems: rural telecommunications system for point to multipoint and cellular system for mobile. These are summarized below.

1.3.1 Rural telecommunications system

This system can provide long distance public telephone service to remote tambons. The rural telecommunications project (Phase I) has been completed in 1992 and it could provide services to the 1,813 tambons out of total about 6,000 tambons in Thailand. Each tambon has an average of three telephone lines: one will be the rural long distance telephone kiosk installed in a building while the remaining two will be rural long distance public telephone booths installed in public place or in governmental offices. Incoming and outgoing calls can be made within the amphoe, the province or to other provinces nationwide.

As shown in Figure 1.1, this rural communications system consists of subscribers, base station (collection point), local exchanges and transmission lines between

subscribers, base stations and local exchanges. The system can provide maximum 15 time slots for digital transmission, enabling the system to accommodate as many as 256 subscribers. The system parameters and the location of the system in the Study Area are shown in Table 1.2 and Figure 1.2 respectively.

1.3.2 Cellular system

Cellular system is a mobile telephone system that can be installed in automobiles, boats and everywhere. The system efficiently allows local and trunk telephone calls, both domestic and international. TOT and CAT have provided the service based on their own targets. Nakhon Ratchasima, Prachin Buri, Ubon Ratchathani, Buri Ram, Si Sa Ket and Mukdahan are the present and planned service regions in the Study Area provided by TOT and CAT. The system consists of four equipment: mobile telephone exchange (MTX), radio base station (RBS), transmission links (TS) and mobile station (MS). Each subscriber on MS is connected with MTX by radio link, and can be accessed to any desired parties through local exchange, transmit exchange or international exchange. The system structure is shown in Figure 1.3 with the main characteristics of MTX on Table 1.3.

1.3.3 Service distribution

Service coverage and level in the Study Area is below average as illustrated in Table 1.1. The average telephone density in the Study Area with respect to the number of main telephone stations is 4.8 per 1, 000 population. This is lower than the average density in any region of the Country except the Northeast. The density varies within the Study Area: 10 in Nakhon Nayok, 9 in Nakhon Ratchasima, 6 in Prachin Buri, 4 in Ubon Ratchathani, 3 in Buri Ram, Surin, Mukdahan and Yasothon, and 2 in Si Sa Ket.

1.4 Issues and Constraints in Telecommunications

Main issues and constraints in telecommunications are discussed here. The discussion refers to the telecommunication system and services in Thailand as a whole rather than to those in the Study Area.

1.4.1 Outdated rules and regulations on communications

Laws, rules and regulations for telecommunications services do not keep up to date and these are not consistent with modern communications technology. These also limit private sectors to join the public sector for a wider and flexible telecommunications services. Moreover these laws and rules do not effectively govern the operation of public agencies for clarity to increase operational efficiency and for doing away with duplication of investment in the provision of services.

1.4.2 Operational inefficiency

Development plans for telecommunications seem to lack in harmony between public authorities due to an absence of a higher regulatory body for telecommunications services comprising representatives from the public and private sectors to formulate policies covering various aspects of communications including determination of pricing of services to ensure fairness to suppliers and users as well as coordination of work programs and control of service fees in telecommunications.

1.4.3 Lack of flexibility on radio frequency management

Present radio frequency management is not always able to control and supervise application of radio frequencies for use in communications services as necessary, and to institute regulations for use of radio frequencies to ensure maximum efficiency. It should enable to control *ad hoc* communication networks and permit expansion only in important cases. The main network should be utilized to the full first to avoid duplication of investment and wasteful use of valuable resources of frequencies.

1.4.4 Shortage of personnel in telecommunications

In spite of large demand of engineers and technicians for telecommunications, education and training institutes for the field are not able to meet the requirements in number and quality. Continuous development of human resources should serve the upgrading of overall telecommunications services.

1.4.5 Flowing out of educated people from provinces

The present rapid development of telecommunications technology requires skilled people and well-educated personnel of the engineering for not only operation and maintenance but also planning, design and development of telecommunications. These people tend to flow into Bangkok to get a better chance of higher incomes to make rural areas less benefited from the modern telecommunications technology.

1.4.6 Limitation of construction capacity

In order to satisfy a target by NESDB to improve the telephone density to 10 per 100 people by the end of Seventh Five Year Plan, six million lines will be totally necessary, which is far beyond the present capacity of line construction.

1.5 Priority and Options for Telecommunication Development in LNE-UE Regions

1.5.1 Priority for telecommunication development

Various telecommunication services in Thailand are heavily concentrated in Bangkok, while many tambons are still deprived of telephones. This is a result of biased investments in the past. Two factors point to the rectification of the situation.

First, the Government policy is to vitalize rural areas by encouraging investments by the private sector. Telephone lines to the farthest peripheries would be effective to encourage various private sector activities.

Second, the development status of Thai economy itself calls for increasing attention to rural areas in telecommunication development. For example, as many people are out migrating from rural areas into Bangkok and other major cities, call to/from other family members would become essential not only for family ties but also for social stability. Also for further socio-economic development of the Kingdom as a whole, the provision of various information related to markets, business opportunities and social services through both institutional and private channels would be a prerequisite.

These two factors have direct relevance to the Study Area, which are predominantly rural. Thus the priority of planning telecommunications for regional development in the Study Area would be accorded to the expansion of telephone networks to every tambon.

Another important aspect for telecommunications in the Study Area is to establish international telecommunication links between major cities in the regions and Indochina for further promotion of border trade and distribution. It would allow domestic business users to communicate effectively with their foreign partners/clients without having to be connected through the long distance telephone exchange in Bangkok. Plans need to be drawn up to build an international transit switching center complete with a linking network so as to satisfy the demand of local business and industries by providing efficient international telephone, data communications and other supplementary up-to-date services in the ISDN.

1.5.2 Options for telecommunication development

Expansion of existing rural telecommunications network would be a realistic option to meet the increasing demand in rural areas urgently. An alternative would be to use a satellite to be launched as THAISAT in the latter part of 1993. These options need to be examined in the light of the priority described above.

Expansion of existing network

TOT has formulated a rural telecommunications project (Phase II) for completion in 1996. This project would contribute much to improving the present shortage of telephone lines. The general idea for expansion is to install a repeater station near the existing TOT's local exchange stations in provinces to extend the network to terminals and repeaters in a cellular-type configuration as shown in Figure 1.4.

Additional specifications are proposed here as characteristics outlined in Table 1.4. These characteristics are thought in consideration of economy through the use of time-division-multiple access (TDMA) method, maximum available number of subscribers by the use of demand assigned multi access (DAMA), wider service coverage by use of cellular configurations and higher spectral efficiency required for an efficient RF frequency assignment and lower interference susceptibility utilizing quadrature phase shift keying (QPSK) modulation. In addition to the ordinary telephone services, the new system should have the capabilities of coin telephone, telex service and data transmission service based on ISDN applications.

Utilization of satellite

THAISAT will much contribute to sweeping away the blind spots of non-telephone tambons by allowing to install very small aperture terminals (VSAT) in provinces from which the telephone lines could be expanded to any necessary places to fulfill the demands. This system will accept communication links for voice, data, telex and other applications, and will have no geographical limitation.

1.5.3 Other possible features

For the development of the Study Area to the year 2010, other more advanced telecommunication systems are envisioned. The international telecommunication

links with Indochina may lead to the establishment of a "teleport" as a base for information exchanges.

A concept of "teletopia" may also become relevant as a center for comprehensive telecommunication services and information exchange encompassing a wide range of areas. The following may be included:

- Agricultural information system,
- Rainfall & water level telemetering system,
- Medical treatment information system,
- Telemeter VAN system, and
- Tourism information system.
- Other systems

CHAPTER 2

DEVELOPMENT PLANS FOR TELECOMMUNICATIONS

2.1 Telecommunications Development Plan

2.1.1 Outline

Two major topics are discussed for the development of telecommunications, which are to increase the telephone lines in tambons for a basic communication for inhabitants and to establish an informational base, so called "teleport", for the promotion of industrial activities. These development will be carried out by three steps: action-oriented development, medium-term development and regional development master plan for the year 2010.

In action-oriented development plan, multiple access subscriber system (MASS) by digital radio is proposed overlapping on existing digital radio concentrator system (DRCS) to efficiently increase the number of telephone line in tambons. This plan will be proceeded as rural public long distance telephone project by TOT with completion year in 1996. In this report the said subscriber system is emphasized for applying to the project with technical and economical reasons.

In medium-term development plan, further increase the number of subscribers and establishing of a gateway are focused on. In this stage targeted in the end of 2001, telephone lines will be expanded into villages. And a gateway of telecommunications could be installed.

In regional development master plan for the year 2010, establishment of international telecommunications lines for border trade is an highlight with more convenient way to talk and cheaper cost. Another issue is telecommunications services of informations, monitoring and control. These are summarized as a teleport.

2.1.2 Strategy for telecommunication development

(1) Strategy for expansion of rural public long distance telephone network.

In view of the special conditions in which the new and proposed systems will have to be specified, installed and operated in the developing areas, and especially the need to provide circuits at minimum cost, the following points must be born in mind:

- The need for selecting the most advantageous basic solution and for the most careful planning of circuit paths so that establishment costs are reduced to a minimum.

- The need to reduce to minimum the cost of establishing the infrastructure required to receive the equipment. This infrastructure includes, in particular, access roads, buildings to house the equipment, accommodation for power supplies, and antenna supports.

- The need to specify equipment for these circuits, the capacity of which is in strict accordance with requirements. In particular, efforts should be made to avoid an

unnecessarily large margin for circuit capacity unless the necessity for such a margin is immediately evident.

- The need for equipment which is easy to maintain so that this work may be done by semi-skilled staff.

- In some cases, the equipment will operate far from any existing power sources. It should therefore have low consumption so that the necessary power supply installation, as well as its maintenance and replenishment, may be as simple as possible.

In addition to the above, there presently exist a digital radio concentrator systems in the Study Area which have been installed during 1986 to 1991. Although these systems cover less than 30 percent of tambons, each tambon has average 3 telephone lines that are still quite small. Existing radio concentrator systems provide multiple access to subscribers by the use of multiple times slots. The number of time slots is 15, which makes maximum subscriber lines of 256 per one system. The number of subscriber lines per system should be larger.

TOT has launched the rural public long distance telephone project in the year 1992 to 1996 by the total budget of 9,000 million baht of which 3,830 million baht is in foreign currency and 5,170 million baht is in local currency. Although less clear is which system will TOT adopt for the project, large number of time slots system would be recommended.

For this project TOT put more emphasis on the benefit of national economic, social development and safety than a direct profit returns to TOT. Therefore, the private enterprises' access to foreign loans/grants under official development assistance should be improved in line with the national policy framed in the Seventh Five Year Development Plan (1992 - 1997) for further promoting the project.

It will be evaluated for TOT to decide that Nippon Telegraph and Telephone company (NTT) can invest their capital in TOT for telephone development in rural areas. This kind of joint efforts should be highly promoted for not only a meaning of rural development but technology transfer.

Possibility study for TOT privatization may start from 1993. The privatization will be inevitable due to the need for greater flexibility to deal with rapid growth in demand, changes in technology and need for modern management over the coming decade. Also the privatization of TOT will be necessary because the organization will soon have to operate in a highly competitive business. The time of privatization, however, should be thoughtful on balancing the total profit, in particular rural areas will take time to produce profit by telephone businesses.

As mentioned above, the 600,000 lines in whole Thailand are part of the TOT's Seventh Implementation Plan in line with NESDB's Seventh Five Year Plan , under which by the end of 1996 there will be six million telephone lines in use in Thailand, which represents 10 telephones per 100 people. There would be three ways to cross the hurdle, which are handle by TOT itself, under a joint venture with private sectors or by international bidding.

Actual situation of present telephones was observed in a tambon named Tanonpo located at about 45 km northeast from Nakhon Ratchashima center. Two public

telephones were installed in a shop run by a chief of the tambon. One coin telephone colored red purchased by the shop is for only local call. People insert 5 baht coin and can speak 5 minutes in local area. The time is counted by the chief of tambon and additional coins are collected if the time is over 5 minutes. Another telephone set is office type telephone provided by TOT which is for long distance call. The chief counts the time of call and the speaker is laid following charge depending on hours.

Hours	*Charge (Bahts/minute)
7 AM to 6 PM	12
6 PM to 10 PM	6
10 PM to 7 AM	4

*In case of calls to Bangkok

Received call to those telephones is subject to keep messages and the chief sends these messages to right person without delay. Nearer residents are announced by a loud speaker on the roof top of the shop.

Average number of the call is 6 times for local call and 7 times for long distance call per day. Revenue by calls is approximate total 3,000 Bahts per month.

Analysis can be made with present status of telephone lines listed in Table 2.1. Population in observed tambon is 3,500, while installed telephone lines are two. In spite of this fairly low density of telephone, the number of calls is not always high. The reasons will be the telephone charge, inconvenience and lack of knowledge about telephone by users.

Telephone charge that is minimum 5 Baht for local call will be high comparing with users income. Most people in tambon may hesitate to pay 5 baht for a telephone call. The locality where there are telephone sets will be inconvenient for the people living far from them. And most people will not know about the telephone, what can do by telephones.

While according to Table 2.1, 17,591 people are listed in the waiting list of telephone. Most of them will be people living outside of tambons. It will not be expected rapid increasing demand of telephone in tambons due to said reasons. To remove these constraints, increase of the telephone number in tambons might be essential coupled with education about the telephone.

(2) Strategy for establishment of teleport as informational gateway

Apart from rural public long distance telephone network, another aspect should be considered as enhancement of the telecommunications network for the development of the industries, with facilities for informational gateway which can play a role of informations base between outside of the area and also with functions for store, processing and transmission of informations in the area. This port of informations, so called "teleport", should be established in some industrial zone in the Study Area.

To accomplish those concept, introduction of integrated services digital network (ISDN) is essential, which will make it possible to provide all the advanced

telecommunication services such as teleconference, high speed digital transmission, packet exchange, image communication and high reliable communications.

Communications utilizing satellite will be for this purpose. Because there exist present satellite telecommunications network as shown in Table 2.2.

The reasons to install a teleport as a strategy of regional development in the Study Area are because there expect some impact summarized below.

Impact of information and communications aspect in teleport area

(1) Reduction of telecommunications cost between outside of the area

By the installation of gateway facilities such as microwave transmission, telecommunications cost in the area can be reduced.

(2) Supply of integrated communications services

By the installation of the high-speed and large capacity transmission network, real time transmission of high vision pictures and high-speed transmission between local area network (LAN) which are requested by the business firms, can be provided with lower cost.

(3) Providing with reliable communications services

Dual network by teleport can reduce risks of shut down and a back up in emergency. These are a merit for the firms which largely consume informations.

(4) Supply of effective urban control

Monitoring of water supply, electric and gas are the examples. Security functions can be also added. Vehicles flow and road conditions can be monitored and controlled to prevent from traffic jams.

Impact of information and communications aspect outside teleport area

(1) Shortening of differences of communications distance

Access between teleports can lower telecommunication cost by which make the differences of communications distance shorten.

(2) Functioning as communications node for large areas

Telecommunications infrastructure modernized in teleport area could support economic activities in the large areas spread outside of the teleport center.

(3) Functioning as a showcase of communications facilities

Facilities of satellite earth station, optical fiber LAN and intelligent building are gathered in the teleoport area, which may be some test case for the introduction of new communications systems.

Impact for aspect of urban development in teleport area

(1) Integration of urban type high-tech firms

Teleport area is a place which can obtain managing source of informations for firms that are financial institutions, insurance companies, software businesses and think tanks. By these environment of teleport it may be expected to be able to gather these businesses.

(2) Reinforcement of informations integration

The synergistic effect by integration of informations can be expected by which will be form a "place" contained originality as informational base.

(3) Coming off urban space as high amenity

Teleport aims at not only providing with excellent informations and communications atmosphere but also providing residents and workers in it with comfortable urban life and urban space.

Impact for aspect of urban development outside teleport area

(1) Effect of creation for employment

New employment will be expected by new installation of the businesses.

(2) Enlargement of regional economy

As the result of the effect of creation for employment and also of the business activities, enlargement of personal income and tax revenue, and increase the consumption will be expected.

(3) Multipolarization

There will be an effect to prevent business activities from gathering in Bangkok.

2.1.3 Development targets

Based on the measures for telecommunications, targets could be described divided into three phases namely 1) action - oriented development stage, 2) medium - term development stage and 3) regional development master plan stage.

Targets in action - oriented development stage

(1) To install telephone lines in every tambons

This will be carried out by TOT's rural public long distance telephone project from 1992 to 1996.

(2) To establish mobile telephone systems in all nine provinces

The activities in the provincial areas will not be able to discuss without mobile telephones. This so called cellular mobile radio system will be expanded by the private sectors under the authority of both TOT and CAT.

(3) Upgrading a quality of telephone services

Following figure is a quality of service data average per month. It is a completed call attempts as percentage of total calls dialled by subscriber year by year.

Year	1986	1987	1988	1989	1990
- Metro. Tel. Area	22.40	29.56	49.90	46.69	47.63
- Prov. Tel. Area	55.37	60.89	58.37	54.37	54.55

In 1990 almost one time out of two calls, it is unsuccessful call due to congestion, called number busy, no answer from called number, faults from subscribers, technical faults and others.

Some recommendations are briefly made in the plan.

Targets in medium-term development stage (for the year 2001)

(1) To install telephone lines in every villages

Proposed system in action-oriented development stage could give suggestions for the further expansion of telephone lines to every villages.

(2) To establish a gateway in Ubon Ratchathani

Gateway is a satellite earth station which transmits signal to the satellite and receives it from the satellite. The station will be able to provide sufficient informations for economic activities in the Study Area.

Targets in regional development master plan stage (for the year 2010)

(1) To establish teleport center in Ubon Ratchathani

Teleport is also a infrastructure like road, park and water resources. It can play a role to revitalize economic activities and to keep comfortable urban life. Discussions may be made about the location for the teleport whether in

Nakhon Ratchasima or Ubon Ratchathani. In this report the latter is proposed, because the former will be close to Bangkok.

(2) To build telecommunications links between the boundary

These links are for border trade between the following sections.

In Thailand	Foreign
Mukdahan	- Savannakhet (Laos)
Chong Chom (Surin)	- Northern part (Cambodia)
Phibun - Mangsuhan and Chog Mek (Ubon)	- Pakse (Laos)
Aranyaprathet (Prachin Buri)	- Phnom Penh (Cambodia)

(3) To start variety of telecommunications services

These services will include following systems:

- Agricultural information system,
- Rainfall and water level telemetering system,
- Medical treatment information system,
- Telemeter VAN system,
- Tourism information system, and
- Others

2.1.4 Measures for telecommunications

Every tambons have telephone lines, which is the first step for the development at all events. Second step comes as expansion of the lines and enhancement of the telephone service quality. Last step could be described as establishment of an integrated services telecommunications network.

In this section each plan is made by stage so as to be pictured more concrete.

Action - oriented development plan

(1) General

Multiple access subscriber system by digital radio should be applied for overlapping on existing network in rural areas. Among the point-to multipoint rural communications systems available at present, the system to be provide more time slots for digital transmission should be applied for rural telecommunications. The system should also allow for ISDN applications.

(2) System Configuration

Shown in Figure 1.4 the multiple access subscriber system can be established from the local exchanges located in the major provinces. A base station will be installed within 40 km from the local exchange which is connected to concentrator in the base station. The base station is linked to terminals directly or through repeater/repeaters. The repeater may be increased up to 11 from a base station with the maximum number of subscribers of 1024 per system. The system can provide those people who can not be reached by conventional wire with telephone services,

this is often due to harsh terrain conditions or the difficulty of maintaining these lines. And subscribers distributed in various patterns such as linear, clusters, homogeneous can be covered by locating the terminals and repeaters in a cellular-type configuration. An example is shown in Figure 2.1. In case that a base station would be located in Nakhon Ratchasima and Ubon Ratchathani. From these two base stations, repeater stations and terminals can be expanded to the outside covering unserviced areas for the telephone lines. These two systems on Nakhon Ratchasima and Ubon Ratchathani will be able to contain maximum 2,048 subscribers. Since the multiple access subscriber system can be freely expanded up to meet the demand, it could be said that the system will be quite convenient and economical way to apply in the Study Area. The outline performance for the system will be as follows;

Service area	:	Typical 600 km radius
Hop distance	:	Typical 20 to 40 km
Transmission capacity	:	4 Mbit/sec
Number of subscriber	:	Up to 1024 per system
Radio frequencies band	:	1.5GHz band , 2.4GHz band and 2.6GHz

(3) Operation and Maintenance

More important considering factor for development planning in the Study area will be operation and maintenance after installation. Telephone system in the study area can be characterized of its low subscriber density, large service coverage, economical restrictions, rough terrain in some areas, lack of qualified technical personnels and small knowledge about the use of telephone set in village people. Moreover limited maintenance staffs of TOT makes it rather difficult to keep normal conditions of public telephone sets. These situations will lead to introduce of centralized operation and maintenance. Figure 2.2 is an image of centralized operation and maintenance which enable at base stations to monitor the operating status in the system. A visual display unit in base station will be able to indicate operating status of repeater and terminal stations, locked-out or blocked status of subscriber circuits, and traffic statistics etc. This centralized operation and maintenance system should be introduced by which man-power requirement will be ideally a maintenance engineer and a maintenance technician with a visual display unit and a maintenance vehicle in typical 600 km radius service area containing total 1024 subscribers.

(4) Frequency Allocation

1.5 GHz band is applied for the existing radio concentrator system for rural subscribers. To overlap new system on the present system, ordinary frequency allocation will not cause any interferences in this development stage, because there will be some spare for new frequency invasion yet. Although proposed system will have capabilities for applying other frequency band of 2.4 GHz and 2.6 GHz, the possibility for using these upper frequencies will be a matter of radio regulatory policy in Thailand.

(5) Configuration of Each Station

Three kinds of stations which are base station, repeater station and terminal station will be required to install for establishing a proposed new rural telecommunications system.

Base stations will be installed in the existing local exchange telephone stations of TOT in some major provinces. The main equipment will be able to mount on a standard 19 inch rack, which will not occupy enough spaces in the equipment room. In the same room or another control room, a visual display unit will also installed for operation and maintenance purposes. An antenna will be mounted on the existing antenna tower and connected to the local exchange through radio equipment and voice distribution frame. As power source for the rural telephone equipment, existing DC-48V will be utilized.

Repeater stations will be constructed at the suitable places with a house to amplify the weakened signals. The equipment will consist of subscriber unit and repeater unit. Since some repeater station will not have commercial power, alternative source of solar power may be installed at the repeater station.

Terminal station will be installed next to the house of tambon chief so that he can manage the telephone. Or it may be installed more suitable places to connect the public telephone sets.

These configuration are summarized in Figure 2.3 to 2.4.

(6) Mobile telephone

Three types of mobile telephone "cellular" has been opened depending on frequencies. These are cellular 470 and 900 opened by TOT, and cellular 800 operated by CAT.

TOT set for the guidelines for the development of cellular 470 MHz mobile telephone emphasizing a study of the structural network of this system to come up with basic design to conform with the master network and to formulate a project to meet the demand. The work plan of the project is divided into two phases. In the initial stage, service will be provided in metropolitan area and the Eastern seaboard area, then to be expanded to Nakhon Pathom, Rajburi, Petchaburi, Chanthaburi, Trad and Supanbure provinces. In the second stage, most provinces of the country will by covered by the mobile telephone network. Nakhon Nayok, Nakhon Ratchasima, Buriram, Si Sa Ket and Mukdahan are provinces being included in the second stage.

Advance Infor Service Co., Ltd. has been granted a concession to provide mobile telephone service, cellular 900, for the period of 20 years from TOT and this service was opened in 1990. This company has plans for expansion of mobile telephone network including the installation of the radio base stations from December 1992 to February 1993. The company had been hurriedly installing and opening services in areas such as Mae Sod, Mae Sai, Sri Chiang Mai, Ban Pai, Chumpae, Ban Pong and Mahachai-Muang Mai. The rush installation plan would see base stations installed in provinces such as Yala, Pattani, Narathiwat, Satun, Chai Nat, Mae Hong Son, Chai Nat, Mae Hong Son, Chaiyaphum, Maha Sarakham and Nakhon Panom. New base stations would also be installed in Bangkok and its surrounding provinces. The stations would be installed between exsisting stations to support the increasing numbers of subscribers at Taling Chan, Victory Monument, Bang Mod, Bang Kruai, Ram Indra, Tungsigun, Rama VI Bridge and the Krung Thai Bank head office. The Cellular 900 system has about 170 radio base stations in the end of 1992, including 67 in Bangkok, 103 in the provinces and six mobile telephone exchanges, one of which serves Bangkok and one in each region of Thailand. Under the expansion

plan, there will be two more mobile telephone exchangers in Bangkok and 40 more radio base stations. The company had also increased the number of channels provided by the 40 original radio base stations. Once the rush plan was completed, the company would continue with its fifth phase installation plan, under which it would invest more than 2,000 million baht to serve 215,000 subscribers in 1993.

Cellular 800 radio communication service managed by CAT has been expanded from the Bangkok metropolitan area to the surrounding provinces and other big cities in order to support growth of business, industry, agriculture and tourism.

These mobile telephone system should be proposed in the local area so as to solve a problem the scarcity of ordinary telephones, especially in areas where telephone service has not reached.

One of the advanced technical reasons to recommend is that the system has unlimited potential for expansion as it can be connected to the main exchanges.

It is recommended for all nine provinces in the Study Area to be involved in the cellular network. And outdated telecommunications act must be modified in accordance with newly technology for telecommunications.

(7) Quality upgrading

Considerations for upgrading of telecommunications quality reach to three ideas: systematic preventive maintenance, monitoring system, and quick corrective maintenance.

- Systematic preventive maintenance

Telecommunications centers which equip telephone exchangers should be scattered and these centers should have back-up functions. And main transmission routes have to be also doubled.

Each unit and part in equipment shall be changed before their life time.

Training for maintenance staffs is other important matter for keeping equipment good conditions.

- Monitoring system

Present conditions on transmission lines and exchanges have to be always monitored so that any faults can be detected before occurring serious damages.

- Quick corrective maintenance

Back up system should be equipped to be quickly changed over the stand-by units. Repair shops which are prepared for any kinds of spare parts can be worked for shortening the time to repair.

Medium - term development plan (for the year 2001)

(1) General

Two activities are included in this plan. One is to expand the number of subscribers into villages, and another is to establish an informational gateway.

It can be done for the proposed system to increase the number of subscribers by adding more lines or overlapping new systems among the existing systems. It has to be emphasized that more important thing will arise among frequency assignment in case that more subscribers are applied in a system. In this section, therefore, a frequency plan is described based on international radio consultative committee's (CCIR) report for avoiding unnecessary interferences.

A satellite gateway, meanwhile, will be established by CAT at Ubon Ratchathani in 1998, which will be a nucleus for teleport installed in master plan stage. Some necessary functions for the gateway are proposed with necessities of the gateway.

(2) Frequency plan for rural telecommunication system

For the proposed system to be capable of serving extended geographical areas with plural number of systems an orderly plan of frequency re-use needs to be established. This section describes such a plan that uses 11 frequency pairs at 1.5 GHz which achieves an acceptable balance between spectrum efficiency, system performance and equipment complexity.

Although proposed system will have capabilities to be operated by frequency bands of 1.5 to 2.6 GHz, only 1.5 GHz is an approved frequency band by the radio regulatory authority in Thailand. The maximum utilization of the frequency will be one of the most important item for the planning of the expansion of rural telecommunication network.

Co-channel interference in the system results from propagation from other cells on the same frequency. The co-channel cell spacing can only be increased if the number of radio frequency (RF) channels used is increased. An example gives cell plans for 11 frequency pairs and it has a large "re-use distance". In addition, for a given cell plan to co-channel interference especially when anomalous propagation occurs, is affected by the operating frequency, mast height and directivity of the antennas.

Adjacent-channel interference in the system depends on the choice of channel separation and filter discrimination consisted with maximizing the number of channels.

Significant interference problems may arise at repeater stations owing to the coexistence of two transceivers. The magnitude of the interference will be particularly affected by the coupling between omnidirectional and directional antennas. Special precautions could be taken to minimize this problem, such as using appropriate antenna configurations, special antennas, etc.

Generally to reduce the required discrimination, some repeating directions need to be forbidden and some frequencies that are transmitted by the base transceivers are reversed in direction with respect to the other frequencies. A plan on Figure 2.5

however does not have forbidden directions because of the greater number of frequencies available.

(3) Installation of satellite gateway

CAT has a plan to establish a satellite gateway in the Study Area in 1998 which will be third gateway followed by existing Sri-Racha gateway and planned Nonthaburi gateway. The satellite gateway in the Study Area will be highly expected to have functions as a part of a teleport which will be installed in the next stage of regional development master plan.

The planned satellite gateway by CAT will equipped three parabolic antennas which are a 21m and 30m of diameter. The gateway should be expected as an informational gate in the Study Area.

Regional development master plan (for the year 2010)

Major topic on the master plan are establishment of a teleport and of direct international communications links for promoting the border trade. Another highlight is teletopia.

(1) Establishment of teleport

This is intended to support economic activities in the area for users will be able to communicate effectively with foreign countries without having to be connected through the long-distance telephone exchange in Bangkok. Plans are drawn up to build the international transit switching center with an initial capacity of 3, 000 international circuits, complete with a linking network, which will satisfy the demands of business and industry by providing efficient international telephone, international data communications and other supplementary up-to-date services in integrated services digital network (ISDN) system.

Figure 2.6 presents an image of teleport.

(2) Establishment of communications link for border trade

Based on the sector report on trade and distribution, three sections are considered for new links for border trade described before, namely Mukdahan, Chong Chom Phibun-Managsahan & Chong Mec, and Aranyaprathet. Opposite side for the link crossing a border are Savannakhet (Laos), Northern part of Cambodia, Pakse (Laos) and Phnom Penh (Cambodia) respectively. These sections have not been installed telecommunications lines yet.

Considering the distances of each section it will technically have no difficulties for install new lines. Matters will arise among negotiations between two countries. In some sections except above, telecommunication lines has been already installed partially, which are results of insurmountable effort by telephone and communication authorities of Thailand. This effort had to be continued to establish said links for further promoting of the border trade.

(3) Start of teletopia

Teletopia is a compound word of telecommunication and utopia. A concept of teletopia is to provide inhabitants and a local society with various useful services through established telecommunications lines. Following services will be born as examples.

- Agricultural information system

This system will provide farmers with useful informations such as agricultural products prices on market, diagnostic results of farm soil and changing weather conditions. These informations may be sent to farmers by facsimiles or visual display units through telephone lines. Each controlled unit will be in tambons or amphoes, which can make more effective agricultural management than smaller individual syndicate for agriculture.

- Rainfall & water level telemetering system

This system is for monitoring and control of water treatment, to quickly respond a changing of water flow and water level of the reservoir, such cases of scattered rain or heavy dry season. In the Study Area drying will be more serious than the flood. Total water management in wider area therefore should be introduced for preventing inhabitants from suffering of extreme lack of water and otherwise flood. The system can be established by using public telephone network with additional transmission links, measuring equipment and supervisory control facilities.

- Medical treatment information system

The level of medical treatment in provinces tends to lower than the big cities like Bangkok. ISDN network will help shortening the differences. Medical staffs in local area can ask staffs in central region to support diagnoses, treatment and pharmaceutical data etc. Integrated digital line can make possible to send and receive various informations by distinct picture with high speed.

- Telemeter VAN system

This system represents services of automatic monitoring. The telecommunications network can be applied to the effective management of such diverse as disaster prevention, emergency information control, and environmental monitoring and so on.

- Tourism information system

Several sightseeing spots are pointed by tourism sector report. These places could be equipped tourism information peripherals which provide tourists with the best menu for them in response to their requests. The system will be a significant infrastructure for tourism.

- Other systems

Environmental monitoring, city water supply monitoring and control system are considered.

2.2 Rural Telecommunications Project

TOT's rural public long distance telephone project, 1992 to 1996, is strongly related to the development in the Study Area. According to the project, its target is to expand rural public long distance telephone service to 4,500 places covering about 3,500 tambons currently still inaccessible by telephone service, other important places like tourist spots, and adopt 1,000 spots on the main highways. Scope of the project is that all 4,500 sites of aforementioned target will be averagely provided with 5 telephone line each and involved with purchase of about 4,500 plots of land on which building will be constructed and equipment and reserved battery will be installed. Also purchase and installation of transmission .

2.2.1 Project description

Rural telecommunications project in LNE-UE regions has an clear objective which all tambons can be received by telephone services. And this objective should not be different from the objective of telephone services for all rural areas in whole country as its nature of telephone network. This means only LNE-UE should not be particularly considered about rural telecommunications but other regions should be planned as same as LNE-UE regions. Our plan is therefore in line with TOT's rural publec long distance telephone project from 1992 to 1996.

Concerning method of implementation, rural telecommunications project in LNE-UE regions will be carried out as TOT's rural public long distance telephone project 1992 to 1996 by means of turnkey basis to be financed partly by TOT's fund and partly loan with particular working units holding responsibilities for management and implementation.

Our scope of the project is to install telephone lines in every tambons in LNE-UE regions, which should be included in TOT's rural public long distance project involved in the following implementation in whole nation.

- Purchase of about 4,500 plots of land on which buildings will be constructed and equipment and reserved battery will be installed.
- Purchase and installation of transmission equipment linking rural public long distance telephone at 4,500 sites and using of other available trasmission circuits such as satellite circuits in transmissiion.
- Purchase and installation of about 20,000 public teleplhones.
- Purchase and installation of 4,500 telephones with private meters.
- Purchase and installation of 20,000 public telephone booths and electrification.
- Purchase batteries for reserve and equipment for use at 4,500 sites.

Forecasted expenses for TOT' rural public long distance project in 1992 to 1996 will be approximately 9,000 million Baht summarized below. The costs for installation of rural telecommunications network in every tambons should be included in it.

Items	Total	Foreign currency	Local currency
Land, buildings & constructions	2,250	-	2,250
Equipment	5,900	3,500	2,400
Management & implementation	70	-	70
Reserved budget	780	330	450
Total	9,000	3,830	5,170

2.2.2 Concepts of rural telecommunications in LNE-UE regions

The objectives for regional development of the Study Area are:

1) To increase income levels of local people to narrow gaps with the national average income by creating employment opportunities in manufacturing and services sectors, increase agricultural production especially during the dry season through crop diversification and livestock improvement, and promoting inter-linkage between these sectors;

2) To enhance the quality of land and water environment for environmentally sound and sustainable development in order to support higher levels of primary production, to add to tourism value for both domestic and foreign tourists, and to promote physical and moral sanitation of local people; and

3) To promote people's participation in regional development for socially viable development through project planning and implementation incorporating socio-cultural value of local people, organization of rural people and utilization of indigenous systems to encourage self-help efforts for production, marketing and basic services.

Considering these objectives, rural telecommunications network should function as integrated informational service to promote inter-linkages between manufacturing and services sectors, and to provide farmers with informational support in order to produce agricultural products to meet changing demand. The telecommunications system should also play a role for local people to easy communications through transmission lines to promote people's participation in regional development for social viable development to encourage self-help efforts for production, marketing and basic services.

These situation lead to a concept which rural telecommunication system must be fit for voice communication and data transmission on any time when people want to talk and send data with nominal charges. This will be a target at Phase III (2002-2010).

2.2.3 Recommendations

(1) General

Endeavor by the authorities of telecommunications for trying to expand telephone lines to the predominant rural area would be admired. And the struggle by staffs for managing/maintaining the lines should be praiseworthy. Telephone lines to tambons are still small number and there exist tambons having no telephone line.

Recommendations are made phase by phase for usefulness of improvements to the public network and for the development of a sound national telecommunications infrastructure.

(2) Phase I (up to 1996)

Rural Public Long Distance Telephone Project has been implemented by TOT from 1992 to 1996 loaned by Asian Development Bank. This project aims at expansion of telephone service to cover all tambons nationwide. Our proposals should be in line with the project.

Recommendation 1

It is recommended that every tambons in the Study Area should have telephone line which apply to integrated services digital network (ISDN).

Recommendation 2

It is recommended that rural telecommunications network should be considered on its ease of operation and maintenance. Centralized operation and maintenance should be deeply considered to avoid unnecessary increase of operation and maintenance staffs and to increase telephone reliability.

Recommendation 3

Education about telephone for people in tambon should be provided in elementary school level so that every residents in tambons can have comprehensive knowledge about telephone.

(3) Phase II (1997-2001)

Increase the number of telephone line in rural areas will be still a subject on this term.

Recommendation 4

It is recommended that every villages in the Study Area should have telephone lines in order to tie each village more firmly.

(4) Phase III (2002-2010)

The economy of the Study Area having taken off, its structure will become more balanced during the phase to allow self-sustained growth.

Recommendation 5

It is recommended that the rural telecommunications network should have enough capacity to provide services in each family house in tambons.

2.2.4 Effects

As TOT's rural public long distance telephone project, several effects will be considered as follows;

(1) Effect to the Government policy

The expansion of rural public telephone service to lower hierarchical communities like tambon and village will considerably benefit the national development since telephone service is the sophisticated basic service currently available for the public which not only facilities the communication of people but also help saving the travel expenses.

(2) Financial and budgetary effect

Investment of the Project is the one in the infrastructure in the rural area involving budget of foreign and local currency portion. TOT's rural public long distance telephone project is solely aimed to social benfit. The Project will therefore not cause any reverse effect on TOT's financial status and the loan to be acquired under the Project will not produce any impact on the national debt ceiling and budget.

(3) Economic effect

The economy generally grows in parallel with telephone density as it is admitted that telephone service which facilitates economic operation is vital factor in economic promotion. The telephone service to the rural areas will facilitate business operation and economic development in agricultural, industrial and tourist sectors.

(4) Military effect

Bordering area is very vital in the supplying of informations. TOT's rural public long distance telephone project in 1992 to 1996 involves about 70 developing strategic villages throughout the country which is one factor in supporting military mechanism of the country by facilitating telecommunications.

(5) Socio-logical effect

Labour influx into the Bangkok Metropolis and perimeter has caused the unsymmetry between the national economic growth and the area. Great difference between the municipal and rural telecommunications has disparated the opportunity of both socio-lies. The rural public long distance telephone service will considerably help narrow such gap by enabling the rural people to equally communicate with their families who migrated to work in the cities.

In addition to the above, the following will be able to mention as other effects in the Study Area.

(6) To help family communication

The Study Area is the largest out-migrating area to the Bangkok Metropolitan Area. Although sufficient employment opportunity will be created in the Study Area, out-migrating condition will last for a while. Expansion of telephone lines to the rural area give people opportunities to talk to family members who have to live separately. This will contribute to the stability on the society and the also to keep family tie firm..

(7) Promotion of exchange with Indochina countries

The Study Area is in a pivotal position to take advantage of the opportunities which can communicate to Indochina countries. To replete telecommunications network in the Study Area will take the lead on development in wider area including closer parts to the border in Laos and Cambodia.

(8) Promotion of careful public administration

Developed telecommunications network expanded into rural areas make careful public administration possible. For instance water resources management is one of the most significant subject in the Study Area. By installation of supervisory control and data acquisition system and utilizing public network, integrated management of water resources will be realized.

(9) Promotion of systematic control for agriculture

Most people in the Study Area are farmers. In order to produce the maximum profit from their farm land, strategic farming will be essential. Both way communication between lower hierarchy like tambons and higher one like provincial government will transmit proper information to the farmers and governments official will be able to confirm their reactions.

2.2.5 Cost estimates

The budgetary rough costs of implementing the above recommendations are set out below:

(1) Phase I (up to 1996)
(Related recommendation 1)

To expand the telephones services into all tambons in the Study Area will cost 1,568 million baht shown below in the price level of the year 1992. Since this services will be implemented by TOT's rural public long distance telephone project (1992-1996), these costs are be included in the TOT's project.

		(Million Baht)
For land, buildings and construction	:	390
For equipment	:	1,030
For management and implementation	:	13
Contingency	:	135
Total	:	1,568

(2) Phase II (1997-2001)
(Related recommendation 4)

Every villages will be able to be received telephone services until the end of this period. The implementing cost in the Study Area will be 190 million baht shown below in the price level of 1992. TOT may formulate the plan for nationwide in 1997 to 2001. In that case, the cost should be included in the TOT's project.

		(Million Baht)
For land, buildings and construction	:	50
For equipment	:	120
For management and implementation	:	5
Contingency	:	15
Total	:	190

(3) Phase III (2002-2010)
(Related recommendation 5)

Every houses in villages in the Study Area will be able to have a telephone line during the end of this period. The cost estimation for establishing this telephone network will not be available before the basic design.

2.3 Teleport Project

2.3.1 Project description

Teleport enables to provide users with long distance and large capacity telecommunications services by which also enables accumulation and supply of informations about economy, industry, financing, agriculture and so on.

It should be located in Ubon Ratchathani considering as a gateway to/from Indochina. Ubon Ratchathani with Warin Chamrap on the other side of the Mun river has the agglomeration of urban population and economic activities almost comparable to the agglomeration in the Nakhon Ratchasima city. Capitalizing on this, this urban center will be further developed as a sub-regional center with multiple functions. In particular, it will be a center for trade and commercial activities, increasingly so as economic links with the Indochina are strengthened. It will continue to offer locations for consumer goods, agro-processing and industries. It will have secondary importance as an alternative location for industries to be relocated from the BMA, including water-intensive ones.

An assumption can be made on necessary land area and total floor area of the teleport, which will be 1 ha and 1,000 sq.m. respectively. Generally a teleport consists of switching, transmission and power supply facilities with their equipment rooms. In addition, customers office, maintenance staffs room, administration office, store room and so on. These facilities are the same as those of present general telephone exchange office. As an teleport, following facilities will be added.

- Earth station
- Related equipment for optical and satellite communications
- Cable TV
- Supervisory control and data acquisition facility
- Exhibition floor

- Public used facilities like TV conference room
- Computers
- Spare floor, spare rooms

2.3.2 Concepts of teleport in LNE-UE regions

The Ubon Ratchathani integrated urban development project is a key project for the area development program in Ubon Ratchathani. It will be formulated during Phase I for subsequent implementation through Phase III. Actual installation of satellite gateway which is a part of teleport will be started in Phase II.

Ubon Ratchathani will be an agro-industrial forefront area which is presented by some project such as agricultural diversification program, rural environment enhancement program and broad based activities promotion program. Based on these Project, following concepts on teleport will be born in mind.

Teleport plays a role as information base from/to overseas so as to help and promote development activities in line with the environment to prevent from pollution. Teleport has a function as port for exchanging culture to create better human life.

2.3.3 Recommendations

(1) Phase II (1997-2001)

A satellite gateway by CAT will be installed in this phase.

Recommendation 6

Teleport should provide services of international telecommunications. These services are presented by TV conference, financing network, data base access. To support these services, a satellite earth station should be installed which will be linked by intelsat.

Recommendation 7

Teleport should provide value added services which can be made by developing the domestic network around teleport. These services will be represented by multi-point TV conference, inter office network of high speed and large capacity. To support this system of domestic network, optical fibre cable, microwave transmission, very small aperature terminal (VSAT) and multiple access network in rural will be accessed to teleport.

Recommendation 8

Specialized services should be provided in teleport area. These services are summarized below as examples.

- Monitoring and control of unmanned shop
- Electronic newspaper to the offices and houses
- Common use computer service by time division
- Multi media transfering service between voice and character
- Automobile translating service

- Convenience banking service by accessing from offices and houses for 24 hours
- Distributing control system enabling to automatic cargo distribution
- Mobile communications system enabling to access everywhere with smaller mobile telephone via teleport
- High vision broadcasting service
- PCM music service providing noise free music

To support these application services, the transmission lines should be suitable for wide band and anti-noise. optical fiber meets these conditions and it will be suitable transmission line to establish local area network (LAN).

Recommendation 9

Teleport should provide a service of cable TV (CATV). Cable TV provides programs which have originality on the area and also provides informations which the area requires. The programs provided by CATV will leach entertainments, culture/education, medical concerned/welfare, life, local news and administration. Optical fiber cable will be suitable for transmission media of CATV.

Recommendation 10

Teleport should provide a service of urban securities. This will contain supervisory control and data acquisition for monitoring the security conditions in the area by telemetering to prevent from fires for instance. Other services will be agricultural irrigation control system, traffic monitoring and control system, city water supply monitoring system, and environmental monitoring system.

Recommendation 11

Teleport should provide facilities for common use in order to make people in teleport area feel closer by it. To support business activities for particularly medium and minor enterprises will be indispensable to be consummate other services by teleport. Common use facilities will be exhibition rooms for latest communications equipment, providing education programs and facilities for the personnels related to information and communications. Computers and TV conference rooms will be also open to the public.

Recommendation 12

During Phase I, detailed system configurations should be worked out for the Teleport, and a base station should be established. Also examined in this phase would be private sector participation in the Teleport and necessary changes in related regulations.

As the first step to establishing the Teleport, a satellite gateway should be established by CAT during Phase II. Various information systems constructing the Teletopia to be realized in Phase III would be developed by private enterprises in respective fields.

2.3.4 Effects

(1) Cost down for telecommunications

Installation of satellite earth station in the Study Area will make it possible to lower the telecommunications costs in teleport area, which will have an effect to invite enterprises to teleport area.

(2) Providing higher telecommunications services

Local area network (LAN) will enable to provide enterprises with high speed and large capacity transmission services which they require for real time transmission of high vision pictures and high speed transmission of data files. These specialized services in teleport area will promote the activities of enterprises to contribute to a development on the area.

(3) Providing reliable telecommunications services

Local area network (LAN) can provide with reliable network. Dual transmission lines by optical fiber, or installation of stand-by equipment will be examples to increase reliability on the system. It will be a merit for enterprises which consume large amount of informations.

(4) Effective urban control

Using enclosed telecommunications network, water supply, sewage, electricity, gas, fire, environment and traffic conditions will be effectively monitored and controlled in a center. This will enhance urban functions.

(5) Linkage with other teleport

To establish links between other teleports will intensify functions as informational base. This will promote industrialization.

(6) Activation of economic activities

Teleport is a basis which supports economic activities by informational distribution. Strategic and preceding development for this basis will activate economic activities in teleport area.

(7) Integration of informational industry

Teleport is a place which provides informations required by the informational industries like dealing, insurance, software and think tank. Enterprises related the field will gather in teleport area to seek easier condition for obtaining informations.

(8) Creating chance of employment

To gather enterprises will creates a chance of employment.

(9) Increase tax income

To gather enterprises and create a chance of employment will bring revenue increase to the provincial government. In addition, enlargement of consumption and increase of income will be expected.

(10) Contributing to balanced development

To establish teleports outside of the BMA will help balanced development.

2.3.5 Cost estimate

The cost estimation for installation of a teleport is not elaborated because the cost varies depending on the level of services of telecommunications. However, 2,000 million Baht may however be offered as an index of a teleport in the Study Area.

2.4 Teletopia

Each project for telecommunications will contribute to establish a society based on teletopia which provides people with services so as to secure comfortable life in both urban and rural areas.

One of the concepts of teletopia is to minimize undesirable aspects in societies such as environmental pollution, traffic congestion, disasters and doctorless condition. To reduce the nitrogen oxide from vehicles, for instance, TV conference should be often used. And when environmental problems are seriously discussed, infrastructural development of telecommunications will be essential. Teletopia aims at ideal society using computers and communications. Followings will be examples.

(1) Agricultural information system

This system can provide farmers with necessary informations about agriculture so that they can strategically produce their products. An image of the system is that each peripheral with display will be placed in the smallest farming groups who aim at produce products at gaining maximum income. These peripherals will be connected to the center which provides agricultural information through rural public telecommunication network. This system will support farmers to produce products strategically and it will also prevent farmers from isolated placing without enough agricultural informations.

(2) Rainfall and water level telemetering system.

The water situation in the Study Area seem almost dismal. Distribution of rainfalls is uneven especially in the Lower Northeast where more or less 90% of the total annual precipitation concentrates in the rainy season of May through October. Generally flat terrains and soil of low water retention capacity make water storage ineffective. Water is critically important for the development of the Study Area as indicated by these characterization. After the development, water management will be therefore indispensable. Rainfall and water level telemetering system can support the water management. This system will consist of agricultural irrigation control system and dam and river control system. In order to measure rainfall and water level, measuring instrument will be set at suitable places with radio equipment. Measured data are sent to the control center via utility-owned radio links to process them. The

monitoring and control will be done by each main river and canal. These collected data will be gather through public telephone lines in order to manage valuable water resources in wider area.

(3) Medical treatment information system

Every patients have a right to equally receive medical services which tend to differ from at urban and at rural areas. Integrated services digital network (ISDN) will help to solve the problem. The network has characteristics to be transmitted distinct picture with high speed. Hospitals and clinics in local or rural areas can equip peripherals with display so as to send and receive medical data to the other hospitals according to the specialization. In order to establish this system, rural telecommunications network should be suitable for ISDN.

(4) Telemeter VAN system

Typical cities in the Study Area like Nakhon Ratchasima and Ubon Ratchathani should facilitate disaster prevention and emergency information control system. Since urban areas hold the potential for great disaster, monitoring by telecommunications technology will be indispensable. Minimizing damage requires that up-to-the-minute information about traffic, weather and high-risk facilities be available at once. This system will be able to store and display informations, and also compile detailed records from the time of the initial emergency notification for later analysis. According to the disaster's type and scale, determined from initial emergency phone call, the computer selects the most appropriate vehicles for response and simultaneously determines a back up response in the event of a successive disaster. Sensors at various locations throughout a city collect various data to appropriate headquarters to enable personnel to respond in the event of disaster such as fires.

(5) Tourism information system

Khmer ruins, elephant park in Surin and Khao Yai National Park will be examples of tourism spots in the Study Area. These spots should equip multi media peripherals so that tourists can easily find their best course according to their tastes. Tourism information system provides tourists with course menue so as to choose their desired one. This system will make it easier and more effective for people to meet with "informations".

(6) Environmental monitoring system

To protect the natural environment is one of the most important tasks. Both preservation of the environment and the growth of industry are necessary to assure of a comfortable human life. Harmonizing the two is the task which an support by telecommunications. There flow major rivers in the Study Area and monitoring of the water quality is essential as well as air. Noise seems not to be paid much attention by people now. Noise monitoring should however be one of the essences at this time to secure better environment. For the water pollution monitoring system, water gauges installed in rivers, lakes and reservoirs collect quality data which is then transmitted by remote terminal units to a central monitoring station, facilitating the monitoring of water quality over a wide area. With air pollution monitoring system, data concerning atmospheric pollutants and the weather are acquired at multiple location in municipalities and factories and forward to a central monitoring station for

processing. Excursive noise from factories and traffic can adversely affect human health. With noise monitoring system, noise levels at various locations can be continuously measured and recorded, then used to compute peak noise values, medium noise values, and others to determine whether or not they exceed recommended levels.

(7) City water supply monitoring and control system

It is usual to hear the news about shortage of water in particular in dry season in the Study Area. This system supervises and controls city water networks; including water source facilities, reservoirs, predication plants, pump stations and water distribution facilities; from one control location, ensuring the efficient use of facilities and a sufficient supply of water to meet demands. In order to deal with water shortage, this system will be able to support to control in advance to prevent from extreme lack of water.

Tables

Table 1.1 Telephone Densities

Area	No. of Exchanges	No. of Line Capacity	No. of Main Tel.Stations	No. of Tel. Usage Local Service Unit:Pulse	No.of Tel. Usage Trunk Services Unit:Call	Population	Main Tel. Station :1,000 Population	Waiting List	Share
North	68	139,148	102,282	189,138,470	26,890,368	10,993,792	9	40,608	7.72%
Northeast	75	116,112	87,661	156,228,167	22,161,332	19,828,941	4	14,298	6.62%
East	38	80,904	58,229	82,461,258	19,738,832	3,690,103	16	66,283	4.40%
West	35	48,408	38,766	54,374,673	12,837,263	3,305,115	12	19,119	2.93%
South	62	106,138	83,583	143,932,385	22,457,930	7,112,762	12	37,184	6.31%
Central	37	33,968	29,387	42,170,459	11,046,195	2,833,950	10	16,460	2.22%
Bangkok & Vicinities	85	1,154,282	924,614	2,062,176,360	70,067,537	8,538,610	108	798,544	69.80%
Thailand	400	1,684,960	1,324,522	2,730,481,772	185,199,457	56,303,273	24	992,496	100%
Study Area									
Nakhon Ratchasima	12	24,808	21,428	35,490,303	4,768,672	2,384,252	9	4,106	1.62%
Buri Ram	10	8,192	4,936	8,893,529	1,216,155	1,441,517	3	67	0.37%
Surin	6	8,704	4,394	7,318,133	1,314,961	1,288,503	3	109	0.33%
Si Sa Ket	2	2,536	2,073	5,568,861	661,200	1,336,161	2	694	0.16%
Ubon Ratchathani	6	10,156	7,737	13,135,605	1,818,005	1,932,052	4	2,170	0.58%
Mukdahan	1	1,000	925	1,884,566	369,515	288,151	3	501	0.07%
Yasothon	1	1,536	1,335	2,661,593	450,965	527,134	3	14	0.10%
Prachin Buri	9	9,688	5,564	7,313,405	2,352,516	877,491	6	713	0.42%
Nakhon Nayok	2	3,584	2,402	2,928,880	846,413	228,981	10	501	0.18%

SOURCE : TELEPHONE STATISTICAL REPORT 1990

Table 1.2 System Parameters of Present Rural Telecommunications

No. of subscribers	:	Up to 256
No. of voice channels	:	15 per RF
No. of optical telex channels	:	Up to 28
Total coverage radius	:	600 km
Coverage radius	:	30 km (cell), 45 km (repeater)
Tandem repeating	:	Up to 13 repeaters
No. of subscribers/stations	:	up to 67
Subscriber line interface	:	2-wire
Modulation	:	Binary FM
Voice coding	:	32 kb/s ADPCM
Radio frequency	:	0.8 - 1.5 GHz

Table 1.3 Main Characteristics of MTX for Cellular System

Application range	:	Max 2,160 base stations
Traffic handling capacity	:	Max. 2,500 erlang
Switching network	:	Fully digital, non-blocking
Control	:	Functional distributed, Hierachically devided
Signalling to PSTN	:	MFC, MFD, CCITT No.7 signalling systems
Base stations	:	Max. 1,024
Operation & maintenance	:	Local/remote for a signal exchange

Table 1.4 Proposed System Characteristics for Rural Telecommunications

Coverage area	:	600 km radius
Hop distance	:	40 km (base station - repeater)
		40 km (repeater - repeater)
		20 km (base station - terminal)
		20 km (repeater - terminal)
Max. No. of repeater	:	11 (from a base station)
No. of subscribers per system	:	1024
Transmission capacity	:	4 Mb/s (60 ch)
No. of subscribers	:	up to 64 (per terminal or repeater)
No. of repeaters/terminals	:	Max. 255 per system
Radio frequency bands	:	1.5 GHz band
		2.4 GHz band
		2.6 GHz band

Table 2.1 Present Status of Telephone Lines in Study Area (1/3)

Name of Province	Location of Switching Eq't	Line Capacity	Line Used	Remaining Lines			Waiting List	Available Cable Pairs	Used Cable Pairs	Remaining Cable Pairs	Lines add in 84-92	Cable add in 84-92
				Spare	Process	Free						
Nakhon Ratchasima	Nakhon Ratchasima	14,752	14,346	90	0	316	4,546	26,740	14,201	12,539	0	26,900
	Pak Chong	3,000	2,605	35	1	359	1,215	3,111	2,561	550	0	200
	Bua Yai	600	600	0	0	0	126	950	590	360	0	1,500
	Sikhiu	1,000	1,000	0	0	0	543	1,604	966	638	600	1,100
	Pak Thong Chai	1,000	957	25	0	18	467	2,119	941	1,178	0	900
	Phimai	1,000	750	25	3	222	71	889	719	170	0	200
	Chok Chai	600	383	15	14	188	0	1,381	382	999	0	0
	Khonburi	1,024	356	25	0	643	0	985	356	629	0	200
	Klang Dong	1,000	419	25	0	556	227	510	420	90	0	0
	Dan Khun Thot	512	493	15	0	4	33	798	484	314	0	0
	Soeng Sang	120	120	0	0	0	0	371	120	251	136	0
	Sung Noen	1,000	621	25	0	354	225	921	600	321	0	100
	Chakkarat	512	174	15	0	323	1	430	163	267	0	0
	Khong	512	172	15	0	325	1	565	166	399	0	0
	Huai Thalaeng	512	188	15	0	309	2	620	191	429	0	0
	Phathai	512	254	15	0	243	0	648	248	400	0	0
	Chum Phuan	512	209	15	0	288	6	816	203	613	0	0
	Non Sung	512	267	15	0	230	4	749	269	480	0	0
	Khet Utsahakam Suranari	1,000	595	25	0	380	64	1,460	590	870	24	0
	Sub-total	*29,680*	*24,509*	*395*	*18*	*4,758*	*7,531*	*45,667*	*24,170*	*21,497*	*760*	*31,100*
Buri Ram	Buri Ram	4,096	2,952	35	0	1,109	5	5,050	2,976	2,074	0	2,725
	Nang Rong	1,024	809	25	0	190	1	1,345	809	536	0	0
	Lam Plai Mat	512	491	21	0	0	18	904	491	413	0	0
	Ban Kruat	128	107	15	0	6	4	157	107	50	0	0
	Huai Rat	128	88	15	0	25	0	164	88	76	0	0
	Satuk	512	416	15	0	81	0	712	416	296	0	0
	Phutthaisong	256	193	15	0	48	0	277	193	84	0	0
	Krasang	512	223	15	0	274	0	685	223	462	0	0
	Nong Ki	512	269	15	0	228	0	782	270	512	0	0
	Prakhon Chai	512	502	10	0	0	10	860	502	358	0	0
	Lahan Sai	128	122	6	0	0	56	182	123	59	0	0
	Chumphon Buri	256	83	15	1	157	0	365	81	284	0	0
	Khu Muang	128	16	15	0	97	0	180	16	164	128	200
	Pakham	128	10	15	0	103	0	200	10	190	128	200
	Sub-total	*8,832*	*6,281*	*232*	*1*	*2,318*	*94*	*11,863*	*6,305*	*5,558*	*256*	*3,125*
Surin	Surin	5,120	3,959	98	22	1,041	112	10,375	4,230	6,145	0	0
	Prasat	1,024	358	25	0	641	0	952	358	594	0	2
	Sikhoraphum	1,024	316	25	0	683	0	812	318	494	0	2
	Rattanaburi	512	271	15	2	224	0	693	269	424	0	1
	Chom Phra	512	171	15	0	326	0	535	169	366	0	0
	Tha Tum	512	170	15	0	327	0	752	170	582	0	1
	Samrong Thap	256	126	15	0	115	0	351	112	239	0	0
	Sangkha	512	229	15	4	264	0	787	219	568	512	900
	Sub-total	*9,472*	*5,600*	*223*	*28*	*3,621*	*112*	*15,257*	*5,845*	*9,412*	*512*	*906*

Table 2.1 Present Status of Telephone Lines in Study Area (2/3)

Name of Province	Location of Switching Eq't	Line Capacity	Line Used	Remaining Lines			Waiting List	Available Cable Pairs	Used Cable Pairs	Remaining Cable Pairs	Lines add in 84-92	Cable add in 84-92
				Spare	Process	Free						
Si Sa Ket												
	Sri Sa Ket	3,072	2,359	35	3	675	22	4,051	2,359	1,692	0	6,600
	Kantharalak	1,000	673	25	1	301	0	1,195	673	522	0	0
	Khukhan	256	234	15	2	5	211	526	234	292	0	0
	Khun Han	256	203	15	0	38	0	551	203	348	0	0
	Uthumphon Phisai	1,024	345	25	0	654	31	1,200	345	855	0	0
	Kanthararom	256	213	15	0	28	0	370	213	157	0	0
	Sub-total	*5,864*	*4,027*	*130*	*6*	*1,701*	*264*	*7,893*	*4,027*	*3,866*	*0*	*6,600*
Ubon Ratchathani	Ubon Ratchathani	7,120	4,772	70	27	2,251	2,928	5,975	4,939	1,036	0	12,000
	Det Udon	512	467	24	0	21	0	792	449	343	0	0
	Amnat Charoen	1,000	865	44	0	91	131	996	841	155	0	200
	Phibun Mangsahan	1,000	448	15	5	532	107	575	455	120	0	600
	Khong Chaim	200	100	15	0	85	0	192	95	97	0	0
	Warin Chamrap	1,536	1,321	25	0	190	818	1,624	1,336	288	0	600
	Muang Samsip	256	132	15	0	109	0	361	126	235	0	0
	Trakan Phutphon	512	202	15	1	294	0	551	183	368	0	0
	Si Muang Mai	128	102	15	1	10	2	184	93	91	0	0
	Khemarat	256	229	15	0	12	2	364	211	153	0	0
	Khuang Nai	256	124	15	0	117	0	368	114	254	0	0
	Ubon Ratchatani 2	2,048	1,946	45	28	29	209	6,000	1,941	4,059	2,048	6,000
	Tan Sum	128	23	15	0	90	0	189	19	170	128	200
	Buntharik	128	66	15	1	46	0	185	64	121	128	200
	Kut Khaopun	128	16	15	0	97	5	189	14	175	128	200
	Sub-total	*15,208*	*10,813*	*358*	*63*	*3,974*	*4,202*	*18,545*	*10,880*	*7,665*	*2,432*	*20,000*
Mukudahan	Mukudahan	2,048	985	106	0	957	1,055	1,276	996	280	0	2,700
	Sub-total	*2,048*	*985*	*106*	*0*	*957*	*1,055*	*1,276*	*996*	*280*	*0*	*2,700*
Yasothon	Yasothon	2,048	1,622	25	1	400	5	2,983	1,583	1,400	0	3,300
	Kham Khuan Kaeo	256	151	15	0	90	0	487	140	347	0	0
	Loeng Nok Tha	512	251	15	1	245	0	860	240	620	0	0
	Sub-total	*2,816*	*2,024*	*55*	*2*	*735*	*5*	*4,330*	*1,963*	*2,367*	*0*	*3,300*
Prachin Buri	Prachinburi	5,120	2,369	127	2	2,622	426	2,730	2,300	430	0	1,800
	Kabinburi	1,024	975	43	0	6	790	1,333	966	367	0	400
	Araniyaprathet	1,536	1,302	25	9	200	552	1,467	1,285	182	0	1,100
	Sakaeo	1,536	658	25	7	846	387	989	651	338	0	1,600
	Khok Pip	128	128	0	0	0	276	534	125	409	0	0
	Na di	128	112	15	0	1	1	273	110	163	0	0
	Watthana Nakhon	512	463	47	0	2	47	760	427	333	0	0
	Si Maha Phot	256	244	10	0	2	225	368	244	124	0	0
	Prachantakham	512	473	15	1	23	69	794	470	324	512	850
	Sub-total	*10,752*	*6,724*	*307*	*19*	*3,702*	*2,773*	*9,248*	*6,578*	*2,670*	*512*	*5,750*

Table 2.1 Present Status of Telephone Lines in Study Area (3/3)

Name of Province	Location of Switching Eq't	Line Capacity	Line Used	Remaining Lines			Waiting List	Available Cable Pairs	Used Cable Pairs	Remaining Cable Pairs	Lines add in 84-92	Cable add in 84-92
				Spare	Process	Free						
Nakhon Nayok	Nakhon Nayok	2,560	1,595	65	0	900	638	1,597	1,540	57	0	3,600
	Ban Na	1,024	1,000	19	0	5	410	1,699	994	705	0	800
	Ongkharak	512	388	15	0	109	507	451	385	66	512	600
	Sub-total	*4,096*	*2,983*	*99*	*0*	*1,014*	*1,555*	*3,747*	*2,919*	*828*	*512*	*5,000*
	Grand total	*88,768*	*63,946*	*1,905*	*137*	*22,780*	*17,591*	*117,826*	*63,683*	*54,143*	*4,984*	*78,481*

Source: Status of Telephne Lines, Waiting List and Cable as of Nov. 1991 (NESDB)

(Note)

1. Line Capacity: Maximum capacity of switching equipment.
2. Line Used: The number of occupied lines on switching equipment.
3. Remaining Lines: (Spare) The number of presently available lines.
   (Process) The number of lines which are presently under construction.
   (Free) The number of lines which arre remained without construction.
4. Waiting List: The number of lines which are being requested by users.
5. Available Cable Pairs: The number of maximum available lines for subscribers.
6. Used Cable Pairs: The number of lines for subscribers which has already used.
7. Remaining Cable Pairs: The number of lines for subscribers which has not served yet.
8. Lines add in 84-92: The number of telephone lines which will be added in 1984 to 1992.
9. Cable add in 84-92: The number of cable which will be added in 1984 to 1992.

Table 2.2 Existing Operation of Satellite Telocommunications in Thailand

Organization	Using Satellite	Function
1. Government	Palapa	Voice and data communication between Government organization. Distribution of TV and radio programs.
2. TOT	Palapa	VSAT service and supplementary network of ground system by consession
3. CAT	Intelsat	Distribution for channel 1 and 3. Voice and data transmission. Provides leased line
4. BBTV: channel 7	Palapa	Inernal use for BBTV. Distribution for channel 5.
5. Samart Telecom Co ., Ltd.	Palapa	Providing inter-firm data communication services approved by PTD.
6. Compunet Corp. Ltd.	Asiasat	Providing inter-firm data communication services approved by PTD.
7. Thanayong Co., Ltd.	Intelsat	Voice and data communication service by consession from CAT.

Figures

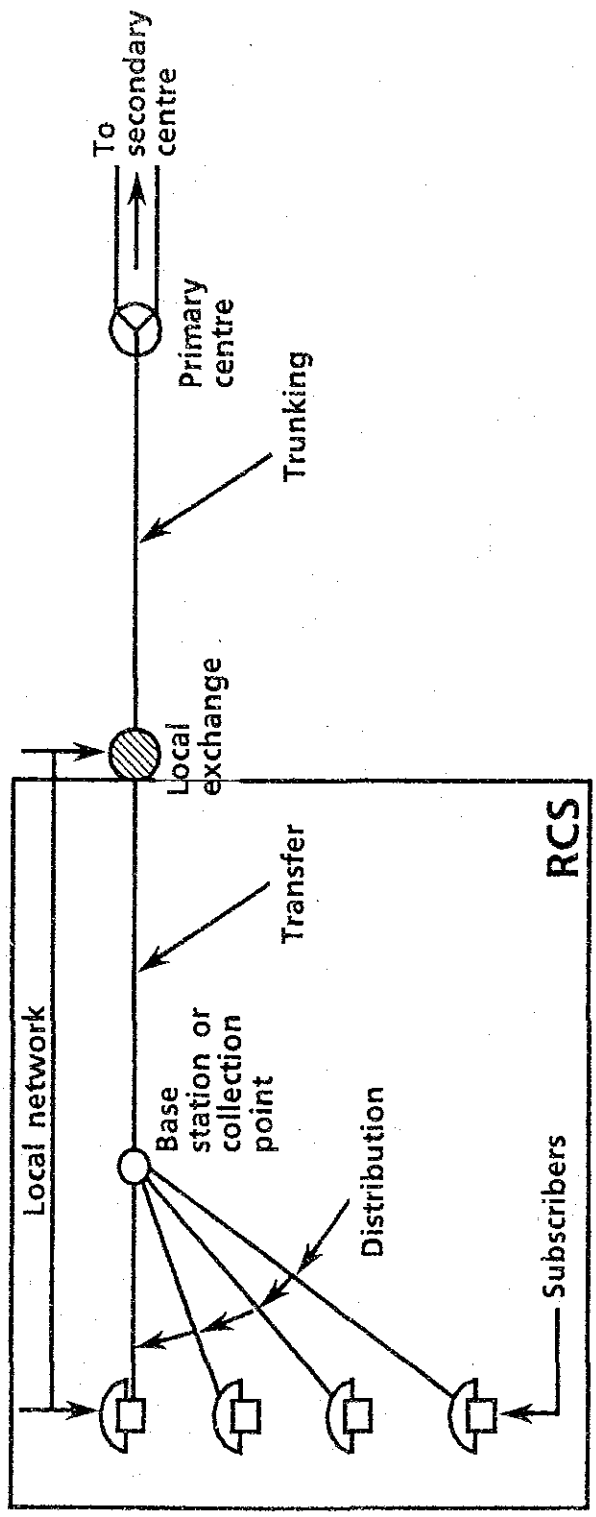

Figure 1.1

Rural Communications System

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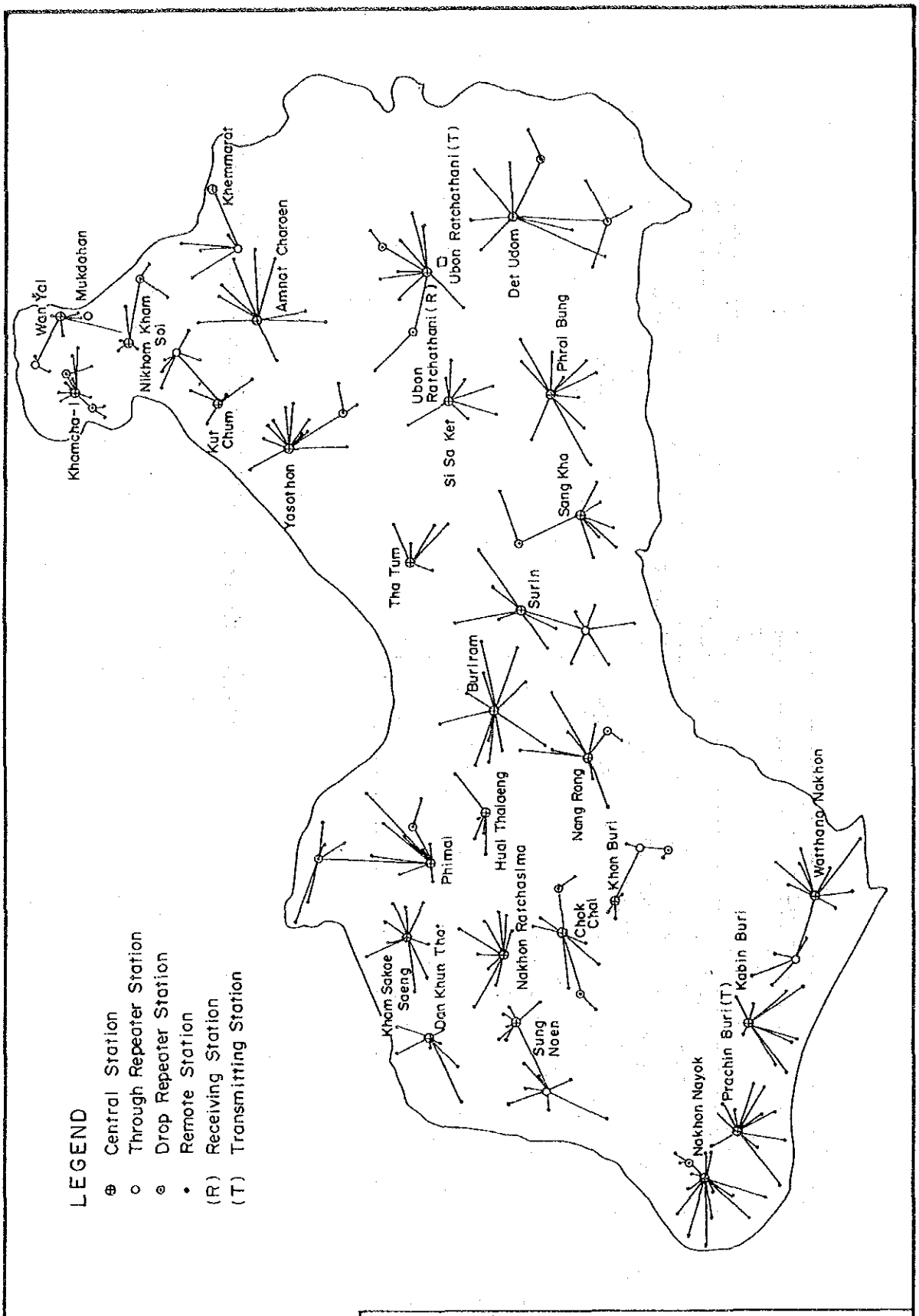

Figure 1.2

Location of Existing Rural Communications System

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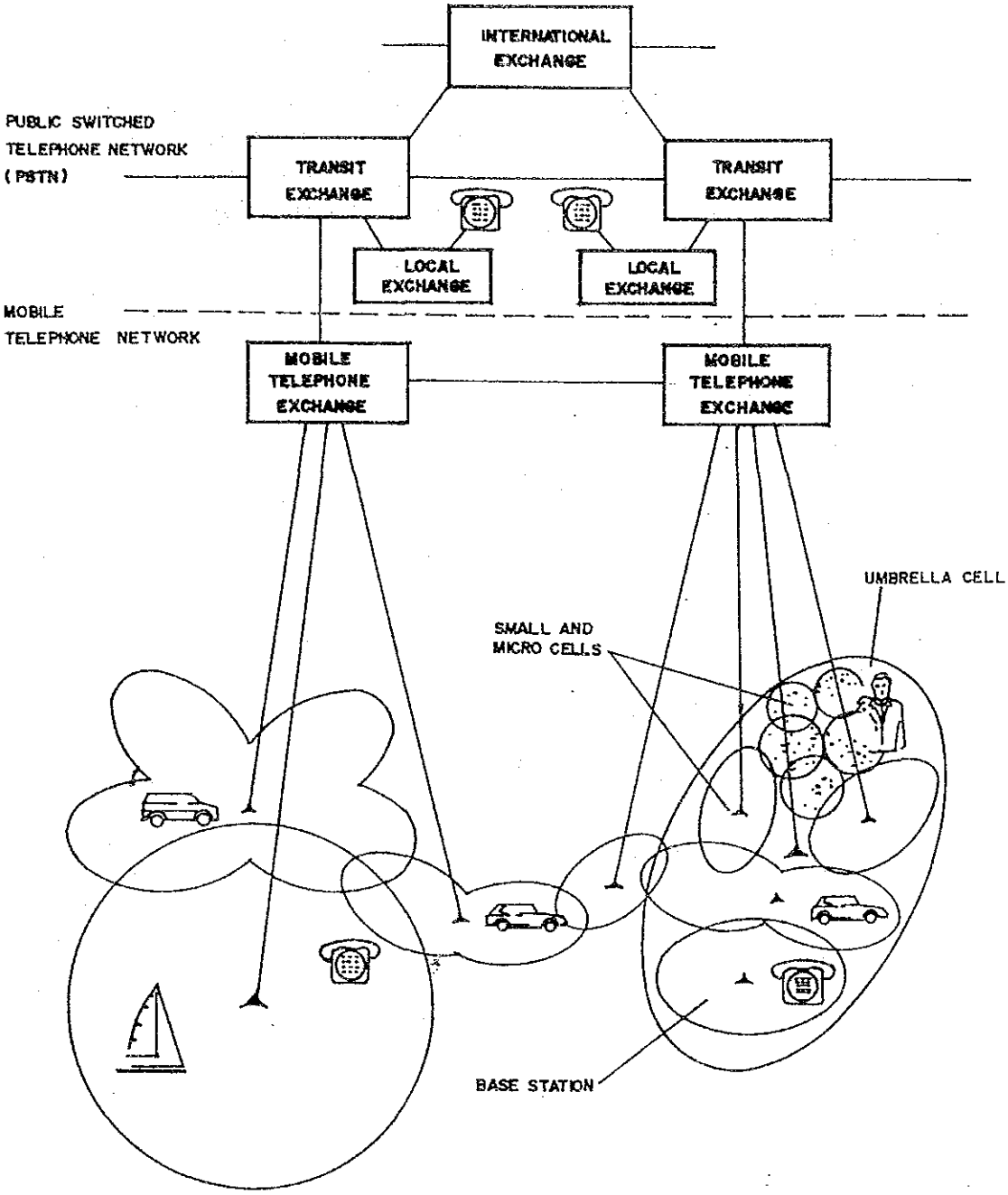

Figure 1.3

Cellular System Structure

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Subscribers distributed in various patterns can be covered by locating terminals and repeaters in a cellular type configuration.

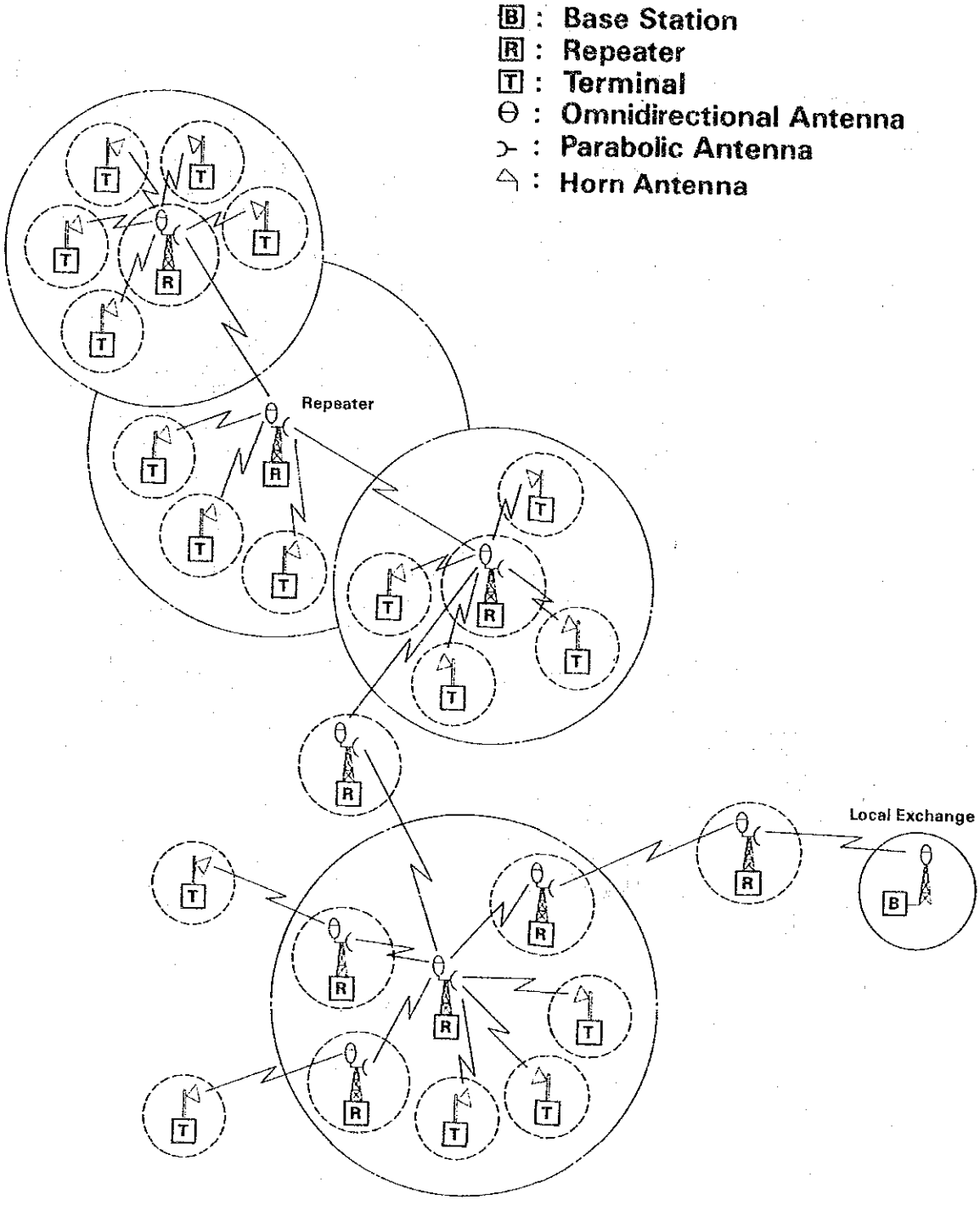

Figure 1.4

System Configuration for Rural Communications Network

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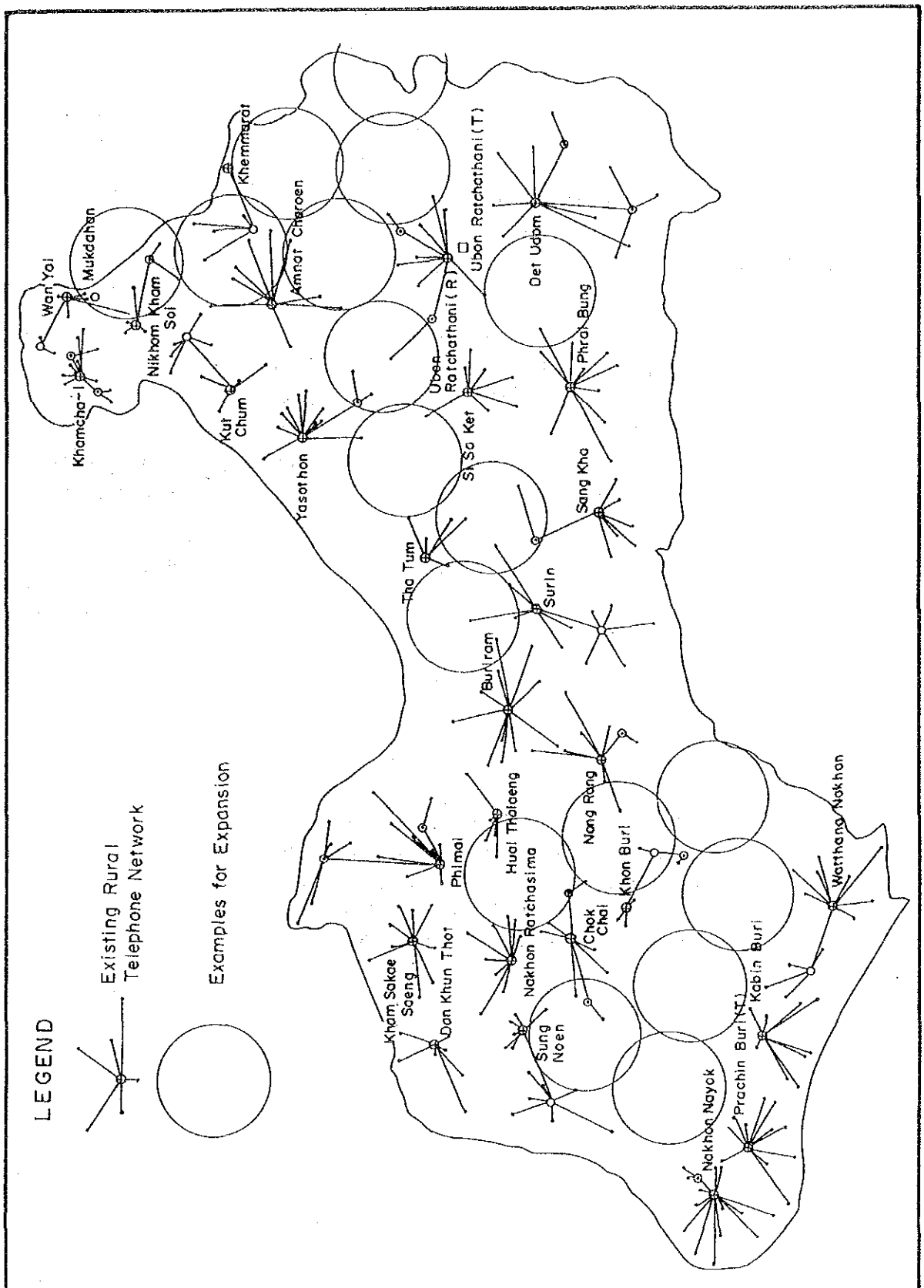

Figure 2.1

Example of Expansion Plan

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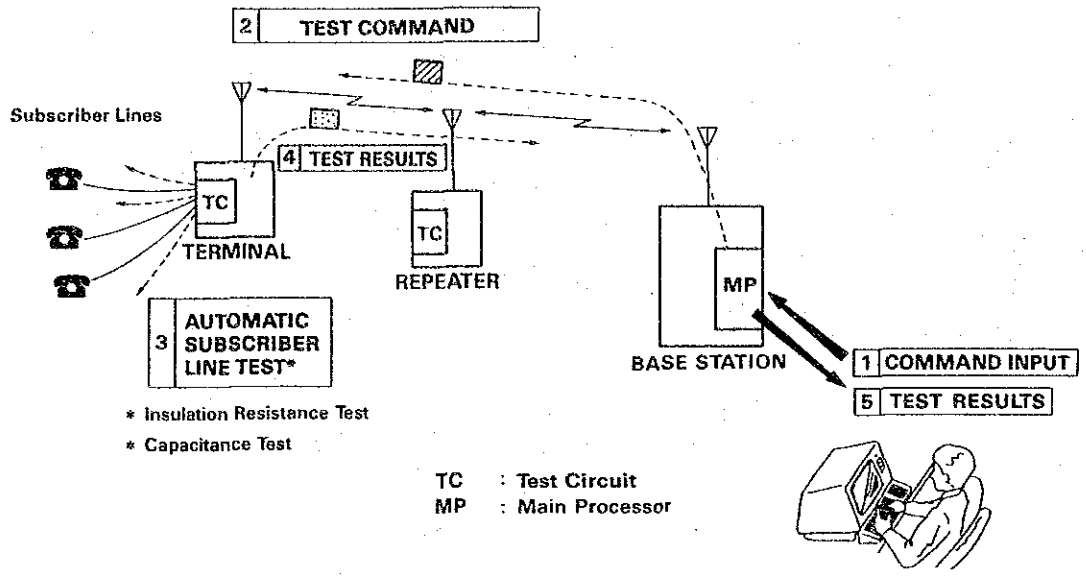

The system will be able to provide maintenance capabilities of alarm reporting, subscriber line tests, traffic statistic reporting and system reconfiguration. These operation will be able to remotely performed through visual display unit.

Figure 2.2

Operation and Maintenance System

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Mounting Example

TCU : TDM Controller Unit
LOEM : Loop Open End Module
BSCM : Base Station Controller Module
VDU : Visual Display Unit
VDF : Voice Distribution Frame

Base station equipment will normally be installed in a local exchange building where, in most cases, DC/AC power and a microwave tower are available.

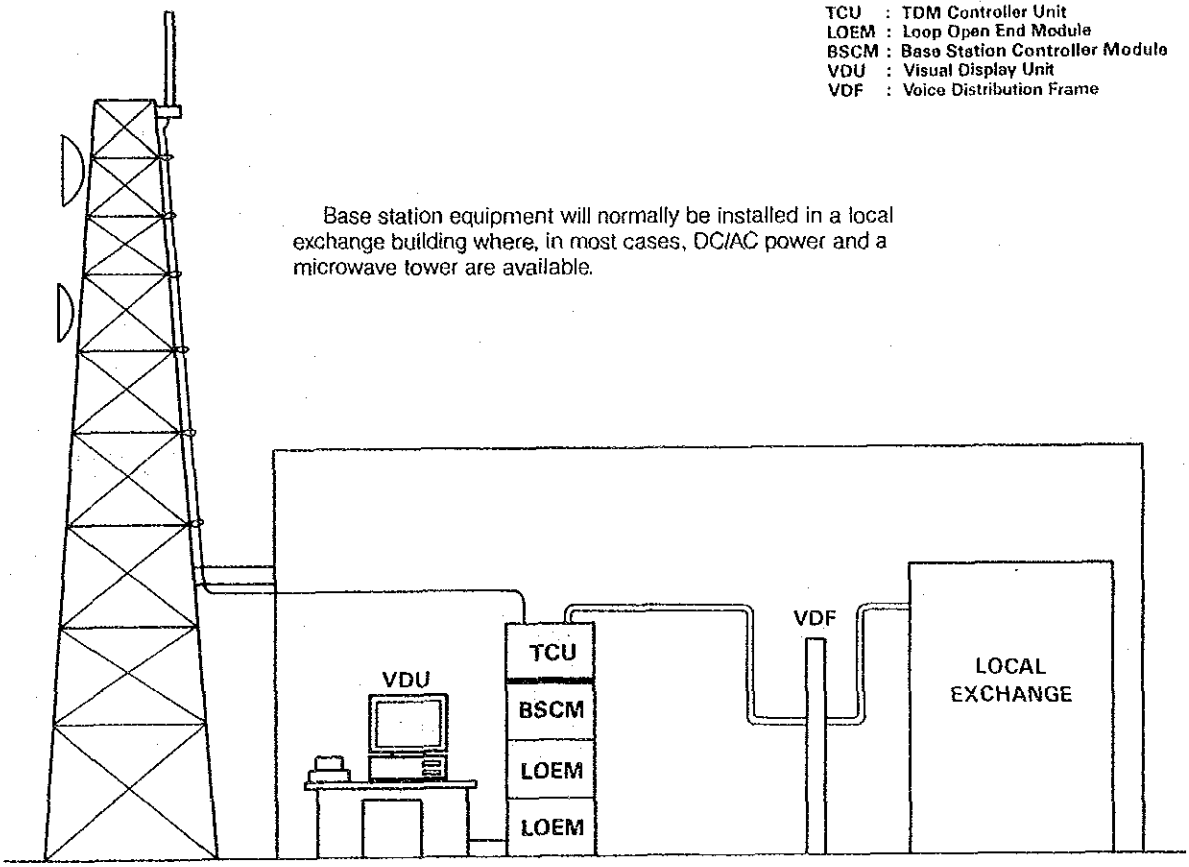

Figure 2.3

Typical Configuration of Base Station

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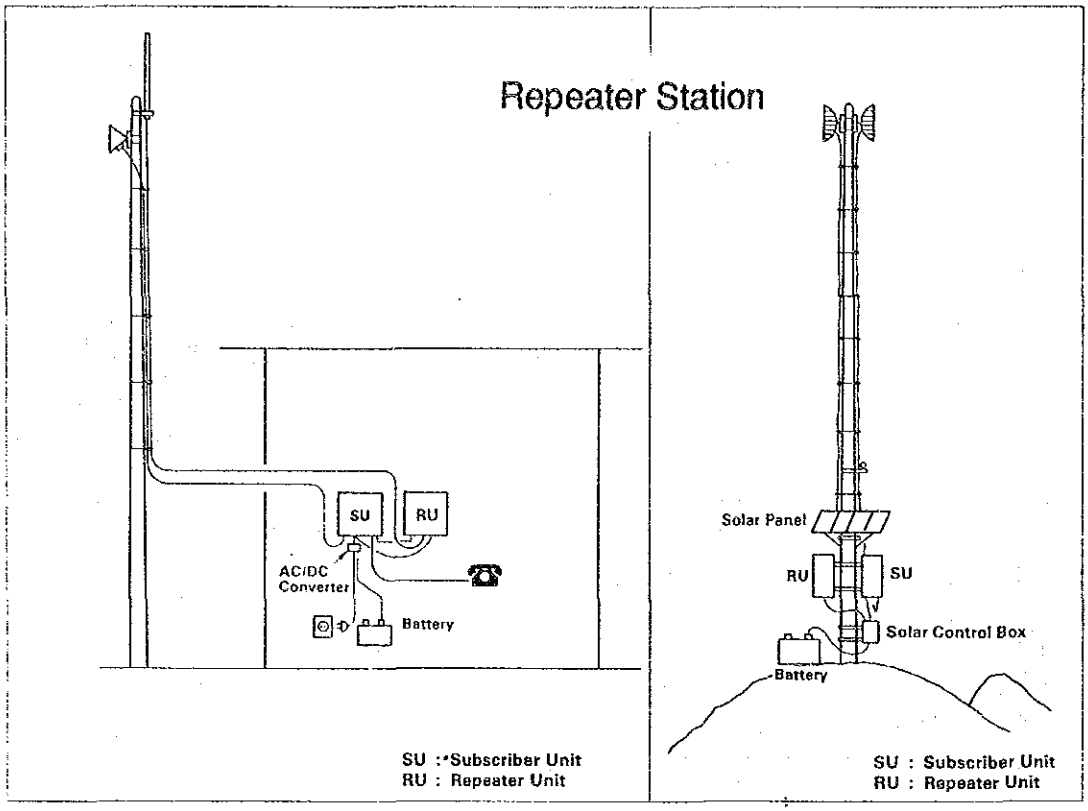

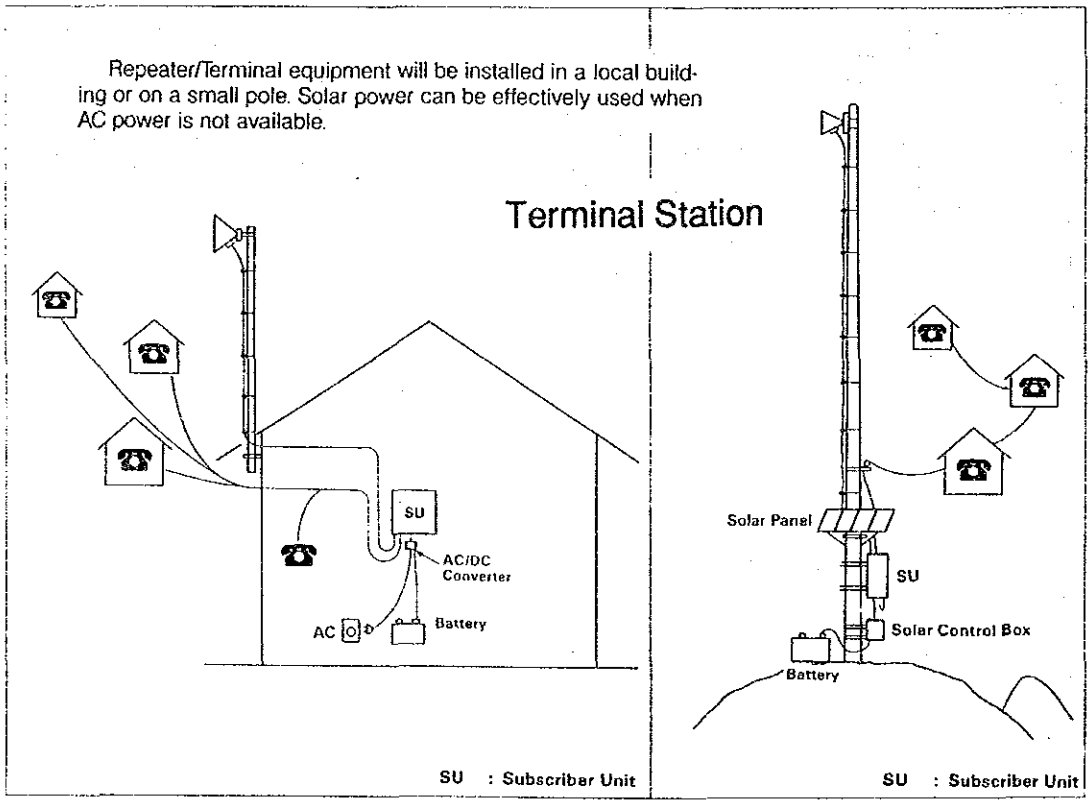

Figure 2.4

Typical Configuration of Repeater and Terminal Stations

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This channel arrangement in the 1.5 GHz is based on the CCIR report No. 379-5.

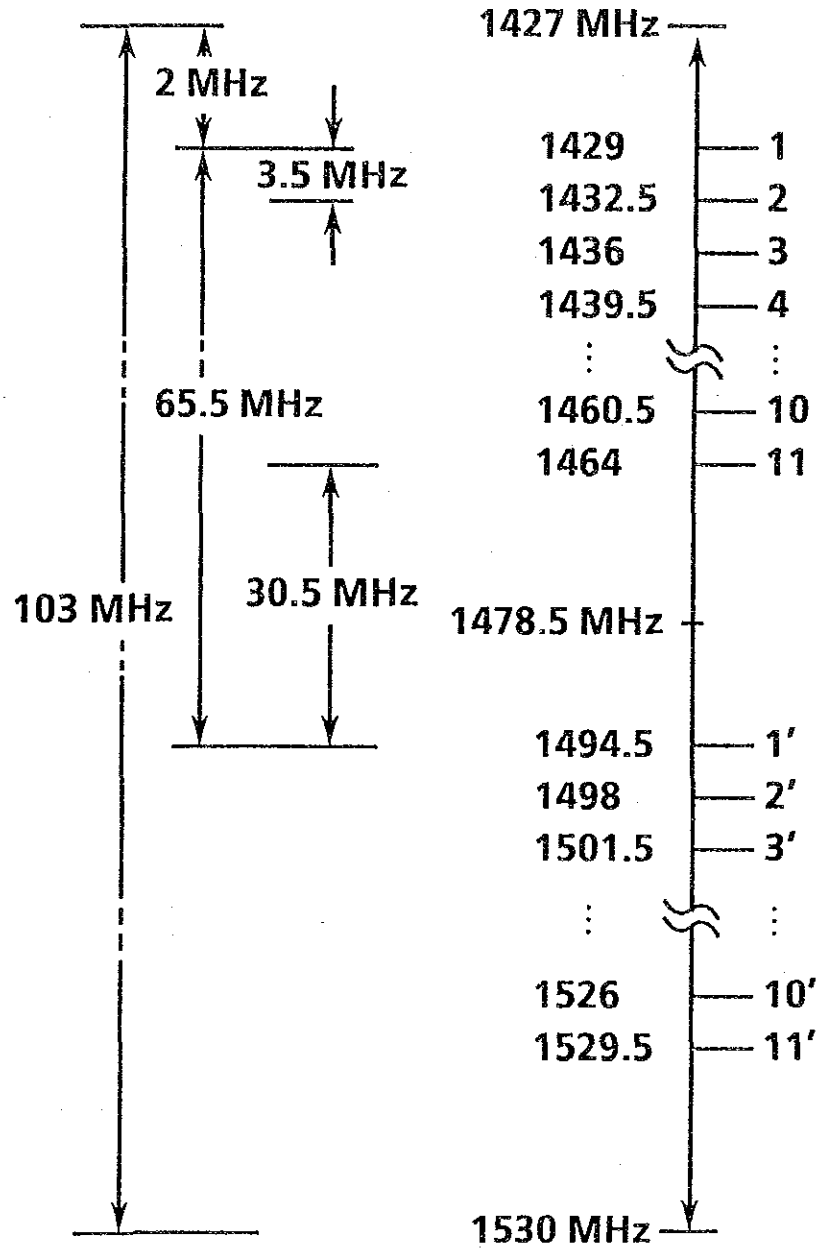

Figure 2.5

Example of Frequency Allocation

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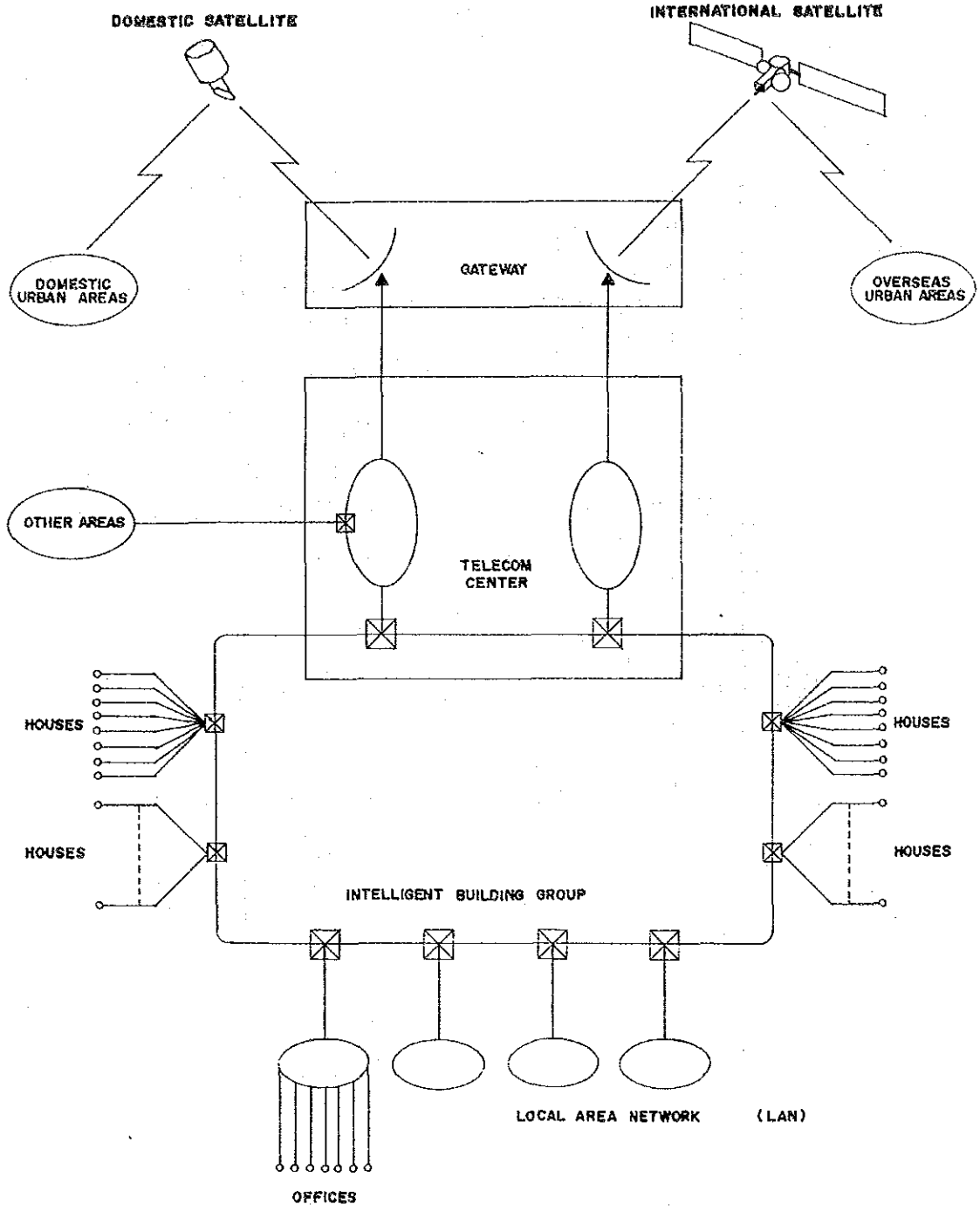

Figure 2.6

System Image for Teleport

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