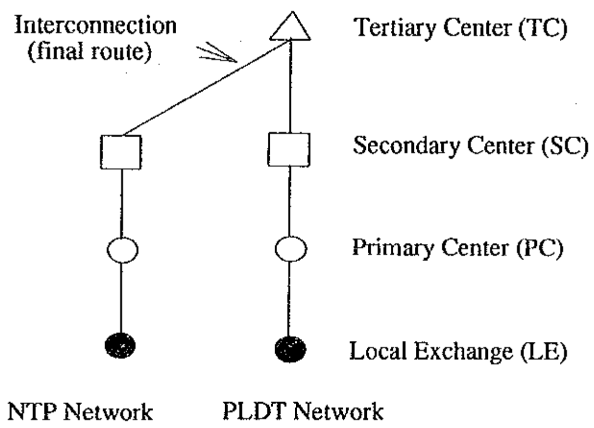
CHAPTER 11 TELECOMMUNICATIONS NETWORK PLAN

This master plan was prepared as a guideline to understanding the perspective and targets of future telecommunications and to put forth a development principle for telecommunications toward the 21st century: thoroughly forecasting the size of a single network and the investment enough to meet the supply targets through the year 2010.

11.1 Network Structure

As described in Section 5.1.1, at present, four hierarchical level structure was adopted in the telephone network. There are two nationwide toll networks in the Philippines: the Philippines Long Distance Telephone company (PLDT) network and the National Telephone Project (NTP) network. They will be connected as shown in Figure 11.1-1.

Figure 11.1-1 Network Structure



11.1.1 Optimizing the Network Structure

This study proposes an optimized national telephone network which should be a single integrated network, even though there are two nationwide networks (PLDT and NTP). Configuring a network requires understanding the needs (forecasting demand and traffic), estimating the number of required local exchanges (according to service areas and offered services), and delineating the toll exchange districts. Decisions must also be made about the number of stages, the network structure (mesh or star), the cities in which to install toll exchanges, and the direct/alternate routes.

(1) Network Structure Patterns

When determining the number of stages, it is necessary to use the number of exchanges and stages as parameters and to compare the switching system and transmission costs of several network configurations. Four network patterns (Figure 11.1-2) were selected for evaluation based on the forecasted traffic matrix in 2010.

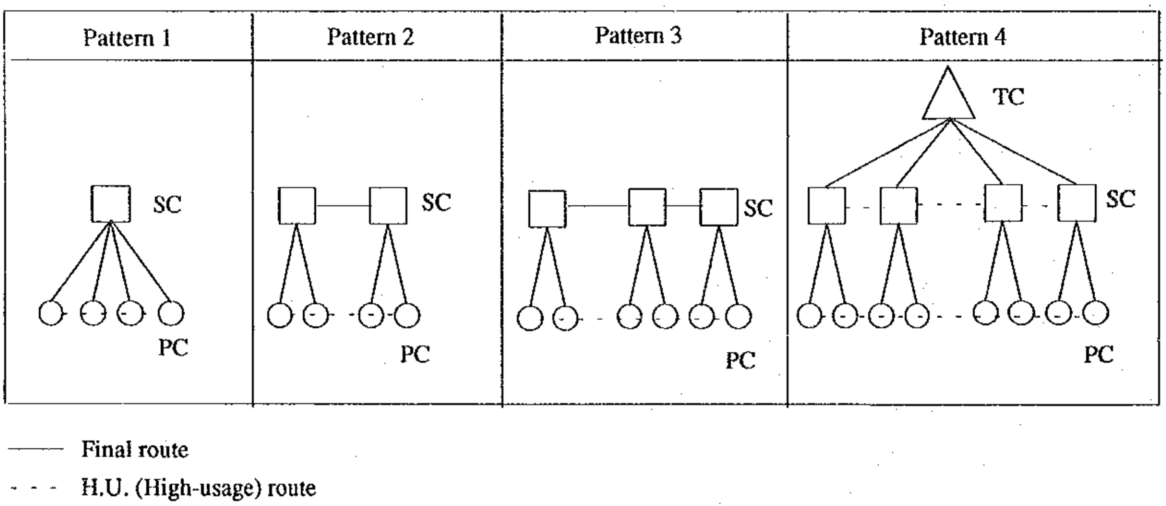
Pattern 1: Two levels of toll switching hierarchy
SC: Metro Manila
PC: 72 provincial centers

Pattern 2: Two levels of toll switching hierarchy
SC: Metro Manila and Cebu
PC: 72 provincial centers

Pattern 3: Two levels of toll switching hierarchy
SC: 12 regional centers
PC: 72 provincial centers

Pattern 4: Three levels of toll switching hierarchy
TC: Metro Manila as national center
SC: 12 regional centers
PC: 72 provincial centers

Figure 11.1-2 Network Structure Patterns



(2) Evaluation Results

Table 11.1-1 shows the comparison results. Pattern 2 is the least cost network adopted in this study, because long distance transmission costs are becoming cheaper, so distance is not a big cost factor anymore. And network decreases in number of switching system and spread of traffic concentration area and service area. In network optimization, the ease of network function development, the efficiency of operation and maintenance, and network stability have become important factors.

Table 11.1-1 Network Pattern Comparison

	Pattern 1	Pattern 2	Pattern 3	Pattern 4
Total Cost (%)	100.0	99.3	100.7	100.0
Switch (%)	100.0	100.0	100.0	100.1
Transmission (%)	100.0	98.7	101.3	100.0
Channel per km	3.63	3.57	3.67	-
Total Channels (circuits)	68,790	69,310	71,160	-

Note: Costs are compared to Pattern 1.

11.1.2 Defining Area of Telehone Network

Traffic volume tends to be higher between cities in the same administrative area. Defining local exchange areas and primary center areas that correspond to the administrative areas as much as possible will improve efficiency. The following area definitions are recommended.

(1) Local Exchange Area

Each local exchange area should generally correspond to the administrative area of a municipality. About 1600 municipalities will need to be served by 2010. For local telephone systems, local exchanges or remote exchanges should be installed based on demand in the area.

(2) Primary Center Area

Each primary center area should generally correspond to the administrative area of a province. Seventy-two primary centers are proposed by 2010, (Table 11.1-2). Homing of local exchanges to their respective primary center is based on established criteria such as proximity to existing transmission media, economics, community of interest, and other optimization aspects.

(3) Secondary Centers

Manila and Cebu are classified as secondary centers. Manila is the center of Luzon island and serves as the transit point to the south. Cebu is the center of the southern Philippines and serves as the transit point from the Visaya and Mindanao exchanges to Luzon.

11.2 Routing Plan

11.2.1 Routing Method

There are usually several possible switching routes between subscribers or between exchanges through transit exchanges. Routing involves selecting the most economical and efficient route, based on the following conditions:

- returns or loops should not exist between exchanges,
- the selection process and control procedure should be simple,
- the circuit should be efficiently used,
- equipment should not be unused, and
- network design and management should be easy.

11.2.2 Selection of the Routing Method

There are several possible routing methods, including fixed routing, alternative routing, and dynamic routing.

Table 11.1-2 Proposed Primary Centers

1998		2004		2010	
Baguio City	Butuan City	Baguio City	Cebu City	Bangued	Kalibo
Laoag	Prosperidad	Laoag	Dumaguete City	Baguio City	San Jose
Vigan	Malaybalay	Vigan	Tacloban City	Laoag	Roxas
San Fernando	Ozamis City	San Fernando	Catarman	Vigan	Iloilo City
Dagupan City	Cagayan de Oro City	Dagupan City	Maasin	San Fernando	Bacolod City
Tuguegarao	Surigao City	Tuguegarao	Catbalogan	Bontoc	Tagbilaran
Ilagan	Tagum	Ilagan	Isabela	Dagupan City	Cebu City
Bayombong	Davao City	Bayombong	Jolo	Tuguegarao	Dumaguete City
Balanga	Mati	Balanga	Bangao	Lagawe	Siquijor
Malolos	Gen.Santos City	Malolos	Dipolog City	Ilagan	Borongan
Cabanatuan City	Tandag	Cabanatuan City	Zamboanga City	Tabuk	Tacloban City
San Fernando	Iligan City	San Fernando	Butuan City	Bayombong	Catarman
Tarlac	Marawi City	Tarlac	Prosperidad	Cabarroguis	Maasin
Subic	Cotabato City	Subic	Malaybalay	Balanga	Catbalogan
Manila	Kidapawan	Manila	Ozamis City	Malolos	Isabela
Batangas City		Baler	Cagayan de Oro City	Cabanatuan City	Jolo
Cavite City		Batangas City	Surigao City	San Fernando	Bangao
Calamba		Cavite City	Tagum	Tarlac	Dipolog City
Boac		Calamba	Davao City	Subic	Zamboanga City
San Jose		Boac	Mati	Manila	Butuan City
Calapan		San Jose	Gen.Santos City	Baler	Prosperidad
Puerto Princesa City		Calapan	Tandag	Batangas City	Malaybalay
Lucena City		Puerto Princesa City	Iligan City	Cavite City	Mambajao
Legaspi City		Lucena City	Marawi City	Calamba	Ozamis City
Naga City		Romblon	Cotabato City	Boac	Cagayan de Oro City
Sorsogon		Legaspi City	Kidapawan	San Jose	Surigao City
Kalibo		Daet	Isulan	Calapan	Tagum
Roxas		Naga City		Puerto Princesa City	Davao City
Iloilo City		Masbate		Lucena City	Mati
Bacolod City		Sorsogon		Romblon	Gen.Santos City
Tagbilaran		Kalibo		Legaspi City	Tandag
Cebu City		San Jose		Daet	Iligan City
Dumaguete City		Roxas		Naga City	Marawi City
Tacloban City		Iloilo City		Virac	Cotabato City
Dipolog City		Bacolod City		Masbate	Kidapawan
Zamboanga City		Tagbilaran		Sorsogon	Isulan
51		63		72	

(1) Fixed Routing

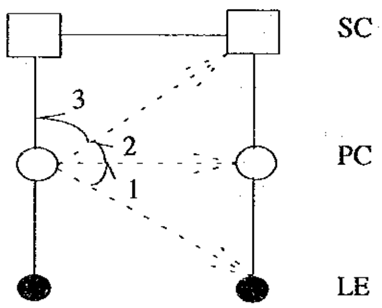
Fixed routing defines only one route between the originating and terminating exchanges. Because this method is easy to control and does not have a store-and-forward function, it is applied to older switches (step-by-step systems). This method, however, is limited in its route selection and is inflexible when dealing with circuit failures. Therefore, it is not considered in this study.

(2) Alternative Routing

With alternative routing, when the primary route circuits are all busy, an alternate route is selected (Figure 11.2-1). If the second route is also busy, another alternative route is selected. This process repeats until an available route is found, or until the last route is found to be busy and the call is dropped. This method is effective for implementing the store-and-forward function. Accordingly, it is applied to crossbar and SPC systems.

As shown in Figure 11.2-1, the route to the furthest exchange from the originating exchange is selected first (the route with the fewest transit exchanges). If this route is busy, the second furthest route is selected. This "far-to-near rotation" method is used in the Philippines.

Figure 11.2-1 Far-to-near Rotation



(3) Dynamic Routing

While in dynamic routing, the route is usually fixed, it is flexible depending on congestion and the busy period for point-to-point traffic. An SPC switching system can handle dynamic routing automatically, enabling economical network configuration and improving the circuit traffic capacity .

NTT is testing this method in Japan. To take full advantage of dynamic routing, it is necessary to consider:
- a circuit calculation that will suitable for dynamic routing,
- a way to transmit and receive traffic network information using CCS No. 7, and
- a call routing algorithm.

The PLDT is proposing a non-hierarchical routing scheme for its toll network.

11.2.3 Optimization of Routing Plan

(1) Toll Network Routing

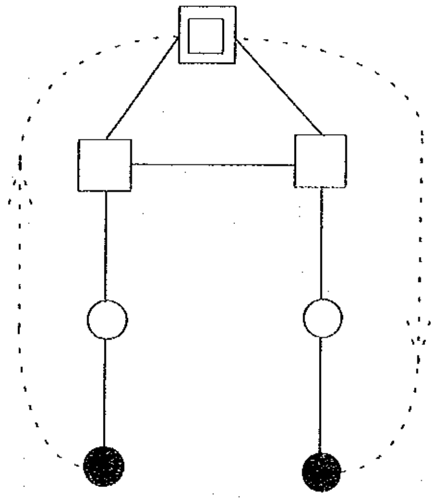
Alternative routing and far-to-near rotation are proposed for the toll network routing plan. Three switching levels are recommended: secondary centers, primary centers, and local exchanges. High-usage routes (direct routes) can be used to interconnect different toll centers in any of the following arrangements: SC-LE, SC-PC, PC-LE, PC-PC, or PC-SC. High-usage routes are used if the traffic volume between two exchanges is sufficiently high and alternative routing is available. In this study, high-usage routes between SCs and LEs and between PCs and LEs are not provided. Specific conditions for high-usage routes are listed in Section 11.9.

(2) International Network Routing

International switching centers (INTS: International Transit Switch) are located at Sampaloc and Machete in Metro Manila. There is a plan to install another one at Cebu in future.

The international switching centers are located at the top of the toll network, as shown in Figure 11.2-2. International calls must pass through an LE, a PC, and an SC, except for calls from or to Metro Manila LE, because in Metro Manila, each LE has direct rout to INTS.

Figure 11.2-2 International Routing Plan



Note: Direct route is provided between Manila LEs and INTS center.

11.3 Switching Plan

The required switching capacity of a telecommunications facility depends on demand, the traffic forecast, and the supply plan. It can be limited by the size of the building. This section describes the recommended switching plan for expanding the telecommunications network.

11.3.1 Toll Switching System

The recommended toll switching system is based on the following conditions:

(1) Toll switching centers are primarily located in provincial capitals. The planned toll switching centers (primary centers) as of 2010 are listed in Table 11.3-1.

(2) Toll switching system is not located in a province with traffic demand below 4000 erlangs. Instead, toll traffic is routed to a toll switching system in an adjacent province.

(3) The toll switching systems are categorized into two types: only toll switching and toll switching combined with local switching.

Table 11.3-1 Switching Centers as of 2010 (Primary Centers)

Region	Provinces	Municipality	Region	Province	Municipality
1	ABRA	Bangued	6	AKLAN	Kalibo
1	BENGUET	Baguio City	6	ANTIQUE	San Jose
1	MT.PROVINCE	Bontoc	6	CAPIZ	Roxas
2	IFUGAO	Lagawe	6	ILOILO	Iloilo City
2	KALINGA APAYAO	Tabuk	6	NEGROS OCCIDENTAL	Bacolod City
1	ILOCOS NORTE	Laoag	7	BOHOL	Tagbilaran
1	ILOCOS SUR	Vigan	7	CEBU	Cebu City
1	LA UNION	San Fernando	7	NEGROS ORIENTAL	Dumaguete City
1	PANGASINAN	Dagupan City	7	SIQUIJOR	Siquijor
2	CAGAYAN VALLEY	Tuguegarao	8	EASTERN SAMAR	Borongan
2	ISABELA	Ilagan	8	LEYTE	Tacloban City
2	NUEVA VISCAYA	Bayombong	8	NORTHRN SAMAR	Catarman
2	QUIRINO	Cabarroguis	8	SOUTHERN LEYTE	Maasin
2	BATAAN	Balanga	8	WESTERN SAMER	Catbalogan
3	BULACAN	Malolos	9	BASILAN	Isabela
3	NUEVA ECIJA	Cabanatuan City	9	ZAMBOANGA DEL NOR.	Dipolog City
3	PAMPANGA	San Fernando	9	ZAMBOANGA DEL SUR	Zamboanga City
3	TARLAC	Tarlac	10	AGUSAN DEL NORTE	Butuan City
3	ZAMBALES	Subic	10	AGUSAN DEL SUR	Prosperidad
3	AURORA	Baler	10	BUKIDNON	Malaybalay
4	BATANGAS	Batangas City	10	CAMIGUIN	Mambajao
4	CAVITE	Cavite City	10	MISAMIS OCCIDENTAL	Ozamis City
4	LAGUNA	Calamba	10	MISAMIS ORIENTAL	Cagayan de Oro City
4	MARINDUQUE	Boac	10	SURIGAO DEL NORTE	Surigao City
4	OCCIDENTAL MINDORO	San Jose	11	DAVAO DEL NORTE	Tagum
4	ORIENTAL MINDORO	Calapan	11	DAVAO DEL SUR	Davao City
4	PALAWAN	Puerto Princesa City	11	DAVAO ORIENTAL	Mati
4	QUEZON	Lucena City	11	SOUTH COTABATO	Gen.Santos City
4	ROMBLON	Romblon	11	SURIGAO DEL SUR	Tandag
4	NCR(RIZAL)	Manila	12	LANAO DEL NORTE	Iligan City
5	ALBAY	Legaspi City	12	NORTHERN COTABATO	Kidapawan
5	CAMARINES NORTE	Daet	12	SULTAN KUDARAT	Isulan
5	CAMARINES SUR.	Naga City	9	SULU	Jolo
5	CATANDUANES	Virac	9	TAWI-TAWI	Bangao
5	MASBATE	Masbate	12	LANAO DEL SUR	Marawi City
5	SORSOGON	Sorsogon	12	MAGUINDANAO	Cotabato City

11.3.2 Local Switching System

Each municipality has one local exchange. The type of the local switching system is defined as follows:

Type of Switching System	Capacity (Lines)
Local Switching system (LS)	Over 3000
Remote Switching Unit (RSU)	301 to 2999
Remote Line Unit (RLU)	Less then 300

11.4 Numbering Plan

11.4.1 General Considerations

Numbering is used for the following purposes;

- connecting to called subscriber,
- controlling networks to receive specific service,
- identifying charging system.

The numbering plan should be logical and based on the following considerations.

(a) It should remain unchanged for a very long time. It must have sufficient numbering capacity to accommodate demand increases over the next 50 years or longer, as well as such new services as cellular telephones.

(b) The same number should be usable throughout the country to call a subscriber, regardless of the location of the calling party.

(c) It should be simple and easy to use. The number length should be reduced as much as possible, because a length that exceeds the maximum length recommended by the ITU would preclude international calling. A fixed dialing procedure should be applied regardless of location.

The following guidelines should be followed, in line with ITU Recommendations E.160 to 167.

(a) "0" should preferably be used for the trunk prefix.

(b) "00" should preferably be used as the international prefix.

(c) The number of digits used for an international number should be 12 or fewer. (for ISDN, it should be 15 or fewer (ITU Recommendation E.164) and it is after 31 December 1996 at 23:59 Coordinated Universal Time: UTI).

(d) The country code should consist of one to three digits.

11.4.2 Classification of Numbering

(1) Types of Numbers

Types of numbers can be divided into the following categories:

0ABC:	mainly for connection to another subscriber (including ABC type for local call),
1XY :	special services for all telephone users, and
*XY and #XY	special services for push button telephone users with push button dialing signal.

(2) Types of Services

Telecommunication services can be classified as follows:

(a) Extended connection area, including connection to other networks (0 A B C type),
e.g., connection to outside local area: (0 + trunk code),
to cellular telephone network: (0 + 9x).

(b) Supplementary service (1XY, *XY, #XY),
e.g., directory assistance (114), Auto Collect Call (105)

(c) Information processing service after connection by sending a dialing signal through the telecommunication network to a computer terminal,
e.g., remote computing service by using a push button dial phone,
seat reservation service by using a push button dial phone

(d) Others
e.g., one idea is to select a speed in future B-ISDN, such as 64 Kb/s or 2 Mb/s.

Item (c) is for using services after connection is made. While it is also a kind of service using phone dialing, it is outside of the numbering scheme. Table 11.4-1 shows the current principle of code allocation in the Philippines.

Table 11.4-1 Number Allocation Scheme

<table>
<tr><th>A \ B</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>0</th><th>*</th><th>#</th></tr>
<tr><td>1</td><td colspan="10">Special service codes and carrier access codes (1XY type)</td><td colspan="2" rowspan="10">Special service for push bottun signaling terminal</td></tr>
<tr><td>2</td><td colspan="10" rowspan="8">Subscriber number for local calls
(xxx xxxx)</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td></tr>
<tr><td>0</td><td colspan="9">Trunk calls and Mobile telephone calls
(0+xx xxx xxxx)</td><td>00</td></tr>
<tr><td>*</td><td colspan="12" rowspan="2">Activate/deactivate special features of stored program control switching system</td></tr>
<tr><td>#</td></tr>
</table>

A: first digit to be dialed
B: second digit to be dialed
00: International call prefix

11.4.3 0ABC Numbering

Since "0" is used as the trunk prefix, a call beginning with "0" is connected to a trunk (toll) switching center to be connected outside of the local area. If the national number is expressed as a letter A,B,C,D,----, "A" represents a regional area and "AB" represents each province generally.
The national number consists of the trunk (area) code followed by the subscriber number. It will not exceed ten (10) digits based on the NTC plan. It is a reasonable scheme considering the national population and it meets ITU standards.

On the basis of NTC plan, the trunk (area) code identifies areas coincident with provincial boundaries. Trunk (area) code assignments are in accordance with the national numbering plan:

- one digit code for Metro Manila and Rizal, and
- two digit codes for provincial numbering plan areas.

The two digit codes generally include numbering in the series 3N" to "9N", where N is any digit from 2 to 9. The trunk (area) code allocation is shown in Table 11.4-2.

Table 11.4-2 Trunk (Area) Code Allocation (Up to 2011)

	A \ B	1	2	3	4	5	6	7	8	9	0
0	1										
	2		Metro Manila, Rizal Province								
	3		Cebu	Iloilo	Negros Occidental	Negros Oriental, Siquijor	Capiz, Aklan	Antique	Bohol		
	4		Quezon, Marinduque	Batangas	Nueva Ecija, Aurora	Pampanga, Tarlac	Occidental Mindoro, Oriental Mindoro, Romblon	Zambales, Bataan	Palawan		
	5		Albay, Catanduanes, Burias Island	Leyte, Southern Leyte	Camarines Norte, Camarines sur	Northern Samar	Sorsogon, Masbate	Western Samar	Eastern Samar		
	6		W. Zamboanga del Norte, W. Zamboanga del Sur, Basilan,	Lanao del Norte, Lanao del Sur	Maguindanao, Western North Cotabato, Western Sultan Kudarat	E. Zamboanga del Norte, Misamis Occidental	E. Zamboanga del Sur	E. North Cotabato, Eastern Sultan Kudarat	Sulu, Tawi-tawi		
	7		La Union	Nueva Vizcaya, Ifugao	Benguet, Mountain Province	Pangasinan	Isabela, Quirino	Ilocos Norte, Ilocos Sur, Abra	Cagayan, Batanes	Kalinga-Apayao	
	8		Davao del Sur, Samal Island	South Cotabato	Davao del Norte	Agusan del Norte, Agusan del Sur	Surigao del Norte, Surigao del Sur	Davao Oriental	Misamis Oriental, Bukidnon, Camiguin		
	9		Laguna				Cavite	Bulacan (Mobile Tel)			Mobile Telephone Service
	0	International Call									

☐ Allocation area for trunk code

(source:PLDT)

NTC plan for allocating trunk codes beyond the year 2011 is shown in Table 11.4-3. The country is divided into seven numbering plan areas (NPAs). Each area has its own closed numbering scheme. The NPA code is one digit. This approach helps avoid an unbalanced allocation of numbering capacity between provinces, which extends the life of the numbering scheme.

Table 11.4-3 Trunk Code Allocation (beyond 2011)

		1	2 -- 9	0
	1			
	2		Metro Manila, Rizal, Bulacan, Cavite, Laguna	
	3		Western Visayas, Central Visayas	
	4		Central Luzon, southern Tagalog	
0	5		Bicol, Eastern Visayas	
	6		Western Mindanao, Misamis Occidental, Southwestern Mindanao	
	7		Ilocos, Cagayan Valley	
	8		Northern Mindanao, Southern Mindanao	
	9			
	0	International country codes		

Source: PLDT

11.4.4 1XY Numbering

Table 11.4-4 shows PLDT's current 1XY code allocation. Codes are allocated logically; for example, the 17Y series is used for operation and maintenance services. This makes it easy for users to understand and enable more economical route setting at the switching center. For special services, there are two broad types of 1XY numbering.

(a) 1XY

connect to

i) operator desk e.g., dial assistance, inquiry

ii) operation and maintenance desk e.g., complaints, service orders

iii) special service equipment

e.g., weather forecast message service

Table 11.4-4 1XY Code Allocation of PLDT

	X	Service Group \ Y	1	2	3	4	5	6	7	8	9	0
1	1	Special Service		DDD/ISD Inquiry		Directory Assistance						
	2	Spare										
	3	Spare										
	4	Spare										
	5	Special service										PILTEL Paging service
	6	Special service							CAPCOM/ Metrodiscom (PNP)			
	7	Operation and Maintenace Service			Repaire/ Complaints	Repair Dispatch	Installer dispatch	Inspector (test)/ Wire Chief				Dial Speed Test (for SXS)
	8	Special service										1800: USA Toll Free Service (Plan)
	9	Special use										
	0	Special Service					Autodirect Collect Calls			Operator Assistance (Overseas)	Operator Assistance (Domestic)	Reverting call

(b) 1XY + xxxxx (supplementary information)
connect to service equipment and then send complement information to the equipment to specify or complete the service
e.g., auto direct collect call (PLDT service)
to America: 105 + 1 xxx xxx xxxx
to Japan: 105 + 81 xx xxx xxxx

In the 1XY coding scheme, codes should be allocated in logical groups to make them understandable to users and to settle simple network routing. Furthermore, they should be consistent nationwide so that users can use the same code in any network.

11.4.5 "*" and "#" Numbering

These symbols can be used by push button telephone users with a push button dial signal. The signal passes through the network to the other party, enabling telephone-to-computer communications. (reference: ITU Recommendation E-131: Subscriber control procedures for supplementary telephone services).
Ideas being considered include:

automatic credit call:	#XY + credit number + secret number + calling telephone number + called number
Message service:	#XY + identification number + secret number + message by voice
Call transfer:	#XY + telephone number to transfer to

The "*" can be used to separate blocks of supplementary information.

11.5 Signaling Plan

Signaling in the public switched telephone network (PSTN) in the Philippines consists of three types, Decadic Pulsing with loop disconnected decadic E&M signaling between non-SPC switching systems in the local and toll networks; MFC R2 signaling between analog SPC switching systems; and Common Channel Signaling No. 7 between local and toll digital switching systems.

(1) Common Channel Signaling System

A common channel signaling system has the following features in comparison with a conventional signaling system.

(a) High speed signal transmission
Dialed information is transmitted at a higher speed than with a channel associated signaling system, because a 4.8 Kb/s or 48 Kb/s data link is used to receive and transmit the signals.

(b) Signal transmission during conversation
Signals can be transmitted in both directions, even during a conversation, because, the speech circuits are separated from the signaling circuits.

(c) Wide variety of signals and a large signaling capacity
In a channel associated signaling system, signal variations, such as in the seizing signal, answer signal, and clear-forward signal, are dependent on the combination of on/off signals and the status of a call, thus precluding many additional signal variations. In the common channel signaling system, there are a wide variety of signals and a large signaling capacity, because signals are expressed in bit strings and because signals can be transmitted at high speed.

(d) Both way speech circuits operation
The speech circuits can be used both ways because they do not have a signaling function. Circuit efficiency is thereby improved.

(2) Common Channel Signaling System Configuration

In a common channel signaling system, the speech circuits are physically separated from the signaling circuits. Consequently, they do not need to follow the same routing. A common channel signaling network therefore has an associated mode and a non associated mode of operation.

(a) Associated mode of operation

In the associated mode of operation, signaling circuits are associated with speech circuits. This facilitates the signal to control the associated speech circuits.

(b) Non associated mode of operation

In the non associated mode of operation, signaling circuits are separated from the speech circuits. Signaling is relayed to the terminating exchange along a separate route than that for the speech. Complicated control is thus needed to associate speech circuits with their signals. The advantage is that it eliminates the need to set up a signal path for each inter-exchange speech circuit, thus making signaling circuits more economical.

PLDT uses a non associated mode of operation and has implemented CCS No. 7 in 21 toll switching centers and 16 local exchanges. There were 6 signal transfer points (STP) for the whole country as of December, 1992.

(3) Selection Procedures

PLDT is expanding its common channel signaling networks of CCS No. 7. When selecting a signaling system, it is necessary to consider not only the signaling systems requirements, but also the configuration and size of the communication network. Ideally, signals should be completely standardized for the entire network, and this should conform to the standard system recommended in the ITU No. 7 Common Channel Signaling System. However, other systems exist such as the MFC R2 signaling system, therefore, interfacing with these other systems is required.

These signaling system has a very close relationship with the switching systems. This is why the selection of switching systems requires consideration of long-term conditions.

11.6 Synchronization Plan

This plan defines the synchronization characteristics for the national telecommunications network. Proper synchronization ensures satisfactory communications between any two locations within the Philippines or between the Philippines and any country where ITU recommendations are being used for digital telecommunications.

Network synchronization plays a key role in establishing a high-quality digital telecommunications network. Network synchronization is indispensable in providing high-speed digital leased circuits or ISDN services and for connecting digital lines internationally.

(1) Synchronization Method

PLDT has adopted master-slave synchronization method. It uses a cesium-beam oscillator located at the Makati toll and international center. The clock timing signal is distributed from the master station to the other offices, called slave offices, according to the clock distribution hierarchy via 2-M b/s interconnection links.

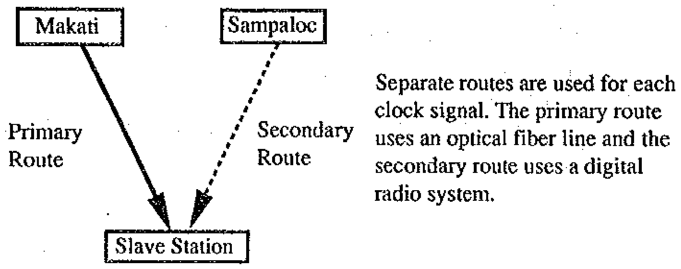
(2) Reliability

The clock signal has to be highly accurate and highly stable. Two techniques are needed to do this.

(a) Two reference sources and two routing

Two reference sources and two routing paths should be provided. In the PLDT network, the slave stations simultaneously receive a primary clock signal from Makati and a secondary clock signal from Sampaloc. However, the government network receives only one clock signal from Sampaloc. This does not provide sufficient reliability. The government network should also receive a secondary signal from Makati. Furthermore, the clock signals should be conveyed over different routes as shown in Figure 11.6-1.

Figure 11.6-1 Configuration of Sources and Routing for Clock Signal



In this study, double routing is used for all circuits (clock signal, common carrier signal, and public). A detailed description of the double routing method is included in the transmission network plan in Section 11.10.

Priority of the clock signal accommodation plan is as follows:

i) Link diversity --- to accommodate circuits in a different link.

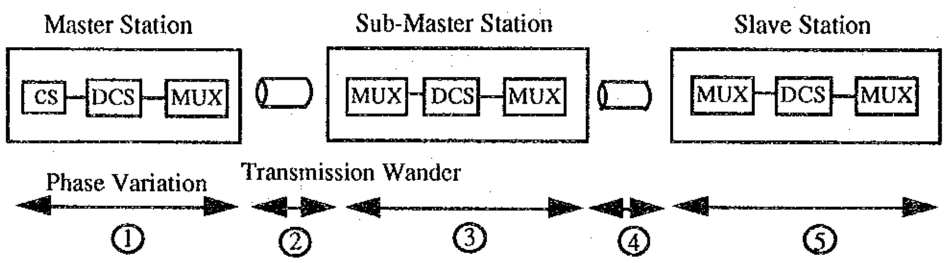
ii) Media route diversity --- to accommodate circuits in a different medium.

iii) System diversity --- to accommodate circuits in a different system.

(b) Error

The maximum time interval error (MTIE) between sending and final reception should not exceed 10 μs according to ITU Recommendation G.823. The links involved in the transmission route are shown in Figure 11.6-2.

Figure 11.6-2 Time Signal Transmission Linkage



MTIE=10 μ≥ ① + ② + ③ +④ +⑤

CS: Cesium-beam oscillator

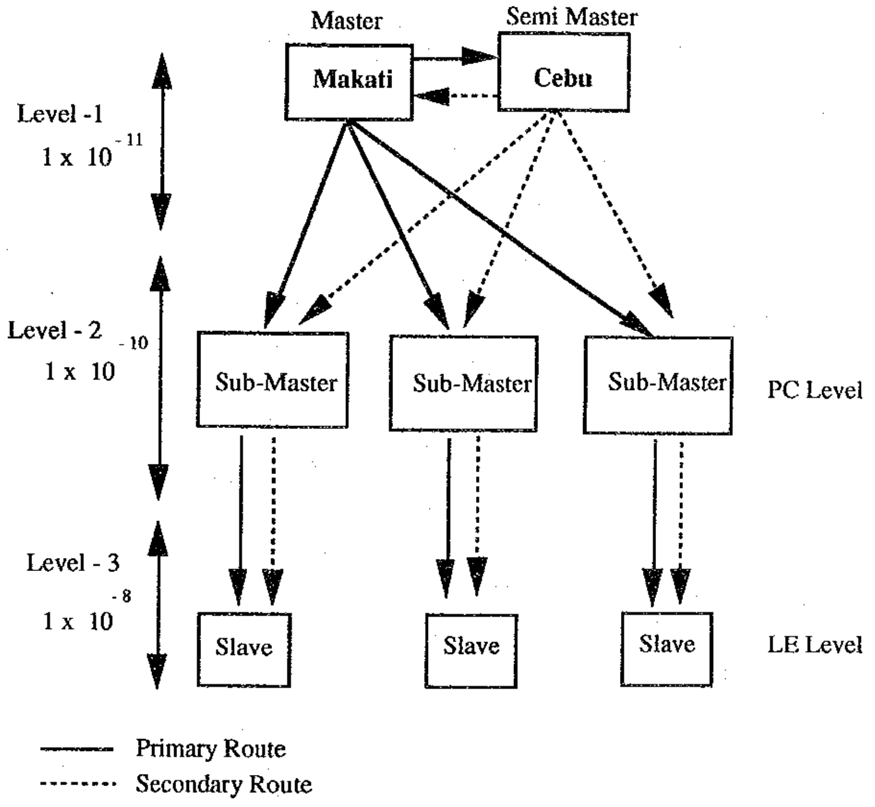
DCS: Digital Clock Supply Equipment

MUX: Multiplexer

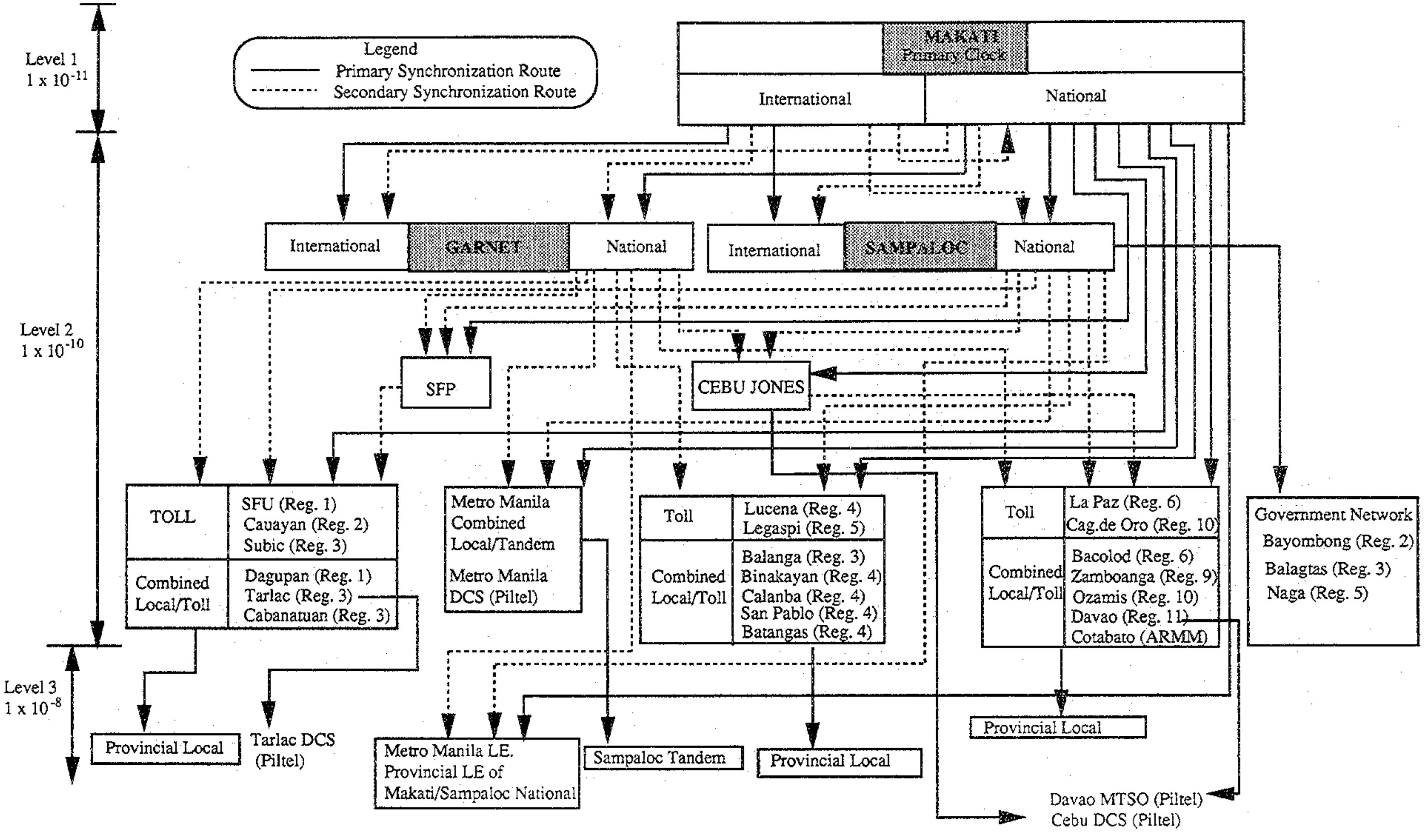
(3) Synchronization Network Plan

PLDT has already implemented a network synchronization plan, since both clocks are with its primary clock and its secondary clock at Sampaloc (Figure 11.6-3).
In Manila, if a disaster strikes, all telecommunications will be shut down. We therefore recommended installing another primary clock in Cebu. The proposed synchronization plan for the integrated network is shown in Figure 11.6 - 4.

Figure 11.6-4 Proposed synchronization Plan for Integrated Network



11.6 - 3 PLDT's Planning Synchronization Network



11.7 Interconnection Plan

Executive Order No. 59: "Mandating Interconnection" and Memorandum Circular No. 9-7-93: "Implementing Guidelines on the Interconnection of Authorized Public Telecommunications Carriers" specify the interconnection requirements..

11.7.1 Interconnection Strategy

(1) Basic Ideas

Generally, telecommunication networks are constructed so as to be economical to operate and convenient to use.

In the Philippines, many private companies supply services to limited franchise areas. There are several points that should be considered related to this.

(a) Economical points

i) Network scale

Networks that are too small are not economical to operate.
For small towns, it may be better to use a RSU (Remote Switching Unit) or RLU (Remote Line Unit) connected to a host switching system in a near by big city. In practice, however, many operators have an individual local switching system in only a small area, and may sometimes use a PABX instead of a local switching system. Each operator should have a franchise area with more than a few thousand subscribers capable of supporting an economical network using RSU or RLU.

ii) RSU or RLU for small service areas

For economic reasons, it is desirable for a small independent local operators to have an RSU that is interconnected to another operator's host switching system through a contract base. There should be no technical problems in doing this. Introducing RSUs have several advantages:

- More economical than individual local switching systems,
- New services can easily be added by changing or adding the function in only the host switching system, and

- economical to maintain because of the centralized supervising system in the host switching system.

(b) Technical points

(i) Eliminating PABX local switching

As mentioned, several local operators use PABX systems as a local switching system. While old PABX systems require less investment, they present several problems:

- difficult to connect incoming calls automatically,
  The operator has to answer incoming calls and they transfer them to the requested extensions (which are the subscribers).
- difficult to introduce CCS No. 7,
- difficult to supply new services, especially intelligent network services
- difficult to connect pay telephone sets,
- no multiple interoffice connection to PCs and other LEs.
- difficult to introduce a centralized charge control system, which is normally located in the PC,

While new digital PABXs can provide all of the functions of a local switching system, they cost more or about the same as a local switching system.

It is not recommended to use a PABX as a local switching system for future enhanced information era.

ii) Maintaining service

MC No. 9-7-93 states that each interconnected carrier shall provide interconnecting facilities up to the main distribution frame (MDF) for each local exchange carrier with 5000 exchange lines or less in the carrier's area. For local exchange carriers with more than 5000 exchange lines, the transmission links and terminating facilities needed to effect interconnection shall be provided by each interconnecting party in accordance with the traffic requirements of each. In the former case, it is clear that the interconnection point is the MDF of the local exchange carrier. While in the latter case, the interconnection point is decided upon by both parties.

MC 9-7-93 requires each operator to maintain his equipment up to the interconnection point. They are responsible for maintaining the quality of their interconnection equipment.

(c) User convenience points

i) Nationwide fixed numbering
A fixed standardized dialing procedure should be applied to facilitate user access regardless of interconnection matters.

ii) Uniform tariff structure
A uniform nationwide tariff structure is needed to avoid user's confusion.

(2) Introduction of Metering System between Interconnection Circuits

A metering system for interconnection calls is needed to ensure that revenues are fairly shared among operators. Meters should be installed on one ,or better, on both sides of each interconnection. By accumulating the charged units for calls passing through the interconnection circuits, revenues can be fairly shared.

11.7.2 Volume of Interconnection Circuits

As mentioned in section 5.2.2, most local operators complaint about insufficient interconnection circuits. Determining how many circuits is sufficient is the problem. It should be based on the accurate traffic data. MC No. 9-7-93 states that the party requesting interconnection must submit to the other party a complete traffic forecast (for at least five years), with routing before interconnection and after interconnection, both parties should review this traffic forecast to determine how many interconnection circuits are needed. The circular does not mentioned how traffic volume should be determined, but this is the key factor. One way to estimate traffic volume is as follows.

(1) Forecasting Traffic before Interconnection

There are two types of interconnections: LE to PC of PSTN and LE to Host LE.

PC to PC is available, but it is not common.

(a) Forecasting calling rate to/from outside LE

The local operator starts by estimating the actual subscriber calling rate (CR), including toll calls. If the local area data is insufficient, the data of neighboring local exchange of about the same scale can be used.

Next, the local operator forecasts the calling rate for traffic to/from outside the LE (TR). This forecasts should be based on the same data that was used to estimate the subscriber calling rate.

(b) Determining required number of interconnection circuits

The traffic to /from outside the LE (TT) is

TT = CR x (The number of subscribers in the LE) x TR.

A simple way to get the number of interconnection circuits required is to use the "table of the erlang loss formula" which is widely available.

(c) Determining traffic volume with routing outside PC

As before, if local area data is insufficient, the data of a neighboring, similar conditions LE can be used. If it is difficult to get the data for interconnection to the PSTN from a neighboring LE, the traffic matrix for the nearest year, calculated using the gravity model, in this report, can be used. The traffic rate in each direction i (RDi) against the total traffic volume to/from outside the PC can then be calculated.

The traffic volume in direction "i" (TDi) is calculated as follows:

TDi = TT x RDi,

where, RDi is the traffic volume in the "i" direction to/from the PC divided by the total traffic volume to/from the PC.

(2) Forecasting Traffic after Interconnection

MC No. 9-7-93 says that both interconnecting parties should share forecasted switching traffic data on a semi-annual basis to facilitate allocation of facilities, --(skip)-- and provide additional circuits based on traffic measurements and studies covering a period of 30 days, conducted separately but simultaneously by both parties.

Measuring the traffic is a problem. SPC switching systems have a function to measure traffic. Traffic volume can ever be calculated for manual local switch board by counting switching cards, which show call direction, speech time, date, and time of day. The problem is with step by step and cross bar switching systems, which do not have a traffic measuring function. In this case it is recommended to count connecting circuits periodically (at every few minutes in a busy hour) with the eye. The average shows the traffic.

(3) Increasing Traffic Volume in Changing from Manual to Automatic Connection.

When the type of interconnection changes from manual to automatic (Direct Distance Dialing: DDD), the expected increase in traffic volume should be considered. Normally PSTN traffic volume increases as follows, derived from NTT experience data:

- manual switching with delay to DDD: 200% increase
- manual switching with no delay to DDD: 40% increase

11.8. Technical Standards

A telecommunication network should satisfy the following conditions for all services, not just for telephone service:

(a) quick connection,
(b) clear sound (correct information transmission),
(c) high reliability,
(d) easy to use,
(e) inexpensive,

Items (a) to (c) are regulated by a technical standards. MC No. 10-16-90 lists all digital telecommunications standards, which are based on ITU recommendations. There are a few more things that need to be described for new technologies and services. ITU is now studying standards for ISDN. Carriers should pay attention to the ITU study work as they implement ISDN. Some of the standards are issued in ITU I series Recommendations. The main study areas are connection delay and availability.

(1) Connection Standard

Many types of traffic will flow in ISDN networks, such as facsimile transmission, data communication, and multiple destination calls. ITU is studying new standards for non-telephone services in ISDN. ITU Recommendation I. 352 describes the overall connection set-up delay (Table 11.8-1).

Table 11.8-1 Overall Connection Setup Delay in ISDN for International Calls

	Connection set-up delay
Mean	4,500 ms
95% of calls	less than 8,350 ms

Provisional values: actual target values will be set later

A provisional recommendation for national calls has also been prepared. (Table 11.8-2).

Table 11.8-2 Overall Connection Setup Delay in ISDN for Domestic Call

	Connection set-up delay
Mean	2,900 ms
95% of calls	less than 3,600 ms

- Provisional value: the actual target values will be set later.
- They show a set-up delay in a domestic connection from an international switching center to a customer equipment.

(2) Transmission Standard

MC 10-16-90 defines CRE (Corrected Reference Equivalents) as the speech quality standard. ITU recommends adopting LR (Loudness Rating) as an accurate and practical unit of speech quality, and it is world tendency.
LR is better than RE (Reference Equivalents) for several reasons.

(a) LRs can be added algebraically.
REs can not, which produces discrepancies of at least +/- 3 dB.

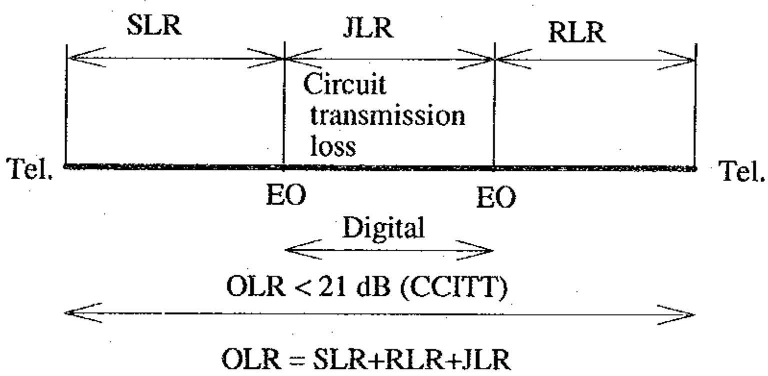
(b) LRs have good replication accuracy.
The replication accuracy of REs is not good; changes in the measuring crew can cause changes of as much as 5 dB.

(c) LRs make it possible to get good reappearance.
Increments of real (distortionless) transmission loss are not reflected by equal increments of REs; a 10 dB increase in loss results in an increase of only about 8 dB in REs.

Overall loudness ratings (OLRs), sending loudness ratings (SLRs), receiving loudness ratings (RLRs), and junction loudness ratings (JLRs) for domestic transmission are defined so that the following equality is achieved with sufficient accuracy for practical telephone connections. Figure 11.8-1 shows the structure.

OLR = SLR+RLR+JLR

Figure 11.8-1 Loudness Rating Structure



ITU recommends a short term objective for OLRs of between 8 and 21 dB.
The Loudness Ratings for international connections (G.111) and national connections (G.121) are shown in Table 11.8-3.

Table 11.8-3 ITU Recommended LR Standards

		SLR		RLR		CLR	OLR
		0 dBr	VASP	0 dBr	VASP		
Optimum value							about 10
Traffic weighted mean values							
Traffic weighted mean values: Long term objective	minimum	7	10.5	1	-3	(note 1)	8
Traffic weighted mean values: Long term objective	maximum	9	12.5	3	-1	(note 1)	12
Traffic weighted mean values: Short term objective	maximum	15	18.5	6	2	(note 1)	21
Maximum values for an average sized country		16.5	20	13	9	n + 0.5 (note 2)	
Minimum for sending		-1.5	2				

Note 1: CLR = 0 for a digital international circuit, and 0.5 dB for an analog one.
The average number for international circuits is about 1.
CLR: Circuit Loudness Rating for international transmission.

Note 2: n is the number of analog international circuits.
VASP: Virtual Analog Switching Points defined in Recommendation G.101

(3) Stability Standard

The ITU is preparing to issue outage criteria for ISDN. The draft recommendation values are shown in Table 11.8-4.

Table 11.8-4 Outage Criteria for Availability Decision Parameters in 64 Kb/s Circuit-Switched Connection of ISDN

	Availability Decision Parameters	Outage Criteria
i)	Connection Set-up Error Probability (CEP) Connection Set-up Failure Probability (CFP)	CEP + CFP > 0.9
ii)	Premature Disconnection Probability (PDP) Premature Disconnection Stimulus Probability (PDSP1, PDSP2)	PDSP1 + PDP + PDSP2 > 0.001

(4) Establishment of Telecommunications Technology Standards Organization

ITU recommendations often obtain alternative standards, sometimes prescribed in an abstract way. As networks change to digital ones, offering new services and increasing interconnections, each country must determine their own standards either based on ITU recommendations or their own standards relevant to their special conditions.

It is recommended to establish a Telecommunications Technology Standards Organization composed of telecommunications operators, manufacturers, representatives of users, and governmental organizations (such as TELOF), to develop the Philippine standard in the telecommunication field. It would pursue the same activities as TTC (The Telecommunication Technology Committee) in Japan, ETSI (European Telecommunications Standards Institute) in Europe, and T1 Committee in North America, standardizing such areas as network connection protocols (e.g. the timing), terminal equipment etc.

Its main activities would be as follow:

(a) study the establishment of standards for telecommunication network,
(b) study and research standards for connection within the national telecommunication network and,
(c) disseminate the standards.

In the Philippines, the Electronics and Telecommunications Standards Institute of the Philippines (ETSIP) was established for about the same purposes. It may therefore be a suitable organization for this role. Furthermore, it is recommended that the work should be carried out in close cooperation with APT (Asia Pacific Telecommunity), which has already started studying national technology standardization.

11.9 Circuits Calculation

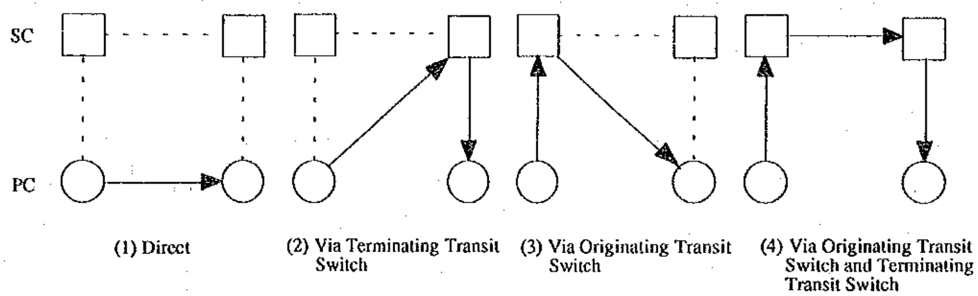
The required number of circuits was calculated from the results of the traffic forecast for each phase, based on the following design conditions.

11.9.1 Design Conditions

(1) Routing Pattern

As mentioned in Section 11.2.2, toll traffic can be routed in various patterns (Figure 11.9-1).

Figure 11.9-1 Toll Traffic Routing Patterns



The routing pattern is determined using the following threshold values to construct an efficient economical network.

- When the traffic volume between any two exchanges is less than 20 erl. (equivalent to 30 lines), traffic is carried via a transit exchange regardless of cost.
- When the traffic volume between any two exchanges is more than 100 erl., direct circuits are established unconditionally.
- When the traffic volume between any two exchanges is between 20 and 100 erl., the routing pattern is determined based on comparative cost, calculated by the LTC (last trunk capacity) method.

(2) Grade of Service

The grade of service for circuits used in this study are listed in Table 11.9-1. They are in accordance with the telecommunication standards in the Philippines.

Table 11.9-1 Grade of Service for Circuits

Category	Grade of Service
Local Call	0.005
RSU - LE	0.010
LE - PC link	0.005
PC - PC link	0.005
PC - SC link	0.005

(3) Types of Circuits

As mentioned in Section 9.1.3, all networks in the Philippines will be digitized by 1998. Therefore, all circuits in the calculations are digital.

11.9.2 Channel Matrix for Toll Network

The number of required circuits was calculated using the above design conditions to satisfy a specified grade of service. Two calculation methods were used depending on the type of traffic.

- The erlang B loss formula was used for random traffic.
- The equivalent random method was used for non-random traffic.

The results of the circuit calculation for each phase are shown in Appendix 11-1, 11-2, and 11-3.

11.9.3 Number of Required Circuits for Local Exchange

The number of circuits for both toll and local calls from local exchanges (including RSUs/RLUs) was calculated using the erlang B loss formula to satisfy the specified grade of service. The calculation results are shown in Appendix 12-2.

11.10 Transmission Network Plan

11.10.1 Concept

The Study Team treat the PSTN transmission network as an integrated single network. Therefore, the transmission network in the Philippines uses the existing transmission media of the PLDT and the government.

The integrated transmission network plan depends on the network configuration and the number of circuits between exchanges are based on the circuit accommodation plan. In this section we will examine the required transmission capacity between nodes.

The results of this study will be useful in planning the future expansion of the Philippines telecommunications networks.

11.10.2 Transmission Network Design

(1) Functional Division of the Transmission Network

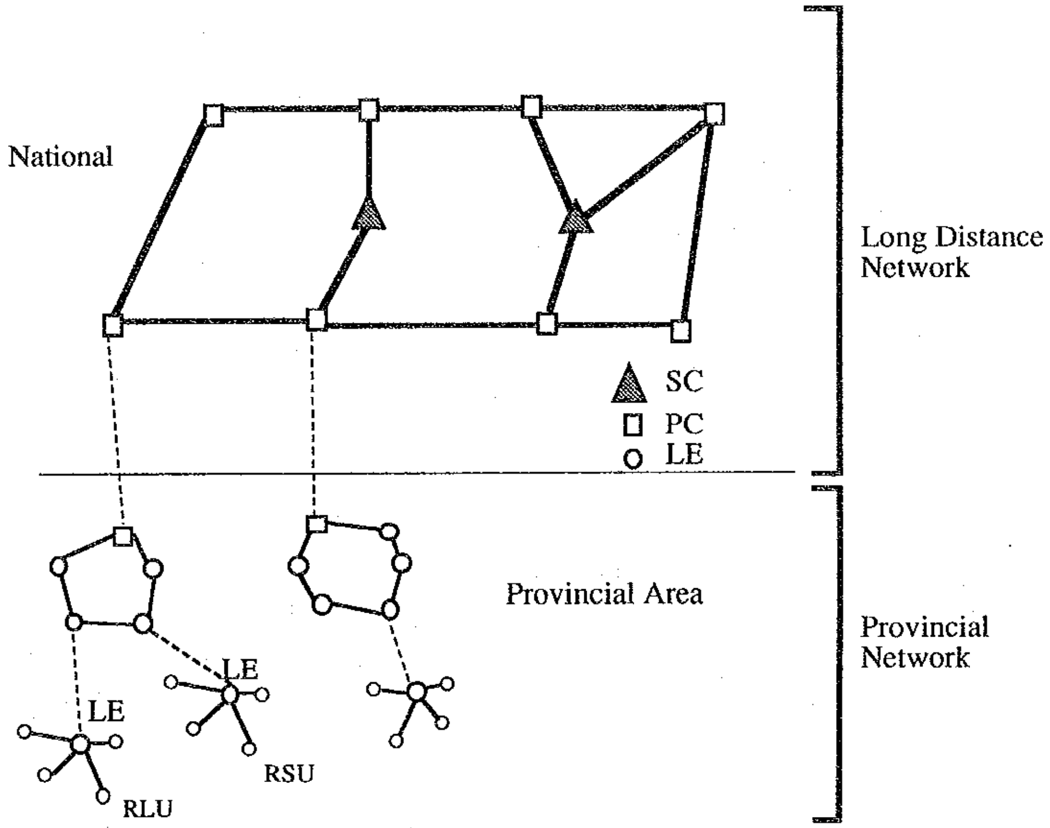
The networks composing the PSTN, the PLDT network and the government network, are tree networks.

An integrated transmission network can be functionally divided into two networks: a long distance transmission network and a provincial transmission network (Figure 11.10-1).
This division makes it easier to handle operations, maintenance, and management.

(a) Long distance transmission network --- connects primary and secondary centers with each other in a ladder and loop-type network for reliability.

(b) Provincial transmission network --- connects primary centers with local exchanges, and local exchanges with remote switching units and remote line units. The PC-LE network is a loop-type network in principle, The LS-RSU-RLU network is a star-type network.

Figure 11.10-1 Division of Transmission Network



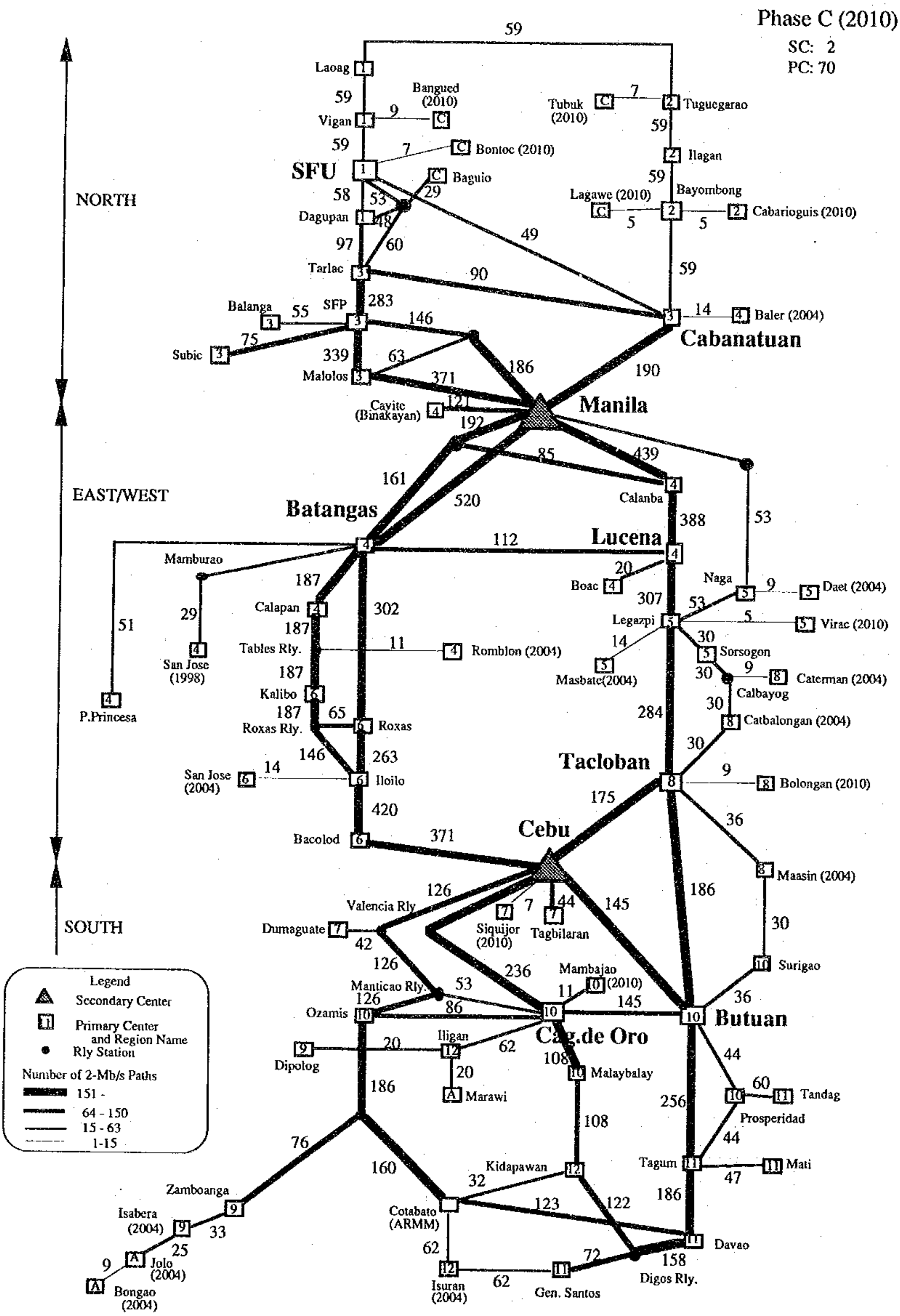
(2) Transmission Network Configuration

The long distance transmission network being developed is based on the expansion plans of each operator. The ladder network consists of nine major nodes (Metro Manila, SFU, Cabanatuan, Batangas, Lucena, Cebu, Tacloban, Cag.de Oro and Butuan), which are the concentration points in the transmission network. Loop networks are used for the other PCs. The configuration of the long distance transmission network is shown in Figure 11.10-2.

(3) Routing Plan

The long distance network is divided into six loops composed of the major nodes. Two circuit routes connect these nodes: one clockwise, the other counterclockwise (Appendix 11-4 (a) to (f)).

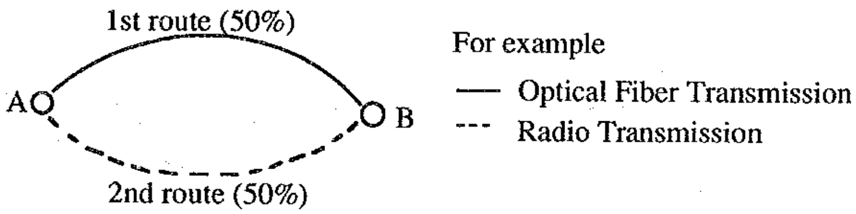
Figure 11.10-2 Long Distance Transmission Network Plan (Integrated Network)



(4) Circuit Accommodation Plan

Double routing of the circuits is used to enhance reliability. That is, circuits run over two routes between exchanges, so that if one route fails, at least 50% of the circuits are still available (Figure 11.10-3). Clock signal and common carrier signal transmission also use this method.

Figure 11.10-3 Double Routing



(5) Reliability

Since the telephone is essential for daily life and economic activities, it is highly important to ensure sufficient reliability in the telecommunication networks. Reliability can be enhanced in several ways.

(a) Route redundancy

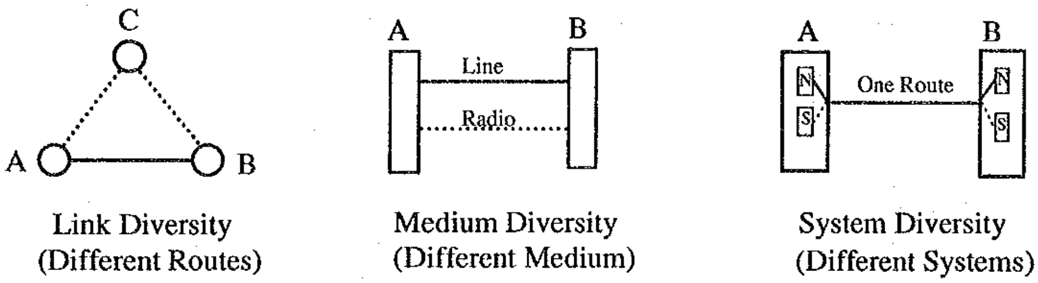
Stand-by systems use some form of route redundancy. The three basic types are shown in Figure 11.10-4. Application of these route redundancy methods is as follows.

- Link diversity --- suitable for high-density traffic areas, such as the junction networks in Metro Manila.

- Medium diversity --- suitable for spur links.

- System diversity --- suitable for loop networks.

Figure 11.10 - 4 Route Redundancy

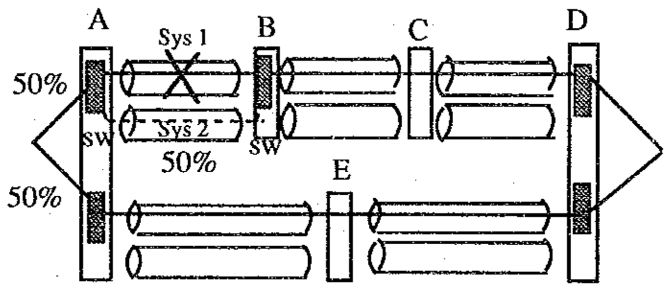


(b) Double-circuit routing

Double-routing works as follows.

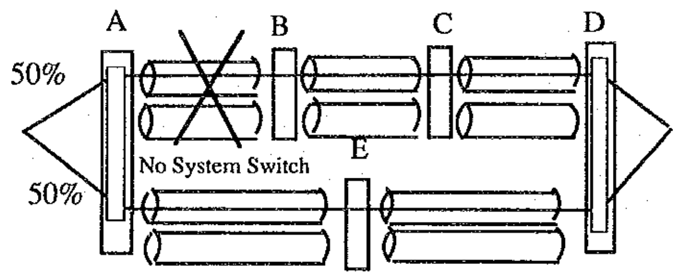
- If a system component fails, the system switches to the stand-by system, and 100% of the circuits are secured (Figure 11.10-5 (a)).

Figure 11.10-5 (a) Component Failure



- If a route is lost, at least 50% of the traffic can be handled on the alternate route (Figure 11.10-5 (b)).

Figure 11.10-5 (b) Route Failure

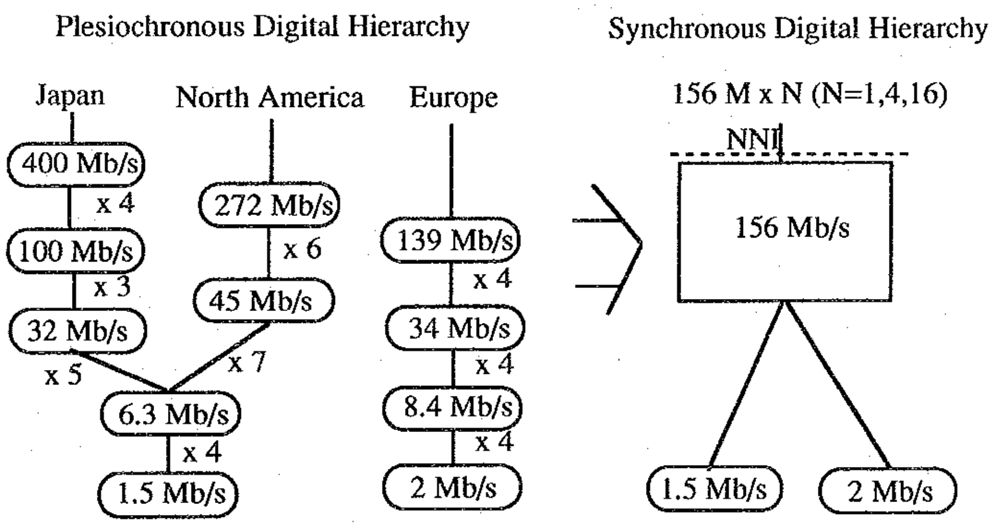


11.10.3 Synchronous Digital Hierarchy

(1) Background of the SDH

Since 1985, ITU has been studying the User Network Interface (UNI) for B-ISDN services and the Network Node Interface (NNI) as a basis for future network architectures. UNI is the high-speed version of the ITU series I interface. The goal is to establish UNI as the worldwide standard. However, this will be difficult with three different types of digital hierarchies being used in the world (Figure 11.10-6). The ITU has therefore developed a synchronous multiplexing scheme and interface to integrate these three hierarchies. It is called Synchronous Digital Hierarchy (SDH) and was standardized in November 1988.

Figure 11.10-6 Digital Hierarchies



(2) Advantages of SDH

(a) Standardization make it possible to interconnect domestic networks with high-speed digital services internationally and to interconnect systems from different manufacturers.

(b) It allows direct access from lower speed signals to higher speed signals without multiplexing/demultiplexing.

(c) It enhances operations, administration, and maintenance capabilities by using an overhead bit to convey various types of information (the bit occupies around 10% of the total payload).

(d) It can easily accommodate B-ISDN circuits, creating a flexible structure for new services.

(3) SDH Equipment Types

ITU Recommendation G.782 describes four basic types of multiplexing equipment as functional models (Figure 11.10-7). The functions of each are described below, and the definitions for the technical terms are in the ITU Recommendation G.707 blue book.

(a) Type I --- provides a primary-speed (described in ITU Recommendation G.703) to the STM-N (synchronous transport module) multiplex function. For example, 63 x 2048-kbit/s signals could be multiplexed to/from an STM-1 output or, 12 x 44.736-kb/s signals could be multiplexed to/from an STM-4 out put. Type I is the basic module; it will be especially effective for spur stations.

(b) Type Ia --- provides the ability to flexibly assign an input to any position in the STM-N frame by using its VC-1/2 (basic virtual container) and/or VC-3/4 (high-order virtual container) path connection functions.

(c) Type II --- provides the ability to combine a number of STM-N signals into a single STM-M signal. For example, four STM-1 signals (from multiplexers or line systems) could be multiplexed into a single STM-4 signal. The location of each of the VC-3/4s in the STM-N signals is fixed in the aggregate STM-M signal. This type will be installed at high-density route nodes in combination with Type I.

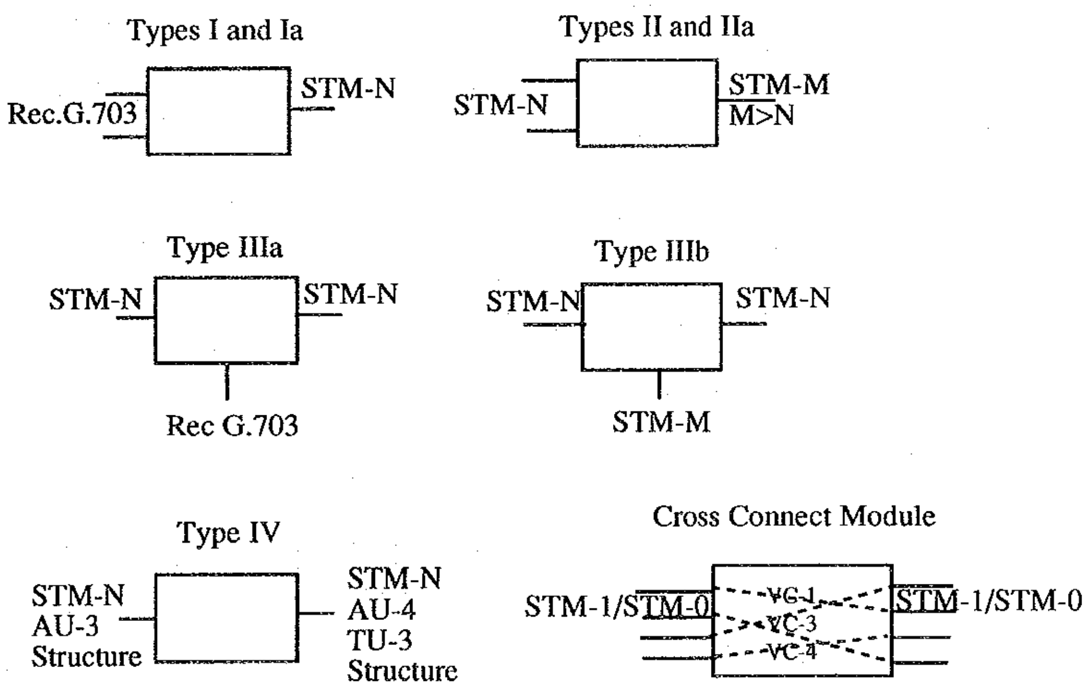
(d) Type IIa --- provides the ability to flexibly assign a VC-3/4 on one STM-N to any position in the STM-M frame by using the VC-3/4 path connection function.

(e) Types IIIa and IIIb --- provide the ability to access any of the constituent signals within an STM-N signal without demultiplexing and terminating the complete signal. The interface provided for the accessed signal can be either according to G.703 or an STM-M (M<N). This type will be installed at intermediate stations in loop networks or at small-node stations.

(f) Type IV --- provides the translation function that allows C-3 payloads in a VC-3 to transit a network that uses SDH equipment which cannot support AU-3. Information on interworking is given in CCITT G.708.

(g) Cross connector module --- makes it possible to connect a VC path with any other VC path within the STM-Ns. The higher order path cross connector works for VC 3/4, while the lower order one works for VC 1/2. This module will be installed at major node stations.

Figure 11.10-7 SDH Equipment Types



11.10.4 Application Standards

The following conditions were considered in our selection of recommended transmission systems:

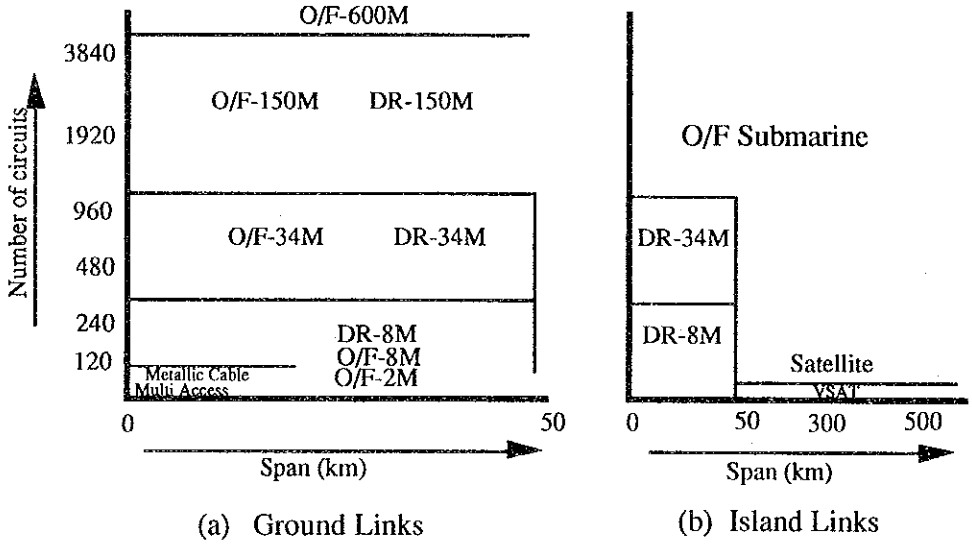
- Environmental conditions
- Reliability
- Cost

Especially, as for the selection of transmission media (radio or optical fiber), it is greatly influenced by the following two major factors:

- Future trend of telephone demand and new services
- Development plans of infrastructure (road, railroad and power)

The application standards we developed for transmission systems to be used as a guideline by the operators when they are planning are shown in Figure 11.10-8.

Figure 11.10-8 Transmission Application Standards for PSTN



O/F: Optical fiber system

DR: Digital radio system

VSAT: Very small aperture terminal

CHAPTER 12

TELECOMMUNICATIONS FACILITIES PLAN

CHAPTER 12 TELECOMMUNICATIONS FACILITIES PLAN

This section describes the installation and expansion plans formulated in accordance with the guidelines discussed in Chapter 9 for the Philippine telecommunications network from 1993 through 2010.
It includes basic telephone, non-voice, and new services. The telephone service facility plan is divided into three sections, representing the following major facilities:

1) Switching Facilities
2) Transmission Facilities
3) Outside Plant.

12.1 Switching Facilities

The type of local switching system is determined by switching capacity and the number of estimated subscriber lines. The number of additional municipalities served in Phase A is 450, in Phase B is 479, and in Phase C is 399 (Figure 12.1-1 and Table 12.1-1).

Figure 12.1-1 Number of Municipalities Served

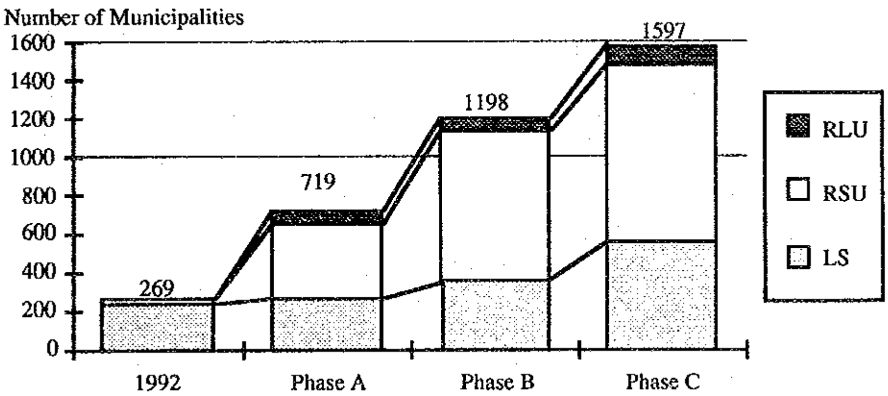


Table 12.1-1 Number of Municipalities Served

	NCR				Provinces			
	1992	Phase A	Phase B	Phase C	1992	Phase A	Phase B	Phase C
LS	17	17	17	17	223	251	330	524
RSU	-	-	-	-	29	387	792	943
RLU	-	-	-	-	-	64	59	113
Total	17	17	17	17	252	702	1181	1580

Note: RSUs in the NCR are not counted
LS: local switch
RSU: remote switch unit
RLU: remote line unit

12.1.1 Expansion Plan

(1) Local Switching Facilities

Local switching capacity grows by 2,077,000 lines in Phase A, 2,550,100 lines in Phase B, and 4,116,000 lines in Phase C (Figure 12.1-2 and Table 12.1-2). Detailed switching capacity data is shown in Appendix 12-1.

Figure 12.1-2 Local Switching Capacity Growth

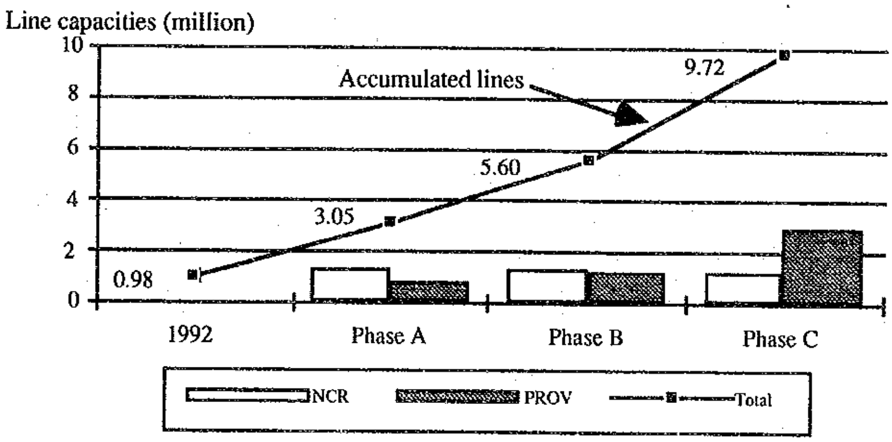


Table 12.1-2 Local Switching Capacity

(Unit: lines)

	1992	Phase A	Phase B	Phase C
NCR	-	1,299,900	1,353,000	1,174,900
Provincial	-	777,100	1,197,100	2,941,100
Total Increase	-	2,077,000	2,550,100	4,116,000
Accumulated	980,177	3,057,177	5,607,277	9,723,277

(a) National Capital Region (NCR)

Local switching capacity growth in the NCR is 1,299,900 lines in Phase A, 1,353,000 lines in Phase B, and 1,174,900 lines in Phase C (Figure 12.1-3 and Table 12.1-3).

Figure 12.1-3 Local Switching Capacity Growth in the NCR

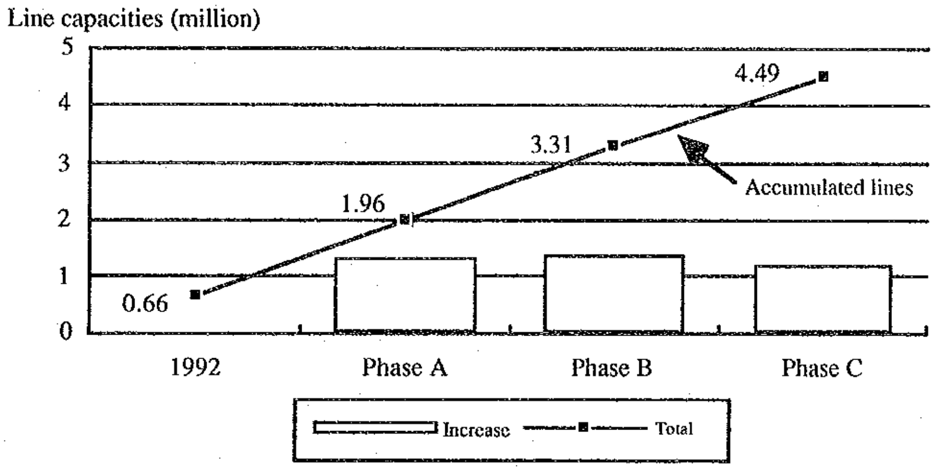


Table 12.1-3 Local Switching Capacity in the NCR

(Unit: lines)

	1992	Phase A	Phase B	Phase C
Increase	-	1,299,900	1,353,000	1,174,900
Accumulated	664,045	1,963,945	3,316,945	4,491,845

(b) Provincial Areas

Local switching capacity growth in the provincial areas is 777,100 lines in Phase A, 1,197,100 lines in Phase B, and 2,941,100 lines in Phase C (Figure 12.1-4 and Table 12.1-4).

The number of switching capacity for each region is shown in Table 12.1-5.

Figure 12.1-4 Local Switching Capacity Growth in the Provincial Areas

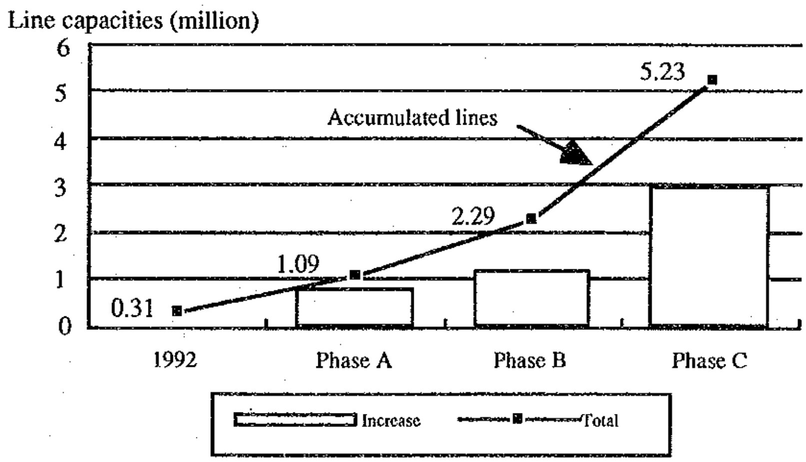


Table 12.1-4 Local Switching Capacity in Provincial Areas

(Unit: lines)

	1992	Phase A	Phase B	Phase C
Increase	-	777,100	1,197,100	2,941,100
Accumulated	316,132	1,093,232	2,290,332	5,231,432

Table 12.1- 5 Local Switching Capacity by Region

(Unit : lines)

	1992	Phase A		Phase B		Phase C	
	Existing	Increase	Total	Increase	Total	Increase	Total
CAR	8,950	6,600	15,550	10,000	25,550	50,300	75,850
Region I	22,300	40,700	63,000	44,200	107,200	147,600	254,800
Region II	6,670	22,200	28,870	21,000	49,870	50,600	100,470
Region III	46,856	134,400	181,256	170,700	351,956	435,700	787,656
Region IV	63,060	197,400	260,460	313,100	573,560	809,200	1,382,760
Region V	10,586	21,600	32,186	35,100	67,286	53,500	120,786
Region VI	31,700	78,400	110,100	93,000	203,100	197,800	400,900
Region VII	58,740	49,700	108,440	130,900	239,340	362,300	601,640
Region VIII	9,150	12,200	21,350	26,700	48,050	58,100	106,150
Region IX	9,950	12,800	22,750	41,900	64,650	66,600	131,250
Region X	20,470	61,500	81,970	108,000	189,970	256,900	446,870
Region XI	17,900	105,100	123,000	168,400	291,400	381,200	672,600
Region XII	3,850	20,000	23,850	14,700	38,550	25,800	64,350
ARMM	5,950	14,500	20,450	19,400	39,850	45,500	85,350
Sub Total	316,132	777,100	1,093,232	1,197,100	2,290,332	2,941,100	5,231,432
NCR	664,045	1,299,900	1,963,945	1,353,000	3,316,945	1,174,900	4,491,845
Total	980,177	2,077,000	3,057,177	2,550,100	5,607,277	4,116,000	9,723,277

(2) Toll Switching Facilities

Toll switching trunk capacity grows by 26,986 trunks in Phase A, 33,016 trunks in Phase B, and 66,774 trunks in Phase C. The growth and total number of trunks and 2M-IF (30 channels) are shown in Figure 12.1-5 and Table 12.1-6.

The number of trunks and 2M-IF by primary center is shown in Table 12.1-7; detailed data by municipality is shown in Appendix 12-2.

Figure 12.1-5 Trunk Growth

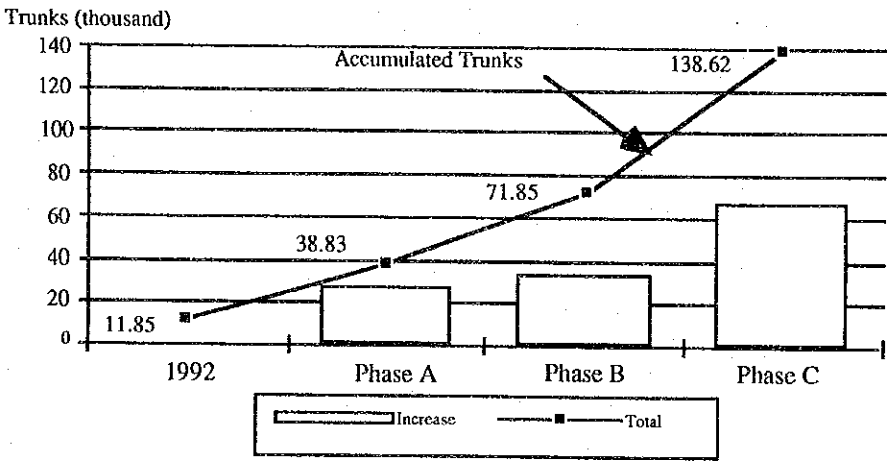


Table 12.1-6 Trunk and 2M-IF

Trunk (PC-PC) (Unit: trunks)

	1992	Phase A	Phase B	Phase C
Increase	-	26,986	33,016	66,774
Total	11,850	38,836	71,852	138,626

2M-IF (PC-LE) (Unit: 2M-IF)

	1992	Phase A	Phase B	Phase C
Increase	-	843	816	1,809
Total	-	843	1,659	3,468

Table 12.1-7 Trunk and 2M-IF by Primary Center

(1/2)

Region	Primary Center	1992	Phase-A			Phase-B			Phase-C		
		Total	Type	Trunk	2M	Type	Trunk	2M	Type	Trunk	2M
CAR	Bangued	0	-	0	-	-	0	-	TLS	235	17
CAR	Baguio	190	TLS	187	7	TS	324	13	TS	656	16
CAR	Bontoc	0	-	0	-	-	0	-	TLS	154	10
CAR	Lagawe	0	-	0	-	-	0	-	TLS	92	12
CAR	Tabuk	0	-	0	-	-	0	-	TLS	126	17
1	Laoag	92	TLS	176	15	TLS	268	13	TLS	565	27
1	Vigan	52	TLS	180	11	TLS	286	14	TLS	608	23
1	San Fernando	766	TLS	169	11	TLS	296	14	TLS	673	25
1	Dagupan	604	TLS	656	32	TLS	1,149	44	TLS	2,463	91
2	Basco	0	-	0	-	-	0	-	-	0	-
2	Tuguegarao	32	TLS	180	10	TLS	266	16	TLS	441	21
2	Ilagan	42	TLS	204	8	TLS	335	27	TLS	568	35
2	Bayombong	221	TLS	62	5	TLS	114	8	TLS	174	13
2	Cabarroguis	0	-	0	-	-		-	TLS	74	5
3	Balanga	121	TLS	288	12	TLS	561	29	TLS	1,202	50
3	Malolos	349	TLS	1,208	53	TLS	2,033	80	TS	4,238	166
3	Cabanatuan	97	TLS	907	34	TLS	1,658	62	TS	3,529	137
3	San Fernando	1,204	TLS	1,314	60	TLS	2,170	85	TS	4,396	156
3	Tarlac	172	TLS	700	23	TLS	1,222	36	TLS	2,480	70
3	Subic	140	TLS	391	16	TLS	759	28	TLS	1,665	57
4	Baler	0	-	0	-	TLS	132	5	TLS	345	14
4	Batangas	143	TLS	894	35	TLS	1,791	65	TS	3,905	160
4	Cavite	418	TLS	758	31	TLS	1,329	54	TLS	2,961	110
4	Calamba	313	TLS	980	36	TLS	1,766	60	TS	3,797	147
4	Boac	0	TLS	96	3	TLS	233	10	TLS	498	16
4	San Jose	0	TLS	146	4	TLS	317	10	TLS	701	18
4	Calapan	0	TLS	266	3	TLS	627	13	TLS	1,375	50
4	Puerto Princesa	0	TLS	144	2	TLS	547	18	TLS	1,284	52
4	Lucena	202	TLS	798	37	TLS	1,554	62	TS	3,498	140
4	Romblon	0	-	0	-	TLS	160	6	TLS	548	23
4	NCR	3,527	-	14,683	-	-	25,309	-	-	43,646	-
4	Rizal	0	-	0	32	-	0	58	-		107
5	Legaspi	279	TLS	245	14	TLS	351	19	TLS	509	23
5	Daet	0	-	0	-	TLS	136	8	TLS	232	11
5	Naga	117	TLS	294	23	TLS	405	37	TLS	700	39
5	Virac	0	-	0	-	-	0	-	TLS	120	13
5	Masbate	0	-	0	-	TLS	193	17	TLS	336	18
5	Sorsogon	0	TLS	82	4	TLS	184	13	TLS	312	14
6	Kalibo	0	TLS	99	6	TLS	238	12	TLS	488	25

(2/2)

Region	Primary Center	1992		Phase-A			Phase-B			Phase-C	
		Total	Type	Trunk	2M	Type	Trunk	2M	Type	Trunk	2M
6	San Jose	0	-	0	-	TLS	243	13	TLS	506	25
6	Roxas	0	TLS	216	6	TLS	412	17	TLS	753	27
6	Iloilo	559	TLS	762	30	TLS	1,177	49	TS	2,152	74
6	Bacolod	344	TLS	1,142	45	TS	1,705	76	TS	3,017	124
7	Tagbilaran	0	TLS	80	1	TLS	400	20	TLS	1,104	46
7	Cebu	723	TS	4,308	36	TS	8,559	73	TS	15,670	143
7	Dumaguete	0	TLS	222	10	TLS	543	25	TLS	1,127	50
7	Siquijor	0	-	0	0	-	0	0	TLS	107	5
8	Borongan	0	-	0	-	-	0	-	TLS	143	12
8	Tacloban	159	TLS	234	14	TLS	357	22	TLS	567	28
8	Catarman	0	-	0	-	TLS	70	3	TLS	163	11
8	Maasin	0	-	0	-	TLS	62	2	TLS	140	9
8	Catbalogan	0	-	0	-	TLS	112	11	TLS	219	5
9	Isabela	0	-	0	-	TLS	114	6	TLS	193	9
9	Dipolog	0	TLS	109	3	TLS	262	14	TLS	526	27
9	Zamboanga	146	TLS	296	5	TLS	620	21	TLS	1,151	34
10	Butuan City	0	TLS	230	3	TLS	402	8	TLS	838	14
10	Prosperidad	0	TLS	108	3	TLS	331	14	TLS	703	30
10	Malaybalay	0	TLS	326	15	TLS	693	30	TLS	1,426	56
10	Mambajao	0	-	0	1	-	0	-	TLS	120	4
10	Ozamis	33	TLS	156	6	TLS	321	10	TLS	681	24
10	Cagayan de Oro	211	TLS	422	14	TLS	766	24	TS	1,443	56
10	Surigao	0	TLS	92	1	TLS	226	8	TLS	659	12
11	Tagum	0	TLS	679	23	TLS	1,360	49	TS	2,786	121
11	Davao	421	TS	1,195	42	TS	2,188	80	TS	4,318	190
11	Mati	0	TLS	196	3	TLS	566	7	TLS	1,113	39
11	Gen.Santos	0	TLS	735	16	TS	1,443	52	TS	2,989	159
11	Tandag	0	TLS	175	6	TLS	499	20	TLS	1,272	58
12	Iligan	0	TLS	218	6	TLS	287	10	TLS	501	15
12	Kidapawan	0	TLS	290	13	TLS	409	17	TLS	650	25
12	Isulan	0	-	0	-	TLS	222	9	TLS	364	21
ARMM	Jolo	0	-	0	-	TLS	188	10	TLS	350	20
ARMM	Bangao	0	-	0	-	TLS	105	7	TLS	182	11
ARMM	Marawi	0	TLS	103	1	TLS	127	2	TLS	475	31
ARMM	Cotabato	173	TLS	435	13	TLS	370	14	TLS	624	23
	Total	11,850	-	38,836	843	-	71,852	1,659	-	138,626	3,468

Note:

Type: switching type
Trunk: total trunks between primary centers
2M : number of required 2M-IF between primary centers and local exchanges
Rizal Province is included in the NCR.

12.1.2 Replacement Plan

(1) Local Switching Systems

Analog switching systems are replaced with digital systems in accordance with the guidelines in Chapter 9. Manual and SXS facilities are replaced during Phase A and XB and SPC-analog facilities are replaced during Phase B. Analog switching line capacity is reduced by 403,235 lines in Phase A and 255,562 lines in Phase B. The total decrease is 658,797 lines.

On the other hand, the digital switching systems in operation at the end of 1992 will continue working for about 20 years. Therefore, replacement of digital switching systems is not planned until Phase C. The plan is to replace 321,380 digital switching line capacities in local switching systems and 11,850 trunks in toll switching systems. The replacement plan for analog and digital switching systems is shown in Figure 12.1-6 and Table 12.1-8.

Figure 12.1-6 Switching System Replacement

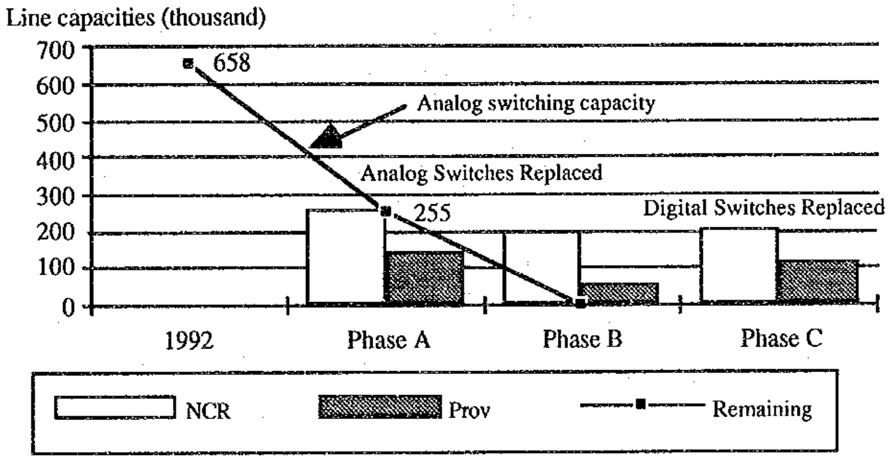


Table 12.1-8 Switching System Replacement

(Unit : lines)

	1992	Phase A	Phase B	Phase C
NCR		260,805	196,000	207,240
Provinces		142,430	59,562	114,140
Replaced		403,235	255,562	321,380
Remaining	658,797	255,562	0	0

Note:

Remaining : analog switching capacity

(a) NCR

Analog switching capacity reduction in the NCR is 260,805 lines in Phase A and 196,000 lines in Phase B. Digital switching capacity replacement is 207,240 lines in Phase C (Figure 12.1-7 and Table 12.1-9).

Figure 12.1-7 Switching System Replacement in the NCR

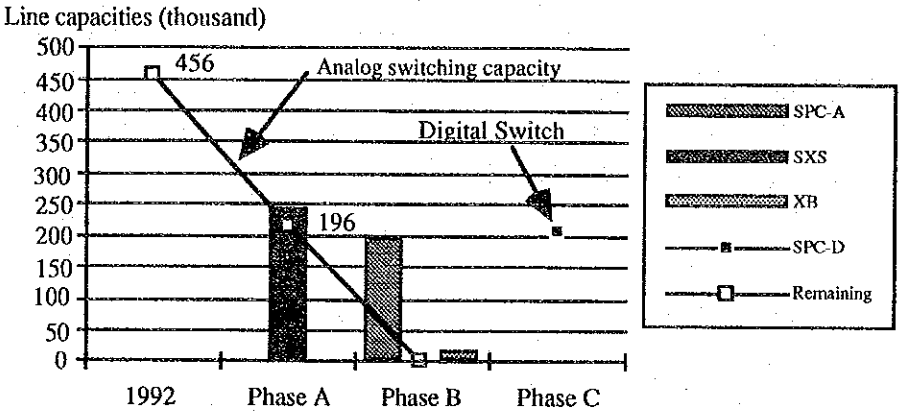


Table 12.1-9 Switching System Replacement in the NCR

(Unit: lines)

	1992	Phase A	Phase B	Phase C
SXS	-	260,805	-	-
SPC-Analog	-	-	196,000	-
SPC-Digital	-	-	-	207,240
Remaining	456,805	196,000	0	-

Note:

Remaining : analog switching capacity

(b) Provincial Areas

Analog switching capacity reduction in the provincial areas is 142,430 lines in Phase A and 59,562 lines in Phase B. Digital switching capacity replacement is 114,140 lines in the Phase C (Figure 12.1-8 and Table 12.1-10).

Figure 12.1-8 Switching System Replacement in the Provincial Areas

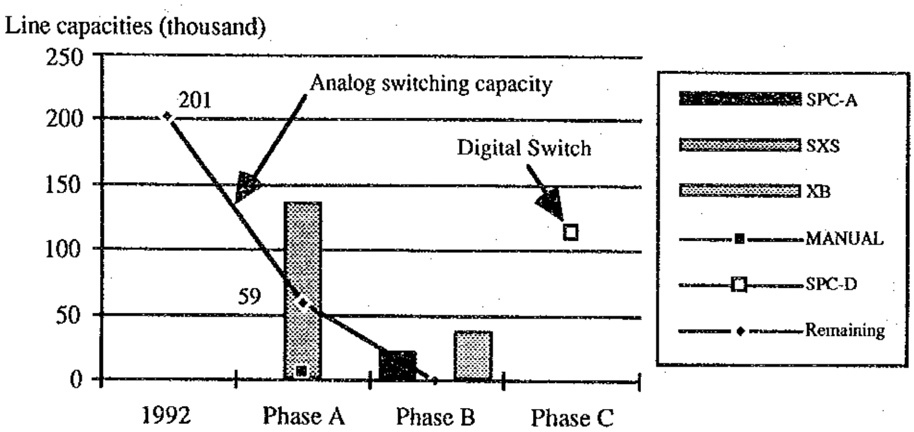


Table 12.1-10 Switching System Replacement in the Provincial Areas

(Unit: lines)

	1992	Phase A	Phase B	Phase C
SXS	-	136,250	-	-
MANUAL	-	6,180	-	-
XB	-	-	37,762	-
SPC-Analog	-	-	21,800	-
SPC-Digital	-	-	-	114,140
Remaining	201,992	59,562	0	-

Note: (Remaining : analog switching capacity)

(2) Toll Switching Systems

Digital switching systems in operation at the end of 1992 will be replaced during Phase C. Therefore, digital toll switching systems, with a capacity of 11,850 trunks will be replaced during Phase C. Digital toll switching system capacity by primary center in 1992 is shown in Table 12.1-11.

Table 12.1-11 Digital Toll Switching Capacity at Yearend 1992

(Unit: trunks)

Region	Provinces	Primary Center	Incoming	Outgoing	Total
CAR	Benguet	Baguio City	91	99	190
1	Ilocos Norte	Laoag	36	56	92
1	Ilocos Sur	Vigan	23	29	52
1	La Union	San Fernando	386	380	766
1	Pangasinan	Dagupan City	288	316	604
2	Cagayan Valley	Tuguegarao	14	18	32
2	Isabela	Ilagan	19	23	42
2	Nueva Viscaya	Bayombong	112	109	221
3	Bataan	Balanga	73	48	121
3	Bulacan	Malolos	227	122	349
3	Nueva Ecija	Cabanatuan City	53	44	97
3	Pampanga	San Fernando	645	559	1,204
3	Tarlac	Tarlac	95	77	172
3	Zambales	Subic	72	68	140
4	Batangas	Batangas City	78	65	143
4	Cavite	Cavite City	311	107	418
4	Laguna	Calamba	177	136	313
4	Quezon	Lucena City	107	95	202
4	NCR(Rizal)	Makati	1,674	1,853	3,527
5	Albay	Legaspi City	135	144	279
5	Camarines Sur.	Naga City	54	63	117
6	Iloilo	Iloilo City	280	279	559
6	Negros Occidental	Bacolod City	174	170	344
7	Cebu	Cebu City	317	406	723
8	Leyte	Tacloban City	74	85	159
9	Zamboanga Del Sur	Zamboanga City	64	82	146
10	Misamis Occidental	Ozamis City	15	18	33
10	Misamis Oriental	Cagayan de Oro City	101	110	211
11	Davao Del Sur	Davao City	151	270	421
ARMM	Maguindanao	Cotabato City	79	94	173
	Total		5,925	5,925	11,850

Note : The number of trunks calculated on the basis of the working lines as of end of 1992.

12.1.3 Switching System Digitization

As analog switching systems are replaced by digital ones during Phase A and B, the percentage of digital system will rise from 32.8% to 91,6% at the end of Phase A and to 100% at the end of Phase B (Figures 12.1-9, 12.1-10, and 12.1-11, and Tables 12.1-12, 12.1-13, and 12.1-14).

Figure 12.1-9 Percentage of Digital Switching Systems

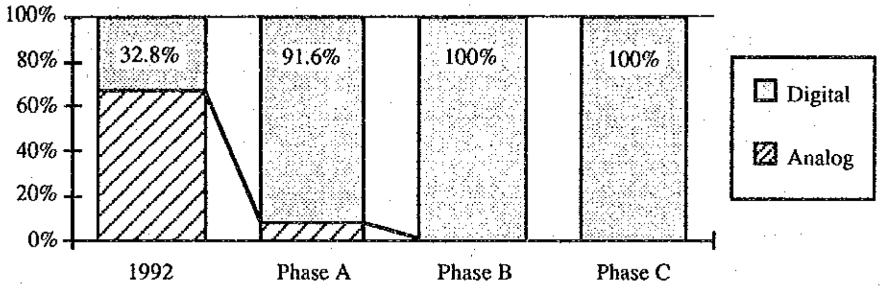


Table 12.1-12 Digitial vs. Analog Switching Systems

	1992	%	Phase A	%	Phase B	%	Phase C	%
Analog	658,797	67.2	255,562	8.4	0	0	0	0
Digital	321,380	32.8	2,801,615	91.6	5,607,277	100	9,723,277	100
Total	980,177	100	3,057,177	100	5,607,277	100	9,723,277	100

Figure 12.1-10 Percentage of Digital Switching Systems in the NCR

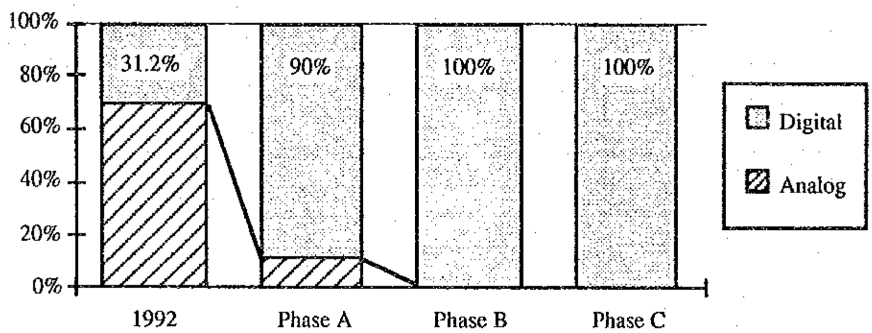


Table 12.1-13 Digital vs. Analog Switching Systems in the NCR

	1992	%	Phase A	%	Phase B	%	Phase C	%
Analog	456,805	68.8	196,000	10	0	0	0	0
Digital	207,240	31.2	1,767,945	90	3,316,945	100	4,491,845	100
Total	664,045	100	1,963,945	100	3,316,945	100	4,491,845	100

Figure 12.1-11 Percentage of Digital Switching Systems in the Provincial Areas

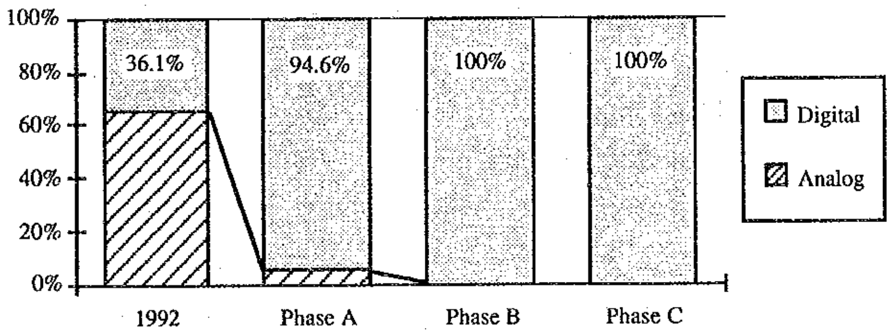


Table 12.1-14 Digital vs. Analog Switching Systems in the Provincial Areas

	1992	%	Phase A	%	Phase B	%	Phase C	%
Analog	201,992	63.9	59,562	5.4	0	0	0	0
Digital	114,140	36.1	1,033,670	94.6	2,290,332	100	5,231,432	100
Total	316,132	100	1,093,232	100	2,290,332	100	5,231,432	100

12.1.4 Cost Estimation

Switching facility cost was calculated for expanding capacity and replacing facilities.

(1) Expansion Cost Formulae

(a) Local Switching Systems

i) Local Switch (LS)

Investment Cost = (L1) x (Unit Price 1)

L1 = number of added lines

Unit Price 1 = US \$ 650 / line

ii) Remote Switch Unit (RSU) and Remote Line Unit (RLU)

Investment Cost = (L2) x (Unit Price 2)

L2 = number of added lines

Unit Price 2= US $ 860 / line

(b) Toll Switching Systems

Investment Cost = (T1) x (Unit Price 3) + (T2) x (Unit Price 4)

T1 = number of added trunk

T2 = number of added 2M-IF

Unit Price 3= US $ 1,000 / trunk

Unit Price 4= US $ 30,000 / 2M-IF

(2) Replacement Cost Formulae

(a) Local Switching Systems

Investment Cost = (LR) x (Unit price 5)

LR = number of lines replaced

Unit Price 5 = US $ 450 / line

(b) Toll Switching Systems

Investment Cost = (TR) x (Unit Price 6)

TR = number of trunk replaced

Unit Price 6= US $ 700 / trunk

(3) Estimated Cost

The estimated costs based on these formulae are shown in Table 12.1-15.

Table 12.1-15 Estimated Cost for Expanding and Replacing Switching Capacity

(a) Expansion Plan (Local)

(Unit : US $ 1,000)

		Phase A		Phase B		Phase C	
		Lines	Cost	Lines	Cost	Lines	Cost
LS	NCR	1,299,900	844,935	1,353,000	879,450	1,174,900	763,685
	Provincial	401,200	260,780	601,700	391,105	2,064,600	1,341,990
	Sub Total	1,701,100	1,105,715	1,954,700	1,270,555	3,239,500	2,105,675
RSU and RLU (Prov)	(RSU)	359,300	308,998	582,700	501,122	845,800	727,388
	(RLU)	16,600	14,276	12,700	10,922	30,700	26,402
	Sub Total	375,900	323,274	595,400	512,044	876,500	753,790
	Total	2,077,000	1,428,989	2,550,100	1,782,599	4,116,000	2,859,465

(b) Expansion Plan (Toll)

(Unit : US $ 1,000)

	Phase A		Phase B		Phase C	
	Trunk	Cost	Trunk	Cost	Trunk	Cost
Trunk	26,986	26,986	33,016	33,016	66,774	66,774
2M-IF	843	25,290	766	22,980	1,881	56,430
Total	-	52,276	-	55,996	-	123,204

(C) Replacement Plan (Local)

(Unit : US $ 1,000)

	Phase A		Phase B		Phase C	
	Lines	Cost	Lines	Cost	Lines	Cost
NCR	260,805	117,362	196,000	88,200	207,240	93,258
Provincial	142,430	64,094	59,562	26,803	114,140	51,363
Total	403,235	181,456	255,562	115,003	321,380	144,621

(D) Replacement Plan (Toll)

(Unit : US $ 1,000))

	Phase A		Phase B		Phase C	
	Trunk	Cost	Trunk	Cost	Trunk	Cost
Total	1,044	730	0	0	10,806	7,564

12.2 Transmission Facilities

The present PLDT backbone network is a combination of analog and digital radio systems; 72% of it is already digital. PLDT plans to achieve full digitization by 1998. The government network is already 100% digital.

We estimated the required number of 2-Mb/s paths by using the results of the circuit accommodation plan. The estimation assumptions and results are presented in this section.

12.2.1 Estimation Assumptions

(1) Long Distance Transmission Facilities

(a) Since there is no information on the existing number of the accommodated units and existing section paths in the each system of the PLDT, therefore, the existing 2-Mb/s paths in the integrated network were estimated based on the 2-Mb/s paths we computed which are called basic 2-Mb/s paths.

(b) Required leased circuits and miscellaneous circuits were estimated to be 10% of the public circuits.

(c) Tansmission system capacity was estimated based on the transmission application standards, considering the ultimate goal is 2-Mb/s paths.

(d) The number of the transmission systems was based on the requirement for 2-Mb/s paths in five years.

(e) Equipment lifetime is considered to be around 20 years, so existing systems are replaced by 2010.

(f) The transmission medium was determined according to the transmission application standards, considering the geographical conditions and the expansion plans of the operators.

(2) Provincial Transmission Facilities

(a) Provincial transmission facilities were estimated based on the number of circuits, as shown in Appendix 12-2.

(b) Required leased lines and miscellaneous circuits were estimated to be 10% of the public circuits.

(c) Circuit routing plans and circuit accommodation plans were not prepared because

- detailed maps of the provincial areas were not available and
- detailed information on franchise areas and existing systems of private operators was not available.

(d) For the reason given item (c) above, a star network was used for PC to LE connections in the facilities plan.

Using these assumptions, we estimated the transmission facilities required for the long distance and provincial networks.

12.2.2 Facilities

(1) Long Distance Facilities

The estimated number of required 2-Mb/s paths for the long distance transmission network is summarized as shown by phase in Table 12.2-1.

Table 12.2-1 Long Distance Transmission Facilities Plan
(number of 2-Mb/s paths)

	Phase A		Phase B		Phase C	
	Expand.	Replace.	Expand.	Replace.	Expand.	Replace.
Required 2M path	2320	76	2691	86	5626	1959
Sub-total	2396		2777		7585	
Total	12758					

The corresponding number of systems is summarized as shown in Table 12.2-2. The number of systems and number of paths for each section are shown in Appendix 12-4.

Table 12.2-2 Long Distance Transmission Facilities Plan
(number of the systems)

System	Phase A		Phase B		Phase C		Total
	Expand.	Replace.	Expand.	Replace.	Expand.	Replace.	
O/F-600M	19	0	11	0	0	0	30
O/F-150M	13	0	6	0	2	1	22
O/F-34M	0	0	2	0	0	0	2
DR-150M	23	6	8	3	4	50	94
DR-34M	2	0	9	0	2	2	15
DR-8M	0	1	0	0	8	0	9
Total	57	7	36	3	16	53	172

(2) Provincial Transmission Facilities

The estimated number of required 2-Mb/s paths for the provincial networks by Region is summarized as shown by phase in Table 12.2-3.

Table 12.2-3 Provincial Transmission Network Facilities Plan
(number of 2-Mb/s paths)

Region	Phase A	Phase B	Phase C	Total
CAR	31	47	108	186
1	134	174	311	619
2	68	107	130	305
3	269	462	735	1466
4	299	544	1007	1850
5	60	153	186	399
6	142	272	391	805
7	62	216	324	602
8	36	131	233	400
9	21	84	131	236
10	80	161	273	514
11	110	229	477	816
12	43	63	102	208
ARMM	17	39	120	176
Total	1372	2682	4528	8582

12.2.3 Cost Estimation

The cost of expanding networks was estimated using the number of 2-Mb/s paths for long distance transmission (Table 12.2-1) and the number of 2-Mb/s paths for provincial networks (Table 12.2-3).

The cost of replacing equipment for the long distance network was estimated using the number of 2-Mb/s paths in Table 12.2-1. However, there is no replacement plan for the provincial network due to incomplete information, as mentioned above.

The estimated cost for transmission facilities is shown in Table 12.2-4.

Table 12.2-4 Estimated Cost for Transmission System
(in US $000)

Long Distance	Phase A		Phase B		Phase C	
	Expand	Replace	Expand	Replace	Expand	Replace
No. of Paths	2,320	76	2,691	86	5,626	1,959
Cost	336,400	11,020	390,195	12,470	815,770	284,055
Phase Cost	347,420		402,665		1,099,825	
Total			1,849,910			

Province	Phase A		Phase B		Phase C	
	Expand	Replace	Expand	Replace	Expand	Replace
No. of Paths	1,372	-	2,682	-	4,528	-
Phase Cost	440,412	-	860,922	-	1,453,488	-
Total Cost			2,754,822			

	Phase A	Phase B	Phase C
Phase Cost	787,832	1,263,587	2,553,313
Total		4,604,732	

2-Mb/s Path cost: Long distance --- US$ 145
: Provincial --- US$ 321

12.3 Outside Plant

12.3.1 Expansion Plan

(1) Expansion Assumptions

The assumptions used for the local cable expansion plan are as follows:

(a) The number of cable pairs was estimated based on the supply target.
(b) The number of leased lines, test pairs and other lines was estimated to be 3% of total connected lines.
(c) The cable pair slack margin rate was estimated to be 30% for all primary cable pairs.

(2) Number of Primary Cable Pairs to be Installed

The total number of primary cable pairs to be installed during each phase was estimated as follows.

(a) The number of lines required to be connected at the end of each phase was calculated using.

$Lr = St \times 1.03$,

where
Lr is the number of required lines,
St is the supply target for telephones, and
1.03 = 1 + (leased lines + test pairs + other lines) / supply target for telephones.

Table 12.3-1 shows the number of lines required at the end of each phase.

Table 12.3-1 Number of Lines Required at the End of Each Phase

(Unit: Lines)

	Phase A	Phase B	Phase C
Total	2,784,375	5,189,414	9,030,551
NCR	1,838,304	3,105,063	4,205,199
Region Total	946,071	2,084,351	4,825,352
CAR	10,592	22,391	67,629
Region I	50,848	95,631	232,530
Region II	24,497	43,289	90,085
Region III	164,659	324,006	731,606
Region IV	232,815	528,607	1,284,846
Region V	26,517	57,832	108,229
Region VI	97,067	184,347	368,999
Region VII	80,138	219,297	556,841
Region VIII	16,378	40,758	92,478
Region IX	20,613	57,506	119,501
Region X	71,193	173,313	412,919
Region XI	113,348	269,227	625,681
Region XII	21,417	34,266	58,290
ARRM	15,989	33,881	75,719

(b) The number of primary cable pairs to be installed during each phase was calculated using

$$Pi(t) = (Lr(t) - Lr(t-1)) / 0.7,$$

where

Pi(t) is the number of primary cable pairs to be installed during each phase,

t is the phase (A, B, C),

Lr(t) is the number of required lines at the end of each phase,

Lr(t-1) is the number of required lines at the end of the previous phase (t); but Lr(A-1) represents the number of required lines at the end of 1992, and

0.7 = 1 - the cable pair slack margin rate.

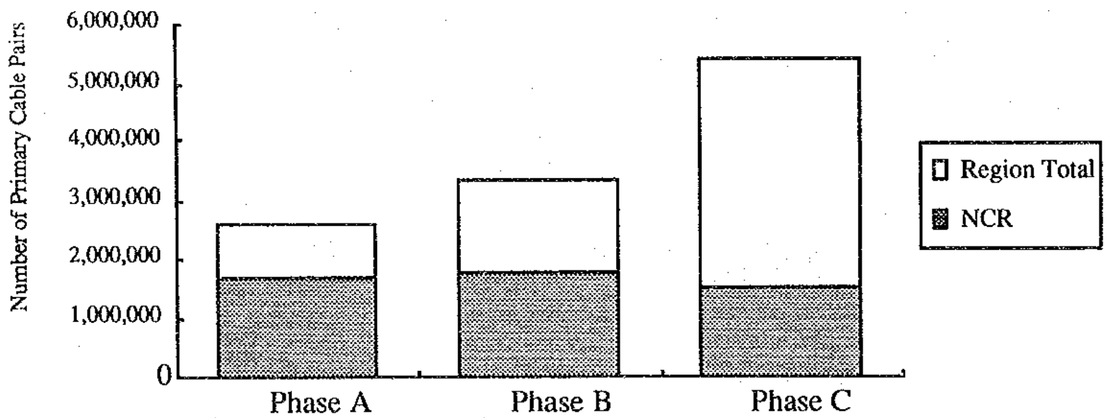
Table 12.3-2 and Figure 12.3-1 show the number of primary cable pairs to be installed during each phase.

Table 12.3-2 Number of Primary Cable Pairs to be Installed during Each Phase

(Unit: Pairs)

	Phase A	Phase B	Phase C
Total	2,672,184	3,435,769	5,487,339
NCR	1,742,370	1,809,656	1,571,623
Region Total	929,814	1,626,114	3,915,716
CAR	2,624	16,856	64,626
Region I	35,679	63,976	195,569
Region II	27,107	26,846	66,852
Region III	171,721	227,638	582,286
Region IV	273,750	422,560	1,080,340
Region V	24,565	44,736	71,995
Region VI	78,531	124,684	263,789
Region VII	51,653	198,798	482,206
Region VIII	9,933	34,828	73,886
Region IX	14,806	52,706	88,563
Region X	71,606	145,887	342,294
Region XI	128,748	222,684	509,221
Region XII	24,784	18,356	34,320
ARRM	14,308	25,559	59,769

Figure 12.3-1 Number of Primary Cable Pairs to be Installed during Each Phase



(3) Cost Estimation Procedure

The outside plant cost is assumed to be represented by the cost for the primary cable pairs. The cost is estimated by first dividing cable installation into two categories, and then calculating the cost for each category.

(a) Categories

We categorized cable pairs as those for large exchange areas and those for small exchange areas. Based on the switching facility plan, the supply target for the large exchange areas was estimated to be the target for subscribers connected to local switches, and the supply target for small exchange areas was estimated to be the target for subscribers connected to remote subscriber units or remote line units.

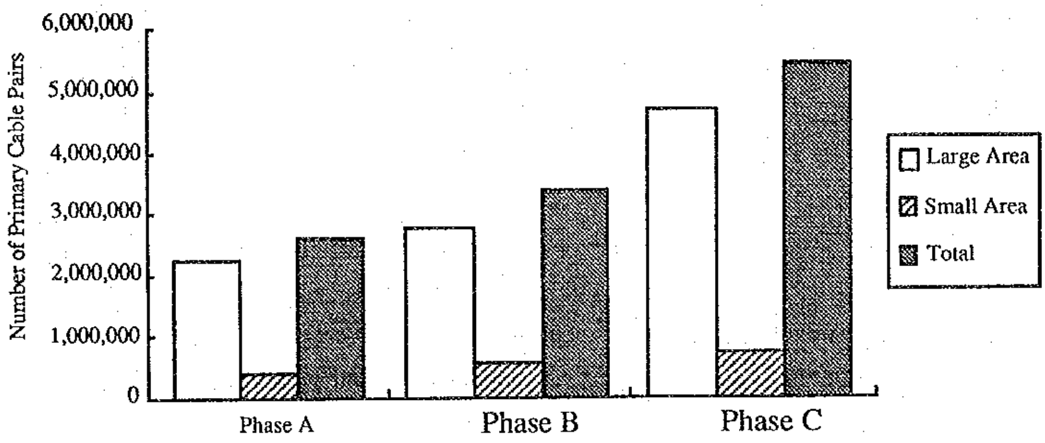
The number of primary cable pairs to be installed during each phase was calculated using the same procedure described in Section 12.3.1 (2). The results are shown in Table 12.3-3 and Figure 12.3-2.

Table 12.3-3 Number of Primary Cable Pairs Installed in Each Area.

(Unit: Pairs)

	Phase A			Phase B			Phase C		
	Large Area	Small Area	Total	Large Area	Small Area	Total	Large Area	Small Area	Total
Total	2,231,392	440,792	2,672,184	2,819,403	616,367	3,435,769	4,731,304	756,035	5,487,339
NCR	1,742,370	0	1,742,370	1,809,656	0	1,809,656	1,571,623	0	1,571,623
Region Total	489,022	440,792	929,814	1,009,747	616,367	1,626,114	3,159,681	756,035	3,915,716
CAR	676	1,948	2,624	8,067	8,790	16,856	25,473	39,153	64,626
Region I	6,312	29,368	35,679	25,315	38,661	63,976	105,458	90,111	195,569
Region II	5,617	21,490	27,107	8,508	18,338	26,846	17,191	49,660	66,852
Region III	101,704	70,017	171,721	165,056	62,582	227,638	582,286	0	582,286
Region IV	142,422	131,328	273,750	346,878	75,682	422,560	1,013,989	66,351	1,080,340
Region V	9,667	14,898	24,565	12,909	31,827	44,736	24,805	47,190	71,995
Region VI	31,753	46,778	78,531	55,553	69,132	124,684	170,400	93,388	263,789
Region VII	27,957	23,696	51,653	115,754	83,044	198,798	392,432	89,775	482,206
Region VIII	5,292	4,641	9,933	9,117	25,711	34,828	22,282	51,604	73,886
Region IX	7,056	7,750	14,806	19,172	33,534	52,706	33,494	55,069	88,563
Region X	48,319	23,286	71,606	79,155	66,731	145,887	237,275	105,020	342,294
Region XI	84,770	43,978	128,748	155,288	67,396	222,684	509,221	0	509,221
Region XII	13,136	11,649	24,784	3,733	14,623	18,356	8,288	26,032	34,320
ARRM	4,342	9,966	14,308	5,242	20,317	25,559	17,088	42,681	59,769

Figure 12.3-2 Number of Primary Cable Pairs Installed in Each Area



(b) Estimated cost

The average number of primary cable pairs to be installed in large areas and in small areas is about 8,500 and 700, respectively. Installation cost was calculated based on data from existing projects and the estimated number of pairs installed. The formula used was

Investment Cost = Vl x Ul + Vs x Us,

where

Vl and Vs are the number of primary cable pairs to be installed in large areas and small areas, respectively, and

Ul and Us are the unit costs (Ul: US$ 441.43, Us: US$ 573.86) represented by the cost to install a primary cable pair in large and small areas, respectively.

Table 12.3-4 shows the installation cost for the expansion of outside plant by phase.

Table 12.3-4 Cost for Expansion of Outside Plant

(Unit: 1,000 US$)

	Phase A			Phase B			Phase C		
	Large Area	Small Area	Total	Large Area	Small Area	Total	Large Area	Small Area	Total
Total	985,003	252,953	1,237,957	1,244,569	353,708	1,598,277	2,088,540	433,858	2,522,398
NCR	769,134	0	769,134	798,836	0	798,836	693,761	0	693,761
Region Total	215,869	252,953	468,822	445,733	353,708	799,441	1,394,778	433,858	1,828,636
CAR	298	1,118	1,417	3,561	5,044	8,605	11,245	22,468	33,713
Region I	2,786	16,853	19,639	11,175	22,186	33,361	46,552	51,711	98,263
Region II	2,479	12,332	14,812	3,756	10,523	14,279	7,589	28,498	36,087
Region III	44,895	40,180	85,075	72,861	35,913	108,774	257,038	0	257,038
Region IV	62,869	75,364	138,233	153,123	43,431	196,553	447,605	38,076	485,682
Region V	4,267	8,549	12,816	5,699	18,264	23,963	10,950	27,081	38,030
Region VI	14,017	26,844	40,860	24,523	39,672	64,195	75,220	53,592	128,812
Region VII	12,341	13,598	25,939	51,097	47,656	98,753	173,231	51,518	224,749
Region VIII	2,336	2,663	4,999	4,025	14,755	18,779	9,836	29,614	39,450
Region IX	3,115	4,447	7,562	8,463	19,244	27,707	14,785	31,602	46,387
Region X	21,330	13,363	34,693	34,942	38,294	73,236	104,740	60,267	165,007
Region XI	37,420	25,237	62,657	68,549	38,676	107,225	224,785	0	224,785
Region XII	5,798	6,685	12,483	1,648	8,391	10,039	3,658	14,939	18,597
ARRM	1,917	5,719	7,636	2,314	11,659	13,973	7,543	24,493	32,036

12.3.2 Replacement Plan

Outside plants equipment is affected by the elements, and thus deteriorates over time. It is therefore, necessary to replace old and deteriorated facilities in order to maintain service quality and to prevent increases in maintenance costs.

(1) Replacement Assumptions

The assumptions used for the outside plant replacement plan are as follows:

(a) All facilities in existence at the end of 1992 will be replaced sometime during the plan.

(b) The number of replaced facilities is level throughout the Master Plan period.

(c) The existing facilities count is based on the number of main lines as obtained from NTC.

(2) Cost Estimation Procedure

The number of primary cable pairs to be replaced was calculated using the same procedure described in Section 12.3.1 (2). The unit cost for large areas was used for calculating the replacement cost because most existing facilities are in large areas. Table 12.3-5 shows the number of primary cable pairs to be replaced and the cost of replacing them by phase.

Table 12.3-5 Number of Primary Cable Pairs and Replaced Cost

(Unit: Pairs and 1,000 US$)

	Phase A		Phase B		Phase C		Total	
	Cable Pairs	Cost	Cable Pairs	Cost	Cable Pairs	Cost	Cable Pairs	Cost
Total	435,165	192,095	435,165	192,095	435,165	192,095	1,305,494	576,284
NCR	294,593	130,042	294,593	130,042	294,593	130,042	883,778	390,126
Region Total	140,572	62,053	140,572	62,053	140,572	62,053	421,716	186,158

12.4 Non-Voice and New Services

12.4.1 Cellular Mobile Telephone Facilities

There are two analog cellular mobile telephone system (CMTSs) service providers in the Philippines, (PILTEL and EXTELCOM); they had 55,920 subscribers in 1992. A new company, SMART began operating a nationwide CMTS service using the TACS standard in 1994. Other mobile telephone service providers, ISLA Communications and Globe Telecom, are now under construction to operate a digital CMTS service using the GSM standard.

(1) Expansion Plan

The CMTS expansion plan was formulated based on the guidelines in Chapter 9. It will provide service to 1,520,000 subscribers by 2010, covering the major cities and the major highways connecting them. Table 12.4-1 shows the expansion plan.

Table 12.4-1 CMTS Expansion Plan

Phase	Phase A	Phase B	Phase C
Demand	183,000	557,000	1,520,000
Fulfillment Ratio (%)	90	90	90
Supply Target	164,700	501,300	1,368,000

(2) Implementation Schedule

1993 - digital CMTS trial projects in Metro Manila and Cebu

1998 - CMTS covering 40% of major urban centers (MUCs) and 30% of key development centers (KDCs), including major highways connecting them

2004 - CMTS covering 80% of MUCs and 50% of KDCs, including major highways connecting them

2010 - CMTS covering 100% of MUCs and 70% of KDCs, including major highways connecting them

The order in which MUCs, KDCs, municipalities, and cities are served will depend upon the priority of needs.

(3) Estimated Cost

Cost was estimated based on the two existing CMTS operators' installation costs and contract prices in foreign countries. Cost represents a complete system with transmission facilities.

(a) The facilities cost was computed using an average cost per subscriber of US$ 2,608 (Table 12.4-2).

(b) It is assumed that the average number of subscribers per cell site with 49 voice channels is 1,340, based on a calling rate of 0.03 erlang/subscriber. Average number of cell sites per mobile switching center is estimated to be 23.

Table 12.4-2 CMTS Supply and Estimated Cost

(cost in US$ 000)

Phase	Phase A	Phase B	Phase C	Total
Supply				
- Additional	164,700	336,600	866,700	1,368,000
- Replacement	--	--	55,920	55,920
Total	164,700	336,600	922,620	1,423,920
Cost				
- Additional	429,581	877,942	2,260,583	3,568,106
- Replacement	--	--	145,854	145,854
Total	429,581	877,942	2,406,437	3,713,960

12.4.2 Radio Paging Facilities

Radio paging services are moving from simple call service to numeric and/or alphanumeric message-added call service. Paging systems must therefore provide various service functions and be easy to maintain. Paging services are currently provided by three operators in Metro Manila and the vicinity provinces (Baguio, Cebu, Cagayan de Oro, and Davao). Each operator is planning to expand nationwide. There were 71,758 subscribers in 1992.

(1) Expansion Plan

The radio paging system expansion plan was formulated based on the guidelines in Chapter 9. Radio paging facilities will expand to cover major cities, where the most of the demand exists. Three types of pagers (tone-only, numeric display, and alphanumeric) will be available in almost all major cities by 2010. The order in which the cities are served will depend on the priority of needs. Table 12.4-3 shows the expansion plan.

Table 12.4-3 Radio Paging Service Expansion Plan

Phase	Phase A	Phase B	Phase C
Demand	362,093	650,881	1,097,636
Fulfillment Ratio (%)	90	90	90
Supply Target	325,884	585,793	987,872

(2) Implementation Schedule

1998 - paging service covering 40% of major urban centers (MUCs) and 30% of key development centers (KDCs)

2004 - paging service covering 75% of MUCs and 50% of KDCs

2010 - paging service covering 100% of MUCs and 70% of KDCs

(3) Estimated Cost

(a) Facility cost was computed using an average cost per subscriber of US$ 2,126.6. Cost represents a complete system with transmission facilities and terminals.

(b) Object facilities
A typical paging system and the object facilities for the cost calculation are shown in Figure 12.4-1. Table 12.4-4 shows the results of the cost calculation.

Figure 12.4-1 Radio Paging Service Network Configuration

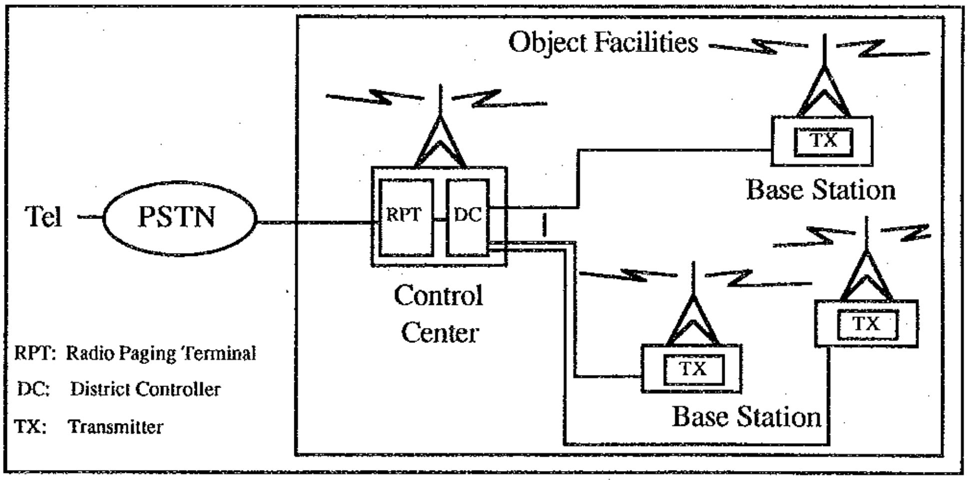


Table 12.4-4 Radio Paging Service Supply and Estimated Cost

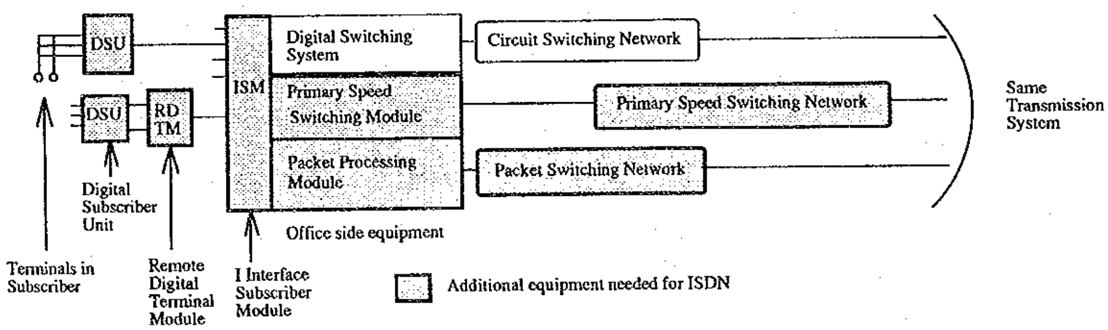
(Unit: US$ 000)

Phase	Phase A	Phase B	Phase C	Total
Supply				
- Additional	325,884	259,909	402,080	987,872
- Replacement	--	--	71,758	71,758
Total	325,884	259,909	473,838	1,059,630
Cost				
- Additional	691,073	551,166	852,654	2,094,893
- Replacement	--	--	152,171	152,171
Total	691,073	551,166	1,004,825	2,247,064

12.4.3 ISDN

ISDN service will require additional functions to a telephone network as shown in Figure 12.4-2.

Fig 12.4-2 ISDN structure



ISDN subscribers are also telephone subscribers. Most of ISDN systems shown in Figure 12.4-2 work in common with the telephone network and are therefore included in the telephone facility plan in this report. ISDN is considered to be a part of telephone network. We will addressed the additional facilities needed especially for ISDN service.

ISDN service is assumed to be introduced in Metro Manila and Cebu in 1998, in MUCs by 2004, and in KDCs by 2010. Subscriber distribution is estimated to be in proportion to the telephone subscriber distribution. Remote digital terminal modules are needed for remote areas, but they are not included here, because it is assumed here that ISDN service is offered only in cities during time period covered by this report. The facility plan and estimated cost are shown in Table 12.4-5.

Table 12.4-5 ISDN Facility Plan and Estimated Cost

(cost in US$ millions)

Year	1998	2004	2010
Introduction area	Metro Manila, Cebu	MUC	KDC
Demand for N-ISDN	75	155,480	1,572,492
Supplied N-ISDN subscriber lines	50	120,544	1,140,847
Additional N-ISDN subscriber lines	50	120,494	1,020,303
Total N-ISDN cost	2.000	36.148	61.218
Demand for P-ISDN	6	13,216	133,662
Supplied P-ISDN subscriber lines	4	10,247	96,972
Additional P-ISDN subscriber lines	4	10,243	86,725
Total P-ISDN cost	1.600	30.729	52.035
Total cost for ISDN	3.600	66.877	113.253

Note: N-ISDN: narrow band ISDN, basic speed of 64 Kb/s
P-ISDN: primary speed ISDN, speed of 2.048 Mb/s
(These abbreviations are defined for use only in this plan)

12.4.4 Intelligent Network

Intelligent network service is a pure telephone service and is supplementary to require telephone service. It provides services from computers connected to a telephone network. The facility plan is for the introduction of computers. Only one NSSP (Network Service Support Point = Service Management Function) is needed in NCR for all of the Philippines, because the processing capacity of the computer is enough for all telephone users in the Philippines that are 9 million subscribers in 2010). One NSP (Network Service Control Point = Service Control Function) in NCR may be enough to handle all users of the Philippines at the beginning of the service in 1998. Then in 2004, additional one will be located in Cebu, and then another one in NCR by 2010.

The NSSP and the NSP are office computers with a data communication function. Their cost varies widely, especially for the software. Additionally interface facilities for CCS No. 7 and switching systems may also be needed, but is omitted here, because the cost is included in the PSTN.

Table 12.4-6 shows the facility plan and estimated cost and Figure 12.4-3 shows the intelligent network structure.

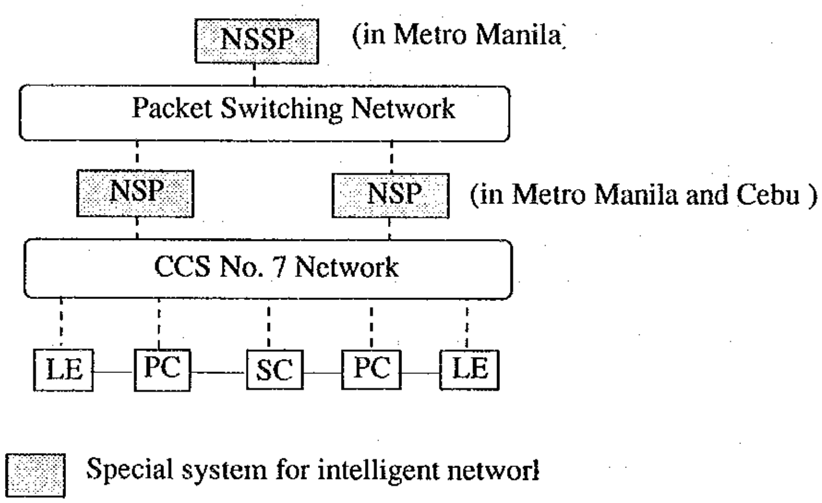
Even though the introduction of intelligent network services will cause the number of telephone calls to increase, switching system capacity is not increased. It is difficult to say how much calling rate will increase. The projected switching systems and transmission systems are assumed to have enough excess capacity to handle the increased load.

Table 12.4-6 Intelligent Network Facility Plan and Estimated Cost

(cost in US$ million)

Year	1998	2004	2010
NSSP	1		
NSP	1	1	1
Cost	4	1	1

Figure 12.4-3 Intelligent Network Structure



12.4.5 Leased Line

All facilities for leased lines are included in the telephone network facility in this plan. If the cost for leased lines is picked up daringly, it is calculated here as follows.
It is assumed that the ratio of leased lines outside of local areas against total leased lines in the Philippines is about 19%, about the same as for NTT in Japan. The Table 12.4-7 shows the facility plan.

Table 12.4-7 Lease Line Facility Plan and Estimated Cost

(cost in US$,000)

Year	1998	2004	2010
Leased line demand	6,428	14,779	30,844
Additional leased lines	5,017	9,762	21,082
Investment cost for local part of leased lines	6,823	13,276	28,672
Leased lines among PCs	1,221	2,808	5,860
Additional leased lines among PCs	939	1,587	3,052
Investment cost of leased lines among PCs	554	936	1,801
Total cost for leased lines	7,377	14,213	30,472

12.4.6 Packet Switching Network

The forecasted demand for packet switching service is assumed that the number of subscribers increases until 2004, but after 2004, users will begin shifting to ISDN and the demand for exclusive packet switching networks will decrease. The facility plan is shown in Table 12.4-8.

Table 12.4-8 Packet Switching Network Facility Plan and Estimated Cost

(cost in US$,000)

Year	1998	2004	2010
Introduction area	NCR, MUC, KDC and up to 31% of other municipalities	up to 46% of other municipalities	up to 52% of other municipalities
Demand for packet switching networks	5,513	14,624	14,624
Supplied subscribers of packet switching network	5,031	13,127	13,127
Additional subscribers	4,103	8,096	0
Investment cost for packet Switching network	3,323	6,558	0

Note: The subscriber cables and trunk circuits are included in the telephone network.

12.5 Cost Estimation

The total investment cost for expansion is summarized in Table 12.5-1; the investment cost for replacement is summarized in Table 12.5-2; and the total investment cost is summarized in Table 12.5-3.

Table 12.5-1 Expansion Investment Cost

(Unit: Million US $)

	Phase A	Phase B	Phase C	Total
Switching	1,481	1,839	2,983	6,303
Transmission	777	1,251	2,269	4,297
Outside Plant	1,238	1,598	2,522	5,359
Sub-total	3,496	4,688	7,774	15,958
New Services				
CMTS	430	878	2,261	3,568
Radio Paging	691	551	853	2,095
ISDN	4	67	113	184
Intelligent Network	4	1	1	6
Packet Switching	3	7	0	10
Sub-total	1,132	1,504	3,227	5,863
Total	4,628	6,191	11,002	21,821

Table 12.5-2 Replacement Investment Cost

(Unit: Million US $)

	Phase A	Phase B	Phase C	Total
Switching	182	115	152	449
Transmission	11	12	284	308
Outside Plant	192	192	192	576
New Services				
CMTS			146	146
Radio Paging			152	152
Total	385	320	926	1,631

Table 12.5-3 Total Investment Cost

(Unit: Million US $)

	Phase A	Phase B	Phase C	Total
Switching	1,662	1,954	3,135	6,751
Transmission	788	1,264	2,553	4,605
Outside Plant	1,430	1,790	2,714	5,934
Sub Total	3,880	5,008	8,402	17,290
New Services				
CMTS	430	878	2,406	3,714
Radio Paging	691	551	1,005	2,247
ISDN	4	67	113	184
Intelligent Network	4	1	1	6
Packet Switching	3	7	0	10
Sub-total	1,132	1,504	3,525	6,161
Total	5,012	6,512	11,927	23,451

CHAPTER 13

OPERATION AND MAINTENANCE PLAN

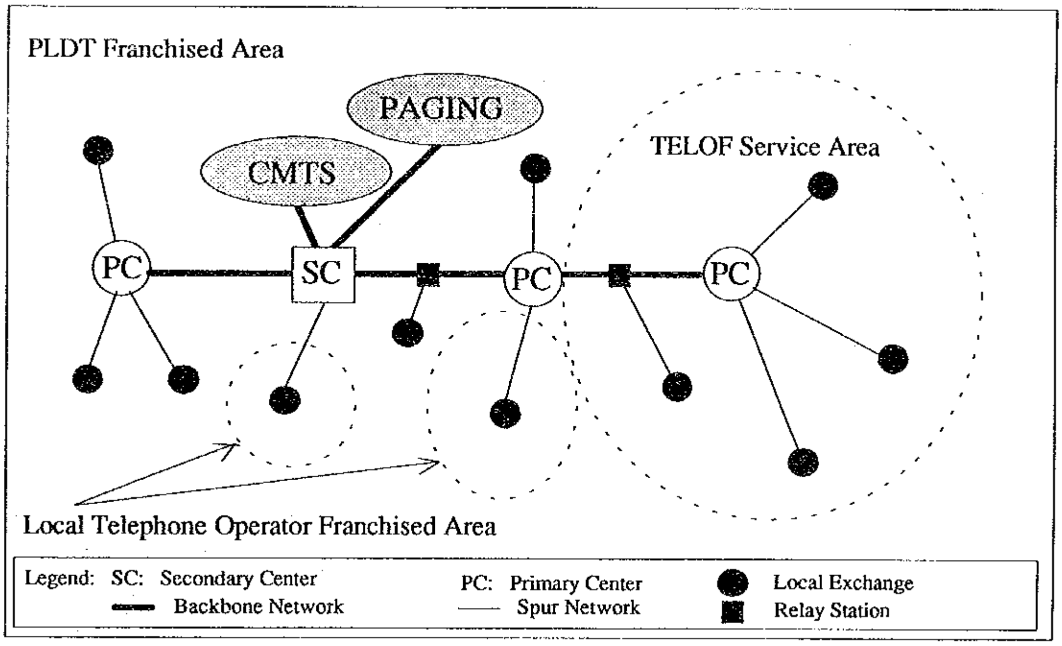
CHAPTER 13 OPERATION AND MAINTENANCE PLAN

Network providers are expected to ensure the reliability of their network during failures and natural disasters, to take adequate countermeasures against abnormal traffic loads, and to maintain the confidentiality of information. To see how network reliability can be improved, we considered and examined the operational efficiency and maintenance plans of the public switched telephone networks (PSTNs) .

13.1 Network Management Systems

As various services become digitized and the number of subscribers expands, network management will come to play a more important role in providing high quality service to subscribers. In the Philippines, the PSTNs are operated and maintained by the respective carriers. Since they are interconnected with each other, an efficient network management system is needed. We therefore considered and examined establishing an efficient network management system. Figure 13.1-1 shows the conceptual configuration of the PSTNs in the Philippines.

Figure 13.1-1 Conceptual Configuration of PSTNs

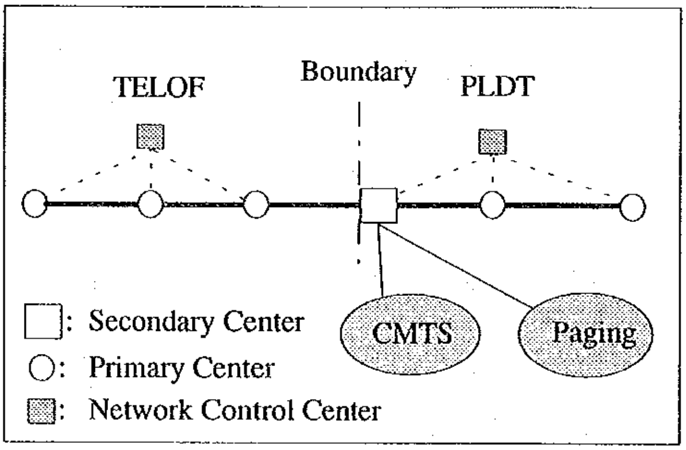


13.1.1 Backbone Network Control System

(1) Present Status

The existing backbone network for the PSTN is primarily composed of two networks, each operated by a different company. They are interconnected with each other, as well as to other networks, such as cellular mobile telephone systems (CMTSs) and radio paging systems. The larger nationwide network belongs to the PLDT and the smaller non-nationwide one belongs to a government organization, TELOF. Each operator controls and maintains their network individually. They also have their own network control system, composed of remote supervision and control equipment. The equipment is not necessarily the same between operators, it depends on the switching equipment used. Figure 13.1-2 shows the conceptual configuration of the existing backbone network control systems.

Figure 13.1-2 Conceptual Configuration of Backbone Network Control System



(2) Problems

Our examination of the backbone network control system identified the following problems.

- Since a centralized control system has not been implemented.
- The condition of the entire network cannot be determined.
- An operator can only determine the condition of his own network.

- It takes a long time to locate a fault because of the interconnected network.
- A support system between operators is not available.
- Other parties are not informed of abnormal traffic conditions.

(3) Improving the Backbone Network Control System

The following actions would improve the control system.

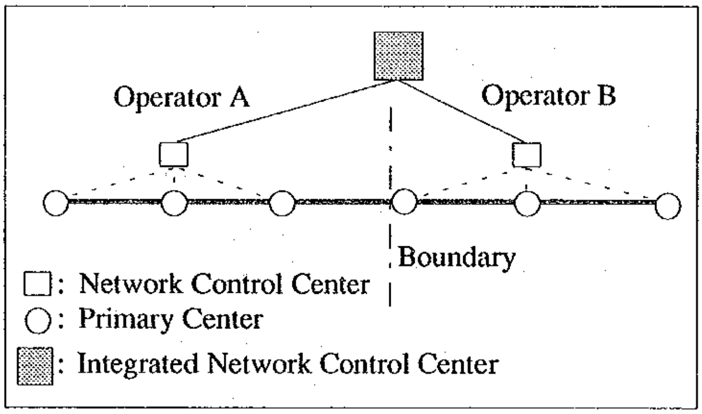
(a) Establish integrated network control center.

An integrated network control center in Metro Manila would make it possible to:

- monitor the status and performance of the backbone network nationwide in real time,
- detect abnormal network conditions,
- direct corrective action,
- collect and analyze network performance data, traffic parameters, etc., and
- issue reports on abnormal network conditions, actions taken, and results obtained.

The control center could be operated by the PLDT, a governmental agency, or another entity. However, it would not be easy to establish an integrated network control center because the individual network operators have information they wish to keep confidential, such as traffic flow data etc. However, it is still possible to transmit alarms between networks. Figure 13.1-3 shows a conceptual configuration of an integrated network control center.

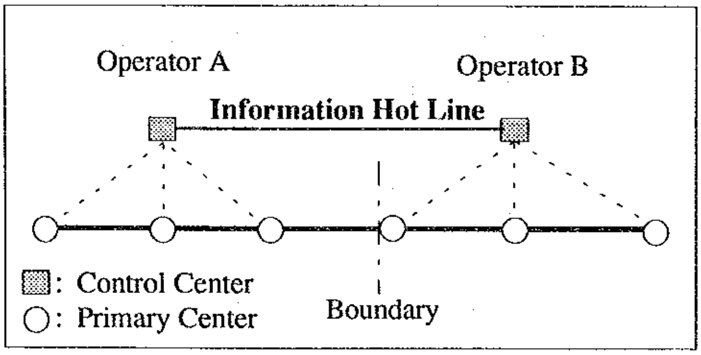
Figure 13.1-3 Conceptual Configuration of Integrated Network Control Center



(b) Establish information hot line

Establishing a hot line is the easiest way to improve a control system. A hot line can be established by connecting each operator's network control room via information transmission lines. Abnormal network conditions can then be broadcast in real time. A hot line would allow each operator to keep their operations independent. Figure 13.1-4 shows the configuration of an information hot line.

Figure 13.1-4 Information Hot Line



(c) Establish Support System

To ensure network reliability during failures and natural disasters, a support system between operators is needed. Introducing a support system would also improve service performance; for example, the PLDT could help another company make repairs. A support system would allow operators to:

- make support arrangements, including i) network regulations during an emergency, ii) multiple alternative routes and the number of necessary circuits, and iii) information contact system.
- lease circuits for forming multiple transmission routes, such as double-circuit routing and looped networks.
- dispatch staff to assist with repairs.

(4) Recommendation

It is necessary to strengthen the communication of operating information between operators in order to reduce network downtime, to prevent abnormal situations due to network congestion, to ensure network reliability during failures and natural disasters, and to maximum the utilization of facilities. We therefore recommended establishing an information hot line and establishing an operator support system .

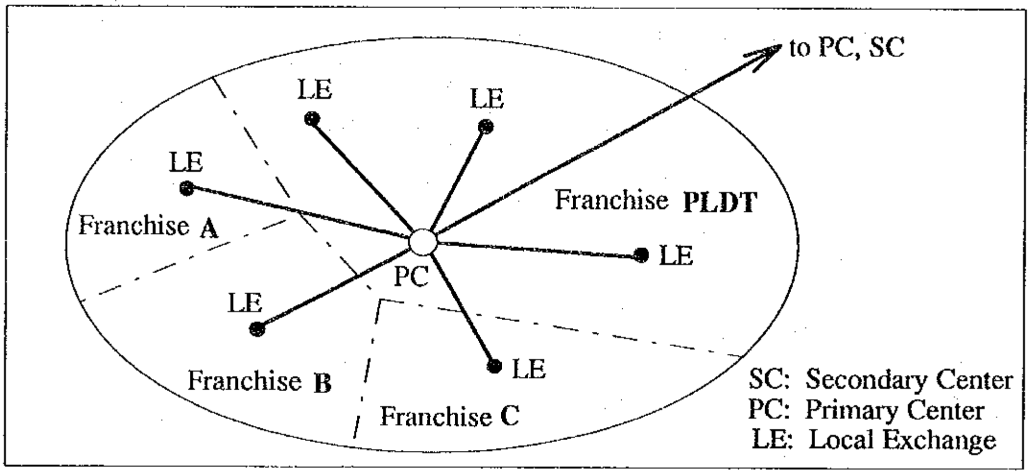
13.1.2 Local Network Control Systems

Local networks consist of spur links and local switching systems; they also play an important role. As fact of the expansion project, it may be necessary to integrate the local network control systems. We therefore considered and examined the possibility of integrating the local networks.

(1) Present Status

The local switching systems and spur links are individually controlled and maintained by the PLDT, governmental agencies, and local telephone companies. Figure 13.1-5 shows the conceptual configuration of the local network control systems.

Figure 13.1-5 Conceptual Configuration of Local Network Control Systems



(2) Problems

A large number of local exchanges are expected to be installed nationwide between now and 2010. These exchanges may create problems in the operation and maintenance of the local networks. These problems include:

- Incompatible switching equipment being used by each operator.
- Delays in locating faults because of complicated networks.
- Different maintenance abilities for each operator (number of technicians, technical level, etc.)
- Decentralized control of switching systems by different operators.
- Unable to determine condition of all local networks.
- No support system between operators.
- Other operators not informed of abnormal traffic conditions.

(3) Improving the Local Network Control Systems

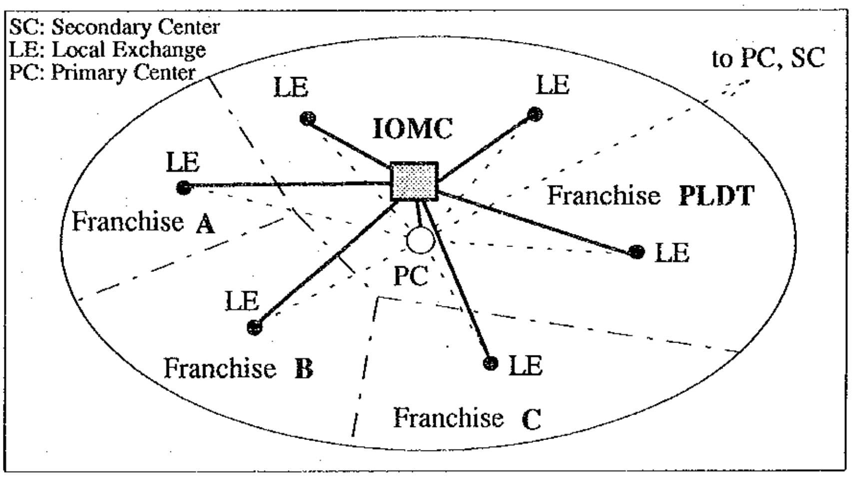
The following actions would improve the control systems.

(a) Establish an integrated operation and maintenance center for each local network (hereinafter called IOMC)

A properly located IOMC (i.e., the technical support staff could be dispatched to a local exchange office within 2 or 3 hours) for a local network would make it possible to monitor, control, and maintain all local network switching, transmission, and power facilities. It will also facilitate taking necessary measures during abnormal situations.

The IOMC could be operated by the PLDT, a governmental agency, or another operator. Figure 13.1-6 shows the idea for an IOMC.

Figure 13.1-6 Idea for Integrated Operation and Maintenance Center

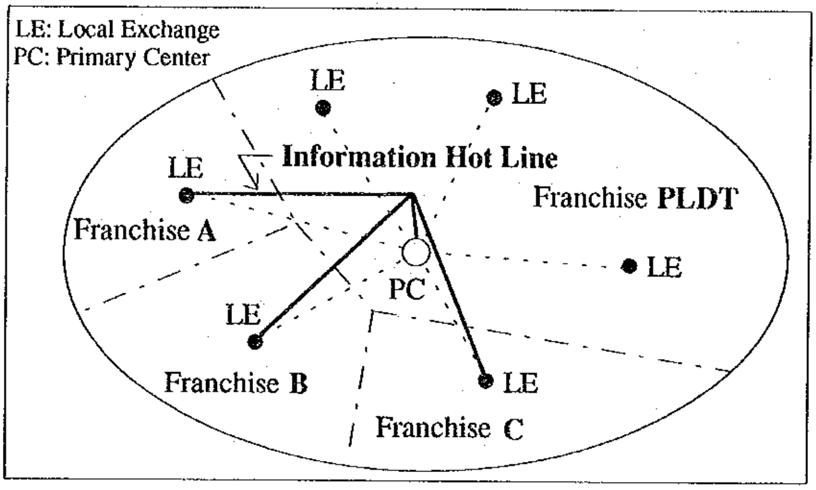


While it is technically feasible to centralize control and supervision of different local switches, it would not be easy to establish an IOMC, because the local switches are owned by different telephone companies, and each company has information they wish to keep confidential, such as traffic flow data. However, it is still possible to transmit alarm information.

(b) Establish information hot line

Establishing a hot line is the easiest way to improve the local network control systems. A hot line can be established by connecting each local telephone operator's network control room via information transmission lines. Abnormal network conditions could then be broadcast in real time. A hot line would allow each local operator to keep their operation and maintenance independent. Figure 13.1-7 shows the configuration of an information hot line.

Figure 13.1-7 Information Hot Line



(c) Unify franchised areas

Unifying several franchised areas under one primary center is another way to improve control.

(4) Recommendation

It is necessary to strengthen the communication of information between operators in order to reduce local network downtime. It is also necessary to reduce the maintenance work volume of local telephone companies. We therefore recommended:

- Establishing an information hot line between local telephone operators' control rooms.
- Introducing unified switching facilities to simplify maintenance and reduce spare parts inventories.

13.2 Subscriber Facilities Maintenance

(1) Present Status

Subscriber facilities are individually maintained by the PLDT, governmental agencies, and local telephone companies.

(2) Problems

The network expansion project will expand the telephone service area to all municipalities; the number of telephone subscribers will grow rapidly (to around 8,768,000). To meet this demand, a large number of subscriber facilities will need to be installed. Most local telephone companies (around 40) will need to make significant investments in expanding their facilities. They will also need to significantly increase their maintenance staffs to construct and maintain these facilities. However, financially most local telephone companies need to prevent employing too many people, therefore they need to improve their operation and maintenance systems.

(3) Improving the Maintenance of Subscriber Facilities

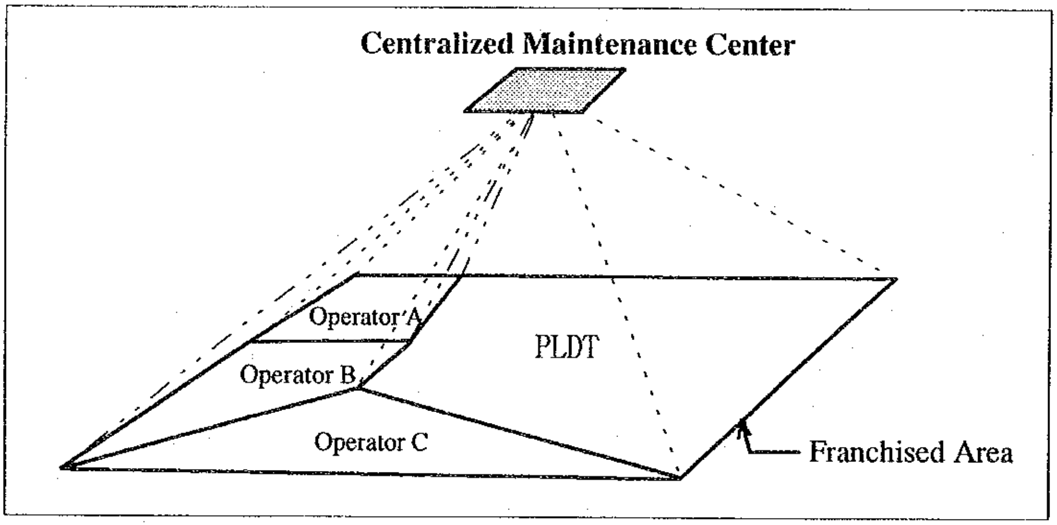
A properly located centralized maintenance center for subscriber facilities (i.e., the technical staff could be dispatched to the most distant subscriber location within 2 or 3 hours) could handle the maintenance and construction work for the local telephone companies. It could handle both intensive maintenance work (maintenance of subscriber facilities and maintenance reporting) and construction of subscriber facilities.

It would ideally have an adequate number of maintenance personnel for the optical fiber cable, subscriber lines, and telephone sets being supported. Figure 13.2-1 shows the idea of a centralized maintenance center.

(4) Recommendation

Since it is necessary to establish properly located centralized maintenance centers, we recommend that this concept be implemented.

Figure 13.2-1 Idea of a Centralized Maintenance Center



13.3 Staffing Plan

As the network expands, many digital switching facilities, transmission and radio facilities, and subscriber facilities will be installed. To smoothly operate and maintain this equipment, and to provide good quality service, an adequate number of personnel must be employed.

13.3.1 Precondition

(a) The number of support personnel to be located at newly constructed telephone offices, transmission relay stations, and radio stations should be based on the amount of equipment to be installed at these offices, considering that highly reliable equipment with a low fault rate will be used.

(b) The support staff should be trained so they can smoothly operate and maintain the PSTN.

13.3.2 Additional Staff

According to the ITU yearbook, the Philippines telephone companies had 648,309 main lines and 20,887 employees as of December 31, 1991. There were 31 main lines per employee (38.8 in 1992 for the PLDT); the average number in 29 countries was 130 in 1991. Workers in the Philippines therefore supported fewer line, on average, than in other countries. However, there was a difference in measurement between the Philippines and the other countries: In the Philippines, the number of employees included all employees of all telephone companies. Therefore, the figure is lower. But in any case, it is still necessary to improve the number to attain an efficient telecommunications network. Table 13.3-1 shows the number of main lines per employee for 29 countries.

(1) Calculation Method

We calculated the number of additional support personnel based on the expected growth in the number of main lines with the correlation curve in Figure 13.3-1, which shows the correlation between the number of main lines and the number of employees in 26 countries.

Figure 13.3-1 Correlation between Number of Employees and Main Lines

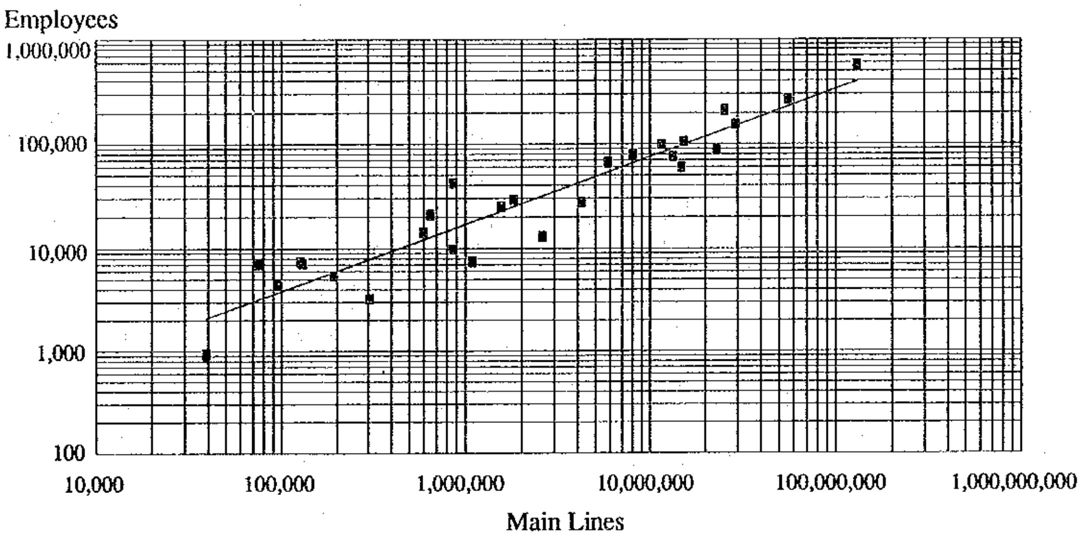


Table 13.3-1 Number of Main Lines per Employee in 29 Countries

Country	Year	Main Lines	Employees	Main Lines/Employee
Myanmar	1988	74,729	6,927	10.8
India	1991	5,074,734	339,814	14.9
Sri Lanka	1991	125,834	7,396	17.0
El Salvador	1991	129,964	7,079	18.4
China	1991	8,450,600	432,700	19.5
Indonesia	1989	863,814	41,815	20.7
Honduras	1991	94,400	4,400	21.5
Philippines	**1991**	**648,309**	**20,887**	**31.0**
Guatemala	1990	191,938	5,396	35.6
Peru	1991	594,213	14,201	41.8
Brunei	1991	39,092	927	42.2
Thailand	1991	1,553,160	24,840	62.5
Malaysia	1991	1,816,860	28,797	63.1
Chile	1990	860,075	9,791	87.8
Mexico	1991	5,841,802	66,024	88.5
Costa Rica	1991	304,863	3,210	95.0
Australia	1991	8,046,029	79,219	101.6
Brazil	1991	11,500,000	98,404	116.9
United Kingdom	1991	25,595,000	210,500	121.6
Canada	1990	15,290,000	105,435	145.0
Singapore	1991	1,085,679	7,457	145.6
Greece	1991	4,190,087	27,593	151.9
Spain	1991	13,264,360	75,492	175.7
France	1991	29,080,190	156,200	186.2
Hong Kong	1991	2,596,397	13,002	199.7
Japan	1991	55,888,000	266,053	210.1
U.S.A	1991	130,110,173	575,622	226.0
Korea	1991	14,831,659	58,896	251.8
Italy	1991	23,071,000	87,595	263.4
Total		361,212,961	2,775,672	130.1

Source: ITU Yearbook of Common Carrier Telecommunication Statistics
(20th edition) (Chronological Series 1982-1991)

(2) Estimated Number of Additional Support Personnel

A total of 48,003 additional support personnel will be required to operate and maintain the additional 7,880,500 main lines expected to be installed through the year 2010. The main source of technical personnel for the telecommunications sector is expected to be the graduates of engineering, technology, and vocational schools, which graduated a total of 32,402 students during the period 1990-1991. The yearly average for additional personnel is 2,667, which is 8.2% of the annual number of graduates. Table 13.3-2 shows the number of additional personnel required through 2010.

Table 13.3-2 Required Additional Personnel through 2010.

	(1992)	Phase A (1993-1998)	Phase B (1999-2004)	Phase C (2005-2010)	Total
Main Line Demand (000)		3,949.8	6,342.9	9,768.9	
Main Lines (000)	887.0	2,703.3	5,038.3	8,767.5	
Main Lines/Employee		83.9	104.6	127.2	
Additional Personnel		11,309	15,955	20,739	48,003

13.4 Training Plan

The network expansion project will require the installation of a large number of digital switching facilities, transmission and radio facilities, and subscriber facilities. To train the 2 to 3,000 new employees who will be hired each year to operate and maintain these facilities, the telephone companies will need to improve their training programs and make them more effective.

13.4.1 Promotion of Efficient Training

(1) Present Status

In 1992, PLDT's Technical Training Center (TTC) trained 4,042 employees. TELOF's Telecommunications Training Institute (TTI) handled 1,254 trainees in 1991. However, most local telephone companies lack training facilities and thus rely on on-the-job training.

(2) Improving Training Efficiency

The following actions would improve the training programs.

- Establish a training center at each telephone company, if possible, otherwise establish centralized training centers.
- Expand the training capacities of the TTI and TTC.
- Enhance the project-associated training in the manufacturer's factories and in the Philippines.
- Also train local telephone company staff at the TTI and TTC.
- Promote regional training programs taught by instructors dispatched from the TTI and TTC.

Establishing Training Centers at each telephone company is important because most local telephone companies will need to add a large number of maintenance personnel to keep their expanded systems in good condition. They need some way to train these personnel.

For those companies unable to set up their own training center, centralized training centers can be set up in the administrative regions to train the local telephone company personnel in that region, using the TTI and/or TTC instructors. However, centralized training is not as efficient because the local telephone companies have different switching facilities (different manufacturers), thus the demand for training is not the same for every company. Therefore, establishing training centers at each company is a better approach.

To train new personnel and upgrade the skills of present personnel, additional instructors are needed. Construction contractors should provide instructor training for their transmission and radio equipment, switching systems, and optical fiber cables. Personnel who have completed this training would then be assigned as instructors at the training centers and as leaders in the telephone maintenance offices.

(3) Training Program

Four types of training are needed.

(a) Leader training

Engineers in charge of operation and maintenance should be provided leader training. Upon completion of this training, these engineers would be responsible for training the staff.

(b) Engineer training

Chief technicians of telephone offices should be provided the training needed for engineers of operation and maintenance.

(c) Technician training

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

(d) New staff training

Newly employed personnel and those changing occupations should be provided with the necessary training for the simple repairing of faults of telephone sets, digital switches, transmission and radio equipment, power equipment, and outside plant equipment.

(4) Recommendation

The following measures are recommended for promoting smooth operation and maintenance.

- Promote on-the-job training.
- Expand the training capacities of the TTI and TTC.
- Enhance the project-associated training in the manufacturer's factories and in the Philippines.
- Also train local telephone company staff at the TTI and TTC.
- Promote regional training programs taught by instructors dispatched from the TTI and TTC.
- Conduct four types of training (leader training, engineer training, technician training, new staff training).
- Establish a training center at each company.

CHAPTER 14

PROJECT EVALUATION

CHAPTER 14 PROJECT EVALUATION

14.1 Framework

14.1.1 Purpose

The project was evaluated to determine its viability and profitability from financial and economic points of view. The Team estimated the cost to carry out the project and the revenue it will generate. The results of our evaluation can be used by the government for policy making and by operating companies to formulate their expansion plans.

14.1.2 Procedure

The project was evaluated as follows:

(1) Identify premises and assumptions in the project.

(2) Estimate capital expenditures and operating expenditure (cash outflow).

(3) Estimate operating revenue (cash inflow).

(4) Create a cash flow table and calculate a financial internal rate of return (FIRR).

(5) Perform sensitivity analyses.

(6) Estimate economic benefits and calculate the economic internal rate of return (EIRR).

14.1.3 Premises and Assumptions

The first step was to identify the premises and assumptions in the project. Realistic and simple assumptions make an evaluation more reliable and accurate. The basic premises and assumptions of this evaluation were as follows.

(1) Object

The object is the expansion plan for basic telephone service formulated in the facilities plan in Chapter 12. This plan consists of three phases and covers from 1993 to 2010. The PLDT and other operating companies have their own investment plans and it is possible that new operators may arise during the project period. The Team evaluated the various plans by many operators as one project.

(2) Operation Period

The project period covers 18 years, from 1993 to 2010. This means that the first main line of the project is installed in 1993 and the last one is installed in 2010. All telecommunications facilities have finite life times: 20 years according to the generally accepted accounting principles in the Philippines. Therefore, the facilities that begin operating in 1993 will come to the end of their useful life in 2012. The operation period was correspondingly set to be 20 years : 1993 to 2012. The unused value was estimated for these facilities having remaining life at the end of the operation period. Scrap value was not taken into account since it is negligible.

(3) Construction Period

The construction of facilities generally starts two years before operation begins. To simplify the cash flow and keep realistic, the facilities cost is assumed to be paid in the previous year. For example, a new main line beginning operation in 2000 is assumed to be paid for in 1999.
Each phase consists of six years, so the annual number of installed telephone lines is assumed to be one-sixth of the total volume in each phase.

(4) Exchange Rate

All revenues and most costs were calculated in Philippine pesos. And the cash flow were calculated in Philippine pesos. But facility costs are estimated in US dollars at 25 pesos = US $1.

(5) Sunk Costs

Sunk costs were not taken into account because for an expansion project, the incremental internal rate of return, which results from considering only the incremental investment, sales, and operating costs, is appropriate since it takes account of the incremental net benefits resulting from the incremental production. Therefore, any past expenses that were already borne were not taken into account. On the other hand, the future costs for rehabilitation, replacement, and renewal of existing facilities were added to the total project cost since well maintained facilities are indispensable for providing the better service quality.

(6) Inflation

The effects of inflation were basically not considered. While price changes affect operating costs as well as revenues, if all prices increase at the same rate at home and abroad, their relative levels stay the same.

However, the prices for utility services including telephone do not usually go up with inflation because they are regulated by the government. In contrast, the construction cost do increase. The effects on FIRR due to increases in network construction costs were examined in a sensitivity analysis.

(7) Revenue and Cost Estimates

The present rate (1993) was used to estimate revenue. To estimate costs, the Team used the data of actual projects in the Philippines. The effects of revenue decreases on the FIRR were estimated by sensitivity analysis.

(8) Ratio of Telephone for Residential Use

The ratio of residential telephone use is currently 61.5%; it is projected to reach 70% in 2010.

14.1.4 Construction Schedule

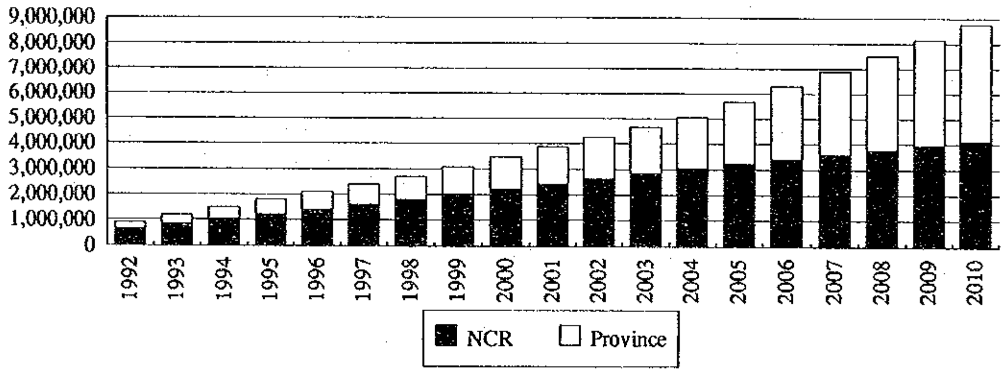
The total number of main telephone lines is expected to reach approximately 8.8 million, almost ten times more than the existing 0.9 million ; 47% of them, four million lines, are planned to be installed in the NCR. Table 14.1-1 and Figure 14.1-1 show the number of main telephone lines in the project period.

Table 14.1-1 Number of Main Telephone Lines in the Project Period

Year	Total	Sub-total NCR	Sub-total Province	New NCR	New Province	RPL. NCR	RPL. Province
1992	**887,229**	**600,626**	**286,603**				
1993	1,189,904	797,982	391,922	197,356	105,319	39,316	21,521
1994	1,492,579	995,338	497,241	197,356	105,319	39,316	21,521
1995	1,795,254	1,192,694	602,560	197,356	105,319	39,316	21,521
1996	2,097,929	1,390,050	707,879	197,356	105,319	39,316	21,521
1997	2,400,604	1,587,406	813,198	197,356	105,319	39,316	21,521
1998	**2,703,279**	**1,784,762**	**918,517**	**197,356**	**105,319**	**39,317**	**21,521**
1999	3,092,444	1,989,739	1,102,705	204,977	184,188	29,546	9,000
2000	3,481,609	2,194,716	1,286,893	204,977	184,188	29,546	9,000
2001	3,870,774	2,399,693	1,471,081	204,977	184,188	29,546	9,000
2002	4,259,939	2,604,670	1,655,269	204,977	184,188	29,546	9,000
2003	4,649,104	2,809,647	1,839,457	204,977	184,188	29,546	9,000
2004	**5,038,266**	**3,014,623**	**2,023,643**	**204,976**	**184,186**	**29,551**	**8,998**
2005	5,659,810	3,192,639	2,467,171	178,016	443,528	31,241	17,247
2006	6,281,354	3,370,655	2,910,699	178,016	443,528	31,241	17,247
2007	6,902,898	3,548,671	3,354,227	178,016	443,528	31,241	17,247
2008	7,524,442	3,726,687	3,797,755	178,016	443,528	31,241	17,247
2009	8,145,986	3,904,703	4,241,283	178,016	443,528	31,241	17,247
2010	**8,767,525**	**4,082,716**	**4,684,809**	**178,013**	**443,526**	**31,243**	**17,244**

RPL = Replacement of existing facilities

Figure 14.1-1 Number of Main Lines in the Project Period



14.2 Revenue Estimation

14.2.1 Revenue Categories

The present rate was used to estimate the revenue. Category of revenue estimation are as follows:

(1) Local Service
(2) Domestic Toll Call
(3) International Toll Call
(4) Others
(5) (Provision for Doubtful Account)

14.2.2 Local Service

Local service charges are different by facility, operating company and area in the Philippines. The charge for analog local switch user is lower than for digital. The number of digital telephone lines will increase year by year from 67% in 1992, as shown in Table 14.2-1. All analog switches used in the Philippines are to be removed and replaced with digital switches by 2004. Since PLDT is the dominant operating company, it has 88% of the subscribers in the Philippines, we used their tariffs in Manila and Ruzon to estimate revenue estimation.

Table 14.2-1 Number of Main Lines by Type of Switching System

unit: line

Year	1992	1998	2004	2010
Analog	596,302	231,279	0	0
Total	887,229	2,703,279	5,038,266	8,767,525
Ratio of Analog	67.2%	8.6%	0%	0%

14.2.3 Domestic Toll Call Charge

The domestic toll call charges used in this study were obtained by sampling data the current rates: 500 pesos and 2,000 pesos for residential and business subscribers, respectively in the NCR, and 1,900 and 7,500 for residential and business subscribers, respectively in the provinces.

14.2.4 International Toll Call

The international traffic per subscriber in the Philippines is quite high compared to other Asian countries. One reason of the fact is that the total number of telephone is quite small compared to the economic situation and the population. International outgoing traffic in the world is shown in Table 14.2-2. The Team projects that the international traffic per person will grow from 2.11 to 5.44, which is the figure for Malaysia, because the economic situation in the Philippines is expected to reach the level Malaysia at now by 2010.

Table 14.2-2 Outgoing International Traffic in the World

as of 1991

Item	IT	M:main line	P:population	**IT/M**	**IT/P**	GDP/P
(unit)	thousand minutes	thousand	thousand	**minutes**	**minutes**	US $
Indonesia	100,027	1,277	187,760	**78**	**0.5**	423
Thailand	115,305	1,553	56,920	**74**	**2.0**	834
Philippines	**132,472**	**648**	**62,870**	**204**	**2.1**	**683**
Korea	229,138	14,832	43,270	**15**	**5.3**	4,838
Malaysia	99,777	1,817	18,330	**55**	**5.4**	2,049
Japan	1,997,300	57,200	123,920	**21**	**9.4**	18,948
Italy	1,341,100	23,071	57,050	**58**	**23.5**	15,066
France	2,182,000	29,080	57,050	**75**	**38.2**	18,583
England	2,700,000	25,595	57,370	**105**	**47.1**	12,943
Germany	3,146,000	29,980	64,120	**105**	**49.1**	22,293

IT: international outgoing traffic

Source: ITU Yearbook of Common Carrier Telecommunications Statistics (20th Edition)

14.2.5 Other Revenues

There are revenues other than local and toll call such as revenue from such as installation, relocation and advertising in the telephone directory. Table 14.2-3 shows the PLDT operating revenue for the past ten years. The latest share of other revenues to the total was 1.4%. Therefore, in this revenue estimation, 1.4% of the total telephone revenue was assumed for other revenue.

Table 14.2-3 PLDT Operating Revenues for the Past Ten Years

(unit: million pesos)

	Total Operating Revenues	Local Service	Toll Service	Miscellaneous	Provision for Doubtful Accounts
1992	17,405	3,762	13,607	252	-216
1991	16,600	3,815	12,783	218	-216
1990	12,839	3,088	9,778	189	-216
1989	9,459	2,536	6,967	172	-216
1988	7,734	2,246	5,540	140	-192
1987	6,591	2,013	4,604	119	-144
1986	6,059	2,020	4,074	105	-140
1985	4,718	1,808	2,916	91	-96
1984	4,311	1,533	2,768	83	-72
1983	2,499	899	1,551	79	-30
Total	88,216	23,719	64,588	1,446	-1,538
Share	100.0%	26.9%	73.2%	1.6%	-1.7%

Source: Financial Statements of PLDT 1983-1992

14.2.6 Provision for Doubtful Accounts

The estimated provision for doubtful accounts, 1.7 percent of operating revenue, was based on the ten-years average for the PLDT shown in Table 14.2-3.

14.2.7 Summary of Revenue Estimation

Table 14.2-4 shows the estimated revenue per subscriber and Table 14.2-5 shows the estimated total operating revenue.

Table 14.2-4 Estimated Revenue per Subscriber

(estimation for 1998, unit: pesos)

	NCR		Province	
	Residential	Business	Residential	Business
1. Local Service	3,000	6,840	2,760	5,160
2. Toll - Domestic	500	2,000	1,900	7,500
3. Toll - International	5,123	35,090	4,253	28,807
4. Other Revenues	121	615	125	581
5. Doubtful Accounts	-149	-757	-154	-715
Total	8,595	43,788	8,884	41,333

Table 14.2-5 Estimated Total Project Revenue

(unit: million pesos)

	Local	Toll-Domestic	Toll-International	Misc	Doubtful Accounts	Total
1993	1,521	764	5,633	111	-137	7,894
1994	3,037	1,524	10,832	215	-265	15,343
1995	4,547	2,278	15,600	314	-387	22,353
1996	6,051	3,028	19,943	406	-500	28,928
1997	7,550	3,772	23,866	493	-607	35,074
1998	9,043	4,511	27,374	573	-706	40,796
1999	10,760	5,500	31,124	663	-817	47,230
2000	12,470	6,482	34,406	747	-920	53,186
2001	14,174	7,458	37,227	824	-1,015	58,668
2002	15,872	8,426	39,592	894	-1,101	63,683
2003	17,563	9,388	41,506	958	-1,180	68,236
2004	19,248	10,343	42,977	1,016	-1,251	72,332
2005	21,765	12,260	45,702	1,116	-1,374	79,469
2006	24,273	14,163	47,780	1,207	-1,486	85,937
2007	26,773	16,052	49,220	1,289	-1,587	91,747
2008	29,263	17,928	50,029	1,361	-1,676	96,905
2009	31,744	19,790	50,217	1,425	-1,754	101,421
2010	34,217	21,638	49,791	1,479	-1,821	105,304
2011	34,217	21,638	45,642	1,421	-1,750	101,168
2012	34,217	21,638	41,493	1,363	-1,678	97,032

14.3 Cost Estimation

14.3.1 Cost Categories

Project costs consist of

(1) Capital Expenditures
(2) Operating Expenses
(3) Working Capital
(4) Taxes

14.3.2 Capital Expenditures

Capital expenditures examined and estimated in Chapter 12 include initial investment and replacement costs (facilities, equipment, land and buildings, civil work, vehicles, construction and installation, consultant fees). Existing facilities as of 1992 require replacement in the project period when their service lives end. A plan was therefore made to replace existing facilities when their useful lives ends. We used this to estimate replacement costs in addition to estimating expansion investment costs.

If facilities that have remaining useful life at the end of the project period, their unused values are assumed to be recovered. Scrap value was not taken into account because it is negligible.

Table 14.3-1 shows the total investment cost. Total investment cost for the project is approximately 18 billion US$, in which Phase A requires the investment cost of about 4 billion US $; Phase B requires 5 billion US $; and Phase C requires 8 billion US $.

Table 14.3-1 Total Investment Cost

(unit: million US $)

	Phase A	Phase B	Phase C	Total
Switching	1,662	1,954	3,135	6,751
Transmission	788	1,264	2,553	4,605
Outside Plant	1,430	1,790	2,714	5,934
Total	3,880	5,008	8,402	17,290

In order to estimate the annual investment cost, it is assumed that one sixth of the cost of each phase is paid in the previous year. Investment costs therefore appear in the cash flow table from 1992. Table 14.3-2 shows the annual investment cost by phase in Philippines pesos.

Table 14.3-2 Annual Investment Cost

(unit: million pesos)

	Phase A	Phase B	Phase C
NCR	1,420	1,407	1,256
Province	761	1,159	2,765
Total	2,181	2,566	4,020

14.3.3 Operating Expenses

Expenses for the operation and maintenance of a telecommunications network consist of personnel costs, operation and administration costs, maintenance costs, and repair costs.

Operating expenses for this project were calculated with the following equation:
Total Operating Expenses = [Operating Expense per Line] x [Number of Lines]

The improvement of working efficiency was analyzed in Chapter 13. According to the results, the average number of main telephone lines per employee, which was 38.6 in 1992, assumed to increase and reach 127.2 in 2010.

The improvement of the working efficiency will reduce the operating expense per line. In 1992 it was 22 thousand pesos, which is from the PLDT latest financial results and is assumed to be 3.5 thousand in 2012.

14.3.4 Working Capital

Working capital consists of cash on hand, inventory, uncollected revenue, and so on. For the financial estimation, working capital was estimated to be 26% of total revenue, based on the share of the current assets to total revenue over the past ten years for PLDT.
The required annual increase of working capital is estimated as component of a cash out-flow of each year and the total working capital is refunded at the end of the project year 2012.

14.3.5 Taxes

The national government has legislated three kinds of tax concerning the telecommunications industry; 3% franchise tax, 35% corporate income tax and 10% overseas communications tax. In the cost estimation franchised tax is taken into consideration as the cost.

14.3.6 Summary of Cost Estimation

Table 14.3-3 shows the future total operating revenue estimates.

Table 14.3-3 Total Cost Estimation of the project

(unit: million pesos)

	Investment	Operating Expense	Working Capital	Tax Expense	Total
1992	16,172	0	0	0	0
1993	16,172	6,687	2,052	237	25,148
1994	16,172	11,490	1,937	460	30,059
1995	16,172	15,108	1,823	671	33,773
1996	16,172	17,931	1,710	868	36,681
1997	16,172	20,195	1,598	1,052	39,017
1998	20,865	22,051	1,488	1,224	45,628
1999	20,865	25,334	1,673	1,417	49,289
2000	20,865	28,367	1,548	1,596	52,376
2001	20,865	31,178	1,425	1,760	55,228
2002	20,865	33,791	1,304	1,910	57,870
2003	20,865	36,225	1,184	2,047	60,321
2004	35,011	38,499	1,065	2,170	76,745
2005	35,011	42,405	1,855	2,384	81,656
2006	35,011	46,049	1,682	2,578	85,320
2007	35,011	49,457	1,510	2,752	88,730
2008	35,011	52,650	1,341	2,907	91,909
2009	35,011	55,648	1,174	3,043	94,875
2010	0	58,468	1,009	3,159	62,637
2011	0	56,786	-1,075	3,035	58,746
2012	0	55,199	-26,304	2,911	57,034

14.4 Financial Evaluation

14.4.1 Cash Flow Projection and FIRR

The project will be financially viable with an FIRR of 11.67%. FIRR for the NCR part of the project is 12.82% and for the Province part is 10.39%. These FIRR exceeds the 6% of NEDA hurdle rate of projects. The reason why the FIRR of NCR part is higher than that of province part is that the network construction cost is cheaper and the revenue per subscriber is higher.

Table 14.4-1 shows the cash flow of this project itself without any outside financing from 1992 until 2012. Annual net cash flow is negative until 1999 and turns to be positive from 2000.

Table 14.4-1 Cash Flow Projection

(unit: million pesos)

	Cash Inflow	Cash Outflow	Total Cash Flow
1992	0	16,172	-16,172
1993	7,894	25,148	-17,254
1994	15,343	30,059	-14,716
1995	22,353	33,773	-11,420
1996	28,928	36,681	-7,753
1997	35,074	39,017	-3,943
1998	40,796	45,628	-4,832
1999	47,230	49,289	-2,059
2000	53,186	52,376	810
2001	58,668	55,228	3,440
2002	63,683	57,870	5,813
2003	68,236	60,321	7,915
2004	72,332	76,745	-4,413
2005	79,469	81,656	-2,187
2006	85,937	85,320	617
2007	91,747	88,730	3,017
2008	96,905	91,909	4,996
2009	101,421	94,875	6,546
2010	105,304	62,637	42,668
2011	101,168	58,746	42,422
2012	314,664	31,806	282,858

14.4.2 Financing

The next main issue is how to provide funds for the project through the project periods. As a premise, 40% of required fund is financed by equity and 60% is financed by loan. Because the debt equity ratio of 40:60 is required for the private companies by the legislation of the Philippines.

Seven billion pesos in equity and ten billion pesos in loans are required for the project in 1993. Some part of equity and loan is supposed to be from foreign companies. Foreign investment in 1992 was 34 billion pesos and loan inflow in 1992 was 186 billion pesos (Table 14.4-2).

Table 14.4-2 Required Funds

(unit: million pesos)

	Cash Flow	Equity	Loans
1992	16,172	6,469	9,703
1993	17,254	6,902	10,353
1994	14,717	5,887	8,830
1995	11,421	4,568	6,852
1996	7,752	3,101	4,651
1997	3,943	1,577	2,366
1998	4,832	1,933	2,899
1999	2,058	823	1,235

14.5 Sensitivity Analysis

14.5.1 Case Assumptions

The project FIRR is calculated as 11.67% on the conditions and assumptions set in the previous sections of this chapter as Base Case. These conditions and assumptions will change in the long-term period. This section tries to see how these changes affect on the feasibility of the project by sensitivity analysis. The Study prepares assumptions on the fluctuation ranges of domestic toll call revenue, international toll call revenue, and capital expenditure, that are main constituent parts of the project FIRR. The following cases are examined.

(1) Change in domestic toll call revenue:

(a) 10% decrease (Case 1-A)
(b) 20% decrease (Case 1-B)

(2) Change in international toll call revenue:

(a) 10% decrease (Case 2-A)
(b) 20% decrease (Case 2-B)

(3) Change in investment cost:

(a) 10% increase (Case 3-A)
(b) 20% increase (Case 3-B)

14.5.2 Results

Table 14.5-1 shows the results of sensitivity analysis.

(1) Domestic Toll Call Decrease Case

When the domestic toll call revenue decreases 10% (Case 1-A) and 20% (Case 1-B), the project FIRR falls to 10.97% and 10.26% from 11.67% of Base Case.

(2) International Toll Call Revenue Decrease Case

When the international toll call revenue decreases 10% (Case 2-A) and 20% (Case 2-B) from Base Case, the project FIRR falls to 10.79% and 9.88% from 11.67% of Base Case.

(3) Investment Increase Case

When the investment cost increases 10% (Case 3-A) and 20% (Case 3-B) from Base Case, the project FIRR falls to 9.90% and 8.43% from 11.67% of Base Case.

Table 14.5-1 Results of Sensitivity Analysis

IRR		Total	NCR	Province
Base Case	100%	11.67%	12.82%	10.39%
Dom. Toll Revenue	90%	10.97%	12.47%	9.31%
	80%	10.26%	12.12%	8.23%
International Toll Revenue	90%	10.79%	11.86%	9.63%
	80%	9.88%	10.85%	8.84%
Investment	110%	9.90%	10.90%	8.81%
	120%	8.43%	9.31%	7.48%

14.6 Economic Evaluation

14.6.1 Methodology

The benefits of telecommunications are various and widely ranging from the direct effect of the users such as substitution of traffic to the indirect effect such as expansion of business opportunities and employment.

To calculate the EIRR (economic internal rate of return), economic benefit and cost is required. Since it is difficult to quantify the economic benefit of the telecommunications, so the idea of consumer's surplus is used in this study. This methodology was developed in a study meeting sponsored by the International Cooperation's Division of the Ministry of Posts & Telecommunications in Japan. The result of this study was complied in a book entitled "Economic Evaluation of Telecommunications Investment Projects" (March 1993).
The economic cost is obtained by modifying the financial cost, putting out the tax from cost item because tax is not cost but transferring from the viewpoint of national economy.

14.6.2 Estimation of Economic Benefits

(1) Economic Benefits

In this study, economic benefits are defined as the benefits which belong to the telephone users. The benefits which belong to the telephone users is the benefits value minus the call charges that the users pay. In other words, economic benefits is the difference between the user's maximum willingness to pay and the actual amount paid for services. This difference is called the consumer's surplus by economists.

The points on the demand curve in Figure 14.6-1 show the prices that consumers would be willing to pay for various quantities. A market price is established at P. Once determined, all buyers pay this pricely uniform. But in fact, this is the price that only the marginal buyers were willing to pay. Other (intramarginal) buyers, more eager for the product, would have been willing to pay higher prices, as indicated by points on the demand curve above A. (Less eager buyers, whose preferences lead to points below A on the demand curve, do not purchase the product.) Yet despite this differential eagerness, they all pay the same price. The difference between what consumers would have been willing to pay and the market price that they actually pay is known as the consumer's surplus. In the diagram, it is measured by the area of triangle PAB.