This method is recommended as it is easy for telephone users to accept, because in the case of this example, 1) the zone code "4" is not changed, 2) the exchange code "43" is left as it is, though "x" is added, 3) the subscriber number "3546" is not changed. Other methods insert the new code "x" in positions other than that between the second and third digit. A modification of the switching equipment is necessary to change the digit control. However, the recommended method does not bring about any more difficulties than the other methods for this modification.

The numbering capacity of the recommended method is 8,000,000 terminals since combinations in the range from 200-0000 to 999-9999 are available.

To expand the numbering range, the addition of the toll prefix code and the zone code to the conventional telephone number has been adopted by many telephone operating entities. An example for the area with the exchange code "43" (used in La Ceiba) is shown below:

Now (6-digit numbering) 43-3546
New (with toll prefix) 0x-43-3546

where, 0x is the toll prefix and zone code
x is one of 2, 3, ..., 9

In this case, the exchange codes "20" to "99" can be assigned besides "43" in the "0x" area. It should be noted, however, that the subscriber must always dial eight digits to make a toll call.

This method is also applicable to the Honduran telecommunications network. This should be studied when the necessity of transferring the existing 6-digit system to 7-digit system comes up in the future.

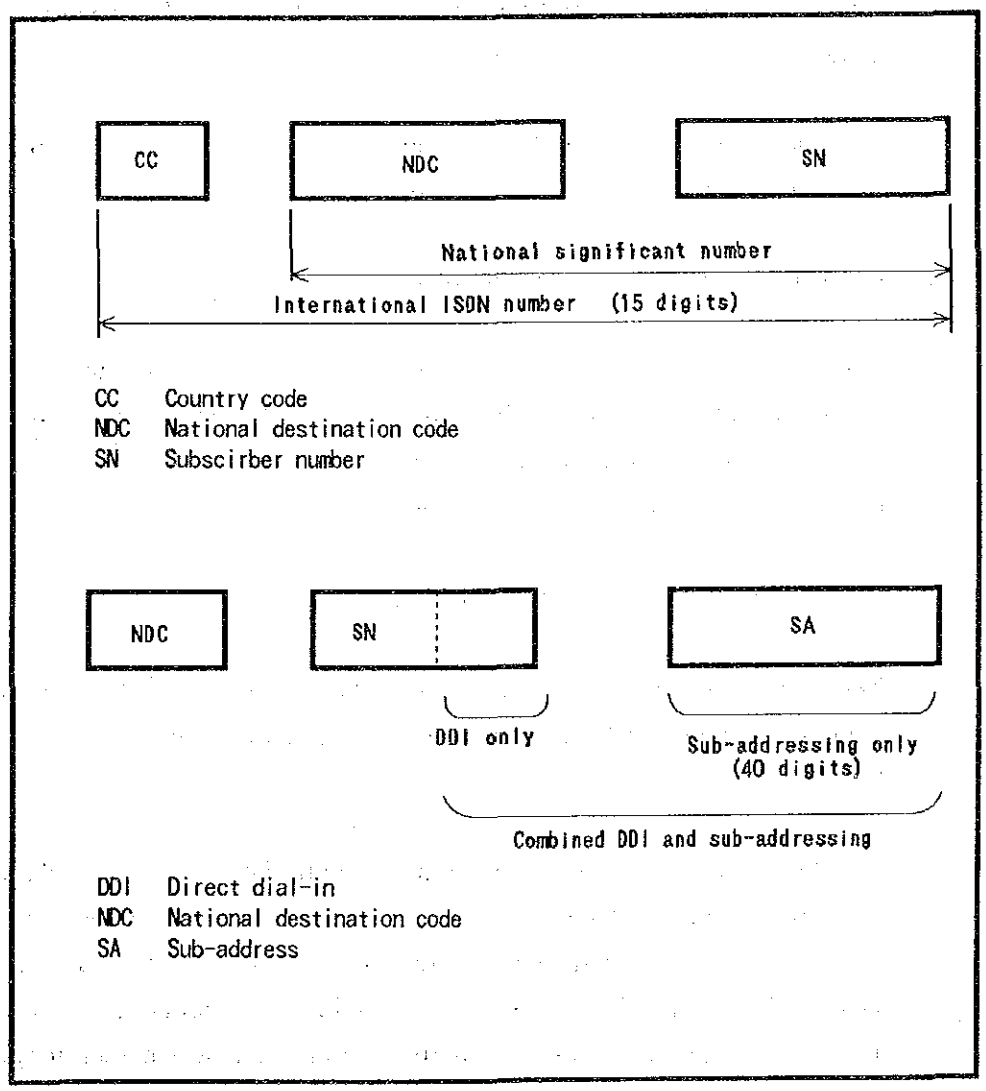
5) Numbering plan in the ISDN era

CCITT recommends taking measures to transfer an existing numbering plan to a new one to cope with the ISDN era. The transfer will be put into effect in December, 1996. According to the CCITT Recommendation E.164, it is stated "... The maximum number length shall be 15 digits. However, some Administrations may wish to increase their register capacity to 16 or 17 digits. The decision on register capacity is left as a matter to be taken by individual Administrations." The length does not include prefixes, language digits, or address delimiters since these items are not

considered part of the international ISDN.

Accordingly, exchanges to be introduced in the future should be equipped with the capacity to meet the requirements stated in the recommendation. Besides, the idea of sub-addressing, which constitutes an intrinsic part of the ISDN addressing capabilities, should be taken into consideration when acquiring switching equipment. The number structure in the ISDN era is shown in Figure 6.5.3-1.

Figure 6.5.3-1 Number Structure in the ISDN Era



6.5.4 Charge unit area

1) Definition of charge unit area

A charge unit area is an area where a call which originates and terminates within it is defined as local call. All calls which originate in the charge unit area and go out of the area are defined as toll calls.

Each of the charge unit areas has a geographical point to represent the area and charge for a call between two different charge unit areas, calculated in conformity with the distance between the two points.

The charge unit area should be decided so that it can be left unchanged for a long time, since it is the base of charge calculation.

2) Relationship with the numbering plan

All the telephone subscribers shall belong to one of the charge unit areas and the telephone number of a subscriber shall indicate clearly the charge unit area to which it belongs. Consequently, the exchange code or the code for a municipality shall correspond to only one charge unit area.

3) Establishment of charge unit area

The charge unit area should be decided based on a result of examination of the technical, economical, maintenance and operation aspects, as well as the users' benefits.

For the technical aspects, consideration should be given to switching equipment functions, characteristics of distribution cables, characteristics of transmission technology to apply, and so on. Most of the switching equipment can handle up to around 1,800 ohm line resistance, including the telephone set, with insulation resistance better than 25 kilo-ohms. In general, extension of a service area by means of normal subscriber cables is about 14 kilo-meters with the above-mentioned conditions and standard transmission loss of HONDUTEL. Accordingly, subscribers situated in a area beyond this distance need some other technical measures. If the subscriber line is extended by a subscriber loop extension system, for example, it will be more costly than using metallic pair cables.

From an economic point of view, it is preferred that the charge unit area is determined such that the subscriber terminals are connected by normal metallic pair cables and that the switching equipment does not need any additional devices. Using hardware which requires parts and/or materials not readily available should be avoided in building the network.

For the telephone users, cutting everyday life area in pieces is not acceptable. Lining by mountain, river, desert, or wilderness is more acceptable for users. Administrative boundaries may also be natural to the users.

The Honduran administrative structure is formed using levels such as caserio or aldea (village), municipio (Municipality), and departamento (Department). There are 18 Departments in the country and about 300 Municipalities. The village is a small community under the Municipality level.

The Departments and the Municipalities have an important city which is situated at a central point of the inhabited areas, in many cases, in the Department or Municipality. Since calls between those cities are presently charged as toll calls, it is easy for telephone users to accept an area around the city as the charge unit area. In this case, making the Municipality correspond to the charge unit area is adequate as it is compatible with the present charging system. While many Municipalities are about 25Km in diameter, most of the inhabited areas can be provided with one point of traffic convergence.

In conclusion, according to the above-mentioned situations, it is proposed that a Municipality or a combination of Municipalities corresponds to a charge unit area.

6.6 Signaling Plan

6.6.1 Inter-exchange signaling

The existing signaling system should be kept in accordance with the principles stated in Section 6.1. Inter-exchange signaling systems now in use in Honduras are R2(D), R2(A), DC/MFC, and DC/DP for domestic channels, and R2(D) and System No. 5 for international channels. Table 6.6.1-1 shows the signaling systems now in use in a matrix between exchanges.

Table 6.6.1-1 Matrix of Signaling

From \ To		LS and TLS				International
		SXS	XB	ESS	DIGITAL	DIGITAL
LS and TLS	SXS	DC	DC	DC	DC	DC
	XB	DC	DC/MFC	R2 MFC(A)	R2 MFC(A)	R2 MFC(A)
	ESS	DC	R2 MFC(A)	R2 MFC(A)	R2 MFC(A)	R2 MFC(A)
	DIGITAL	DC	R2 MFC(A)	R2 MFC(A)	R2 MFC(D)	R2 MFC(D)
International	DIGITAL	DC	R2 MFC(A)	R2 MFC(A)	R2 MFC(D)	R2MFC/#5

For the section to be introduced in relation to this Plan, as a rule, the signaling system R2(D) will be applied. However, if the counterexchange is not equipped with this function, a signaling system equipped for the counterexchange will be applied.

All the switching systems to be introduced in the future should be digital using a stored program control so that the switching system can be flexible in interfacing with a possible change of signaling system in the future. The No. 7 Common Channel Signaling System is preferred for the national telecommunications network in the future.

6.6.2 Subscriber line signal

The existing signaling system will be kept in accordance with the principles stated in Section 6.1. As for the subscriber signal, a loop disconnect type of signaling and a multi-frequency in-band signaling are presently used in Honduras. The former has two types: 10 p.p.s. and 20 p.p.s.

6.7 Charging Plan

6.7.1 Local call charge

Switching equipment to be introduced in relation to this Plan should be digital using stored program control so that the switching system can be flexible in changing the charging method. Charging methods for local calls are as follows:

- Flat rate
- Unit fee charging
- Time charging

The existing charging method should be kept and the switching equipment should be programmed in accordance with specified requirement when introducing actually. When a rural subscriber is connected to an existing or a new exchange, the subscriber will be charged by the method applied to the exchange.

All the exchanges are equipped with subscriber call meters. One meter corresponds to an individual subscriber. A single charge unit is raised for each chargeable call. With this method now in use in Honduras, the charge for the call taks into account its duration. A single charge unit is a call of three minutes or less. The unit is recorded by a mechanical meter for a mechanical switching system, or in a data base for a digital switching system.

6.7.2 Toll call charge

The charge for the toll call takes into account its distance and duration. This method now in use should be kept.

Using this method, with a mechanical switching system, the switching system must be able to determine the appropriate rate for the call and ensure that it is recorded, either while the call is in progress or on its termination. In all cases it is usual to have a minimum call charge time. This is the time allowed for one call charge unit. The time depends upon the distance: a longer time is given for nearer calls and a shorter time for more distant calls.

In the case of the electro-mechanic and digital switching system, it must be able to measure the duration of a call. The duration is then converted to call charge units at the end of the call or the basic data can be transferred to the billing system where the appropriate call charge is calculated. This ability to provide/record detailed information (hereinafter referred to as "AMA") about each call should be installed in the switching system to be introduced in the future.

6.7.3 International call

For international calls, the destination and duration of the call is measured at the international switch located in Tegucigalpa and the data are transferred to the billing system where the appropriate call charge is calculated in accordance with the tariff established by HONDUTEL. Information about the calling subscriber is transferred to the national center from the local exchange via the toll exchange. This method of charging international calls should not be affected by the incorporation of the rural telecommunications network.

6.7.4 Charging for the rural telecommunications network subscriber

The rural telecommunications network subscribers should be charged in the same way as that effective now in the urban telecommunications network in order to maintain a unified charging system in the country. That is, the call should be charged in such way that the local call is charged in accordance with its duration, the toll call in accordance with its duration and distance, the international call in accordance with its duration and destination. The toll call and the international call should be charged by the method having a bill of detailed call information.

6.8 Engineering Standard

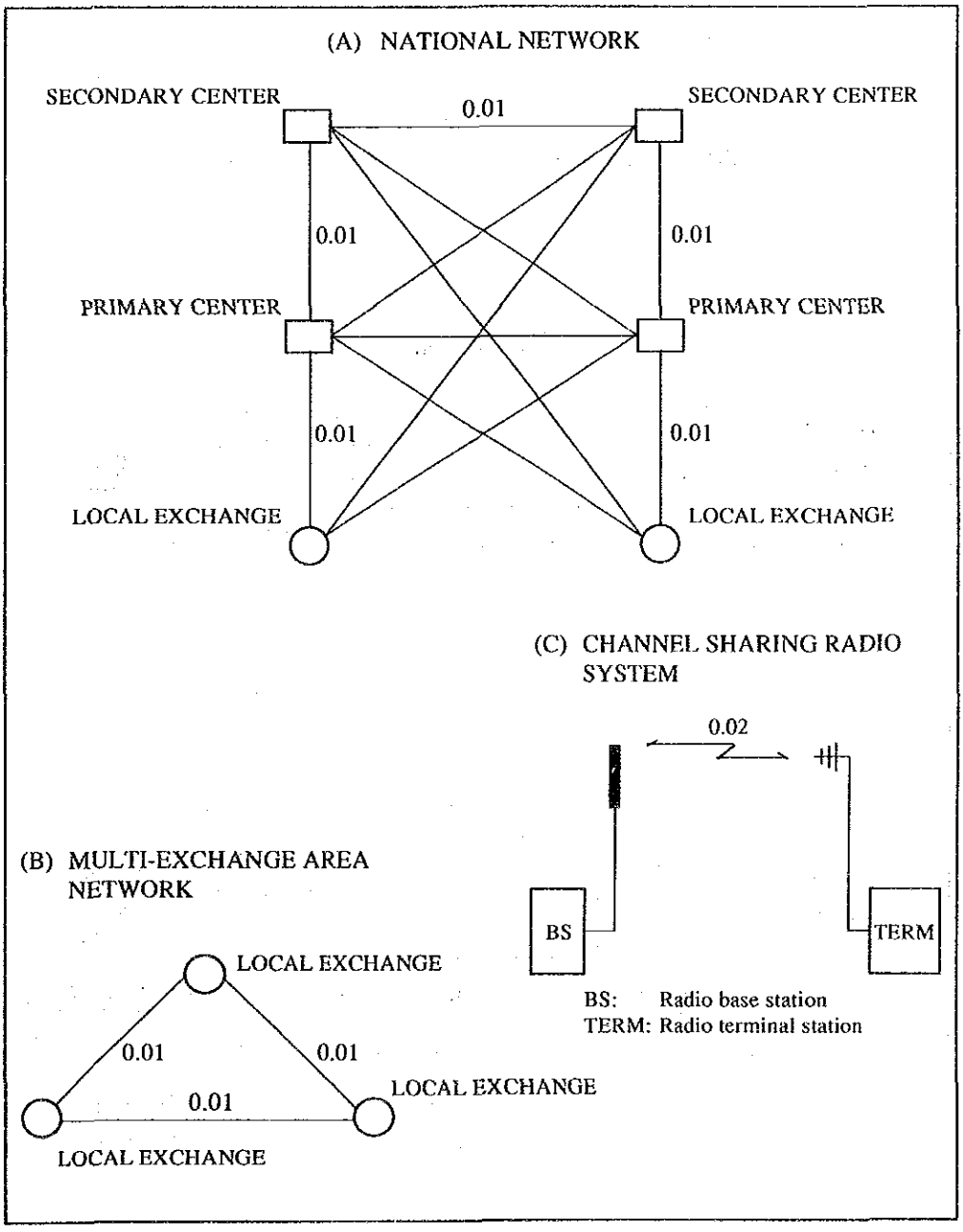
6.8.1 Connection loss probability

The connection loss probability now applied to the existing urban telecommunications network should be kept. For the exchanges to be introduced in relation to this Plan, the connection loss probability or the rate of call attempts which are blocked or excessively delayed within the exchange should be designed as shown in Table 6.8.1-1. Connection loss probability in route selection in the network should be shown in Figure 6.8.1-1, in accordance with the existing standard. The connection loss probability between the telephone exchange and the terminals to be connected by means of a channel sharing radio transmission system is determined in consideration of the total grade of service. For the rural telecommunications network, it is recommended to apply double the urban telecommunications network value or 0.02 for making the rural telecommunications network economic, by taking into account the fact that the Honduran telecommunications network is a 3-level hierarchy.

Table 6.8.1-1 Connection Loss Probability at Switching Point

Type of connection	Probability
Internal	10^{-2}
Originating	5×10^{-3}
Terminating	5×10^{-3}
Transit	10^{-3}

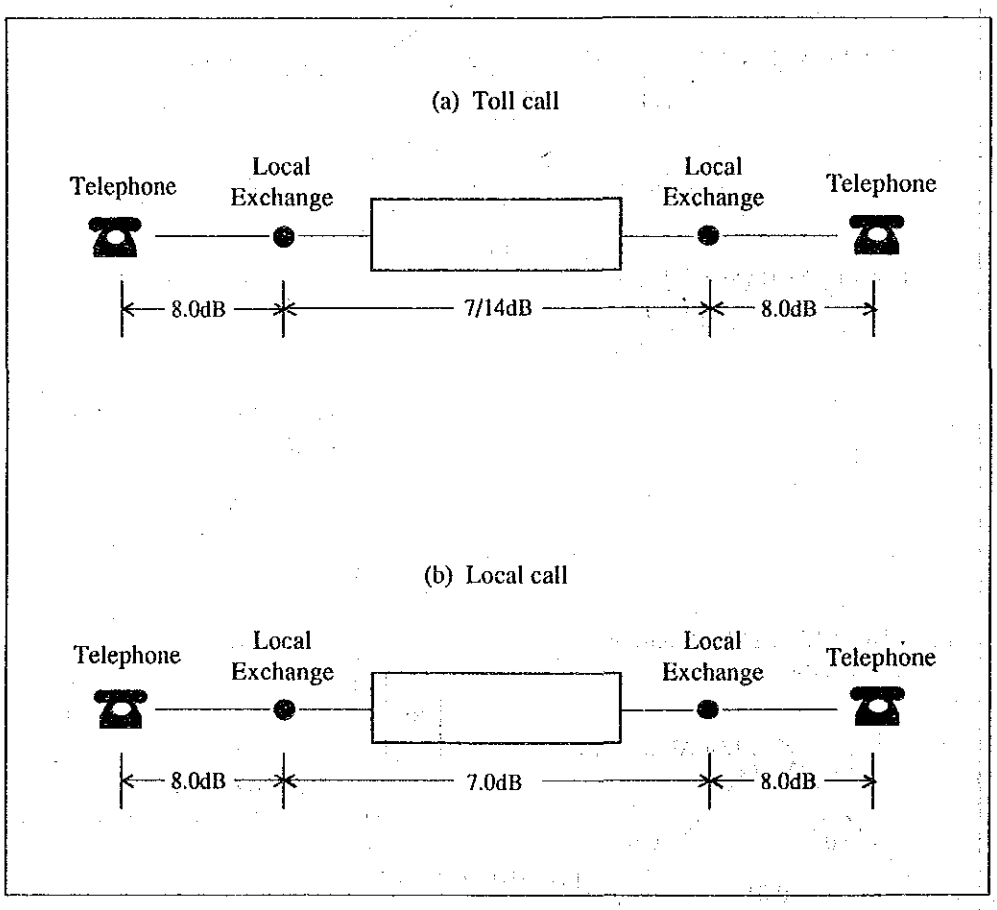
Figure 6.8.1-1 Connection Loss Probability



6.8.2 Transmission loss assignment

The transmission loss assignment now applied to the existing telecommunications network should be kept. The standard transmission loss is 23 dB for digital-to-digital connection and 30 dB for analog-to-analog connection. Figure 6.8.2-1 shows the present standard. However, it is not economical some times to provide all the rural subscribers with the present standard or 8 dB between the subscriber terminal and the telephone exchange. Hence, it is proposed that the same transmission loss as analog-to-analog connection presently effective or 30 dB be allowed for rural subscriber connection even if the rural subscriber is connected to a digital exchange.

Figure 6.8.2-1 Transmission Loss Standard



6.9 Network Synchronization Plan

6.9.1 Purpose of network synchronization

Synchronization in a digital network is a means to control the slip rate so that the quality of services can be maintained at an acceptable level. Popular network synchronization methods are as follows:

- Plesiochronous synchronization
- Master-subordinate synchronization
- Mutual synchronization

6.9.2 Network synchronization used in Honduras

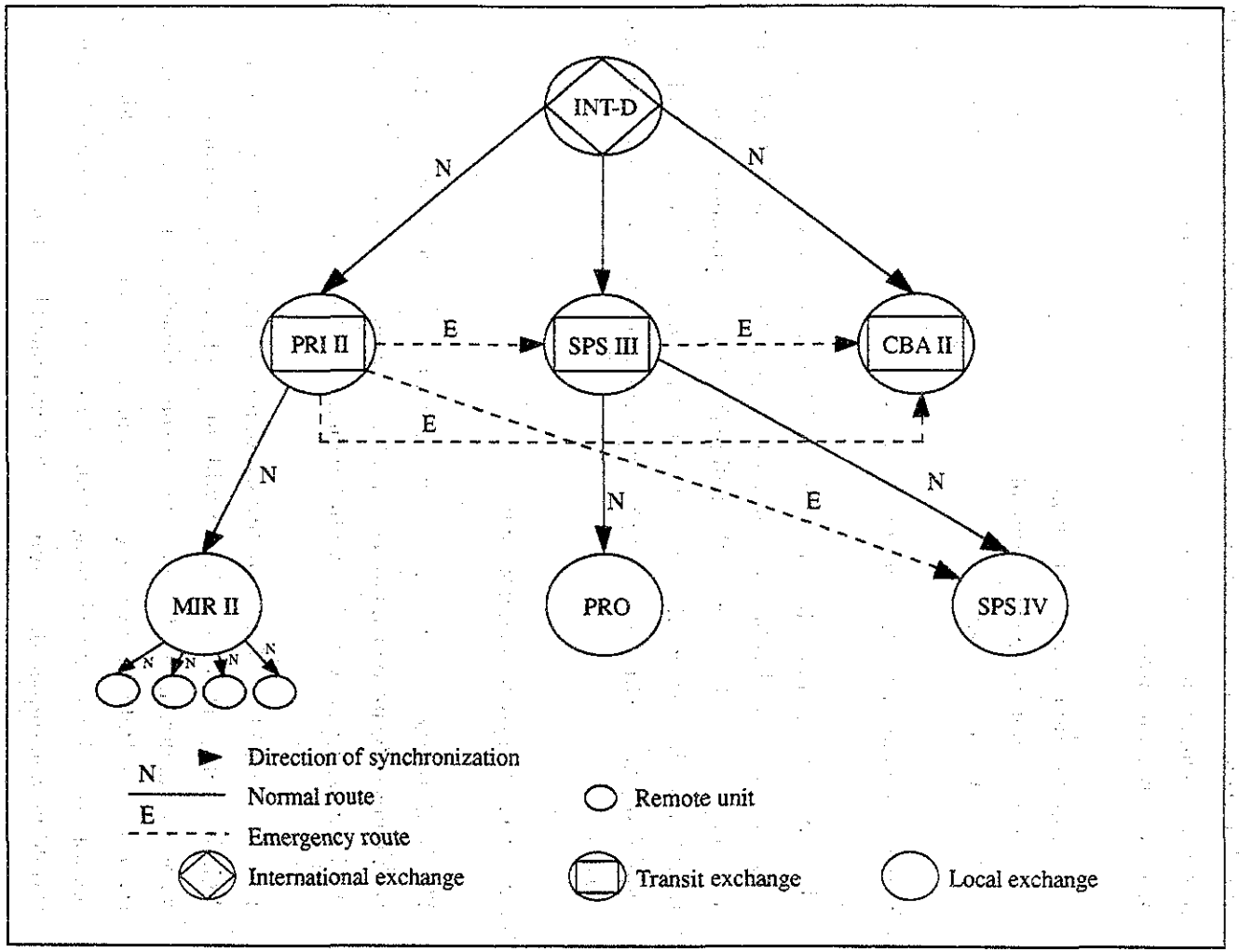
The synchronization method used in Honduras is master-subordinate synchronization. A cesium clock with frequency accuracy 10^{-11} is placed at the national center in Tegucigalpa to supply the clock pulses to the national telecommunications network. This clock accuracy is in conformity with the CCITT Recommendation G.822 to cover the requirements for slip rate. The existing synchronization diagram is shown in Figure 6.9.1-1.

6.9.3 New network synchronization plan

The base of the existing synchronization plan will be kept without change. The exchanges to be introduced in the rural telecommunications network will be distributed clock pulses from PC in the existing national telecommunications network.

The main objective of the synchronization is to maintain the slip rate in a worldwide digital connection in accordance with the CCITT Recommendation G.822. In the recommendation, the end-to-end slip rate performance required for the Standard Digital Hypothetical Reference Connection is stated. The slip rates are allocated to different sections of an international connection. The slip rate objectives for domestic connection should be determined in reference to that slip rate allocation.

Figure 6.9.1-1 Existing Synchronization Diagram



Presented by HONDUTEL

HONDUTEL has already adopted, in conformity with the Recommendation, a cesium clock with frequency accuracy 10^{-11}. This clock is the master of the domestic network and the clock pulses are distributed to all the digital exchanges in a master-subordinate hierarchy. To maintain the clock frequency stability of the subordinate exchange, it is recommended that a clock with frequency stability of 10^{-10} be used for the SCs, PCs, and exchanges with short-cut circuits, and one at 10^{-6} be used for the others including the remote unit.

HONDUTEL has already taken into account measures for coping with possible faults because of the importance of the synchronization clock pulse. The digital master clock is equipped to INT-D with a spare. Emergency clock paths are provided in consideration of confusion which may be brought about in the digital network by a possible power failure, fire, flood, trouble in circuits, or clock path disconnection.

CHAPTER 7 RURAL TELECOMMUNICATIONS NETWORK PLAN

CHAPTER 7 RURAL TELECOMMUNICATIONS NETWORK PLAN

7.1 Basic Policy of Plan Making

7.1.1 Base of design

The rural telecommunications network was designed based on the principles of HONDUTEL, which intended to establish a network mainly by means of digital radio technology taking into consideration the factor for facilities maintenance and for keeping the service level at a certain reasonable level.

In designing the rural telecommunications network in the Plan, the use of existing facilities and systems, compatibility with existing technology, facilities maintenance, and economy balance were also taken into consideration.

In order to guarantee reasonable operation and maintenance, the network was made as simply as possible, avoiding introduction of different technologies. This Plan was made on the condition that exchanges, transmission systems, and rural telecommunications systems to be introduced were all digital.

In addition to the above-mentioned points, the initial cost and the operating cost were to be kept as low as possible.

7.1.2 Target of rural telecommunications network plan

This Plan aims to provide 12,090 telephone lines, which was the result of the telephone demand forecast for the year 2002 performed on the subject communities, based on the information obtained by the field survey in Honduras. The telephone density will increase to 1.66 main lines per 100 inhabitants, when the 12,090 telephones are provided.

7.1.3 Services to offer

This Plan aims to offer the automatic subscriber dial telephone service in the subject areas. General individual telephone lines are counted. The public telephone service is assumed to be realized with operator assistance by means of the general telephone line. Adoption of coin telephones was dismissed, because the coin telephone is troublesome compared with the general telephone, and placed at a remote rural office. The facsimile and data transmission services can be realized by connecting the proper terminals to the

telephone line when necessary.

The local, toll, and international calls will be connected primarily by subscriber dialing. Operator assistance service can be available for the toll and international calls, when necessary, by means of special codes.

The grade of service was designed to be equivalent to that of the existing telecommunications network. The possibility is open that when the ISDN services are introduced in the urban area, they can also be introduced to the rural telecommunications network since it was designed with digital exchanges and digital transmission systems.

7.1.4 Term of the Plan

This Plan aims to design the facilities of a telecommunications network that will satisfy telephone demand in the year 2002.

7.1.5 Consideration for present facilities

1) Land and facilities

For planning an economical rural telecommunications network, land and facilities owned by HONDUTEL were used as much as possible. They were land, access roads, towers, and buildings as the basic facilities, as well as exchanges, cable and radio transmission systems as the telecommunications facilities. The main points applied in establishing this Plan were as follows:—

Land is the space necessary for constructing towers and buildings, and for placing containers. The equipment should be installed in existing buildings in order to avoid new acquisitions of land and buildings. Containers should be placed on the land possessed by HONDUTEL. In most cases in the rural communities, land must be newly acquired.

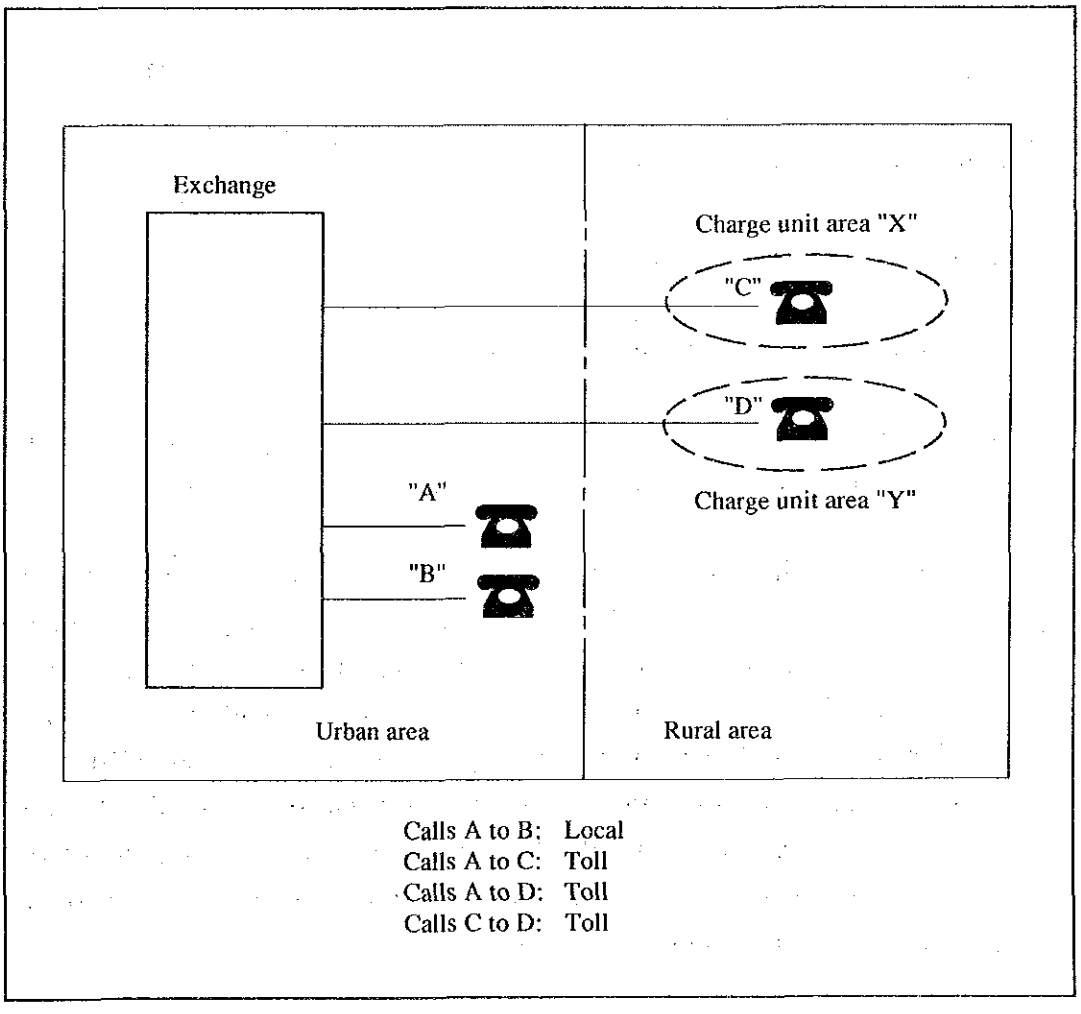
Towers are used for installing transmitting and receiving antennas of radio systems. Existing towers should be used for that purpose as much as possible. In rural communities there are no existing towers, so new ones will have to be installed. The access road is the way to get to the radio station. A new one should be made when a station is allocated in this Plan.

The use of existing exchanges should be determined taking into consideration the equipment , available physical capacity, and geographic conditions of the relevant rural community.

Both analog and digital exchanges are now in use in Honduras. The analog system is available if there are enough free terminals to connect the subscribers in the rural community, and the calls from the subscribers do not present charging problems, that is, the calls can be dealt with as local calls.

Figure 7.1.5-1 shows an example where subscribers from different charge unit areas are connected to one exchange. In this case the detailed billing function is indispensable. Exchanges that already have this function are available if they have enough free terminals.

Figure 7.1.5-1 Attendance of Subscribers in Different Charge Unit Areas



The use of existing exchanges is determined taking in consideration the above conditions. Table 7.1.5-1 shows the relationships. In conclusion, a digital exchange will be introduced by this Plan if there are no free terminals nor exchange installation plans in HONDUTEL.

Table 7.1.5-1 Choice of Existing Exchanges

Free terminal	Expansion plan	Exchange type	Possiblity of application of exchanges		Necessity of expansion or introduction of new exchange
			Subscribers in the city	Subscribers out the city	
Yes	- -	Analog Digital	Yes Yes	No Yes	No No
No	Yes	Analog Digital	Yes Yes	No Yes	Yes, Other projects Yes, Other projects
	No	-	-	-	Yes, This Plan

The existing cable and radio transmission systems facilities should be used, if available, to provide transmission links in the rural telecommunications network.

Both the analog and digital systems are now in use in HONDUTEL. Of these, only the digital links should be used. The rural telecommunications systems to be introduced by this Plan have been defined as digital.

2) Connection to the new rural telecommunications network

The Study proceeded based on the principles stated below.

The existing urban telecommunications network will connect subscribers in the new rural telecommunications network or accept their converged traffic.

The mode connecting subscribers in the new rural telecommunications network can be divided into two categories: 1) direct connection to an exchange in the urban area by metallic cable, 2) connection to an exchange in the urban area via a rural exchange or any rural telecommunications system, such as a digital multi-access system, a digital subscriber carrier system, etc. In either case, it is proposed that HONDUTEL provide the exchanges in urban areas with enough terminals to connect the forecasted number of rural subscriber terminals. If it is necessary to connect rural subscribers, thicker cables than those used presently should be used, since it is more economical than cable and/or radio transmission system.

The new exchanges to be introduced in the rural telecommunications network, which will connect and converge the traffic of rural subscribers not connected to the urban exchanges, should be connected to the digital exchange in the urban area. The signaling system applied between them is the R2(D) system.

In this Plan, the exchanges to be introduced in the rural telecommunications network are defined to be the independent and portable type so that HONDUTEL can be flexible in transferring and/or replacing them in proportion to increase demand in the future. Then the links between the exchanges are essentially R2(D). However, the connection between them may be realized the manufacturer's own way, if the network is consists of a host and remote unit.

However, the possibility of introducing a remote unit of the urban network exchange may be proper in some cases. Application of the remote unit brings about some disadvantages: 1) the capacity expansion of the remote unit is subject to the software and hardware conditions of the host exchange, because the host and the remote unit are always of one technology; 2) accordingly, the remote unit cannot be connected to an exchange of differenct technolgy. As a result, the dependency to the manufacture is very high.

3) Expansion of existing equipment

The Plan was made up on the assumption that an adequate expansion of exchanges in the existing telecommunications network would be realized by projects other than this, if it will be necessary to establish this new rural telecommunications network.

For expansion of the transmission systems in the existing telecommunications network, the Study was made for providing the equipment by this Plan, in case HONDUTEL did not have adequate expansion plans. Provision of transmission systems to link the exchanges in the rural telecommunications network to those in the existing national telecommunications network was included in this Plan. Existing systems and those listed in HONDUTEL's project were assumed to exist and applied in this Plan. Expansion of analog transmission system was out of the Study because the rural exchanges were defined as digital.

4) Cooperation with expansion plans

This Plan was made up in conjunction with and assumption of the expansion plans of HONDUTEL, which aims to bring the installed capacity to 241,000 in the three major cities and 62,200 in other important cities. The details are presented in the Appendix.

It is proposed that expansion of adequate capacity should be taken into account to accept the traffic to/from the rural telecommunications network. Modification may be necessary of the present expansion plans.

The exchanges in the urban telecommunications network which are used to connect rural subscribers should be expanded to have enough traffic capacity and terminals. The same should be applied to those introduced in the future. Traffic capacity and inter-exchange trunk circuits should also be taken into consideration if the exchange is to have links with the rural exchanges.

Introduction of some exchanges in the rural areas was decided on in order to converge telephone traffic in these areas. The transmission system capacity between the new rural exchanges and those in the existing national telecommunications network was decided on in accordance with the technical standards of HONDUTEL and forecast traffic volume.

HONDUTEL should provide the existing national telecommunications network with an adequate number of subscriber terminals, inter-exchange circuits, and traffic capacity to connect rural subscribers in relation to the new rural telecommunications network. The number of subscriber terminals to be provided should be determined in conjunction with the forecast demand of each exchange as shown in Table 7.2.4-1. The number of inter-exchange circuits to be provided is shown in Table 8.2.2-2. The traffic capacity to be provided should be calculated using the total number of subscriber lines and inter-exchange circuits of the exchange.

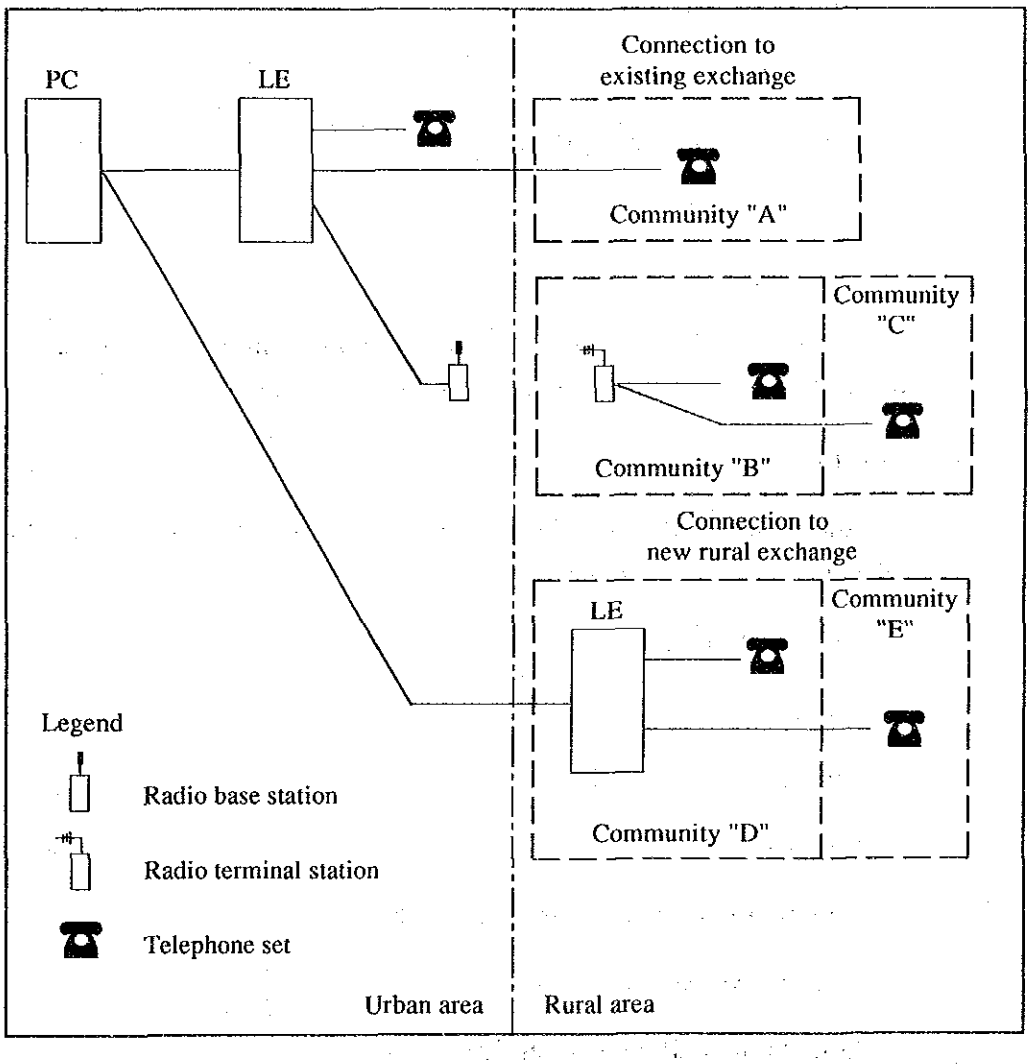
7.1.6 Facilities for the rural telecommunications network

1) Exchange

Switching equipment for the rural telecommunications network was defined to offer the services equal to the existing telecommunications network.

The rural subscribers will be connected to the exchanges in the following ways. The first case is where the rural subscribers are connected to the exchange, existing or planned, in the existing national telecommunications network. The second one is where the rural subscribers are connected to the exchange to be newly introduced for this rural telecommunications network. Figure 7.1.6-1 shows these modes of incorporation. The switching system or exchange was defined based on the policies stated below.

Figure 7.1.6-1 Incorporation Modes of the Rural Communities



a) Connection to the exchange in the existing telecommunications network

In this case, the specification of the exchange in the existing telecommunications network will be maintained. However, if not equipped with a detailed billing function, the exchange will not be used for this Plan, so as to avoid charging problems. The detailed charging system is necessary in the case shown in Figure 7.1.5-1.

b) Connection to the new rural exchange

Exchanges will be introduced in some communities if it is beneficial after an economic comparison. In this case the exchange should be defined as follows:

- **Basic services**

In this Plan, the exchange will be chosen to offer automatic telephone service in the rural telecommunications network. The exchange should have the following functions.

- Automatic local cal
- Automatic toll call
- Automatic international cal
- Special number call
- Operator call

These basic services include malicious-call trace, interception of calls, absent-subscriber service, call barring, and line monitoring.

- **Additional services**

Additional services are as follows. These services are now available in the urban telecommunications network.

- Abbreviated dialin
- Call diversion
- Conference call service
- Call waiting
- Completion of call to busy subscribers
- Hot-line call service
- Originating call control service

- **Hardware and software of exchange**

In consideration of flexibility of replacement or transfer which may be caused by increased demand in the future, the exchanges to be introduced in the rural telecommunications network in the future should be the digital, independent, and portable (or container) type.

Expansion of existing exchanges depends on the manufacture. This can not be realized by the user. HONDUTEL usually replaces exchanges with one of larger capacity in order to cope with increased demand. This is reasonable, especially for the small exchanges popular in Honduras. The policy of introducing the independent and portable exchange in this Plan is in line with this practice.

The exchange to be introduced in this Plan shall be digital and have the following hardware and software conditions. The terminal capacity of the exchange should be designed to have adequate redundancy to guarantee smooth system operation and to keep the service quality at a certain level. It will do this by providing reserved terminals for operation and maintenance, and for temporary and unexpected demand peaks due to accidents, social events, and local projects. Adequate redundancy must be designed into the basic hardware depending on the traffic volume, number of calls and the local data base.

- Enough capacity to meet the forecast demand
- Stored program control system
- Load control function
- Detailed billing functio
- Number storage function to meet ISDN requirements
- MFC-R2(D), MFC-R2(A) signaling system

2) Inter-exchange transmission systems

The inter-exchange transmission system to be introduced in this Plan should be a digital system for consistency with the digital exchanges. The transmission system between exchanges can be generally provided by cable transmission technology or by radio transmission technology. Either one of those technologies will be adopted after considering the economy, topographical condition and maintainability.

a) Subject of system examination

For cable transmission technology, an optical fiber system is one of those widely adopted by many operating companies in the world. At the same time, the digital microwave transmission is the technology used in many operating companies in

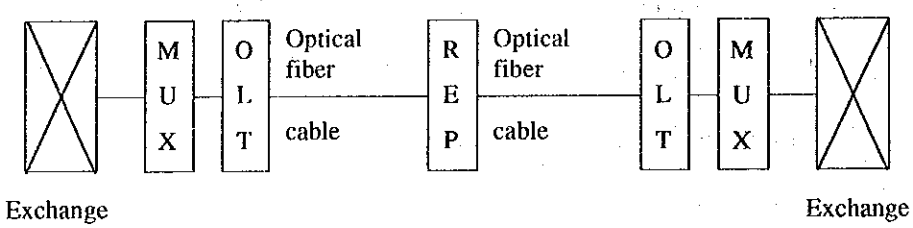
establishing radio links for this purpose. An examination was made on those two technologies.

- Optical fiber transmission system
- Digital microwave transmission system

b) System configuration

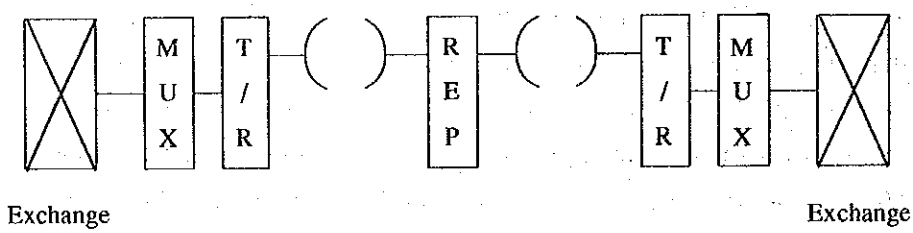
Typical system configurations of those two systems are shown in Figure 7.1.6-2 and Figure 7.1.6-3.

Figure 7.1.6-2 Schematic Diagram of Optical Fiber Transmission System



MUX: Multiplexer
OLT: Optical line terminal
REP: Repeater

Figure 7.1.6-3 Schematic Diagram of Digital Microwave Transmission System



MUX: Multiplexer
T/R: Radio equipment
REP: Repeater

c) Examination of the economic considerations

The examination on the economic considerations was made, focussing on the following points.

- Transmission capacity

  Transmission capacity should correspond to the number of inter-exchange trunk lines. The same capacity should apply to the optical fiber and the digital microwave transmission systems.

- Basic facilities

  The optical fiber transmission system should include the sites and office buildings.

  The digital microwave transmission system should include the towers but not include the sites, office buildings and access roads.

- Power supply equipment

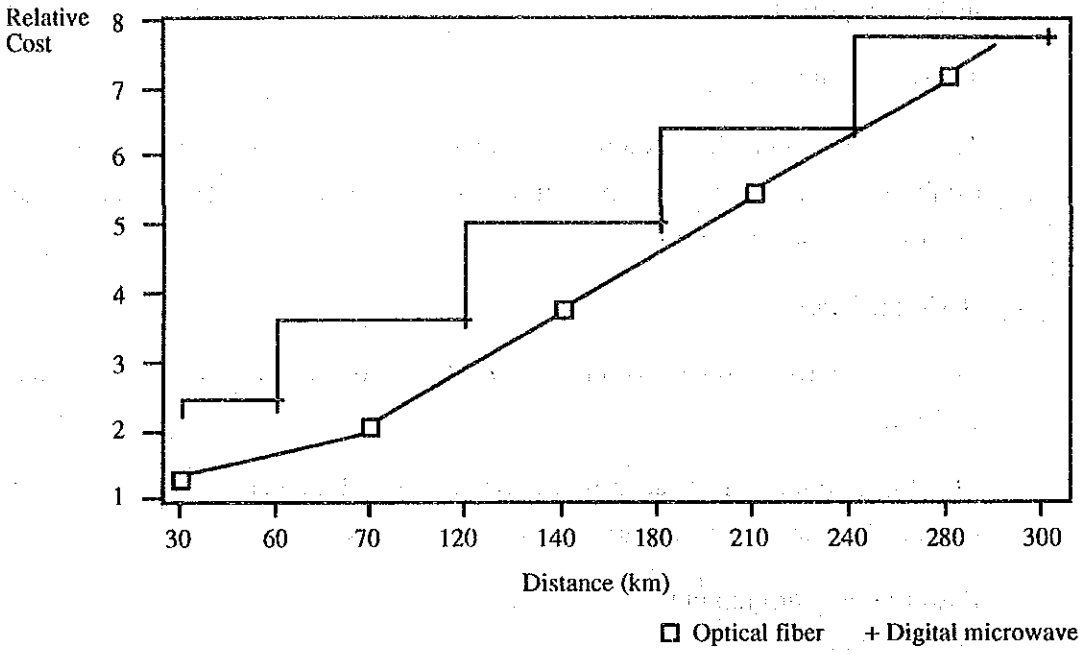
  Since optical fiber transmission cables will be laid along the main roads, commercial power supply can be easily obtained. Therefore only the rectifiers and batteries should be provided for the power supply equipment.

  In the digital microwave transmission system, commercial power supply can be easily obtained for the terminal stations in the cities but not for the repeater stations on the mountain. The terminal stations should be provided with rectifiers and batteries. The repeater stations should be provided with diesel generators in addition to equipment for the terminal stations.

  Figure 7.1.6-4 shows the result of the cost comparison made on the optical fiber and the digital microwave transmission systems under the above mentioned conditions.

  The comparison result indicates that the optical fiber transmission system is more advantageous economically than the digital microwave transmission system.

Figure 7.1.6-4 Cost Comparison between Optical Fiber Transmission System and Digital Microwave Transmission System



d) Examination under other conditions

Table 7.1.6-1 outlines the result of examination made under the other conditions.

Table 7.1.6-1 Comparison of Inter-exchange Transmission Systems

	Optical fiber transmission system	Digital microwave transmission system
Topographical condition	(1) Laying the cable along the roads makes it unnecessary to construct access roads for the construction and maintenance of repeater stations, reducing the construction cost. (2) Consequently, joint use of power poles of ENEE, the public corporation for power supply in Honduras can be expected, further reducing the construction cost.	(1) New construction of repeater stations on the mountains is expected, necessitating the construction of access roads for construction and maintenance work. This is expected to drastically raise the construction cost. (2) Since it is difficult to obtain commercial power for the repeater stations on the mountains, power supply equipment must be specially considered, contributing to the higher construction cost.
Maintainability	(1) To construct the repeater station between the principal rural communities and the capital of the Municipality, the cables are expected to be laid along the principal roads in order to make the maintenance easy. (2) Standard repeater station intervals are approximately 70 km. This reduces the number of repeater stations and makes the maintenance operation comparatively easy. (3) Optical cable connection and other special techniques are needed for the maintenance operation.	(1) It takes time for the staff to reach a repeater station on the mountain. (2) Recovery from a fault may be prolonged if the power supply equipment should fail at a repeater station not serviced from the commercial power supply. (3) Conventional maintenance method for the digital microwave transmission system will be sufficient for maintenance.
Expandability in the future	Transmission capacity can be increased by replacing or by adding MUX and OLT.	When the transmission capacity for the pertinent frequency bandwidth is exceeded, the equipment for other frequency bandwidth must be arranged.
Conclusion	When compared with the digital microwave transmission system, this system is judged to be more advantageous.	When compared with the optical fiber transmission system, this system is not judged more advantageous.

e) Result of the examination of the inter-exchange transmission systems

On the basis of the result of examinations c) and d) above, the optical fiber transmission system should be adopted for the inter-exchange transmission system.

3) Subscriber line extension system

The subscriber line extension technology is used for a section where the ordinary metallic cable system cannot be applied because of distance conditions. The technology to be introduced under this Plan was selected after considering the economy, topographic condition, maintainability and future expandability. The metallic cable system should be used in as many cases as possible if the engineering standards are satisfied. The limit of applicable distance of the metallic cable system is stated in a later paragraph on the subscriber line facilities.

a) Subject of system examination

i) Digital Multi-Access System (hereinafter referred to as DMAS)

- Connects multiple service areas in scattered locations with the central base station via a radio system.
- Allocates each service area with an independent set of frequencies for sending and receiving.
- Concentrates lines by dividing a radio channel into several tens of time slots.
- Supervises and controls the system with the on-line terminal devices installed at the base station.
- Enables about 10 hops of repeating.
- Uses the frequency bandwidth of 400 to 2500 MHz.

ii) Digital Subscriber Cable System (hereinafter referred to as DSCS)

- Connects multiple service areas in scattered locations with the exchange via optical fiber cable transmission system.
- Accommodates a total of about 120 channels.
- Has a transit transmission distance of about 45km (can be extended to about 70km by using additional devices.)

- Supervises and controls the system with the on-line terminal device installed at the central base station.
- Uses a single mode optical fiber cable with a wavelength of 1.31 micro-meters, for example.

iii) Single Channel System

- Accommodates remote single subscribers with the radio system.
- Uses frequency bandwidth of 60 to 800 MHz.
- Uses principally an analog modulation system.

iv) Satellite System

- Applies to international channels in case topographic difficulties are foreseen when using a conventional radio and/or cable system.
- Small capacity and low cost system is under development.
- Systems on the earth necesitate large power consumption.
- Transponder is costly.
- Has a short life of about 10 years.

The single channel radio system is used as a means of communication with isolated communities having small demand for communication. This system has capacity for only one speech channel in one direction. This system is not suitable for covering the average number of demand of 55 per community found by the present survey judging from the problems of frequency allocation, counter-interference measure, and network expandability after installation. Consequently, this system is not subject to examination for this time.

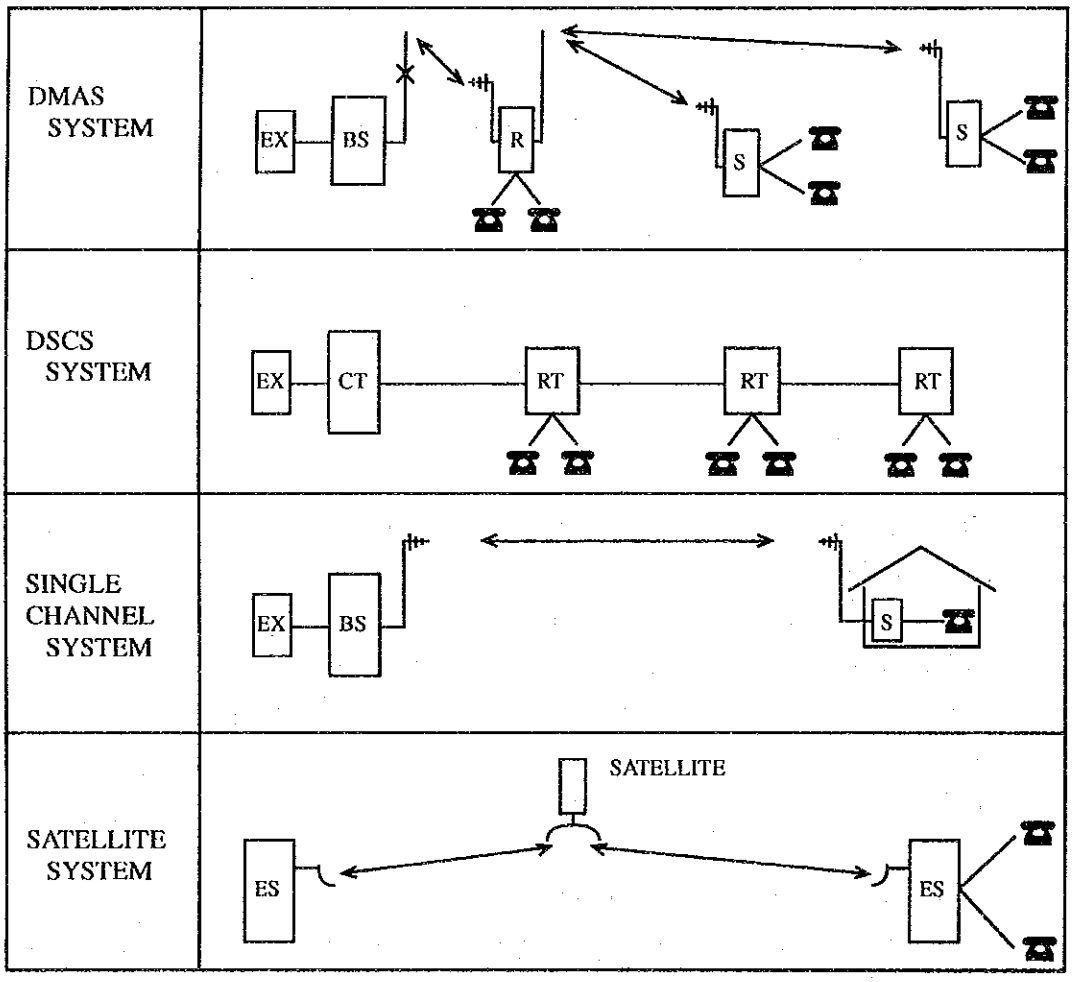
A satellite-based communication network, DOMSAT, has been operating in Honduras since 1990 and presently accommodates five (5) cities for public use as of the end of 1991. This system has no reserve satellite, and the launching of a reserve satellite or a new active satellite is not scheduled in the near future. Moreover, the life of present satellite is supposed to expire at the subject year of this Plan. This system has poor speech quality because of the delay time of 0.24 second per hop that is generated physically. Furthermore, the cost of this system is higher than that of DMAS. Consequently, this system was not included in the examination for this Plan.

Network construction may be considered by using INTELSAT and other satellites, but it was not considered here because of such economic reasons as transponder rental charges and the construction cost of an earth station, and of the degradation of speech quality because of the delay time.

b) System configuration

Figure 7.1.6-5 shows the outline of the rural telecommunications systems.

Figure 7.1.6-5 Rural Telecommunications Systems



EX: EXCHANGE
BS: BASE STATION UNIT
R: REPEATER UNIT
S: SUBSCRIBER UNIT
CT: CENTRAL TERMINAL
RT: REMOTE TERMINAL
MUX: MULTIPLEXER
ES: EARTH STATION

c) Examination on the basis of economy

From the above mentioned item a), the digital multi-access system and digital subscriber cable system should be examined as candidates for the subscriber cable extension system.

i) Examination conditions

– Transmission capacity

Since the transmission capacity for the digital subscriber cable system is 120 channels per system, the digital multi-access system was compared with the identical capacity.

– Basic equipment

The repeater stations for the digital subscriber cable system were included in the comparison. The digital multi-access system repeater stations to be newly constructed included the site, access road and towers. Where the existing repeater station is used, these items were not included.

– Power supply equipment

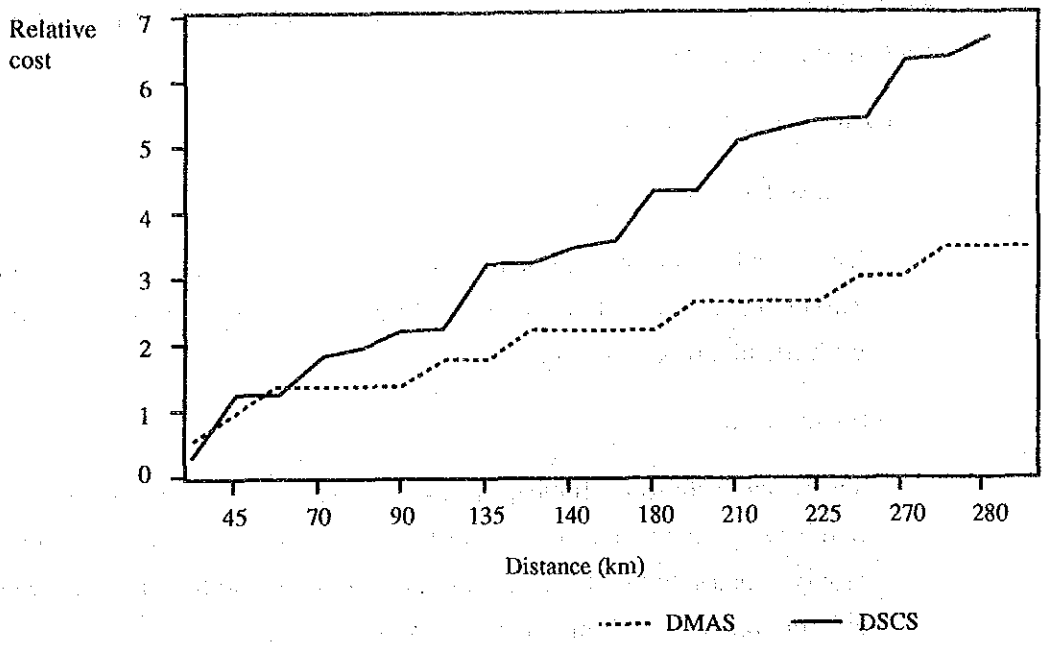
In the digital subscriber cable system, the commercial power supply is needed. Therefore, rectifiers and batteries were included in the comparison for the power supply equipment.

In the digital multi-access system, commercial power supply can be easily obtained for the radio base stations in the cities but not for the repeater stations on the mountains. Consequently a solar cell system and batteries should be provided for the latter.

ii) Result of the examination

Figure 7.1.6-6 shows the result of the cost comparison made on the digital subscriber cable system and digital multi-access system. The comparison result indicates that the digital multi-access system (DMAS) is more advantageous than the digital subscriber cable system (DSCS).

Figure 7.1.6-6 Cost Comparison between Digital Multi-Access System and Digital Subscriber Cable System



d) Examination under other conditions

Table 7.1.6-2 outlines the result of examination made under other conditions.

Table 7.1.6-2 Comparison of Subscriber Line Extension Systems

	Digital subscriber cable system	Digital multi-access system
Topographical condition	(1) If all the demand for telephone subscriber is covered by this system, a total of over 5,000 km of optical fiber cable will be required. Much difficulty is predicated for laying the optical fiber cable because it must go over the mountains and across the rivers. (2) Optical fiber cable is laid along the roads. However, the road condition is extremely bad in the mountain areas.	(1) This system is suitable for connecting the local communities scattered over a vast area. It is hardly affected by the road conditions. (2) Although a good line-of-sight is required between the repeater stations, an appropriate system can be constructed by building repeater stations at appropriate points. (3) Existing repeater stations can be utilized.
Maintainability	(1) Difficulties of maintenance operation are expected as the total length of optical fiber cable is great. (2) Cable laying route is affected by the topographical conditions, which may degrade the maintainability of optical fiber cable.	(1) As examined on the economy of construction work, building appropriate access roads enables the maintenance of repeater stations.
Future expandability	(1) Transmission capacity can be increased by replacing the equipments of the digital subscriber cable system with MUX and OLT equipments.	(1) Although dependent on the accommodation capacity of the radio base station, the number of subscribers can be increased easily by installing an end office with the permitted capacity.
Result of examination	Compared with the digital multi-access system, this system is less advantageous as the subscriber line extension system.	Compared with the digital subscriber cable system, this system can be judged more advantageous as the subscriber line extension system.

e) Result of the examination of the subscriber line extension systems

On the basis of the results of examination c) and d) above, the digital multi-access system should be adopted for the subscriber line extension system.

4) Combination of applicable technologies

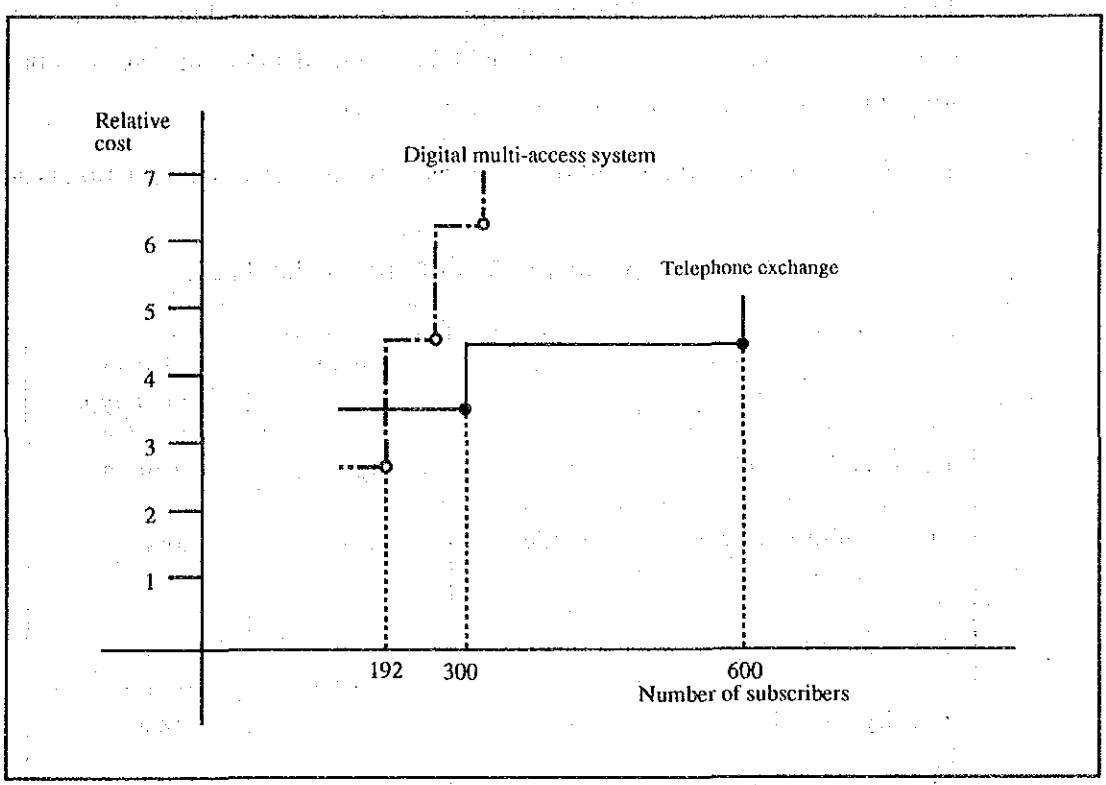
Another way for accommodating rural subscribers to the national telecommunications network, involves installing an exchange in the service area, in place of providing subscriber line extension systems, DMAS for example, which was discussed previously.

Thus as described so for, it is apparent that DMAS is advantageous among the subscriber line extension systems. However, applicable frequencies are limited in DMAS and this in turn limits the margin for the future expansion of the system. Consequently, it is better to introduce a telephone exchange in an area with telephone demand higher than a certain level.

Therefore, it is necessary to compare the cost of DMAS and the telephone exchange construction in relation to the number of subscribers concerned, to obtain the cost demarcation point.

Figure 7.1.6-7 shows the result of these comparisons. The cost of the respective systems is based on a model calculation. The inter-exchange transmission distance is calculated as being less than 50km by considering the topographic and actual conditions of the telecommunications network configuration in Honduras. According to this figure, the demarcation point is set at a demand of about 200 subscribers. It indicates that the construction of a telephone exchange is more advantageous if the total number of subscribers exceeds about 200.

Figure 7.1.6-7 Cost Comparison between Digital Multi-Access System and Telephone Exchange



5) Outside plant

Basic policies for outside plants are as follows:

- Taking into account rural area conditions, outside plants must be highly fault resistant.
- Priority is placed upon ease of maintenance.
- Low cost.

a) Facilities of inter-exchange circuits

i) Examination of cable

The optical fiber transmission system was found to be advantageous in the preceding comparison of inter-exchange transmission. Since non-gas single mode type cables are widely used in establishing the inter-exchange circuits, they are chosen in this Plan. The cables will be laid overhead by means of poles.

ii) Examination of line type

There are three types in cable construction: burial type, conduit type, and aerial type. The type to be selected should be decided after making a general judgement on the topographic and economic factor.

Table 7.1.6-3 shows the result of comparison of respective construction types.

Table 7.1.6-3 Comparison of Cable Construction Types

Items \ Types	Aerial type	Conduit type	Direct buried type
Construction cost	low	high	medium
Degree of difficulty or ease of construction	excellent	poor	good
Maintainability	excellent	good	poor
Facility reliability	good	excellent	good
Total evaluation	excellent	poor	good

On the basis of the above result, an aerial cable type should be applied.

iii) Selection of route

- For the ease of repair of faults and checking operation, the cable route should be along the road. Such roads should be passable during the rainy season.
- Considering the economic and maintenance factors, the routing should be determined in the shortest possible distance.

iv) Examination of cable core number

The necessary cable core number should be the number of necessary system lines plus a spare core.

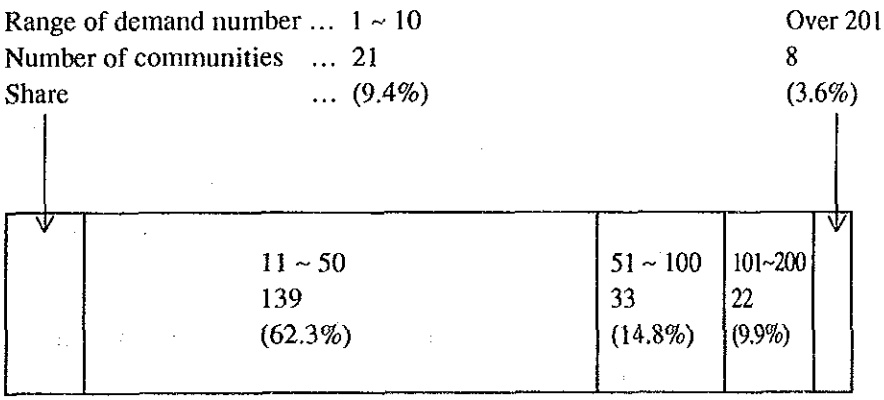
b) Subscriber line facilities

i) Demand distribution state

Subject communities surround an area of approximately 1km x 1km centering around the offices of the governmental institutions. Most of the telephone demand is expected to be in the central part of the communities.

Figure 7.1.6-8 shows the distribution of communities according to the demand.

Figure 7.1.6-8 State of Community Distribution According to the Demand Number

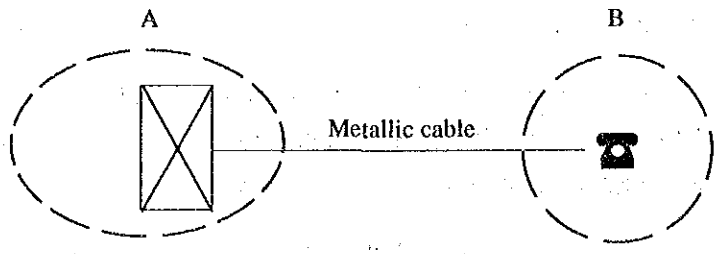


ii) Wiring types

Wiring types for the line equipment will be as follows:

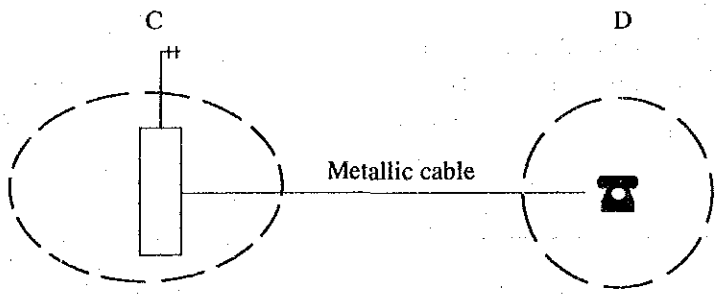
Type-I is the balanced cable pair to be laid from the new exchange to the existing ones. To accommodate subscribers, cables will be laid in a community having an exchange like Community A in the figure or in a community like Community B which is several kilometers away from A. In the case of the latter, the limit distance is 14km.

Figure 7.1.6-9 Wiring Type I (between a telephone exchange and subscribers)



Type-II is the same as Type-I except that the exchange is replaced with a radio multi-access terminal station.

Figure 7.1.6-10 Wiring Type II (between a radio terminal station and subscribers)



Type-III is a wiring type that starts and ends within a community.

Figure 7.1.6-11 Wiring Type III (between a telephone exchange or a DMAS terminal station and subscribers)

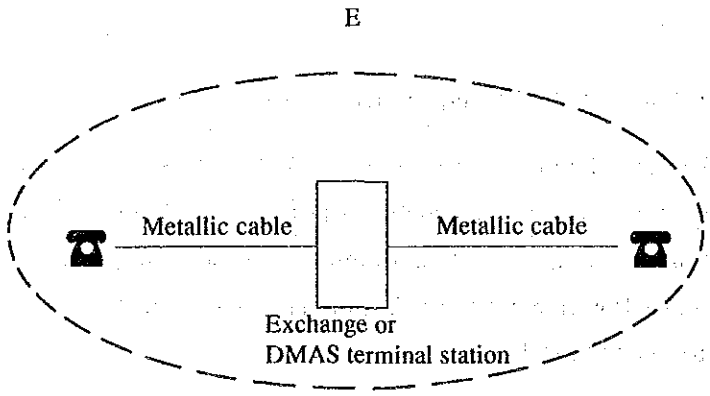


Table 7.1.6-4 indicates the number of communities to be connected using the above mentioned wiring Types I, II, and III out of a total 223 areas covered by the present survey.

Table 7.1.6-4 Number of Communities by Wiring Types

Type	Contents	Number of communities
I	Connection to the existing exchange office	13
	Connection to a newly established exchange office	14
II	Connection to a newly established radio terminal station	7
III	Wiring is limited to within a community only	189
Total		223

iii) Examination of line type

In consideration of the above mentioned demand and its distribution, applicable line types were examined. Table 7.1.6-5 shows the result of the examination.

Table 7.1.6-5 Comparison of Line Types

Items \ Type	Aerial type	Underground type
Construction cost	low	high
Degree of difficulty or ease of construction	excellent	good
Maintainability	excellent	good
Facility reliability	good	excellent
Flexibility to demand fluctuation	excellent	good
Total evaluation	excellent	good

According to the above mentioned comparison result, the aerial line facilities using the cable should be optimal in the present project.

iv) Examination of cable

Color corded polyethelene (CCP) cables are widely used for local telecommunications network to reach subscriber terminals and thus the CCP cable should be chosen in this Plan. In areas with higher possibility of lighting damage, aluminium polyethelene sheathed (ALPES) cables are preferred. Where countermeasures for fire from the burning of dead grass on the hills is required, the use of flame-resistant cable should be considered.

An optimal cable conductor diameter that meets with the allowed transmission loss value to be allocated to the local line should be selected. In the present rural telecommunications network, a maximum transmission loss of 11.5dB is allowed and the limit value for the line length should be as follows. Cable characteristics should meet the local (HONDUTEL) specifications.

Table 7.1.6-6 Limit Distance and Cable Conductor Diameter for 11.5 dB Loss

Cable conductor diameter (mm)	Limit distance (km)
0.4	6
0.5	7
0.65	9
0.9	14

v) Examination of aerial cable pair number

The aerial cable pair number was designed to have a certain allowable extension as stated in Chapter 8.

vi) Selection of routes

The same standard applies as for the inter- exchange circuit.

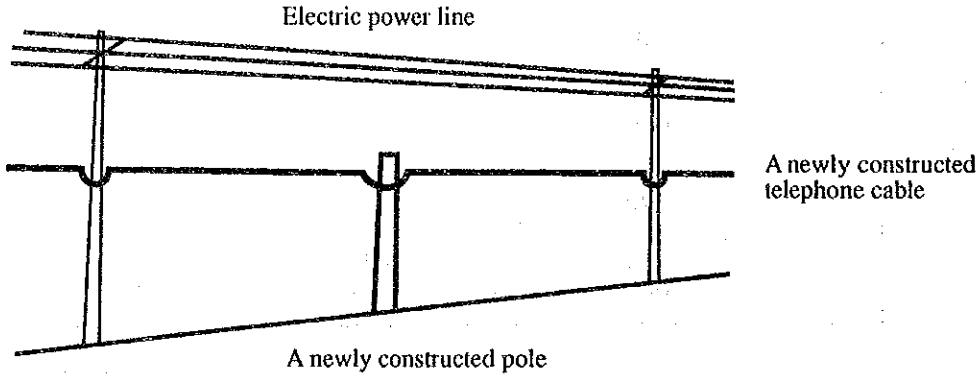
vii) Examination of line equipment

– Common laying of telephone cable to the power poles

In the rural telecommunications networks, aerial cable is used for connection with respective subscribers. This requires the construction of a number of telephone poles which is expensive.

As a result of the field survey, it was found that approximately 78% of the subject area is already distributed with electric power. It is estimated that the power distribution poles can be jointly used for about a half of the telephone poles required for the aerial cables. Figure 7.1.6-12 shows an example of joint use of a power pole for telephone cabling. The same is true with the inter-exchange cable line facilities.

Figure 7.1.6-12 Common Use of Electric Power Poles for Telephone Cables



Though the line equipment does use the power distribution poles, no agreement has been concluded yet between HONDUTEL and ENEE, the power company, for the use of the latter's poles for the laying of telephone lines, hence no charges have been determined. Since the joint use of power poles is expected to increase in the future, an early conclusion of the joint use agreement is recommended.

Table 7.1.6-7 indicates the required separation distance between electric power lines and telephone lines.

Table 7.1.6-7 Required Separation Distance between Electric Power Lines and Telephone Lines

(Unit: cm)

Electric power line / Tele-phone line	Voltage					
	AC600V or less		AC600 – 7000V		More than AC7000V	
	Cable	Insulated wire	Cable	Insulated wire	Cable	Insulated wire
Drop wire and Cable	30	75	50	150	50	–

– Prevention from fire and vagrancy damage

It is not possible to predict a specific section or area that may be affected by damage. This makes it difficult to implement damage prevention measures and raises the construction cost.

To minimize the effects of fire from the burning of dead grass on the hills or from theft, one solution would be to install the line with a higher ground clearance. The above matters apply to the inter-exchange facilities as well.

The following Table 7.1.6-8 indicates required ground clearance in Japan:

Table 7.1.6-8 Required Ground Clearance

Ground condition	Required ground clearance
Road	5.0 m or more
Side walk (where the road is divided for pedestrians and vehicle traffic)	2.5 m or more
Railroad crossing	6.0 m or more
Locations other than above	3.5 m or more

– Protection from lightning

Since this project is aimed at rural areas, there is a need for protection from lightning. To prevent the interference of surge current on the telephone sets caused by lightning, a protector should be installed between the subscriber's drop wire and his telephone set. This a protector should be connected to a ground rod with the ground wire.

– Prevention of interference by a radio broadcast transmitting station on the telephone line

It was found that a certain part of the surveyed area is being affected by interference from radio waves. There is a report that this interference can be reduced by 90% by replacing the telephone sets. However, where it is

possible to specify the area affected by interference, other necessary measures should be taken instead of replacing the telephone set.

6) Power equipment

The power equipment was designed based on the policies stated below.

a) Power equipment for an exchange

The power system for exchanges should run by commercial power. The power system consists of power receiving equipment, a generator, rectifier, and batteries. For exchanges used only for the rural network, the power equipment should have enough capacity for the power consumption. When transmission equipment is installed in addition to the exchange, power consumption of the transmission equipment should be included in the capacity in addition to that of the exchange. The battery capacity should be large enough to feed the power for eight hours in case of commercial power failure.

b) Power equipment for transmission

The power system consists of power receiving equipment, rectifier, and batteries. Normally, commercial power should be applied. A generator or a solar cell system will be applied in the case where the commercial power is not available. The solar cell system will be chosen when the power comsumption is not great, in other cases the generator will be applied.

7.1.7 Application to the rural telecommunications system

The technology to be applied should be determined by considering not only economic aspects such as initial investments and operating cost, but also the standardization of technologies, network structure security, flexibility of network evolution, and constraints on buildings.

It is better for operating companies to standardize the technological choice within the operating area, even though this may seem more expensive from a financial point of view. This standardization avoids the need for staff in an elementary area to have a multiplicity of skills, and permits the elimination of some of the problems which arise from the difficult and costly interfacing of some technologies.

A more expensive solution can be chosen provided the financial premium is not too great, if it gives less troublesome results for users when a part of the switching equipment or cable breaks down.

For a flexible of network evolution, it must be recognized that the present hypotheses on which the plans are based is time limited. This applies to traffic data, subscriber forecasting, technologies to be used and cost formula. Therefore, the network should be designed to be convenient for future modification.

In accordance with the previous Study results, the Plan was designed based on the policies stated below.

- The rural telecommunications network should be established using a digital multi-access system.
- Subscribers in a rural community should be connected by metallic pair cables if the community is located within a radius of 14 Km or less from an exchange and/or radio terminal station.
- An exchange should be introduced if the forecast demand is about 200 or more in the year 2002.
- The new rural exchange should be connected to the existing national telecommunications network by means of optical fiber cables.

7.2 Rural Telecommunications Network Plan

7.2.1 Principles of designing the network

This section discusses the formulation of the rural telecommunications network, based on the characteristics of each technology and economic aspects clarified in the previous sections.

The principles for designing the rural telecommunications network are defined as follows:

- The existing and/or planned facilities in the existing national telecommunications network should be used where possible.

- The rural telecommunications network should be designed in harmony with the expansion plans of HONDUTEL.

- The system should be free from foreseen problems, especially those on charging.

- The rural telecommunications network should be flexible to allow evolution in the future.

7.2.2 Preparation of alternative plans

In formulating the network plan, various plans, such as use of existing or new rural satellite telecommunications, installation of an exchange in each area, etc., were examined. This was done in relation to the geographic situation, size of areas, location of existing and new exchanges, disposition and technical level of maintenance personnel, provision of economical systems, etc. As a result, the following three plans can be considered possible alternative plans.

a) Plan 1

All the rural subscribers are connected to one of two exchanges; Tegucigalpa, the center of the southern part, and San Pedro Sula, the center of the northern part. This model is called the Centralized Type.

The exchanges to which rural subscribers are connected shall be those included in the expansion plan of the urban telecommunications network. The capacity of those exchanges shall be determined by considering the telephone demand in the rural areas in addition to that in the urban areas.

The two cities are situated at the geographical centers and the centers of the telecommunications network of the southern and northern parts of the country. The existing transmission routes spread over the country from both cities. This means that the existing infrastructure, such as transmission facilities and maintenance staff, can be utilized. However, the infrastructure conditions between the existing telecommunications facilities and rural subscribers are the same as those of other plans.

With this plan, some rural subscribers will be directly connected to those exchanges by metallic cables, but most of the rural subscribers will be connected by cable or

radio transmission systems. Therefore, some nodes will be required at appropriate locations to concentrate the rural traffic. A multiplexer and an exchange of adequate size which concentrate the traffic, can be used as a node depending on the case. The most suitable system will be chosen in accordance with the size of the coverage area and the volume of traffic intensity.

b) Plan 2

All rural subscribers are connected to the nearest exchange. This model is called the Dispersion Type.

Automatic exchanges are located in thirty cities and towns in the country, and almost all Department capitals have the leading exchange for their Departments. Some of these exchanges have expansion plans. Rural subscribers are, in principal, connected to those exchanges. However, the areas bordering El Salvador: Lempira, Intibucá and La Paz Departments, have neither adequate existing exchanges nor installation plans. Rural subscribers in those areas will be connected to the Santa Rosa de Copán or Comayagua exchanges.

The capacity of exchanges to be expanded or newly installed should be determined considering not only the telephone demand in the urban areas but also that in the rural areas. Since there are not adequate existing exchanges in the border areas mentioned above, nodes will be allocated in accordance with the traffic flow in the area.

With this plan, some rural subscribers are directly connected to the nearest exchange by metallic cables and others are connected by cable or radio transmission systems.

c) Plan 3

Rural subscribers are, in principle, connected to the digital exchanges in the cities where the primary center is located. If a digital exchange is located at a nearer place than those exchanges, the rural subscribers are connected to it. This plan is called the Mixed Type.

The exchanges to which the rural subscribers are connected by this plan are located in Tegucigalpa, Choluteca, Comayagua, San Pedro Sula, and La Ceiba. Since there is no adequate exchange in the western part of the country, Santa Rosa de Copán has been chosen to accommodate the rural subscribers in that area.

Furthermore, considering the geographic conditions and expansion plans, six additional exchanges have been chosen: Catacamas, Danlí, Juticalpa, Nacaome, Villanueva, and Zamorano.

With this plan, some rural subscribers will be directly connected to those exchanges or traffic nodes by metallic cables and others will be connected by cable or radio transmission systems. Therefore, a multiplexer or a small exchange will be placed at appropriate locations according to the traffic flow of the area.

2) The evaluation method of the alternative plans

The rural telecommunications network structure is determined by choosing the most suitable plan based on the principles described in the previous sections. The plans will be evaluated taking into account technical feasibility, cost and flexibility in the future.

The evaluation of the exchanges, or switching systems, will be made in accordance with the following aspects and the summary of the several conditions described before.

- Preservation of uniformity in charging.

  To accomplish this, the rural subscribers should be connected to a digital exchange. An analog exchange will be used only when the subscriber can be regarded as a local area subscriber.

  An existing exchange and a newly installed exchange will accommodate rural subscribers within the conditions mentioned above.

  In case there is no existing exchange and installation plan, the installation of a new exchange for the rural telecommunications network will be planned.

- The limiting of the effect of a fault to an allowable level.

- The securing of flexibility for the increase of demand in the future.

The evaluation of the transmission system to concentrate rural subscribers will be made in the following way, in addition to the above mentioned conditions.

- The radio transmission system and multi-access system of digital technology should be used.

- The cable system is chosen if it is much cheaper than the radio system and reliable taking consideration the geographical conditions.
- A cable pair system is adopted if it is technically and financially feasible .
- The system to be chosen must be flexible for demand increases in the future.
- Accidents, such as fire and theft, must be fully considered.

7.2.3 Comparison of the plans

1) Plan 1

Advantage:

- Charging problems will not occur.

Disadvantages:

- Many rural communities are connected to one exchange, so a problem in one exchange will be spread over a wide area.
- It will be difficult to connect all rural communities to two exchanges when the number of rural communities is increased in the future.
- Links connecting rural subscribers are extremely long in comparison with the other plans.

2) Plan 2

Advantages:

- Links connecting rural subscribers are the shortest of the three plans.
- Problems at one exchange will have the least effect of the three plans.
- Compatibility is not a problem when the number of rural communities increases in the future.

Disadvantage:

- Analog exchanges have no detailed billing functions.

3) Plan 3

Advantages:

- Charging problems will not occur.
- Problems in one exchange will not have much effect elsewhere.
- Compatibility is assured when the number of rural communities increases in the future.

Disadvantage:

- Links connecting subscribers are longer than in Plan 2.

Comparing these three plans, Plan 3 is generally the best for building the rural telecommunications network because the lack of charging problems is very important.

7.2.4 Basic network structure

1) Conditions for designing the network

The basic network structure is in line with the existing network structure. However, the exchange to be introduced in the PC areas of Choluteca and Comayagua were designed to have direct links with the PC in Tegucigalpa, since digital exchanges are not provided in those areas. It is proposed that the routing plan in those areas be changed in order to make it more economical when introducing a digital exchange.

2) Exchange location and rural community connection plan

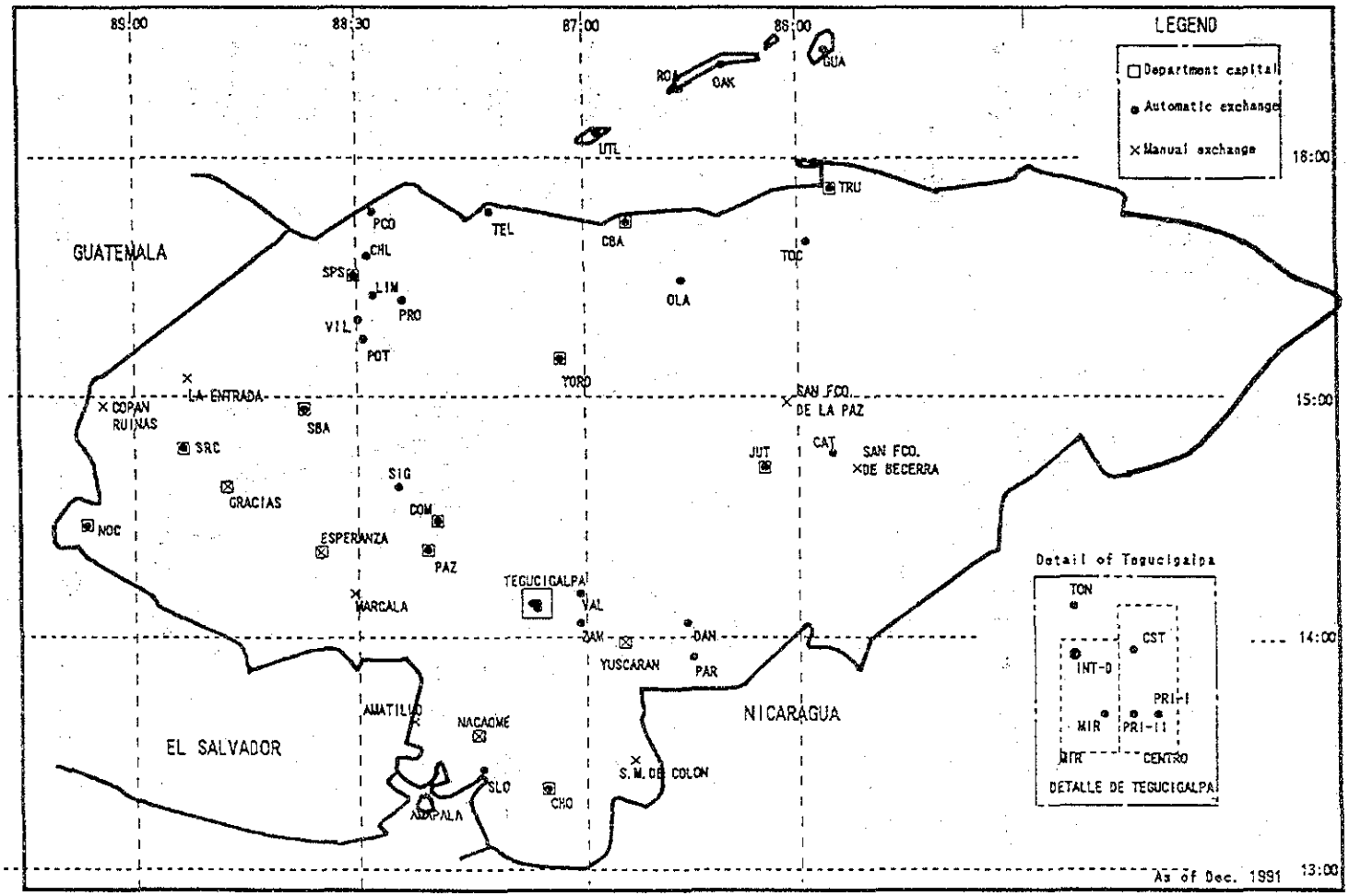
- New exchange location

  The new rural exchanges are planned to be introduced in accordance with the principles stated in the application of technology and the results of comparing the three plans. Figure 7.2.4-1 shows a location plan for the new rural exchanges.

- Constitution plan for the rural telecommunications network

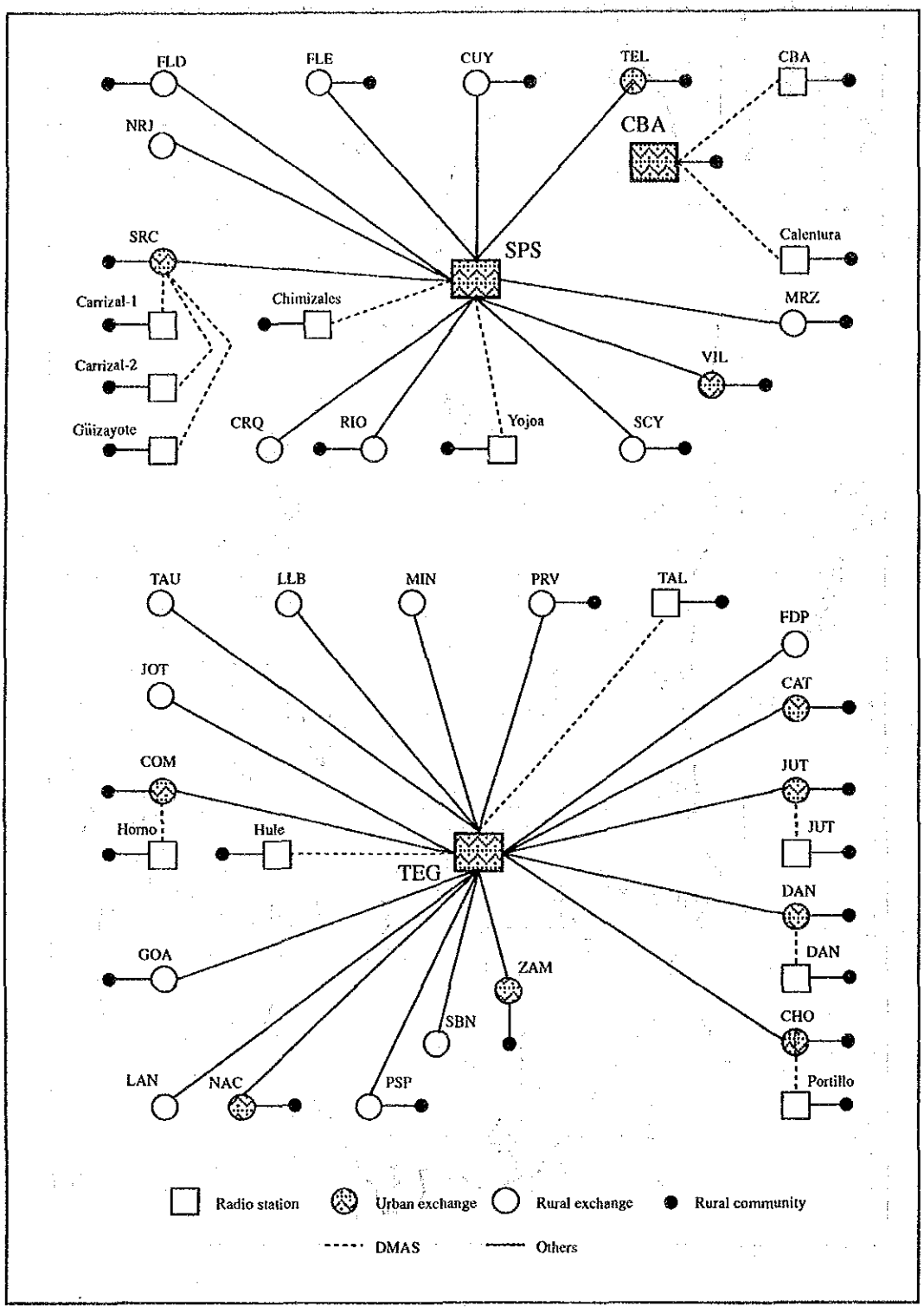
  The constitution of the rural telecommunications network was designed based on the Study result of the applicable technology and the comparison of the three plans. Figure 7.2.4-2 shows a constitution plan for the rural telecommunications network.

Figure 7.2.4-1 New Rural Exchange Location Plan



Note: Automatic exchanges are as of December 1991.

Figure 7.2.4-2 Constitution of Rural Telecommunications Network



– Telephone demand of each exchanges

The telephone demand in the year 2002 of each exchange is shown in Table 7.2.4-1.

Table 7.2.4-1 Telephone Demand by Exchange in 2002

Exchange	Number of communities	Lines in the year 2002 General	Public	Total
Existing				
CAT	1	73	6	79
CBA	24	864	65	929
CHO	26	712	54	766
COM	13	641	48	689
DAN	17	502	38	540
JUT	12	532	40	572
NAC	1	31	2	33
SPS	35	1,304	98	1,402
SRC	40	1,409	106	1,515
TEG	19	647	49	696
TEL	1	31	2	33
VIL	1	73	6	79
ZAM	1	5	1	6
(Subtotal)	(191)	(6,824)	(515)	(7,339)
New				
CRQ	1	269	20	289
CUY	1	186	14	200
FDP	1	370	28	398
FLD	4	261	20	281
LAN	1	94	7	101
LLB	1	276	21	297
MIN	1	370	28	398
MRZ	3	399	30	429
NRJ	1	186	14	200
PRV	2	190	14	204
PSP	2	291	22	313
SBN	1	186	14	200
SCY	1	276	21	297
TAU	1	370	28	398
GOA	3	187	14	201
JOT	1	148	11	159
RIO	4	187	14	201
FLE	3	172	13	185
(Subtotal)	(32)	(4,418)	(333)	(4,751)
Total	223	11,242	848	12,090

– Rural community connection plan

The 223 subject rural communities will be connected to one of the exchanges in the rural area or in the existing national telecommunications network by means of metallic cables or the digital multi-access system. The details of the rural community connection plan, the service areas of each DMAS, and exchange connection plan are shown in the Appendix.

7.2.5 Basic traffic forecast

The basic traffic was calculated at each exchange in accordance with the rural community connection plan. The traffic volume of each digital multi-access system, existing exchanges, and the new rural exchanges are shown in Table 7.2.5-1 and -2.

Table 7.2.5-1 Main Lines and Traffic of DMAS (2002)

No.	RBS	Main lines in 2002	Traffic (erl.)	Number of communities
1	CBA	488	26.10	14
2	CHO	691	36.95	24
3	COM	650	34.80	12
4	DAN	474	25.35	14
5	ENT	563	30.10	11
6	JUT	471	25.20	11
7	SBA	669	35.80	19
8	SPS	733	39.20	16
9	SRC	410	21.95	7
10	TEG	260	13.90	7
11	TRU	399	21.35	9
12	VLD	542	29.00	22
13	TAL	436	23.35	12
Total		6,786	363.05	178

Note: RBS: Radio Base Station

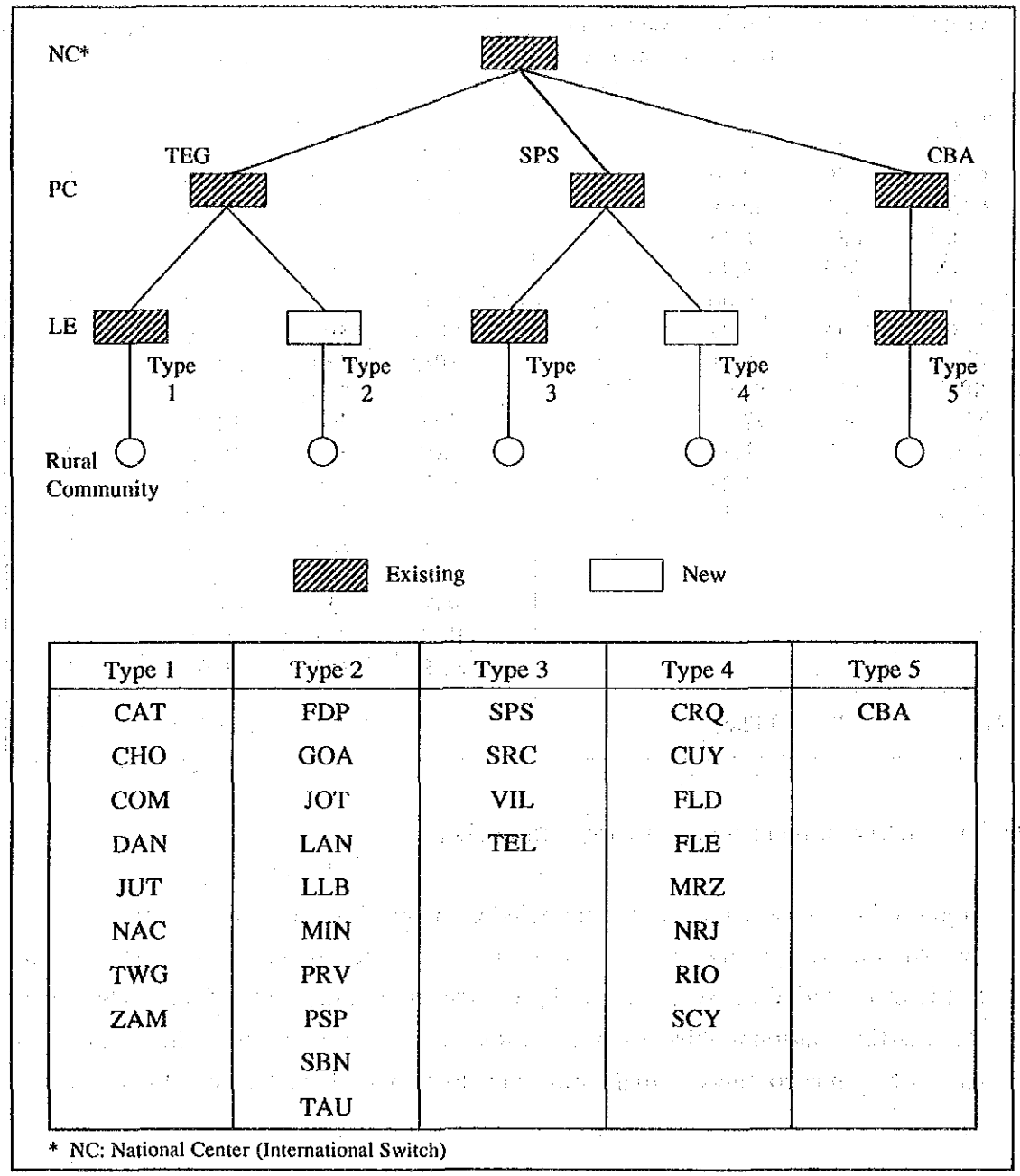
Table 7.2.5-2 Main Lines and Traffic

Exchange	Main lines	Traffic (erl.)	Number of communities	Exchange	Main lines in 2002	Traffic (erl.)	Number of communities
Existing				New			
CAT	79	4.23	1	CRQ	289	15.46	1
CBA	929	49.70	24	CUY	200	10.70	1
CHO	766	40.98	26	FDP	398	21.29	1
COM	689	36.86	13	FLD	281	15.03	4
DAN	540	28.89	17	LAN	101	5.40	1
JUT	572	30.60	12	LLB	297	15.89	1
NAC	33	1.77	1	MIN	398	21.29	1
SPS	1,402	75.01	35	MRZ	429	22.95	3
SRC	1,515	81.05	40	NRJ	200	10.70	1
TEG	696	37.24	19	PRV	204	10.91	2
TEL	33	1.77	1	PSP	313	16.75	2
VIL	79	4.23	1	SBN	200	10.70	1
ZAM	6	0.32	1	SCY	297	15.89	1
				TAU	398	21.29	1
				GOA	201	10.75	3
				JOT	159	8.51	1
				RIO	201	10.75	4
				FLE	185	9.90	3
Total	7,339	392.65	191		4,751	254.16	32

7.2.6 Rural telecommunications network routing plan

Figure 7.2.6-1 shows a proposed rural telecommunications network routing plan. The new rural exchanges may require short-cut circuits, depending on their location and traffic characteristics. While, in the figure, the short-cut circuits of the exchanges in the existing national telecommunications network are omitted, they should be established in accordance with the traffic intensity of each exchange in the network.

Figure 7.2.6-1 Rural Telecommunications Network Routing Plan



Type 1	Type 2	Type 3	Type 4	Type 5
CAT	FDP	SPS	CRQ	CBA
CHO	GOA	SRC	CUY	
COM	JOT	VIL	FLD	
DAN	LAN	TEL	FLE	
JUT	LLB		MRZ	
NAC	MIN		NRJ	
TWG	PRV		RIO	
ZAM	PSP		SCY	
	SBN			
	TAU			

* NC: National Center (International Switch)

CHAPTER 8 FACILITIES PLAN

CHAPTER 8 FACILITIES PLAN

8.1 Basic Policy of the Facilities Plan

8.1.1 Subject of the facilities plan

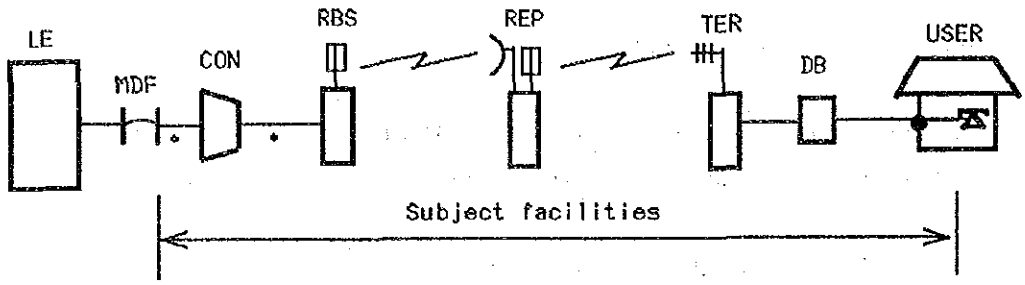
The subject facilities are those necessary to offer the telephone service to the 223 subject communities in the rural areas. These facilities are listed below.

- Exchanges to be introduced in the rural areas
- Transmission systems connecting the exchanges in the rural areas to those in the existing national network
- Digital multi-access system (DMAS) for the rural areas
- Transmission systems connecting the DMAS for the rural areas to the existing national network
- The facilities connecting the rural subscriber terminals to the exchanges and/or DMAS terminal stations for the rural areas. The subscriber terminals are not included.

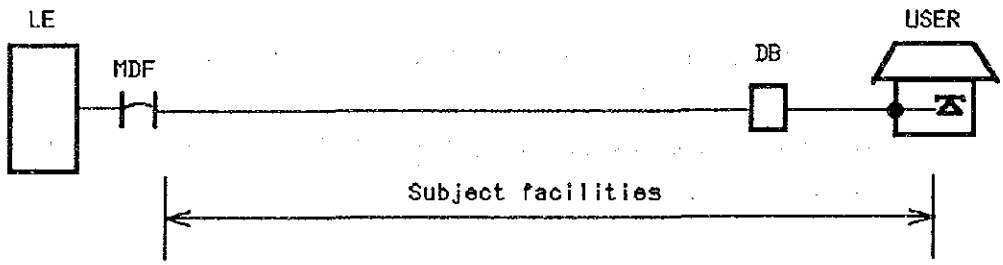
The subject facilities of this Plan are shown in Figure 8.1.1-1.

Figure 8.1.1-1 Subject Facilities of this Plan

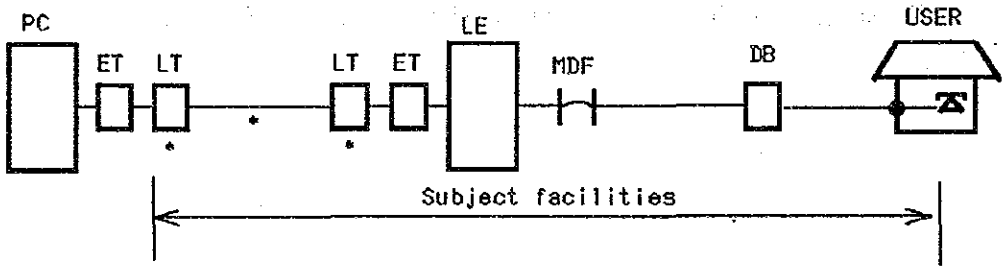
(A) Service provision by new digital radio multi-access system



(B) Service provision by direct connection to existing exchange



(C) Service provision by new exchange in rural area



Note: (*) Not quoted if an available system exists or is planned.

PC:	Primary center	DB:	Distribution box
LE:	Local exchange	RBS:	Radio base station
ET:	Exchange terminal	REP:	Repeater station
LT:	Line terminal	TER:	Terminal station
MDF:	Main distribution frame	CON:	Concentrater

8.1.2 Use of existing facilities

Existing facilities were used as much as possible to make up the rural telecommunications network. The facilities listed in the existing expansion plans, including the Telecommunications Expansion Plan 1992-1996, were all included in making the rural telecommunications network.

8.1.3 Capacity of facilities

The capacity of the facilities to be introduced in Phase-I was designed to meet the forecast demand in the year 2002. For the facilities to be introduced in Phase-II, a certain amount of capacity margin was included; that is, for the demand three (3) years after the installation of the exchanges, transmission systems, and DMAS, and five approximately (5) years for the subscriber network. (The details of the phases will be described in Chapter 10.)

8.1.4 Consideration for new services in the future

The exchange and transmission systems to be introduced by this Plan were designed with digital technology, for possible incorporation into an ISDN system in the future, and also considering the worldwide trend of digital telecommunications network.

8.2 Facilities Plan

8.2.1 Subscriber line extention system

The construction plan for the subscriber line extension transmission equipment to accommodate a total telephone demand of 12,090 for the year 2002 shall be as follows, for it was decided that the DMAS be used for the subscriber line extension system as stated in Chapter 7.

1) Utilization of existing telecommunications facilities

The rural telecommunications network shall be economically designed by effectively utilizing the towers and buildings of the existing telephone offices and radio repeater stations. Tables 8.2.1-1 and -2 indicate the state of utilization of the existing telephone offices and repeater stations.

2) Accommodation method of subscribers

The accommodation method of subscribers shall comply in principle with the current numbering plan and charge areas. However, should this method turn out to be economically disadvantageous considering the radio transmission conditions, etc., another method shall be considered including the accommodation by other offices.

3) Telecommunications system

To efficiently accommodate the telephone demand of 12,090 for the year 2002 with the exchanges, a subscriber line extension system using the digital multi-access radio system shall be adopted as the telecommunications system.

Table 8.2.1-1 DMAS Radio Base Station Condition

R.B.S. name	Site	Building	Tower	Power	Road
Portillo	existing	existing	planning	planning	existing
Yojoa	existing	existing	existing	existing	existing
Horno	existing	existing	existing	existing	existing
Carrizal-1	existing	existing	existing	existing	existing
La Ceiba	existing	existing	existing	existing	existing
Carrizal-2	existing	existing	existing	existing	existing
Güizayote	existing	existing	existing	existing	existing
Danlí	existing	existing	existing	existing	existing
Talanga	planning	planning	planning	planning	unnecessary
Chimizales	existing	existing	existing	existing	existing
Calentura	existing	existing	existing	existing	existing
Juticalpa	existing	existing	existing	existing	existing
Hule	existing	existing	existing	existing	existing

R.B.S. :Radio base station

Table 8.2.1-2 DMAS Repeater Station Condition

Rep. name	Site	Building	Tower	Power	Road
Bañaderos	existing	existing	existing	existing	existing
Valladolid	planning	planning	planning	planning	planning
Cerro Masaya	planning	planning	planning	planning	planning
Moncerrato	existing	existing	existing	existing	existing
Politrón	existing	existing	existing	existing	existing
Carrizalito	existing	existing	existing	existing	existing
Zapote	existing	existing	existing	existing	existing
Fray Pedro	planning	planning	planning	planning	planning

Rep. :Repeater station

4) Digital multi-access system

As stated in Chapter 7, it was decided that the DMAS be used for the subscriber line extension system. A total telephone demand of 6,786 in the year 2002 in 178 areas was designed to be accommodated using a total of 13 systems. (The demand in the rest 45 areas was designed to be directly connected to exchanges without using DMAS.)

a) Frequencies

Radio frequencies to be used by the subscriber system transmission equipment are in the 1.5 GHz and 2.4 GHz bands from 1427 MHz to 1530 MHz and from 2300 MHz to 2500 MHz. Figure 8.2.1-1 shows the details of these frequencies.

b) System parameters

Table 8.2.1-3 indicates the parameters for an example of DMAS.

5) Error performance

The CCIR classifies error performance of digital radio telecommunications into the three different grades of High, Medium, and Local. The error performance of the rural telecommunications is stipulated to belong to the Local grade. Since the DMAS is a radio telecommunications type of subscriber system, the error performance of Local grade is applied.

The error performance objectives of a 64 Kbit/s rural local HRDP (Hypothetic Reference Digital Path) are as follows:

- 1×10^{-3} for more than 0.05% of any month (integration time of 1 second)
- 1×10^{-6} for more than 1.5% of any month (integration time of 1 minute) (Ref. CCIR Rep. 380-3)

Figure 8.2.1-1 Frequency Allocation

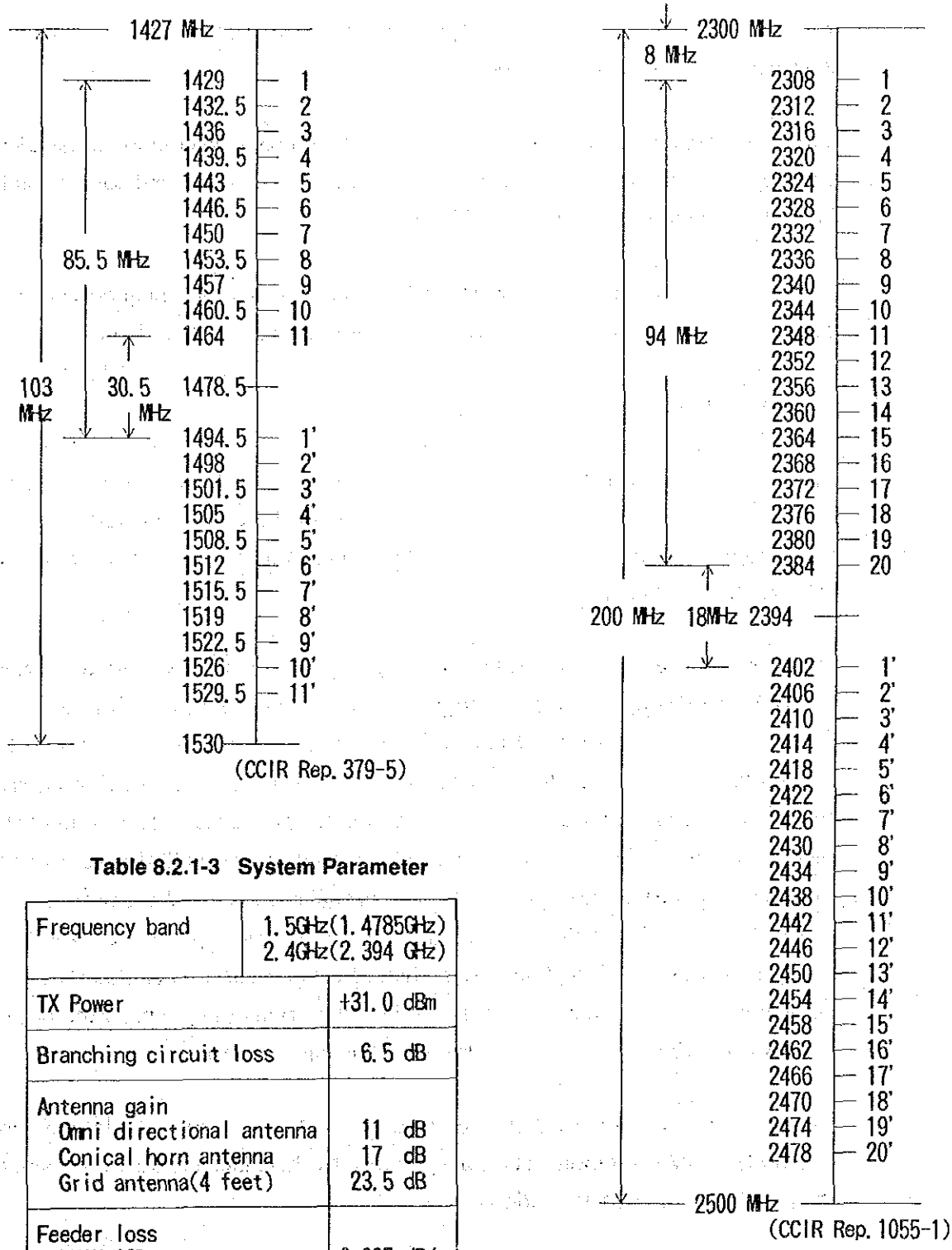


Table 8.2.1-3 System Parameter

Frequency band	1.5GHz(1.4785GHz) 2.4GHz(2.394 GHz)
TX Power	+31.0 dBm
Branching circuit loss	6.5 dB
Antenna gain Omni directional antenna Conical horn antenna Grid antenna(4 feet)	 11 dB 17 dB 23.5 dB
Feeder loss LHPX-10D LHPX-20D	 0.095 dB/m 0.055 dB/m
Threshold level (Upward) BER=10^{-3}	 -92.0 dBm

6) Power supply equipment for DMAS

For radio base stations, the power supply equipment of existing telephone exchanges and repeater stations will be applied.

The power supply equipment of radio repeater stations, except those supplied by existing repeater stations, will consist of a solar power system and battery banks having a retention period of seven (7) days.

The power supply equipment for terminal stations will be a combination of a solar power system and battery banks having a retention period of five (5) days.

7) Main work items

Table 8.2.1-4 outlines the number of main work items of the digital multi-access system. In case an exchange is not installed with the radio base station signal transmitter-receiver, the tie cable shall be installed under a separate project of HONDUTEL.

The present system is predicted to have 60 time slots and its service areas shall be determined by considering the topographic conditions, demand distribution and frequency utilization plan. Upon deciding on the number of subscribers for accommodation, consideration shall be given to the demands for data communications and facsimile communications. Moreover, to operate the system smoothly by maintaining a fixed level of service quality, consideration shall also be given to meeting temporary surges of traffic due to seasonal events, social events, and local projects. Thus, should the traffic for the year 2002 exceed approximately 80% of the system capacity, a telephone office shall be established in a community with a comparatively large demand. It shall be separated from this system, or the system itself shall be divided to lower the traffic of the entire system.

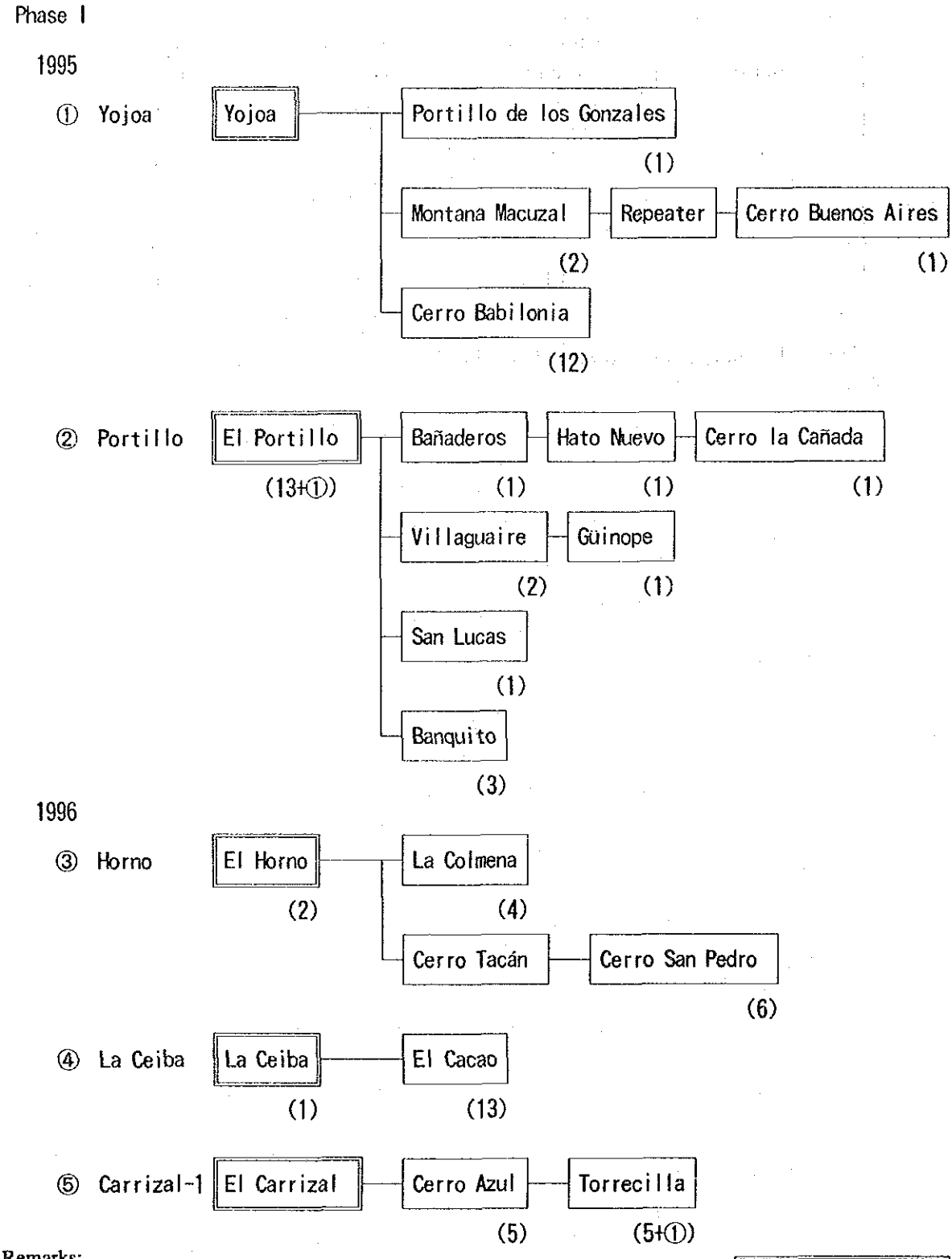
Figure 8.2.1-2 shows the DMAS network. Table 8.2.1-5 shows the latitude and longitude of DMAS stations which are provided by this Plan. Figure 8.2.1-3 shows the location of the DMAS stations.

Table 8.2.1-4 Number of Main Work Items of Digital Multi-Access System

Phase	Number of systems	Number of repeater stations	Number of terminal stations
I	7	23	104
II	6	18	67
Total	13	41	171

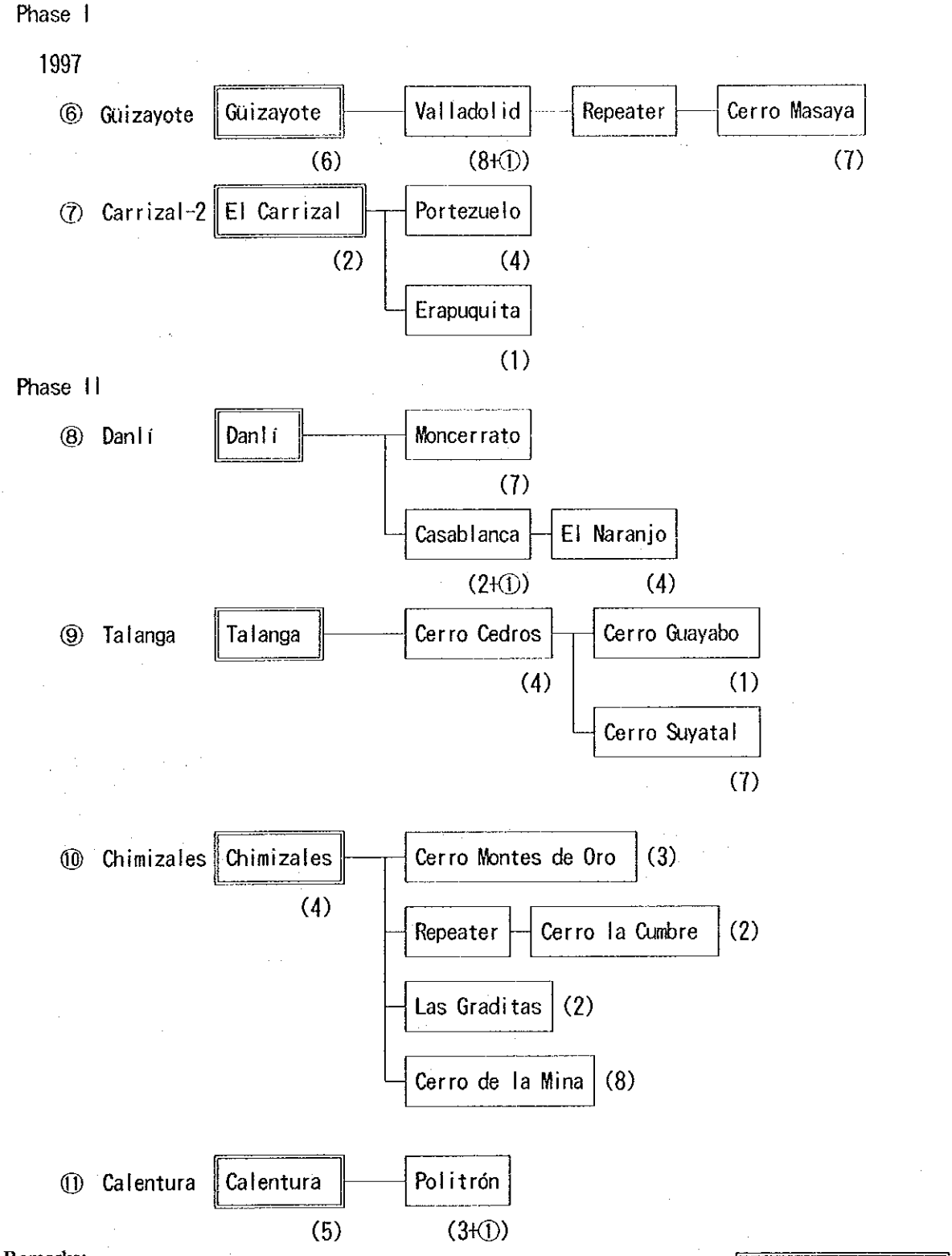
Note: The phases are stated in Chapter 10.

Figure 8.2.1-2 DMAS Network (Radio base stations and repeater stations) (1/3)



Remarks:
( ): Number of communities to be connected.
○ : Number of communities connected by metallic cable from terminal stations.

Figure 8.2.1-2 DMAS Network (Radio base stations and repeater stations) (2/3)

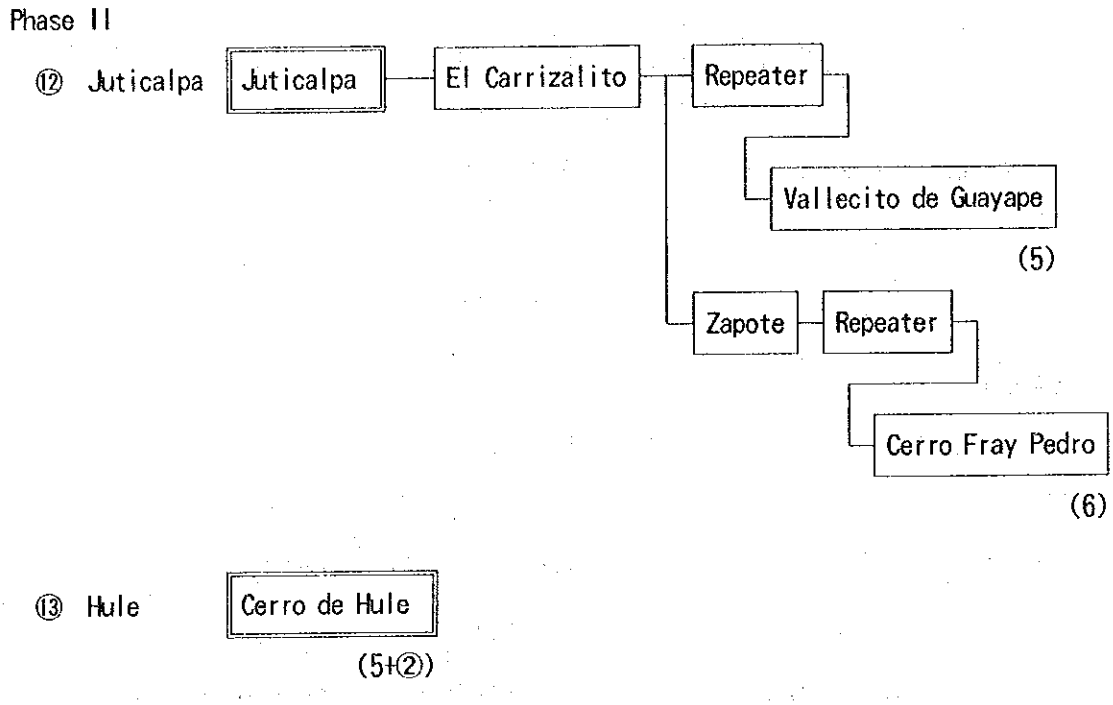


Remarks:
( ): Number of communities to be connected.
○ : Number of communities connected by metallic cable from terminal stations.

Radio base station

Repeater station

Figure 8.2.1-2 DMAS Network (Radio base stations and repeater stations) (3/3)



Remarks:
( ): Number of communities to be connected.
○ : Number of communities connected by metallic cable from terminal stations.

Radio base station

Repeater station

Figure 8.2.1-3 Location of DMAS Stations

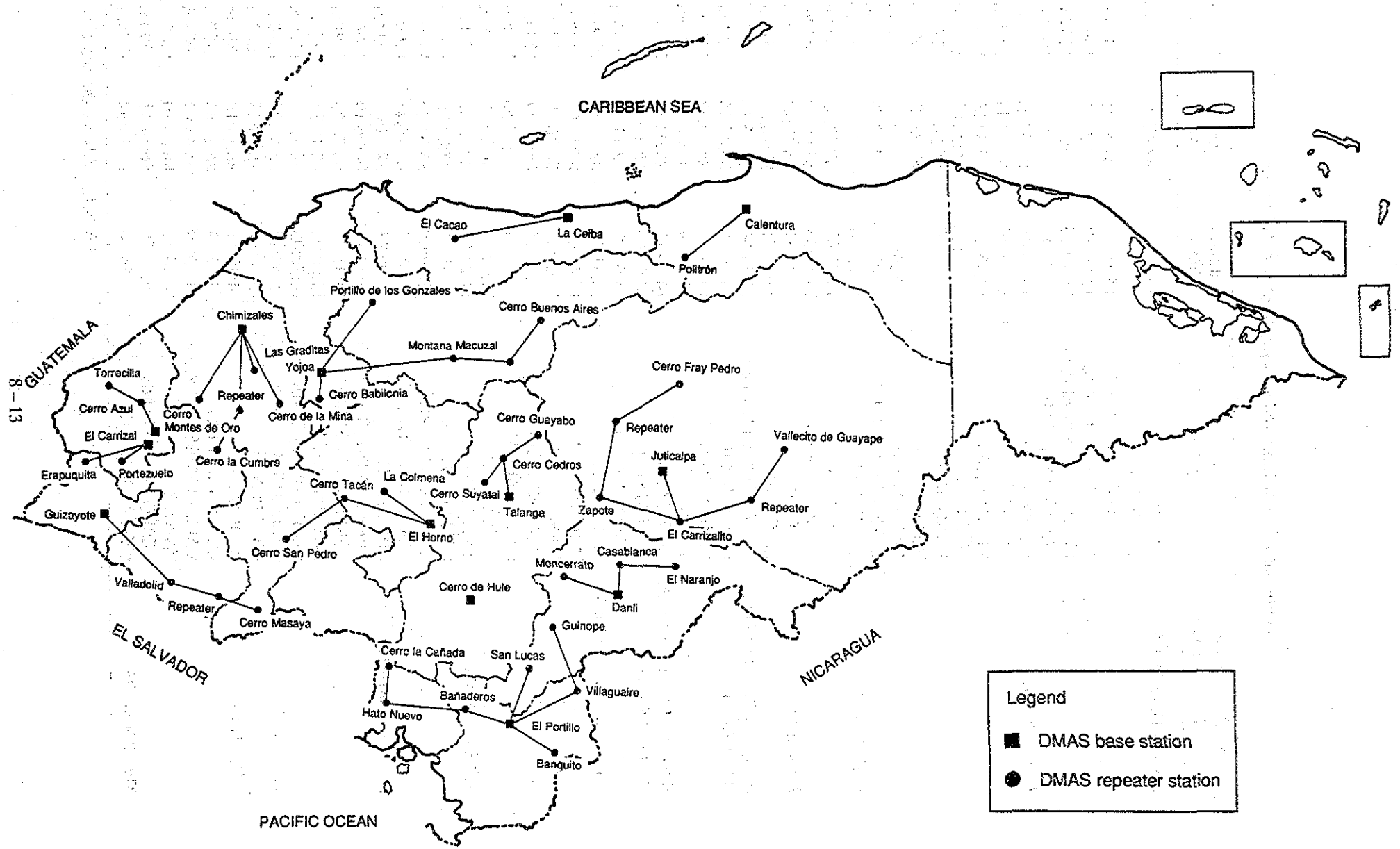


Table 8.2.1-5 Latitude and Longitude of DMAS Stations

Name of exchange to be connected	Name of stations	Latitude North	Longitude West	Height A.S.L.
SAN PEDRO SULA	YOJOA	15:01:34	87:48:27	983m
	PORTILLO DE LOS GONZALES	15:18:42	87.38:18	420m
	MONTANA MACUZAL	15:04:12	87:20:15	1962m
	CERRO BUENOS AIRES	15:19:55	86:53:51	1167m
	CERRO BABILONIA	14:58:47	87:58:42	1093m
CHOLUTECA	EL PORTILLO	13:28:46	87:09:31	1060m
	SAN LUCAS	13:44:25	86:57:17	1270m
	VILLAGUAIRE	13:33:31	86:47:09	1300m
	GÜINOPE	13:52:54	86:56:03	1570m
	BANQUITO	13:42:10	86:58:17	970m
	BAÑADEROS	13:32:04	87:23:00	705m
	HATO NUEVO	13:36:22	87:43:28	242m
	CERRO LA CAÑADA	13:48:17	87:42:29	332m
COMAYAGUA	EL HORNO	14:26:26	87:33:25	1730m
	LA COLMENA	14:35:09	87:40:39	895m
	CERRO SAN PEDRO	14:19:34	88:05:59	2020m
LA CEIBA	LA CEIBA	15:47:11	86:47:27	5m
	EL CACAO	15:42:41	87:18:05	518m
SANTA ROSA DE COPAN (ENTRADA)	SANTA ROSA DE COPAN	14:45:56	88:46:36	1161m
	EL CARRIZAL	14:45:35	88:47:15	1290m
	CERRO AZUL	14:57:19	88:40:52	1319m
	TORRECILLA	15:02:24	88:48:32	780m
SANTA ROSA DE COPAN (VALLADOLID)	GÜIZAYOTE	14:26:17	89:03:53	2293m
	VALLADOLID	14:09:09	88:44:15	1324m
	CERRO MASAYA	13:57:25	88:17:15	1096m
SANTA ROSA DE COPAN	EL CARRIZAL	14:45:35	88:47:15	1290m
	PORTEZUELO	14:41:02	88:57:06	1366m
DANLI	DANLI	14:01:44	86:36:00	770m
	MONCERRATO	13:56:04	86:52:17	1783m
	CASABLANCA	14:05:37	86:35:50	1316m
	EL NARANJO	14:02:20	86:20:09	590m
TEGUCIGALPA	TALANGA	14:25:03	87:05:02	790m
	CERRO CEDROS	14:35:24	87:06:26	1180m
	CERRO GUAYABO	14:39:09	86:53:05	1410m
	CERRO SUYATAL	14:33:37	87:14:45	1200m
SANTA BARBARA	CHIMIZALES	15:09:38	88:21:00	1731m
	CERRO MONTES DE ORO	14:52:11	88:26:19	1506m
	CERRO LA CUMBRE	14:41:46	88:28:53	1598m
	LAS GRADITAS	14:52:02	88:19:33	720m
	CERRO DE LA LIMA	14:58:05	88:12:12	1120m
TRUJILLO	CALENTURA	15:52:17	85:57:24	1210m
	POLITRON	15:36:32	86:19:33	687m
JUTICALPA	JUTICALPA	14:40:11	86:13:18	395m
	EL CARRIZALITO	14:37:19	86:15:43	725m
	VALLECITO DE GUAYAPE	14:40:39	85:46:09	903m
	ZAPOTE	14:34:31	86:43:10	1385m
	CERRO FRAY PEDRO	14:57:55	86:14:41	1590m
TEGUCIGALPA	CERRO DE HULE	13:56:46	87:14:32	1725m

*A.S.L.: Above the sea level

8.2.2 Exchange and power equipment

1) Type of exchange

The exchanges to be introduced in the rural areas (the rural exchagnes) were defined as follows:

- Digital, stored program control, independent, and portable (or container) type exchange.
- Small exchange with about 500 subscriber line terminals at its final stage.

2) Subscriber line terminals

- Rural exchanges

  The number of subscriber line terminals, or subscriber line interfaces, to be equipped to each exchange in the rural telecommunications network is 4,900.

- Exchanges in the existing national telecommunications network

  The number of subscriber line terminals to be equipped to each of the exchanges in the existing national telecommunications network should be determined taking into consideration the forecast demand. In the demand forecast, 515 public and 6,824 normal telephones are assumed for the year 2002.

3) Power equipment for exchange

The power equipment applied to the rural exchange is as follows. An engine generator was assumed for each exchange in addition to the power equipment listed below.

- Power receiving panel
- Rectifier
- Battery banks
- Air conditioning equipment

The capacity of each equipment should be enough for the consumption at the stage of full load of the exchange. The batteries should have enough capacity to maintain normal operation at the busiest hour rate of the exchange for eight hours.

4) Main work items

18 telephone exchanges were planned according to the rural community connection plan. The main work items are shown in Table 8.2.2-1.

The exchange now used in Catacamas (CAT) is planned to be transferred to Santa Cruz de Yojoa (SCY) by HONDUTEL in 1995. The old SCY exchange will be replaced with a digital exchange according to this Plan in the year 1999. This is also in accordance with the exchange life plan of HONDUTEL and takes into consideration possible problems in spare parts supply.

Table 8.2.2-1 Number of Main Work Items for Rural Exchanges

Phase (Year)	Exchange	Lines	Switching equipment	Power equipment	Building (container)	Land	Remarks
Phase I							
1995	GOA	210	1	1	1	1	
1995	LAN	110	1	1	1	1	
1995	MRZ	430	1	1	1	1	
1995	PSP	320	1	1	1	1	
1995	RIO	210	1	1	1	1	
1995	SCY	300	1	1	1	1	*
1996	FLD	290	1	1	1	1	
1996	JOT	160	1	1	1	1	
1996	LLB	300	1	1	1	1	
1996	NRJ	200	1	1	1	1	
1996	TAU	400	1	1	1	1	
1997	CRQ	290	1	1	1	1	
Phase II							
	MIN	400	1	1	1	1	
	PRV	210	1	1	1	1	
	CUY	200	1	1	1	1	
	FLE	190	1	1	1	1	
	FDP	450	1	1	1	1	
	SBN	230	1	1	1	1	
Total		4,900	18	18	18	18	

* : The container exchange ACC-23 will be transferred from CAT in the year 1995 and be replaced by a digital exchange in 1999.

Note : The phases are stated in Chapter 10.

5) Inter-exchange circuits

The number of inter-exchange circuits was calculated for the terminals to be equipped, in accordance with the technical standard. The exchange traffic volume for equipped terminals and the number of inter-exchange circuits are shown in Table 8.2.2-2.

Table 8.2.2-2 Inter-exchange Circuits (in 2002)

Exchange	Terminals equipped	Inter-exchange To/from	Circuits traffic (erl.)	Circuits
CRQ	290	SPS	11.64	20
CUY	200	SPS	8.02	15
FDP	450	TEG	18.06	28
FLD	290	SPS	11.64	20
FLE	190	SPS	7.63	15
GOA	210	TEG	8.43	16
JOT	160	TEG	6.42	13
LAN	110	TEG	4.42	10
LLB	300	TEG	12.04	21
MIN	400	TEG	16.05	25
MRZ	430	SPS	17.26	27
NRJ	200	SPS	8.02	15
PRV	210	TEG	8.43	16
PSP	320	TEG	12.84	22
RIO	210	SPS	8.43	16
SBN	230	TEG	9.23	17
SCY	300	SPS	12.04	21
TAU	400	TEG	16.05	25
Total	4,900		196.65	342

8.2.3 Inter-exchange circuit transmission equipment

1) Selection of system

The inter-exchange circuit transmission equipment is designed by using the optical fiber transmission system as described in 7.1.6. In other words, the 18 telephone exchanges to be newly established will be connected to the existing telephone exchange or radio repeater stations with optical fiber transmission equipment. The existing telephone exchanges or repeater stations should be connected to a pertinent telephone exchange by using the existing line or one to be constructed under a separate project by HONDUTEL.

2) Transmission capacity

The transmission capacity of the inter-exchange circuit transmission equipment for respective sections should be designed to meet the telephone demand for the year 2002. The hardware configuration of the inter-exchange circuit transmission equipment should be designed with at least a secondary digital group so as to be able to meet the increased demand or demand for data communications lines and leased lines in the future.

The transmission capacity of the optical fiber transmission equipment should match the traffic volume of the related exchanges. The transmission system was provided with a transmission speed of 8Mb/s and/or 34Mb/s.

3) Power equipment for the transmission equipment

The optical fiber transmission equipment to be newly introduced should have the following power equipment and air conditioner:

- Rectifier unit
- Battery banks
- Air conditioner

4) Site and building

To install the optical fiber transmission equipment and power equipment, the sites of appropriate areas and buildings are needed.

In other words, a total of 16 sites and the buildings should be provided.

The existing facilities should be entirely utilized for the telephone exchange or radio repeater stations to which the new telephone exchanges are connected, thereby reducing the construction cost.

5) Main work items

Table 8.2.3-1 shows the number of main work items for the inter-exchange circuit transmission. Figure 8.2.3-1 shows the new optical fiber network.

Table 8.2.3-1 Number of Main Work Items for the Inter-exchange Circuit Transmission

Phase	Number of exchanges to be connected	Number of sections
I	12	12
II	6	6
Total	18	18

Note: The phases are stated in Chapter 10.

Figure 8.2.3-1 New Optical Fiber Network (1/2)

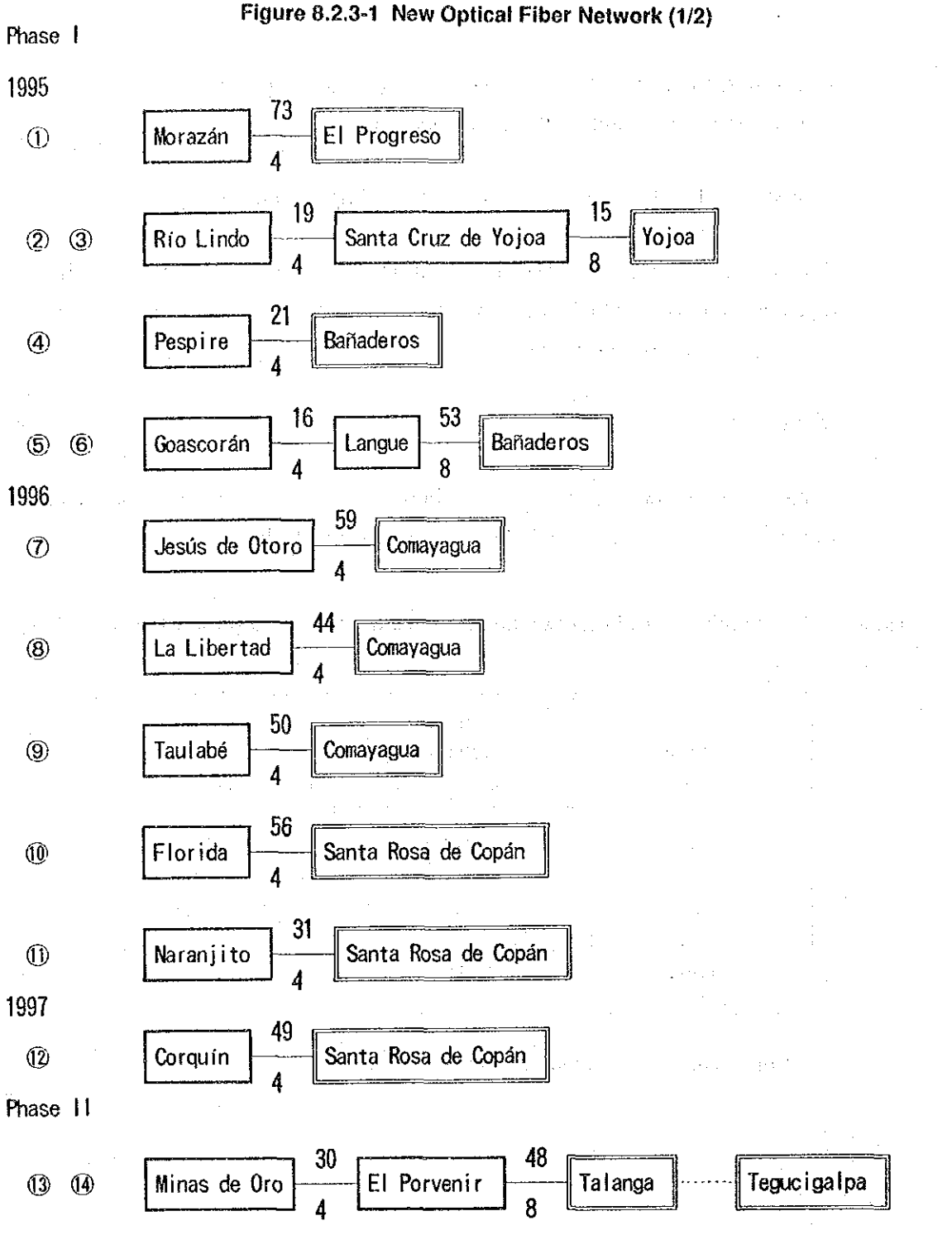


Figure 8.2.3-1 New Optical Fiber Network (2/2)

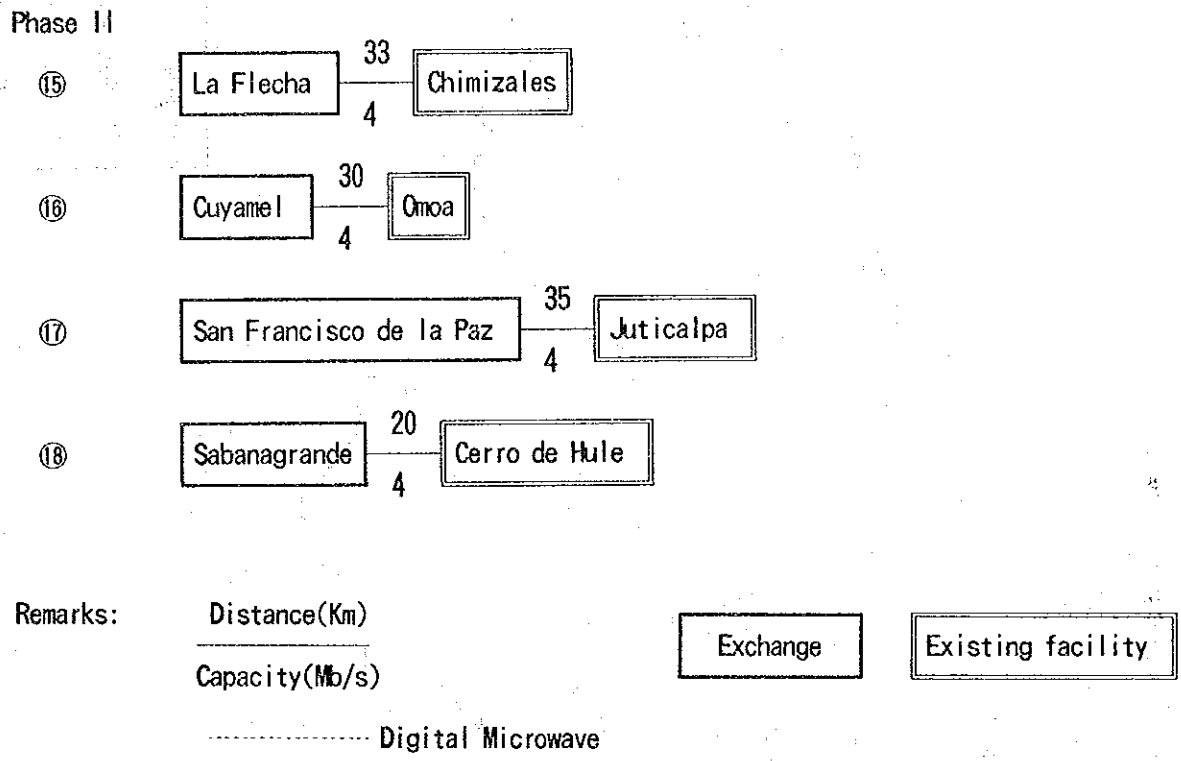
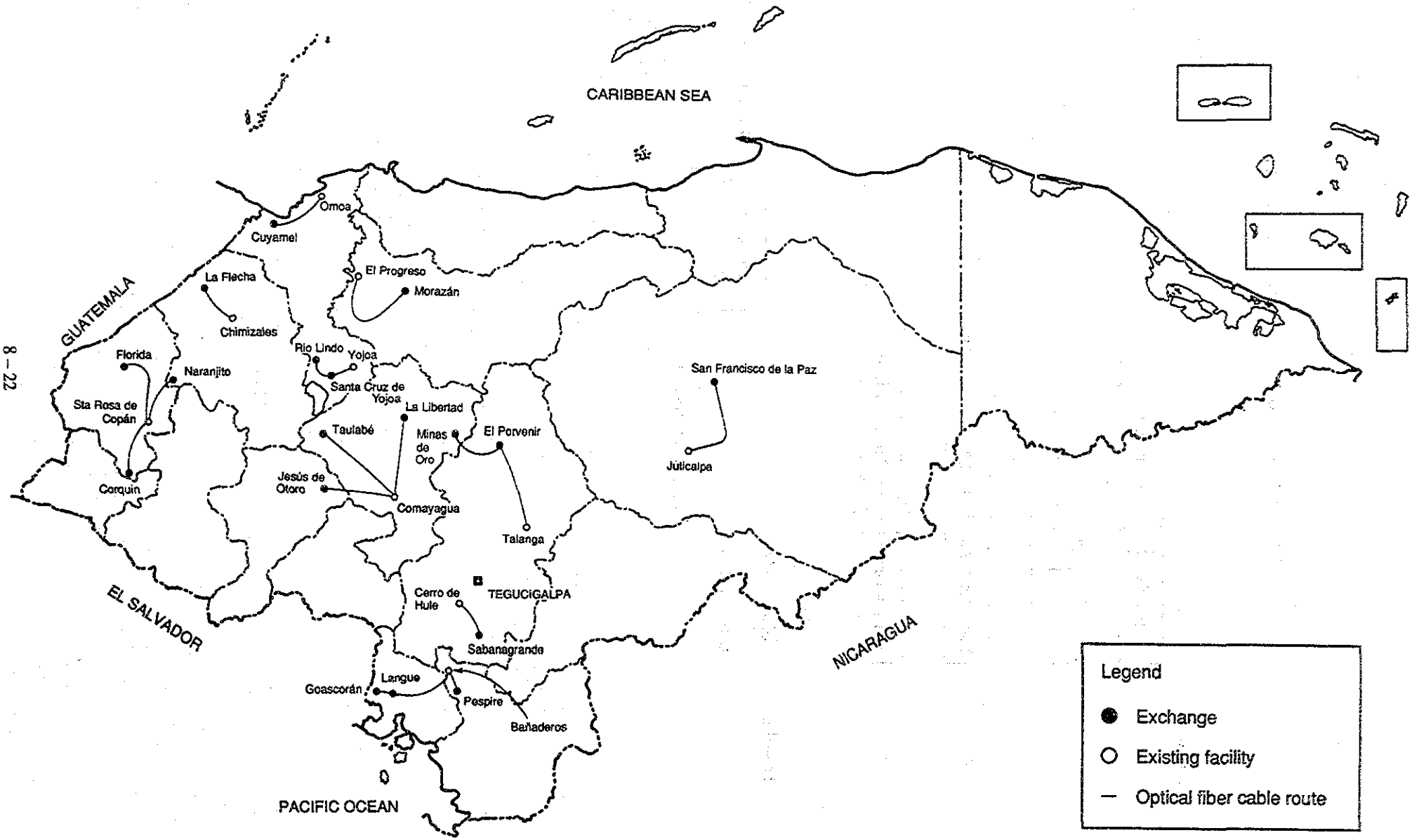


Figure 8.2.3-2 Optical Fiber Cable Route



8.2.4 Outside plant

1) Inter-exchange circuit line facilities

a) Selection of cable

Optical fiber cable of the non-gas system, single mode (SM) type, should be used.

b) Selection of line type

From the examination results described in 7.1.6 (5), an aerial type line should be used.

c) Decision on the number of cable cores

The required number of cores for respective sections in the year 2002 is 3. However, the closest cable commercially available that meets the above core number requirement is a 4-core one. The number of cores required for the respective sections and the pertinent distances are presented in the Appendix.

d) Main work items

Main work items should be calculated as follows:

i) Optical fiber cable should be constructed to the exchange located approximately at the center of the respective communities.

ii) Telephone poles should be erected at intervals of 40 meters. The power distribution poles should be jointly used for about one half of the planned telephone poles.

Table 8.2.4-1 shows the main work items for inter-exchange circuit line facilities.

Table 8.2.4-1 Main Work Items for Inter-exchange Circuit Line Facilities

Phase	Optical fiber cables (core × Km)	Poles (Number of poles)
I	1,944	6,075
II	784	2,450
Total	2,728	8,525

Note: The phases are stated in Chapter 10.

2) Subscriber line facilities

The results obtained in Chapter 6 should form the basis for the construction of subscriber line facilities.

a) Selection of line type

An aerial type line should be applied.

b) Selection of cable

Color corded polyethylene (CCP) cable should be used. A self-supporting type cable should mainly be used. Moreover, where necessary for the purpose of maintenance operation, alpeth cable and flame resistant cable should be used.

Cable conductor diameter should be determined so as to meet the allowable transmission loss value.

c) Determining the number of cable pairs

An allowance of 20% was taken in to the forcast demand.

d) Cable laying sections

The cable laying sections and the respective distances are indicated in the Appendix.

e) Main work items

The main work items are calculated as follows:

- A rural community is defined as having a radius of 0.5km.
- New telephone exchanges and terminal stations should be established at the center of the communities.
- Cables should be laid bi-directionally from the center with a radius of 0.5km.
- Telephone poles should be erected at intervals of 40m. The power distribution poles should be jointly used for about one half of the planned telephone poles.

Table 8.2.4-2 shows the main work items for subscriber line facilities.

Table 8.2.4-2 Main Work Items for Subscriber Line Facilities

Phase	Metallic cables (pair × Km)	Poles (Number of poles)	Drop Wires (Number of lines)
I	15,670	3,713	7,544
II	14,850	2,538	4,546
Total	30,520	6,251	12,090

Note: The phases are stated in Chapter 10.

3) Telephone set

The characteristics of the telephone set should satisfy normal operation with a loop resistance of 1,800 ohms including the internal resistance of the telephone set.

8.2.5 Buildings

Fifty-seven (57) buildings will be provided by this Plan as shown in Table 8.2.5-1.

Table 8.2.5-1 Buildings to be provided

For	Quantity
Public telecommunications service stations	41
Optical fiber transmission system stations	16
Total	57

8.2.6 Sites

One hundred eight (108) sites will be provided by this Plan as shown in Table 8.2.6-1.

Table 8.2.6-1 Sites to be provided

For	Quantity
Public telecommunications service stations	41
New rural exchanges	18
Optical fiber transmission system stations	16
Digital multi-access system stations	33
Total	108

8.2.7 Access roads

Thirty-three (33) access roads will be provided for the digital radio multi-access system by this Plan.

CHAPTER 9 OPERATION AND MAINTENANCE PLAN

CHAPTER 9 OPERATION AND MAINTENANCE PLAN

With the implementation of this Project, the telecommunications service area of HONDUTEL will be greatly expanded. This will increase the amount of maintenance equipment including some of the advanced technology. Therefore, an operation and maintenance plan is proposed as it is imperative for maintaining the level of service quality.

9.1 Present State of Operation and Maintenance

The present state of operation and maintenance is as follows:

1) Operation and maintenance control organization

The existing telecommunications equipment of HONDUTEL is controlled by the Central-South Region Telecommunication Division, the North-West Region Telecommunication Division, and the Atlantic Coast Region Telecommunication Division located in Tegucigalpa, San Pedro Sula, and La Ceiba respectively. This divides the nation's eighteen Departments into three maintenance areas.

The respective telecommunication divisions perform the operation and maintenance through their maintenance departments. Figure 9.1-1 shows the organization of a maintenance department that consists of the sections of exchange, transmission, outside plant, electric power, and civil works, and service centers. The service centers respond to the subscribers' calls received by the fault acceptance telephone number 194. Figure 9.1-2 shows outlines of the operation and maintenance control organization and Figure 9.1-3 shows the maintenance areas of HONDUTEL.

Figure 9.1-1 Organization of Maintenance Department

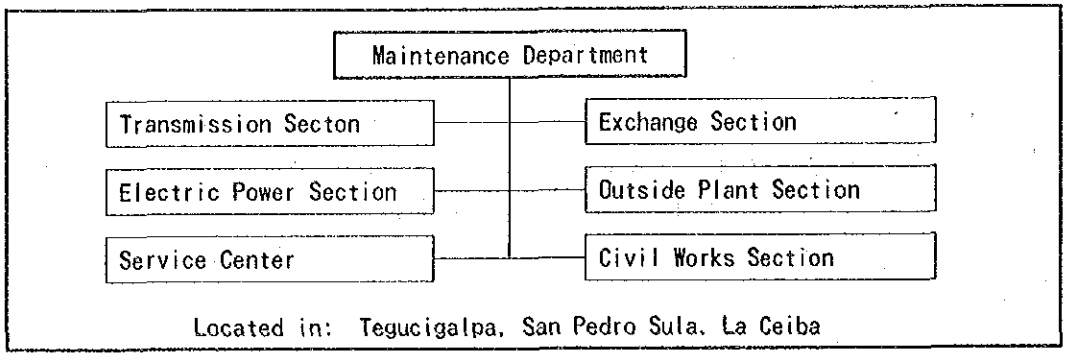


Figure 9.1-2 Outlines of the Operation and Maintenance Control Organization

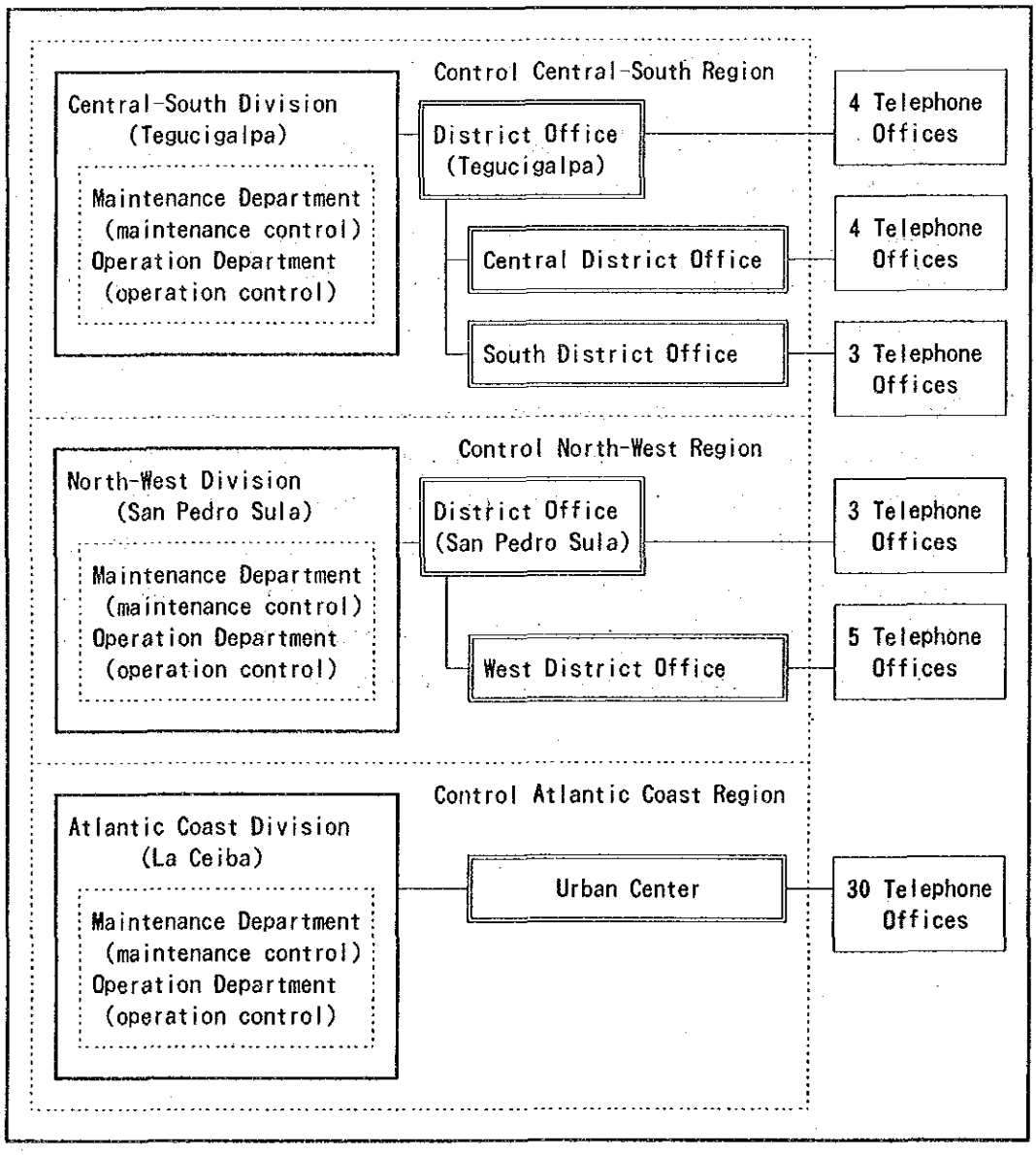
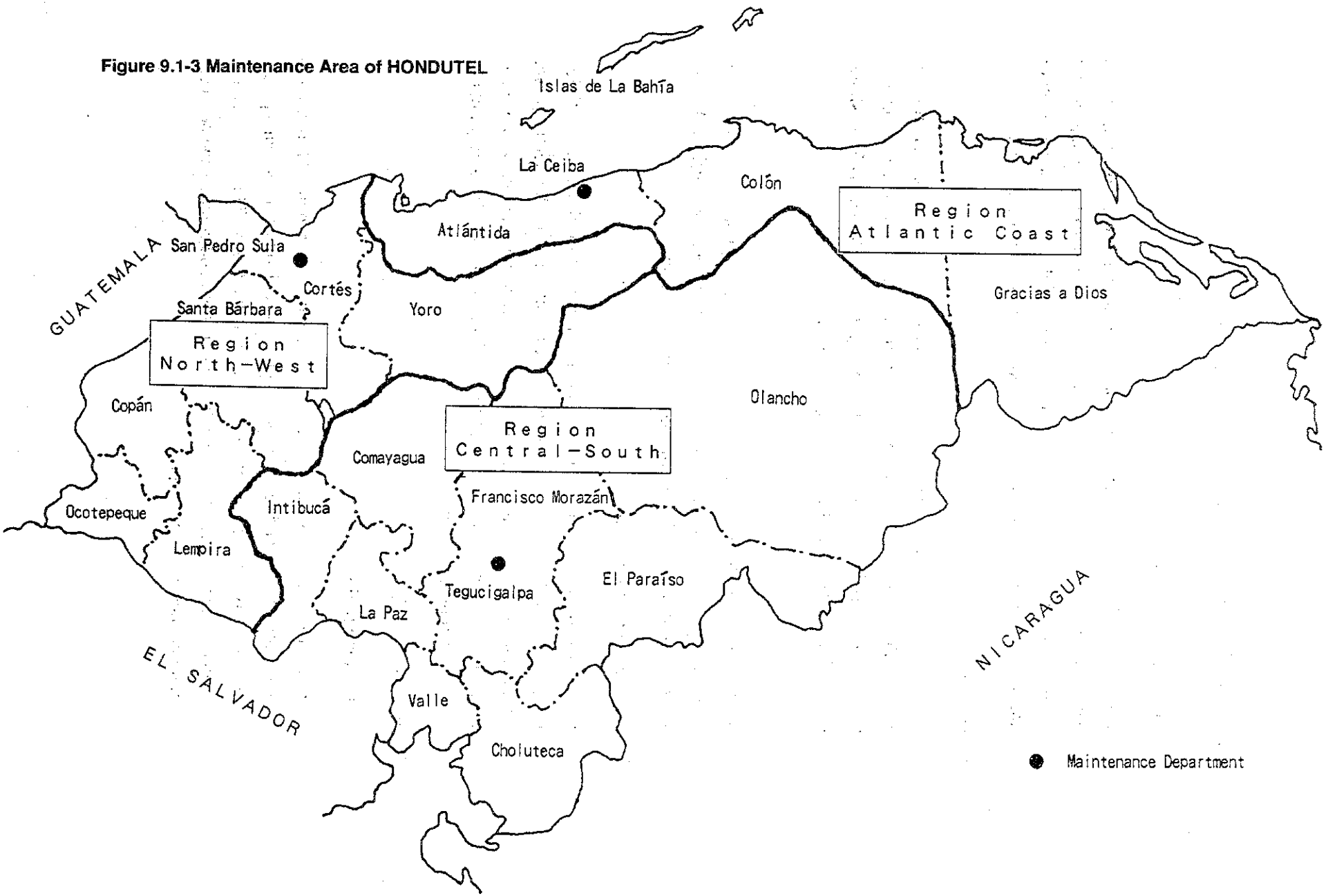


Figure 9.1-3 Maintenance Area of HONDUTEL



2) Maintenance of Telecommunications Network

a) Inter-exchange transmission systems

The transmission section of the maintenance department carries out centralized remote supervision and maintenance of inter-exchange transmission equipment within the maintenance area. Appendix 9.1-1 shows the staff and duty hour of transmission section. Appendix 9.1-2 shows the supervising station.

b) Exchange systems

Staff in charge of exchange systems of respective telephone offices are responsible for the supervision and maintenance activities of the exchange systems of their own office (Part of system is centrally supervised). Appendix 9.1-3 shows the staff and duty hour of the exchange section.

c) Outside plant

Staff in charge of the outside plant of the respective telephone offices carry out the operation and maintenance of the outside plant of their own office. Appendix 9.1-4 shows the outline of the outside plant section.

d) Electric power equipment

The electric power sections of the Tegucigalpa, San Pedro Sula, and La Caiba Telephone Offices carry out the operation and maintenance of the electric power equipment of the telephone offices and radio repeater stations within their assigned maintenance areas. Appendix 9.1-5 shows the staff and duty hour of the electric power section.

e) Procedure for faults

i) Daytime faults

Subscribers in the urban areas having a service center, dial 194 to report a telephone trouble and request for repair. Those in other areas shall contact the respective telephone offices for repairing the faults. The service center shall conduct testing, etc. depending on the fault and contacts the pertinent maintenance sector for repair.

ii) Nighttime faults

When a equipment fault occurs at night, the employee of the telephone office on duty should contact the manager. The manager in turn summons other employees to attend to the trouble. Usually the actual repair is made on the following day. The transmission section has some service vehicles available and the staff is dispatched for repair around the clock.

iii) Support system

If a telephone office require support from the maintenance department, it should report the state of the fault to the latter via telephone, telex, facsimile or other means.

3) State of faults

a) Number of faults

Except for the urban areas of the Central-South region, no sufficient data is yet available since the maintenance departments of the respective telephone offices have only recently started collecting and analyzing data on the number of faults and repair work.

i) The number and major causes of faults that occurred in the urban areas of the Central-South region are as follows:

Table 9.1-1 Number and Major Causes of Faults (1990)

Outside Plant (1990)

Causes	Faults
Ground	155
Wire break	1,231
Poor contact	54
Wetting	340
Short	814
Others	10
Total	2,604

Locations	Faults
Drop wire	779
Apparatus	918
Terminal	45
Tel. office	109
Cable	8
PBX	172
Others	573
Total	2,604

Telephone Apparatus (1990)

Manufacturers	Faults
OKI	19
ITT	92
GTE	29
SIEMENS	4
STRUMBERG	4
Others	13
Total	161

Fault Rate (1990): 5.76%

Source: HONDUTEL INFORME ANUAL 1990 DEPARTAMENTO MANTENIMIENTO C.S.

Number of Exchange Faults (Jan. to Nov. 1991)

Offices	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
TEG	2	1	3	4	4	3	3	3	3	3	3	32
COM	1	1	1				1	1	1	1	1	8
CHO	1	1	1	1	1	1	1	1	1	1	1	11
PAR	1	1		1	1	1		1	1	1	1	9
SIG		1	1			1	1	1	1	1	1	8
CAT	2											2
JUT		1	1	1								3
DAN	2		1	1	1	1						6
SLO			1									1
PAZ			1	1								2
PALACIO	1	1	1	1	1	1	1					7
Total	10	7	11	10	8	8	7	7	7	7	7	89

ii) The total number of faults for 1991 is as follows according to the data obtained from the telephone office during the field survey conducted in February, 1992:

Table 9.1-2 Number of Faults (1991)

Telephone Office	Items			Telephone Office	Items		
	Outside Plant	Electric Power	Telephone Sets		Outside Plant	Electric Power	Telephone Sets
TEG		11		PAZ	5		
JUT	70			SRC			20
PRO	70			TOC	20		15
DAN	40	22	4	OLA	14		4
CBA	205		29	CHO	100		
PAR	10			SLO	30		10
SBA	20			YOR	3		1
COM	3	4					
				Total	590	37	83

b) Repair time

Approximately one half of the faults reported in the urban areas are fully repaired within two days.

i) Repair time in the urban areas in the central-south region (for 1991)

- Faults repaired within 2 days: 52.06%
- Faults that required 2 days or more for repair: 47.94%

ii) The table below indicates the time required for repairing faults according to the data (for 1991) obtained during the field survey. A longer time is required for repairing the outside plant and telephone sets.

- Outside plant: 3 hours to 3 days
- Exchange: Within 1 hour
- Telephone set: 2 hours to 2 days
- Electric Power: Within 1 day

9.2 Operation and Maintenance Plan

9.2.1 Basic policy

The basic policy for the preparation of the operation and maintenance plan for the telecommunications system in the rural areas is as follows:

1) Organization

The existing operation and maintenance sector in the current organization shall be responsible for the operation and maintenance of the rural telecommunications system. The establishment of a new organization or integration and/or abolition of existing organizations shall not be made for the rural telecommunications system. The operation and maintenance of the rural telecommunications system shall be covered by increasing the number of staff required.

2) Staff

i) An appropriate number of staff shall be positioned at the TEG, SPS, CBA, SRC, CHO, COM, DAN, and JUT telephone offices considering the amount of equipment to be introduced to these offices and the facts that it is highly reliable equipment with a low fault rate.

ii) New staff shall not be positioned in the existing public telecommunications service offices in the rural areas.

iii) An appropriate number of staff shall be positioned at the newly established public telecommunications service offices.

iv) Security staff shall be positioned at the newly established rural exchanges, radio base stations, and repeater stations.

v) The current number of staff shall be maintained if possible, by providing them with necessary training in the future.

3) Service

The existing telegram service in the rural areas shall be provided continuously.

4) Training

Necessary training shall be provided so as to perform smooth operation and maintenance of the rural telecommunications system.

5) Others

i) A new public telecommunications service office shall be established for a rural area currently having no such office. An appropriate number of employees shall be deployed to provide the users with public telephone service and public telegram service via telephone.

ii) Employees of the public tele communications service offices in the rural areas shall handle the public telephone and public telegram services of the respective areas. In addition, they shall perform the simple repair of faults of telephone sets, wiring, transmission and radio equipments, and exchange in their area according to the instruction given by the Maintenance Telephone Office.

iii) An appropriate number of maintenance vehicles shall be arranged for the maintenance telephone offices of the rural telecommunications system.

9.2.2 Operation and maintenance system

The following items shall be examined for each office and station according to the basic policy of the operation and maintenance plan. An operation and maintenance system shall be proposed on the basis of the results of the above-mentioned examinations.

a) Maintenance classification

b) Equipment supervision

c) Principal operation

d) Staff

1) Operation and maintenance control sector

The operation and maintenance shall be controlled by the three telecommunication divisions.

2) Operation and maintenance employees

Figure 9.2.2-1 shows the employees of HONDUTEL.

3) Telephone office in charge of maintenance

a) Maintenance classification

i) Employees of the following eight telephone offices that will be connected and installed with the exchange system, transmission equipment, and telephone sets for the rural telecommunications service shall be responsible for the maintenance of the exchange system, transmission equipment, outside plant, and telephone sets.

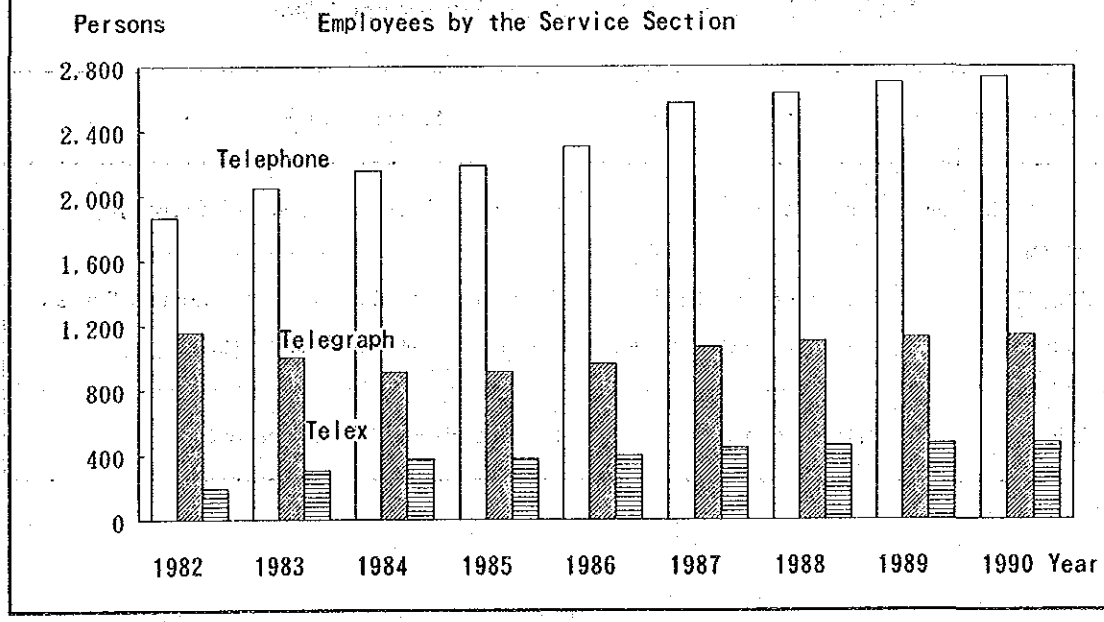
– The telephone offices in charge of operation and maintenance for the rural telecommunications equipment (maintenance telephone offices):

TEG, SPS, CBA, SRC, CHO, COM, DAN, JUT

Figure 9.2.2-1 Employees of HONDUTEL

Employees of HONDUTEL

Year		1986	1987	1988	1989	1990
Employees		3,662	4,078	4,188	4,293	4,349
Service Section	Telephone	2,303	2,570	2,632	2,700	2,735
	Telegraph	962	1,065	1,099	1,125	1,139
	Telex	397	443	457	468	475
New Employment		—	—	36	93	152
Retirement		80	36	20	80	52



ii) Tables 9.2.2-1 and 9.2.2-2 indicate the maintenance sector at the eight maintenance telephone offices.

Table 9.2.2-1 Maintenance Sector

Telephone Office	Section in charge	Maintenance Facilities
• TEGUCIGALPA • SAN PEDRO SULA • LA CEIBA	Exchange	Exchange
	Transmission	Transmission, Digital Multi-Access System
	Outside Plant	Outside Plant, Telephone Sets
	Electric Power	Electric Power

Table 9.2.2-2 Maintenance Sector (No Section Office)

Telephone Office	Staff in charge	Maintenance Facilities
• SANTA ROSA DE COPAN • CHOLUTECA • COMAYAGUA • JUTICALPA • DANLI	Exchange	Exchange, Electric Power of Exchange
	Transmission (Staff shall be newly posted)	Transmission, Digital Multi-Access System, Electric Power of Transmission
	Outside Plant	Outside Plant, Telephone Sets

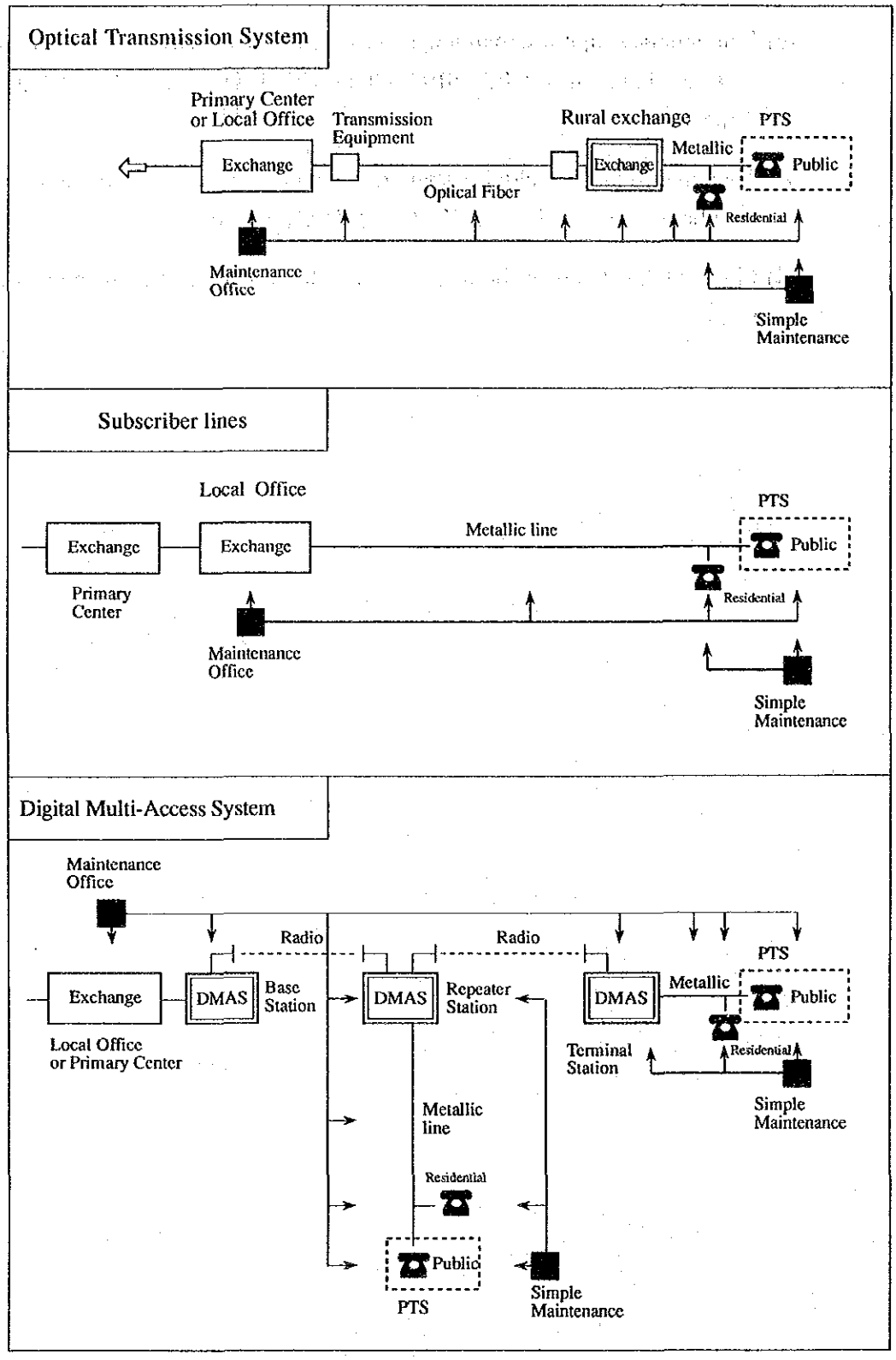
iii) The three telephone offices of TEG, SPS, and CBA shall provide assistance to the other maintenance telephone offices upon receiving a request.

iv) Maintenance supplies, maintenance tools, and spare parts shall be provided with the TEG, SPS, CBA, SRC, CHO, COM, DAN, and JUT telephone offices.

v) Two maintenance vehicles shall be provided for each of the following telephone offices: SRC, CHO, COM, DAN, and JUT.

vi) Figure 9.2.2-2 shows the maintenance classification of respective equipment.

Figure 9.2.2-2 Maintenance Classification of Respective Equipment



PTS: Public telecommunications service office

b) Equipment supervision

i) The maintenance telephone offices shall be responsible for supervising the exchange, and transmission and radio equipments at the telephone offices, rural exchanges, and repeater stations (remote control for the rural exchanges and repeater stations). Table 9.2.2-3 indicates the supervision system.

Table 9.2.2-3 Supervision System

Duty Hour	Office	Contents of Supervision Operation
24 hours a day	TEG, SPS, CBA	• Supervision (Exchange, Transmission and DMAS) • Regular examination (Exchange, Transmission and DMAS) by remote control • Fault location • Tramsmission and subscriber loop test • Preparation of repair • Administration work of systems
Daytime 8 hours	SRC, CHO, COM, DAN, JUT	

ii) Table 9.2.2-4 indicates sections in charge of equipment supervision.

Table 9.2.2-4 Sections in Charge of Equipment Supervision

Telephone Office	Supervise Equipment	Sections or Staff in charge
TEG, SPS, CBA	Exchange	Exchange Section
	Transmission	Transmission Section
SRC, CHO, COM, DAN, JUT	Exchange	Staff in charge of Exchange
	Transmission	Staff in charge of Transmission (Staff shall be newly posted)

iii) Since no automatic warning is provided for a fault in the subscriber's terminal equipment, necessary action shall be taken upon receipt of notice from the subscribers or public telecommunications service offices.

c) Principal operation

i) Maintenance sector

* Exchange equipment (telephone offices and rural exchanges)

- Exchange maintenance
- Traffic supervision and measurement
- Updating of the subscribers data according to the opening of new subscriber lines and/or completion of transfer construction work
- Updating of the office data according to the line opening construction work, etc.
- Centralized control of maintenance supplies and repair arrangement

* Outside plant

- Optical fiber cable maintenance
- Subscriber line equipment maintenance, installation, transfer, and repair of telephone sets
- Centralized control of maintenance supplies and arrangement for repair service
- Statistics, analysis and action for faults

* Transmission equipment (telephone office and repeater station)

- Transmission and radio equipments maintenance (DMAS, MUX, etc.)
- Centralized control of maintenance supplies and arrangement for repair service
- Statistics, analysis and action for faults

* Electric power equipment (telephone office, rural exchange, and repeater station)

- Electric power equipment maintenance (batteries, air conditioners, electric power receiving equipment, solar power supplies, etc.)

- Centralized control of maintenance supplies and arrangement for repair service
- Statistics, analysis and action for faults

ii) Transportation sector

Vehicle operation during operation and maintenance

iii) Security sector

Supervision and guarding of telephone offices, newly established rural exchanges, and repeater stations

d) Staff

i) Staff posting policy

- Maintenance staff of DMAS and transmission equipment shall be newly posted at five telephone offices having no transmission personnel.
- The number of maintenance staff for the optical fiber cable, subscriber line, and telephone sets shall be increased taking into consideration the amount of equipment involved.

ii) Table 9.2.2-5 indicates the posting of staff at the telephone offices based on the staff posting policy.

Table 9.2.2-5 Posting of Staff at Telephone Office

Office	Section	Existing Staff	Necessary Additional Staff	
TEGUCIGALPA	Exchange	39	2	Total
	Transmission	23	4	
	Outside Plant	168	4	10
	Electric Power	45	–	
SAN PEDRO SULA	Exchange	30	2	
	Transmission	26	4	
	Outside Plant	102	4	10
	Electric Power	21	–	
LA CEIBA	Exchange	15	–	
	Transmission	8	3	
	Outside Plant	32	2	5
	Electric Power	5	–	
SANTA ROSA DE COPAN	Exchange	1	2	
	Transmission	–	4	
	Outside Plant	7	4	12
	Transportation	2	2	
CHOLUTECA	Exchange	6	–	
	Transmission	–	3	
	Outside Plant	4	2	7
	Transportation	2	2	
COMAYAGUA	Exchange	5	2	
	Transmission	–	4	
	Outside Plant	3	4	12
	Transportation	2	2	
DANLI	Exchange	6	–	
	Transmission	–	3	
	Outside Plant	12	2	7
	Transportation	–	2	
JUTICALPA	Exchange	2	2	
	Transmission	–	4	
	Outside Plant	2	4	12
	Transportation	–	2	
Total		568	75	75

3) Rural exchanges, radio base stations, and repeater stations

a) Maintenance classification

Employees of a maintenance telephone office shall be responsible for the maintenance of equipment at the rural exchanges, radio base stations, and repeater stations.

b) Supervision operation

Employees of a maintenance telephone office shall be responsible for the supervision by using remote supervisory and control equipment installed at the maintenance telephone office.

c) Principal operation

Employees of a maintenance telephone office shall perform the maintenance and operation.

d) Staff

Security staff shall be posted at the newly constructed radio base stations, repeater stations, and rural exchanges. The details are shown in Table 9.2.2-6.

Table 9.2.2-6 Posting of Security Staff at Exchange and Station

Division	No. of Stations	Necessary Additional Security Staff	
Rural Exchange	18 (New 18)	36	(2 Persons /Station)
Radio Base Station	13 (New 1)	2	
Repeater Station (Radio)	41 (New 33)	66	
Repeater Station (Transmission)	1	2	
Total	73	106	

4) Public telecommunications service office

a) Maintenance classification

Employees of public telecommunications service offices shall handle the public telephone and telegraph services of the related area. In addition, they shall be responsible for making simple repairs of faults to telephone sets, wiring, transmission equipment, and the exchange system (such as replacement of panels, fuses, or resetting alarm, etc.).

b) Supervision operation

Supervision of the subscriber line condition in a rural area to which a public telecommunications service office has been established.

c) Principal operation

- Public telephone control, acceptance of public telegraphs, delivery and collection of charges.
- Simple repair of faults to the subscriber line equipment and telephone sets and request for repair to the maintenance telephone office.
- Simple repair of faults to the exchange, transmission and radio equipments installed into unmanned stations, that are established in the vicinity of the public telecommunications service offices according to instruction from the maintenance telephone office.

d) Staff

Staff shall be posted according to Table 9.2.2-7.

Table 9.2.2-7 Posting of Staff at Public Telecommunications Service Office

Division	Number of Offices	Necessary Additional Staff	
Existing Public Telecommunications Service Office	182	—	Existing staff shall be trained as a rule.
New public Telecommunications Service Office	41	123	Staff shall be posted after training (3 persons/office). (Current state: 3 persons/office)
Total	223	123	

5) Table 9.2.2-8 indicates the number of staff required up to the year 2002.

Table 9.2.2-8 Number of Necessary Staff up to the year 2002

Office and Station	Phase I			Phase II	Total
	1995	1996	1997	1998 - 2000	
TEGUCIGALPA	10				
SAN PEDRO SULA	10				
LA CEIBA		5			
SANTA ROSA DE COPAN		12			75
CHOLUTECA	7				
COMAYAGUA		12			
DANLI				7	
JUTICALPA				12	
Public Telecommunications Service Office	45 (15)	33 (11)	12 (4)	33 (11)	123 (41)
Radio base station				2 (1)	2 (1)
Repeater Station (Radio)	22 (11)	12 (6)	6 (3)	26 (13)	66 (33)
Repeater Station (Transmission)				2 (1)	2 (1)
Rural Exchange	14 (7)	6 (3)		16 (8)	36 (18)
Total	108	80	18	98	304

Note: ( ) Number of offices or stations

The details of phases will be described in Chapter 10.

6) Number of main lines per employee

Number of main lines per employee for 1990 is about 20, which represents a level lower than the rest of Central and South America. The telephone penetration rate was 1,88 main lines per 100 inhabitants and the number of main lines was 92,386. In 2002, the number of main lines will reach approximately (*) 394,000. If the number of employees remains at the current level, the number of main lines per employee in the year 2002 will be improved to 91 by considering the number of subscribers in the rural areas. This figure represents a value closer to that for advanced countries. Therefore, it is desirable that the present Project is carried out with the current number of employees without new recruits. The streamlining and review of the operation including the repositioning of employees in the telegraph sector is required for better efficiency.

Table 9.2.2-9 shows the number of main lines per employee in 24 countries.

(*): This is based on the urban area telephone demand (Source: Expansion Plan 1990-1994 HONDUTEL) and rural area telephone demand (Chapter 4, of this report).

Table 9.2.2-9 Number of Main Lines per Employee in 24 Countries

Name of Country	Year	Main Lines	Employees	No. of Main Lines/Employee
India	1987	3,487,908	312,303	11.2
China	1989	5,680,400	404,460	14.0
El Salvador	1987	104,527	5,895	17.7
Honduras	1990	88,038	4,349	20.2
Philippines	1989	570,643	19,053	30.0
Guatemala	1989	158,840	5,181	30.7
Peru	1989	530,674	15,926	33.3
Brunei	1989	30,217	730	41.4
Malaysia	1988	1,247,687	28,168	44.3
Chile	1988	625,466	11,315	55.3
Thailand	1989	1,158,014	18,885	61.3
Costa Rica	1988	256,521	3,174	80.8
Brazil	1989	8,852,540	104,560	84.7
Australia	1989	7,602,572	88,003	86.4
Mexico	1989	4,702,439	49,203	95.6
Singapore	1989	981,723	10,112	97.1
United Kingdom	1987	22,137,000	223,084	99.2
Greece	1989	3,786,429	29,654	127.7
Canada	1989	13,919,840	103,010	135.1
Spain	1989	11,797,159	71,155	165.8
Hong Kong	1988	2,153,776	12,800	168.3
France	1989	26,942,452	157,313	171.3
Japan	1990	52,034,176	276,992	187.9
Korea	1989	12,003,839	53,033	226.3

Source: ITU, Yearbook of common carrier telecommunication statistics (18th edition 1980-1989) Geneva 1991

9.2.3 Training Plan

With the implementation of this Project, many radio digital multi-access systems, digital exchange systems, and other advanced equipment will be installed. To conduct smooth maintenance activities of this equipment to maintain a good quality of service, necessary training shall be provided according to the following plan:

1) Current state of training

The employee training is currently being provided at Centro de Capacitacion de HONDUTEL (CENCAPH) under the jurisdiction of Direccion de Recursos Humanos.

The training center, CENCAPH, aims at expanding the employees' knowledge for better productivity and business performance, training them to improve their engineering strength and capabilities, and controlling the training programs.

Figure 9.2.3-1 shows the outline of the training organization and the principal operation content. Table 9.2.3-1 indicates the training facilities in Tegucigalpa and San Pedro Sula and the state of the actual training. Table 9.2.3-2 shows the training state. Appendix 9.2.3-1 and 9.2.3-2 show the details of the training organization and the training course in 1991.

Figure 9.2.3-1 Outline of Training Organization

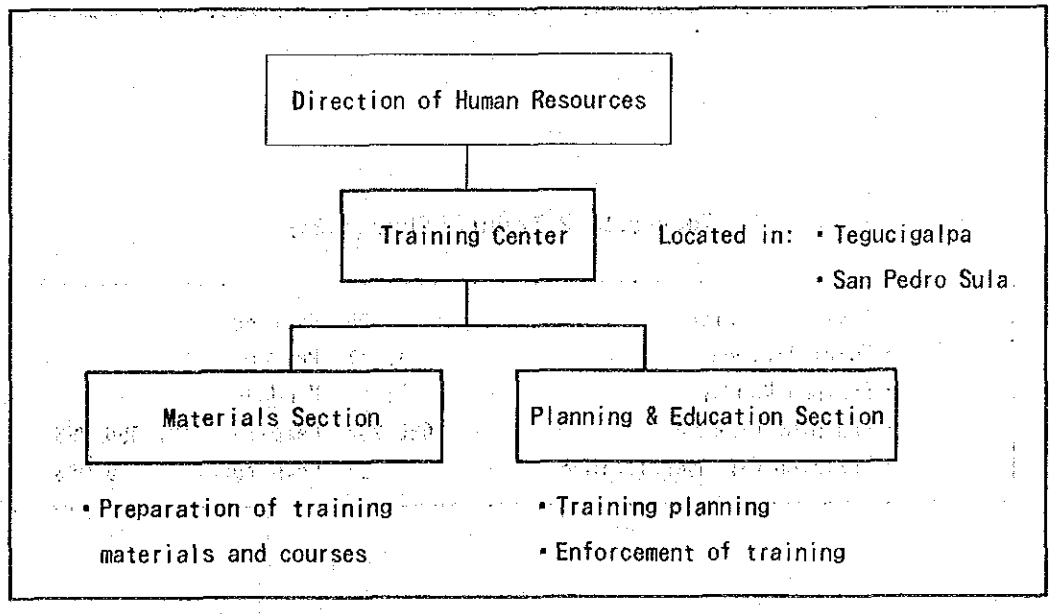


Table 9.2.3-1 Training Facilities (1992)

	Tegucigalpa Training Center			San Pedro Sula Training Center		
Training Rooms	Room	Areas (㎡)	Seats	Room	Areas (㎡)	Seats
	1	42	15	1	59	60
	2	90	61	2	30	36
	3	35	20	3	25	30
	4	29	20			
	5	37	25			
	6	37	25			
	7	39	15			
	8	94	15			
Total	8	403	196	3	114	126
Instructor (number and Specialty)	• Computer technology ····· 3 • Exchange, Transmission, Digital electronics ····· 2 • Telephone operation ····· 1 (National, International, and English) • General ····· 1 • Outside plant ····· 3 • Safety and hygiene ····· 1 • Education by correspondence ·· 1			• Exchange ····· 1 • Customer service ····· 2 Instructors and materials are arranged by Tegucigalpa Training Center		
Total	12			3		

Table 9.2.3-2 Training State (1991)

• Training Course ·····	66	Courses
• Total Trainee ·····	1,047	Persons
• Trainee Manday ·····	21,881	Mandays
• Training Expenses ·····	690,962	Lempiras (127,956 US$)
• Training Expenses/Trainee ·····	32	Lempiras (6 US$)

2) Training plan

a) Training plan preparation policy

To promote smooth operation and maintenance of newly installed equipment, the training shall be conducted according to the following policy:

i) Training of leaders

Instructors at the training center, managers in charge of operation and maintenance, and senior engineering staff shall be provided training for the leaders. Upon completion of the training, these leaders shall be responsible for training the technicians.

ii) Training of engineers

Assistant managers and chief technicians of telephone offices shall be provided necessary training for the engineers of operation and maintenance (capable of repairing complicated faults).

iii) Training of general maintenance technicians

Necessary training for routine operation and maintenance (performance of daily maintenance activities and simple repair of faults) shall be provided to the general technicians in the engineering sector of the telephone offices.

iv) Training of staff at the public telecommunications service offices

Staff of the public telecommunications service offices shall be provided with the necessary training for the simple repairing of faults of the telephone sets, exchange, transmission and radio equipments, and outside plant.

b) Training facilities

i) Classrooms

Classroom training at the training center shall be continued as is.

ii) Practical training equipment

Practical training equipment for the new technology to be introduced under the Project is not available.

iii) Instructors

Instructors shall be required to provide training for the new technology to be introduced under the Project.

Judging from the above-mentioned conditions, the contractor of the construction should provide training for the leaders and engineers of the transmission and radio equipments and exchange system. The personnel who have completed the training course should be assigned as instructors at the training center and leaders at the maintenance telephone offices.

c) Training plan

The following training shall be provided on the basis of the training plan preparation policy and taking into consideration the actual state of the training facilities. Figure 9.2.3-2 and Table 9.2.3-3 indicate the training schedule and the training implementation plan.

Figure 9.2.3-2 Training Schedule

Course Name	Training Schedule
	Start — Construction — Complete
Leaders Course	(Contractor's factory etc.) New technology, Management
Engineers Course	(Contractor's factory etc.) New technology, Operation and maintenance
General Maintenance Technicians Course	(Classroom study, Construction Work) Routing work Trouble shooting
Staff Training Course	(Classroom study, On the job training) Operation (Telephone & telegraph), Repairing method

Table 9.2.3-3 Training Implementation Plan

Course	Term	Contents	Section	Trainees	Place / Instructor
Leaders Course	3 Months	* Digital Exchange	Exchange	6	* Contractor's factory etc. / Contractor
		* Digital Multi-Access System * Optical Transmission * Optical Fiber Cable	Transmission	7	
		* Optical Fiber Cable	Outside Plant	4	* Houduras / Contractor
Engineers Cource	3 Months	* Digital Exchange	Exchange	11	* Contractor's factory etc. / Contractor
		* Digital Multi-Access System * Optical Transmission * Optical Fiber Cable	Transmission	18	
		* Optical Fiber Cable	Outside Plant	14	* Honduras / Contractor
General Maintenance Technicians Course	1 Month	* Digital Exchange	Exchange	13	* Training Center, Telephone Office / Instructor or Engineer, who finished the leaders course.
		* Digital Multi-Access System * Optical Transmission * Optical Fiber Cable	Transmission	27	
Staff Training Course	1 Month	* Outline of Rural Telecommunications Facilities * Telephone set Repairing * Tel. & Telegraph Services	Public Telecommunications Service Office	669	* Maintenance Telephone Office / Engineer who finished the leaders course or engineers course.
Total				769	

d) Number of trainees

Tables 9.2.3-4 and 9.2.3-5 indicate respectively the number of trainees of the telephone offices and public telecommunications service offices.

Table 9.2.3-4 Trainee of Telephone Offices

Course Name	Section	Training Center	Telephone Offices								Total
			TEG	SPS	CBA	SRC	CHO	COM	DAN	JUT	
Leaders Course	Exchange	2	2	2							6
	Transmission	2	2	2	1						7
	Outside Plant		2	2							4
Engineers Course	Exchange		4	4		1		1		1	11
	Transmission		5	5	3	1	1	1	1	1	18
	Outside Plant		4	4		2		2		2	14
General Maintenance Technicians Course	Exchange		5	5		1		1		1	13
	Transmission		5	5	5	3	2	3	2	2	27
Total		4	29	29	9	8	3	8	3	7	100

Table 9.2.3-5 Trainee of Public Telecommunications Service Offices

Course Name: Staff Training Course			
	Existing Offices	Newly Constructed Offices	Total
Number of Trainees (Number of Offices)	546 (182)	123 (41)	669 (223)
	(Existing Employees: 3 persons/Office)		

CHAPTER 10 IMPLEMENTATION PLAN

CHAPTER 10 IMPLEMENTATION PLAN

10.1 Division of the Areas into Some Phases

This rural telecommunications network project involves 223 rural communities which are spread over almost the whole country. Therefore, it is preferable to divide the Project into various phases, assigning an appropriate number of subject communities to each phase. The division into phase should consider the economic aspects, project implementation organization, and personnel training, etc. At the same time, regional development plans of each local area should be taken into consideration as well as the importance of each community.

The following are the points to be considered when dividing the areas.

1) Southern and south-western part

In the southern and south-western part of Honduras, such as the Departments of Choluteca, El Paraíso, Intibucá, Lempira, Ocotepeque, Copán, Valle, and La Paz, there are many development plans as follows:

a) An agricultural improvement plan has been made with aid from the European Community for a triangle zone shared by Guatemala, El Salvador and Honduras.

b) An irrigation project of 3,000 hectares for large scale agriculture in Choluteca is planned with aid from the Government of Japan.

c) An irrigation project of 6,500 hectares for small scale agriculture in Nacaome is planned with aid from the Government of Italy.

d) Shrimp farms covering 6,000 hectares will be constructed at El Triunfo in the Department of Choluteca by 1993.

e) Honduras plans to use the port of El Salvador near San Lorenzo, because the port of San Lorenzo is too small to accommodate large ships. An access road to the port of El Salvador via El Amatillo in Department of Valle and Valle is planned.

f) Gold and silver are mined at Jamastran in the Department of El Paraíso.

g) The number of people crossing the border is increasing, as conditions in neighboring countries are improved. So immigration offices at Agua Caliente

in the Department of Ocotepeque, at Guasaule in the Department of El Paraíso, and at El Amatillo in the Department of Valle need modification and expansion.

2) Northern part

In the northern part, such as the Departments of Cortés, Atlántida, Yoro, Colón, and Santa Bárbara, there are also many development plans as follows:

a) An industrial zone is being constructed in San Pedro Sula.

b) A free zone will be constructed at Puerto Cortés in the Department of Cortés.

c) A tourism project is planned at El Cajon in the Department of Cortés.

d) Agro-industry of milk, meat, fruit, and marine products, etc. is being introduced into Valle de Sula in the Department of Cortés and La Ceiba in the Department of Atlántida.

e) A port will be constructed at Trujillo in the Department of Colón.

f) A banana plantation at Alto Aguan in the Department of Colón and Zona del Platano in the Department of Colón plan to be expanded.

g) Gold and silver are mined at Quitagama in the Department of Santa Bárbara.

3) Central part

In the central part, such as the Departments of Francisco Morazán, Comayagua, and Olancho, there are development plans as follows:

a) A new airport is planned at Comayagua.

b) An irrigation project of 5,000 hectares in Comayagua is planned with aid from the Government of Japan.

c) The cultivation of corn and wheat is planned to be introduced at Guayape in the Department of Olancho with aid from the Government of Canada.

For smooth implementation in harmony with the above mentioned national projects and importance of respective areas, it is necessary to divide the Plan by Department into two(2) phases as follows:

1) Phase-I

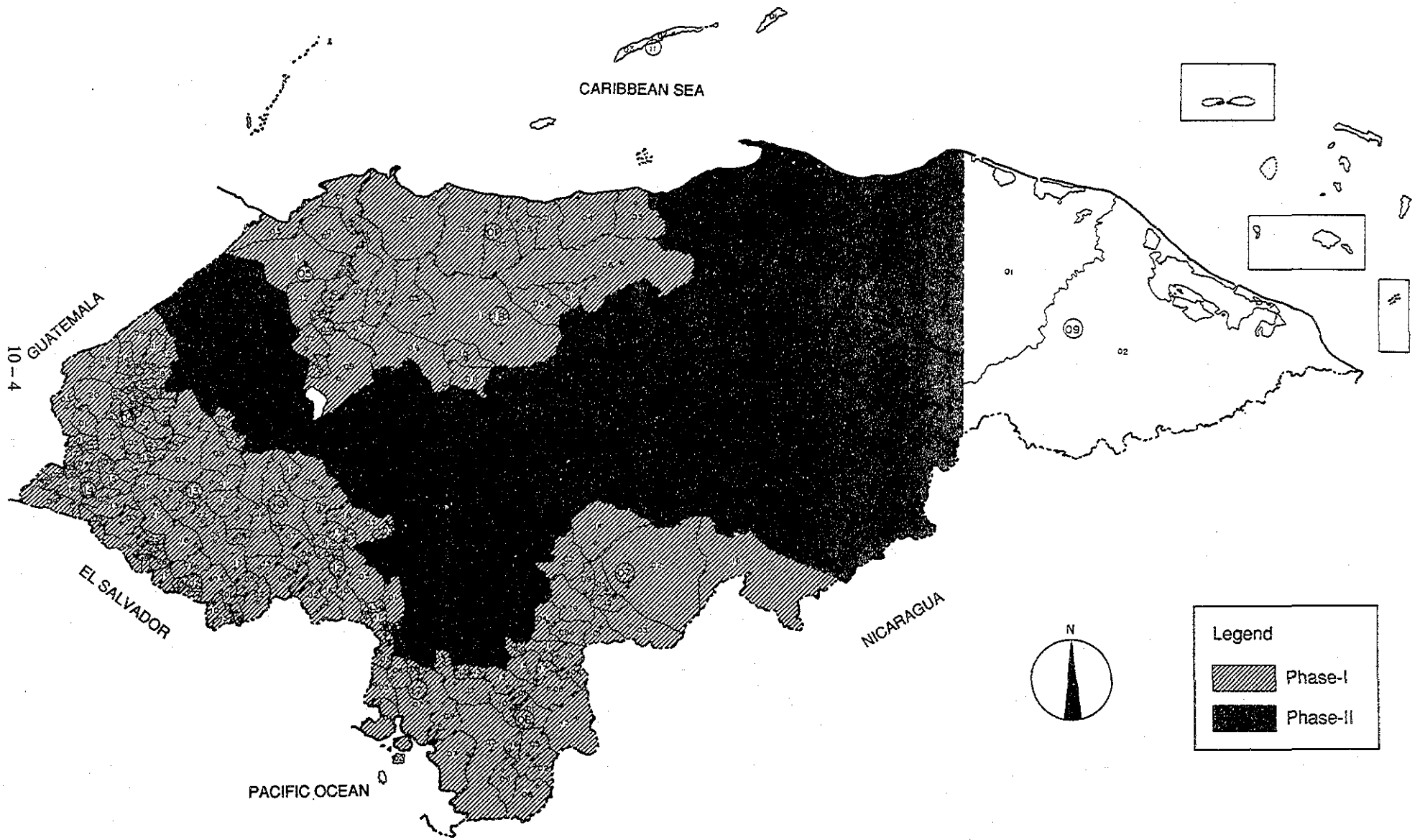
Choluteca, El Paraíso, Intibucá, Lempira, Ocotepeque, Copán, Valle, La Paz, Cortés, Atlántida, Yoro

2) Phase-II

Comayagua, Colón, Santa Bárbara,Francisco Morazán, Olancho

Figure 10.1-1 shows subject areas by phase.

Figure 10.1-1 Map of Subject Areas by Phase



10.2 Implementation Schedule

The Plan consists basically of the digital multi-access system. The following table shows the segments of the Plan divided by units of the digital multi-access system.

Table 10.2-1 Segment by the Unit of Digital Multi-Access System

No.	Segment (RBS* name)	Department	Demand in the year 2002	Number of the subject rural areas	Population of the subject rural areas
1	Yojoa	Cortés, Yoro	1,739	25	78,011
2	Portillo	Choluteca El Paraíso Valle	1,414	33	63,293
3	Horno	La Paz, Comayagua	1,543	16	40,399
4	La Ceiba	Atlántida	563	16	38,279
5	Carrizal-1	Copán	1,044	16	33,495
6	Güizayote	Lempira Ocotepeque Intibucá	831	23	29,981
7	Carrizal-2	Copán	410	7	12,326
8	Danlí	El Paraíso	540	17	53,724
9	Talanga	Francisco Morazán Comayagua	1,038	15	30,954
10	Chimizales	Santa Bárbara	1,054	23	51,622
11	Calentura	Colón	399	9	21,291
12	Juticalpa	Olancho	1,049	14	44,299
13	Hule	Francisco Morazán	466	9	10,812
Total			12,090	223	508,486

* RBS : Radio Base Station

In consideration of the regional development projects of each area and the importance of the border areas, it is assumed here to group No.1 to No.7 in Phase-I and the rest in Phase-II.

The order of the implementation is presented below, considering the benefit to the population and the development of industry in the subject areas.

(1) Yojoa

(2) Portillo

(3) Horno

(4) La Ceiba

(5) Carrizal-1

(6) Güizayote

(7) Carrizal-2

The implementation schedule is shown in Figure 10.2-1. Phase-I, and Phase-II should be completed by 1997 and 2000 respectively.

Table 10.2-2 shows the number of subscribers with service in each year based on the implementation schedule.

Table 10.2-2 Number of Subscribers in Service

Year	1995	1996	1997	1998	1999	2000	2001	2002
Number of Subscribers	1,765	3,641	4,511	6,051	7,765	9,837	10,898	12,090

10.3 Investment for the Plan

1) Preconditions in estimating investment.

The preconditions in estimating the investment for this Plan are shown below.

a) The subject facilities for estimating investment are as follows:

- The facilities between the MDF terminal of the existing exchanges and the subscriber terminal boxes are involved.

Figure 10.2-1 Implementation Schedule