9.7 International Telecommunications Development Indicator

9.7.1 International Network Plan

The prime definition of network planning is to provide the right equipment, at the right place, at the right time, and at the right cost in order to satisfy expected demand and give an acceptable grade of service.

(1) Main Use of Optical-fiber Submarine Cable

For international transmission lines, the optical-fiber submarine cable shall be used mainly in order to provide the customers with the most reliable and superior services by routing the international traffic on its submarine cable circuits instead of satellite circuits. As a result of the activation of the new international optical-fiber cable transmission lines such as the SEA-ME-WE3 and the CSC, the circuit use ratio of the cable to the satellite shall be raised remarkably. Up to the year 2000 it is recommended to increase the cable circuits occupancy ratio from 60 % to 80 %. Da Nang Earth station (DAN-1B) can be dismantled as a result of the activation of the SEA-ME-WE3 cable system.

(2) Distribution of the several services of circuits to the plural routes

In providing the international circuits it is necessary to take the connectivity with other destination, economization and the reliability into account. The international circuits are distributed to several transmission media (submarine cables and/or satellite, etc.) and to the switching centers. The objective of the distribution to the plural routes is to secure network reliability in the case of failure on transmission media or switching equipment. I n this respect, the satellite circuits can be used to supplement the optical-fiber submarine cable network and be used to route the telephone calls by making diversity with the cable circuits to secure the high reliability network. For example, in case of large capacity of the communication destination, the international circuits are distributed to set up the ratio at 2:1 between the optical-fiber cable and the satellite, 67% routed via cable and 33% routed via satellite, for the mutual back up purpose.

With transmission line failures, telecom service degradation should be prevented at all costs, and the simpler the corrective action the better. Predetermining the concentration or distribution of transmission lines can bring about effective measures. Advance consideration should also be given to accommodating the most vital lines to the line exchange. Distribution also plays an important role in preventing exchange

failure-related service degradation through line accommodation to multiple international gateway exchanges. Transmission line distribution should be planned on the basis of actual traffic rather than calculated traffic conditions. The probable distribution effect should also be confirmed from the viewpoint of the network as a whole. In this respect it is recommended to the following direct circuits to accommodate to multiple international gateway exchanges (ITC-1 and ITC-2).
The international telephone circuits for Cambodia, India, Indonesia, Malaysia, Poland and Russia shall be rearranged to distribution of circuit accommodation in the two ITC's (Ho Chi Minh and Ha Noi)

(3) Expansion of direct telephone circuits
From the viewpoints of the national interests, the communications reliability and the circuit cost efficiency, it is desirable to establish the direct circuits when there is a traffic in excess of approximately 60,000 minutes per year. Currently Vietnam links the international telephone with 26 countries by direct international telephone circuits and has the direct dialing access to more than 180 countries. The network planning with expansion of the direct circuit is more advantageous to when the rapid growth of traffic is expected.

9.7.2 Service Plan

The international ISDN service will forward the development as the nucleus of the international telecommunication service and then the Internet, the broadband ISDN, Frame Relay service, ATM service, the intelligent network service, the GMPCS and the personal communication network service will follow on to make the engine of the evolving global Information Society toward the year of 2020.

(1) ISDN Basic Principles
Integrating multiple telecommunication services creates ISDN, using digital data processing technology. The general principles of ISDN are specified by ITU-T Recommendation I.120. Followings are the summary of ISDN principles.

(a) Service Integration: ISDN is basically characterized by supporting voice/data/image communication services through the same network. Therefore, a limited set of the user-network interface shareable for multipurpose communication must be standardized and various standard digital connection functions must be provided in the network.

(b) Connection functions: The network may support both switched connection services (a calling terminal is connected to a called terminal by call request) and semi-permanent connection (a calling terminal is always connected to a called terminal). The switched connections include circuit switching and packet switching.

(c) Basic services: The 64 Kbps circuit switching service is supported as basic service. Various other services can be supported at the same time.

(d) Intelligence: The network has a high-level processing control capability (intelligence) for providing service features maintenance and network management functions. Sometimes, terminals also may have such capability.

(e) Layered protocol structure: The protocol (signaling procedures that specify the communication control) for access to ISDN has a layered structure.

(f) Progressive evolution: An implementation to realize ISDN depends on specific national situations. ISDN should be evolved stage by stage: The first stage is to constitute a digital telephone network, and the next stages are to add various functions to it. It takes a long time to change current networks to a complete ISDN. During this transition, internetwork connection (e.g. between the existing data networks and ISDN) is important.

(g) Broadband capability: ISDN is an evolving network. It will provide also a broadband connection (more than 64 Kbps).

(2) Introduction of international B-ISDN, Frame Relay and ATM services

What the B-ISDN (Broadband ISDN) aims at are summarized as follows.

(a) B-ISDN is possible to carry the user information more than H_4 channel (approximately 135 Mbps) at the interface point of the user and network. Within the information channel it can be set up the service at the arbitrary speed of information effectively.

(b) In addition to the provision of the conventional type of voice and image transmission services under the Constant Bit Rate (CBR), packet type and image type service which is variably coded can be also set up under the Variable Bit Rate (VBR) efficiently.

(c) As for the information transfer transmission delay or loss of information (cell loss, code errors etc.) the B-ISDN is realized to provide the different multimedia type of service with high grade of service simultaneously and effectively.

(d) Many kind of connection types such as 1:1, 1:n and n:n can be set up simultaneously over the B-ISDN and it can meet the various kind of user's service requirements flexibly.

Multimedia communications, which involve video, still pictures, and data as well as conventional voice, is becoming a center of attention in both business and the home. Factors behind the emergence of multimedia are the increasing power and lower cost of personal computers and progress in digital media processing technology. Together with the increasing importance of LAN and client-server applications, and also, in line with the growth of economic in Vietnam, these factors will create strong demand for multimedia communication services. ATM (Asynchronous Transfer Mode) is switching technology that makes possible to meet this demand. ATM bits to hundreds of megabits per second, and it was designed to handling of all kinds of media in the same way. For these reasons, ATM is expected to serve as the basic switching method for the broadband communications network (B-ISDN). In addition to enabling high-speed transmission of large volumes of data, ATM has opened up new fields in telecommunications and spurred the development of new applications in existing fields. The following are examples of applications to be expected introduction of new services over the international ATM: Intranets, Electronic commerce, Remote medicine, Video transmission, Remote learning and High-volume LAN communications.

In Vietnam it is recommended to be launched the international Frame Relay and ATM service after the year of 2000 in parallel with the growth of the optical fibers used for subscriber access lines.

(3) Introduction of Intelligent Network Services

The network capabilities called intelligent network is studied and introduced as a new services such as free dial service and VPN (Virtual Private Network) over the ISDN.

To improve the communication network functions, this intelligent network will provide high performance communication service by intelligence (control database or communication control processor) in the network, and exchanges dispersed in the network operate with the support of this intelligence. The reverse charge communication (the called party pay charges) service and VPN service will be required to launch in parallel with the growth of digital telecommunication network. VPN makes a physical public network (ISDN or telephone network) used as it is a corporate network constructed using a leased circuit. For example, the following functions are considered useful using a network control function such as the database in a network: Bulk-charge discount, User defined numbering plan, Routing according to time or calling location, Screening, Various call rerouting, Authorization, Call logging and Multimedia integration

(4) Introduction of GMPCS

A new generation of non-geostationary satellite systems is being developed to provide global communications coverage. These Global Mobile Personal Communications by Satellite (GMPCS) systems promise to enable users to make and receive calls via mobile handsets from virtually anywhere in the world. A number of different systems are already in service or being launched. Most attention has focused on a handful of Low-Earth Orbit (LEO) systems that plan to provide global voice service coverage (see Table 9.7.2-1), although there are a range of proposals, some of which use more conventional geostationary orbits or hybrids. In Vietnam it is likely that the GMPCS operations can be launched in the year of 2000.

Table 9.7.2-1 Selected Global Mobile Personal Communications by Satellite (GMPCS) systems

	GlobalStar	ICO	Iridium
Planned service start date	1999 3Q~4Q	2000	1998
Estimated system cost (US $ m)	2200	2600	2400
Current equity(US $ m)	800	1400	2650
Handset cost (US $)	750	1000	2500-3000
Call charges per minute(US $)	around US$ 1	around US$ 2	US$ 3
Number of satellites	48	10	66
Satellite lifetime	7.5 years	12 years	5 years
Lead partner(s)	Loral(USA), Qualcomm(USA)	INMARSAT	Motorola(USA)

9.7.3 Facilities Construction and Improvement Plan

(1) Basic Objectives

The step by step development of the economy, the trend towards industrialization and internationalization throughout society, and progress in science and technology will expand the trade export/import, info-communication sector and the scope of interchange in human activities. Up to 2010 the information infrastructures will be built in Vietnam in the expectation that a huge market will develop for tradeable electronic information. International telecommunications plays an important role for information infrastructure supporting all of these activities, and utilization is increasing every year. To cope with this trend toward global information infrastructure, international telecommunications services shall be changed from voice to multimedia and high performance computer and multimedia network will be built in line with the growth of the info-communication sector. The main target of the facility plan is to make good base for info-communication infrastructure during the period of the early of 21st century.

(2) Main Investment Items up to 2010

Time Frame: the Existing to 2000

(a) In 1999, construction of SEA-ME-WE3 cable will complete and some of the satellite links with west European countries will be transferred and routed via the SEA-ME-WE3. The international services for west European countries shall be expanded and improved. (Cost: 33 Million US $)

(b) Up to 2000, construction of CSC optical fiber cable over the land will complete and some of the satellite links with the neighboring countries (China, Lao, Thailand, Malaysia and Singapore) shall be transferred to route the CSC and the quality of services by using the optical cable shall be improved. (Cost: 15 Million US $)

(c) To expand the business applications needs for the IPLC services and to upgrade the domestic satellite communication network with VSAT in the rural and remote area, the additional investment for expansion of the VSAT network is required in 1999. (Cost: 5 Million US $)

(d) Introduction of GMPCS service

GMPCS operations to improve the mobile telecommunication service in the rural and remote area shall be put into service in 2000.

(Cost: 5 Million US$)

Time Frame: 2001 to 2009

(a) Introduction of facilities for the international frame relay service and the international ATM service

Frame Relay is newly developed technology for high-speed data transmission. Frame Relay is suitable for LAN to LAN interconnection because of high throughput and low delay by simplifying data transmission protocol between a user and a network.

As for the rapidly increasing Internet, International High bandwidth/High speed and cost reasonable service is strongly required by user of them. International ATM service is most suitable service for these requirement. ATM service is especially advantageous for customers who require circuit speeds faster than 1.5 Mbps. Initially the services will be a direct subscription service under which customers sign a contract with VTI that specifies the required PVC (Permanent Virtual Circuit).

To construct the Frame Relay Gateway System at ITC-1 and ITC-2 in 2004 (Cost: 3 Million US$)

To construct switching system for the international ATM service at ITC-1 and ITC-2 in 2005 (Cost: 6 Million US$)

(b) To realize the Global Maritime Distress Safety System (GMDSS) for handling distress messages from international shipping and to provide the full scale INMARSAT services, it is planned to install the INMARST Land Earth Station (LES) in Haiphong, and also, planned to improve 11 coast radio stations in the northern part of the country that will utilize MF, HF and VHF bands.

The first shore stations between Danang and the Chinese border will be completed in 2000 and the next shore stations in the southern part of country in south of Danang in 2002. (Cost: 40 Million US$)

(c) In order to cope with increasing volume of multimedia traffic and with varied customers needs typified B-ISDN (Broadband Integrated Service Digital Network) supplementary services and IN (Intelligent Network) services, introduction of well-designed large scale ATM switching systems will be required. In this connection it is required to develop the second-generation digital switching systems in succession to existent AXE-105 series switching systems.

The first ATM gateway switching system will be put into service in 2005 at ITC-2 Ho Chi Minh and the next system in 2006 at ITC-1 Ha Noi.

(Cost: 30 Million US $)

(d) Development and deployment of the telecommunication systems for telemedicines and distant learning
Remote consultation, diagnoses and distant learning system through digital telecommunication (VSAT network, ISDN and ATM) shall be introduced in order to promote the health care and education in 2006.
(Cost: 20 Million US$)

(e) Development and deployment of the integrated Network Management System toward realization of the TMN concepts
It consists of networks for telecommunication service, such as telephone, leased circuits, corporate communications and Internet, supported by a common transmission network. To provide customers with stable and high-quality services, all of these networks must be continually monitored, and steps must be taken to restore service immediately whenever a fault occurs.
To guarantee the quality and to increase the efficiency of network utilization, the development of the integrated Network Management System with the TMN concepts shall be planned in Vietnam in 2009.
(Cost: 20 Million US$)

(f) To construct a domestic submarine optical cable network along the coast to be completed in order to improve the existing backbone network in both quality and quantity responding to the present and future telecommunications traffic demands in the international and domestic telecommunication services. (Cost: 135 Million US $)

(g) To launch Vietnam's first telecommunication satellite (VINASAT)
The satellite network shall be developed and deployed for the governmental use and Public Security, Vietnam Television and other public utilities to use the satellite as a multi-purpose multimedia satellite.

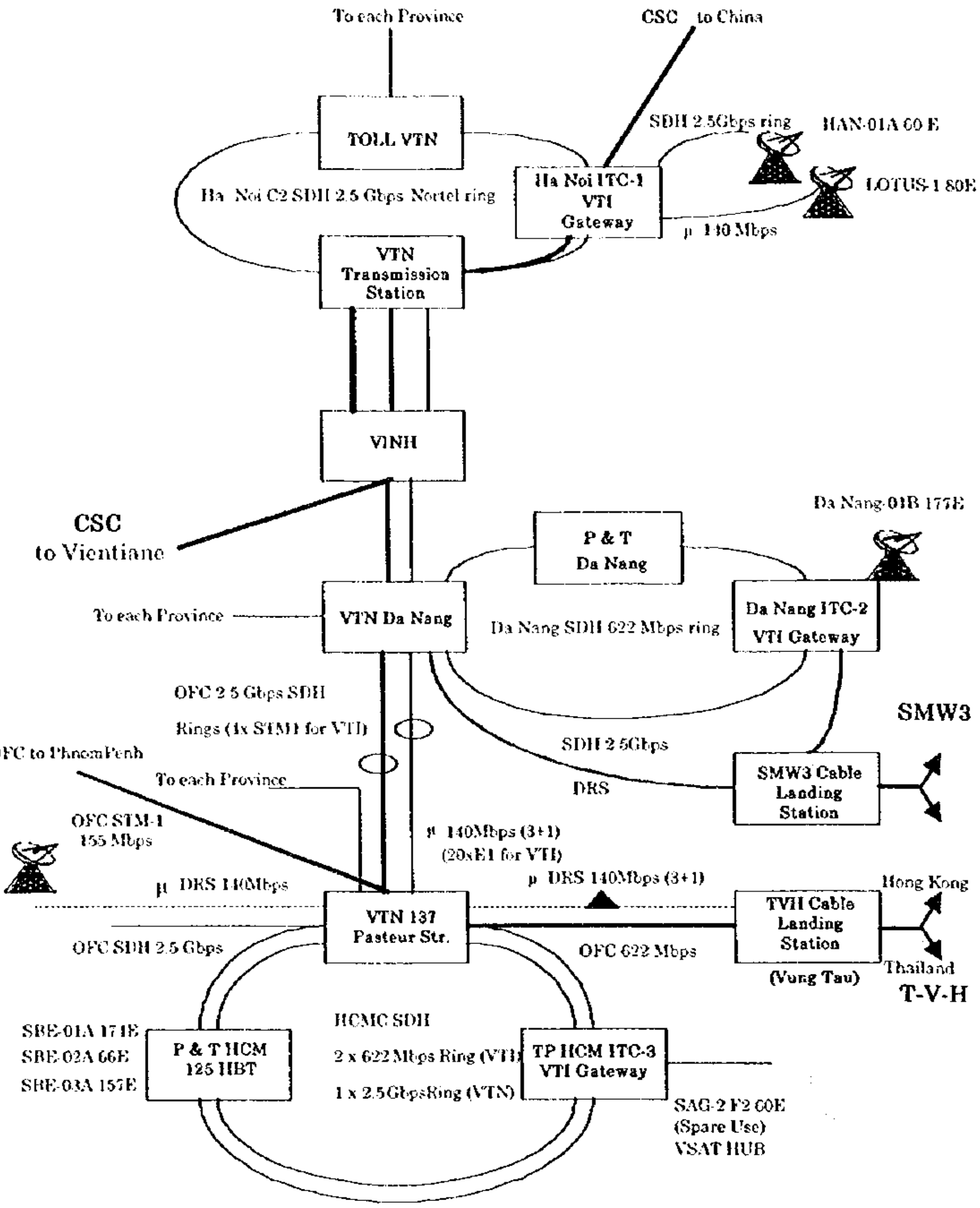


Figure 9.7.3-1 Vietnam International Network Planning in 2000

9.8 Orientation on Private Network Development

9.8.1 Exclusive Telecommunications Network Owners

Exclusive telecommunications network owners are Vietnamese agencies, organizations and enterprises and foreign agencies and organizations operating lawfully on Vietnamese territory, that are licensed by DGPT to set up exclusive telecommunications networks in order to provide internal communications for members of such agencies, organizations and enterprises.

These network owners would be Government organizations, Railways, Electricity, aviation, oil company etc..

9.8.2 Exclusive Telecommunications Network

This network is to provide internal communications for member of network, which is consisted of two or more telecommunication equipment interconnected through transmission lines leased or set up by the network owner, including at least two equipment and one transmission line installed on Vietnam territory. These networks are classified into the national exclusive networks, the inter-regional exclusive networks and the regional exclusive networks.

Exclusive telecommunications networks are allowed to connect with public telecommunications network at local switch of service-providing enterprises by lined subscribed thereto for exclusive use by network owner hired from service-providing enterprises (VNPT) or self-build. (No.04/1998/TT-TCBD)

Current status of these private networks and future plan are not clear.

9.8.3 Orientation on Private Network Development

Private networks are not compared with public network in terms of size and volume and VNPT is responsible to offer the best choice to set up a private network to satisfy the customer's requirements.

Following conditions are to be considered for setting up exclusive telecommunications network rather than public network.

a) Cost for construction and maintenance is cheaper than public network.

b) Reliability and service grade of public telecommunications network is not satisfactory.

c) New sophisticated technology are required which are not available in public networks.

9.8.4 Trend of Private Network in the World

(1) Business Network Environment in Japan

Many corporation are now facing the rapid change of business environment, such as growing global market, flexible alliance between corporations and the necessity for more efficient corporation management. At the same time, corporations have been experiencing rapid change of network environment, such as world-widely spreading Internet, growing usage of PC LAN and upcoming multimedia applications.

Under these dramatic changes in corporate activities, business network is expected to accomplish the following points.

- Speed up in information distribution
- Efficient information sharing
- Flexible alliance with other corporations
- Reduction of network cost

VPN, IP and Outsourcing of maintenance & operation work are the three keywords for meeting these demand, especially the demand for the reduction of network cost.

(2) The trend from PN (Private Network) to VPN (Virtual Private Network)

Traditional PN is connecting each site to site using leased circuits (mesh type connection). As a result, network cost become very expensive. On the other hand, VPN is connecting each site by site using shared network and virtual private connection. As a result, network cost can be reduced because many users can share the same network. The disadvantage of VPN might be the possibility for users to be suffered from other user's heavy traffic. However, telecommunications carriers can solve performance problems caused by sharing the network. Also, as the numbers of users is getting larger, the network price for one user is getting smaller. This effect is called as "Large scale benefit effect".

Furthermore, users can outsource the network maintenance and operating work by using VPN which is managed and maintained by telecommunications careers. Network maintenance and operating work is usually a big problem for users. VPN can provide outsourcing solution to users.

(3) Trend of IP networking

The Internet, open networking using Internet Protocol (IP), has been spreading explosively in the world. In 1997, IP traffic between USA and Japan surpassed telephone/Fax/data traffic. Over 60% of present traffic between Japan and USA is now IP traffic. This trend is happening all over the world.

Under the competition of many venders, IP related equipment is getting better performance with less expensive price. IP-VPN, which is matching the VPN trend and IP networking trend, is expected to be the key issue for the future business network.

(4) Market demand for IP-VPN service in the world

Market size of IP-VPN is expected to grow explosively in the world under the trend from PN to VPN and the trend of IP networking. The research which collected response from 1,500 companies in Japan, shows that about 40% of 1,500 companies (about 630 companies) have demand for IP-VPN service. And over 60% of 630 companies expressed that they wanted to get the service within two years.

(5) Advantage of VPN service

VPN service provides low-cost and secure connection service which makes users feel as if they are connected by leased circuits from anywhere in the world.

This service provides measures to share resources such as circuits, equipment and technology, and human resource for maintenance and operation.

This service provides users the following advantage:

- Reduction of network cost
- High performance by the direct connection to IP backbone.
- Outsourcing of maintenance and operating work

CHAPTER 10

TELECOMMUNICATIONS NETWORK PLAN

CHAPTER 10 TELECOMMUNICATIONS NETWORK PLAN

10.1 Switching Network Plan

10.1.1 Telephone Network Structure

The policy for network planning is very important to build a flexible infrastructure corresponding to the change of environmental conditions. Also the policy shall be continuously evaluated and revised.

(1) New Telephone Network Structure Introduction Policy

(a) National Network Plan

New national telecommunications service will be operated by not only VNPT but also some other operators from now to the future. The examination and the evaluation of overall national network should be performed from the viewpoint of national strategy. Especially the regulation of interconnection such as interconnection condition, signaling plan and numbering plan shall be conducted by DGPT.

(b) Planning Priority

Cost, maintainability and reliability are taken into consideration when evaluating network construction. However, cost is given first priority because quantification of maintainability and reliability is difficult. In the stage when demand increases quickly, cost is the most important element, and the improvement on maintainability and reliability also needs to be taken into consideration.

(c) Simple Network

Master plan recommends that new telephone network should have simple network structure and the function of each network element needs to be defined clearly. The network administrator shall understand the function of network and construction policy in order to perform operation and maintenance management of national network efficiently.

(d) Flexible Network

The demand and services to be provided may change according to the variation of telecommunications condition. Therefore, a telecommunications network plan needs to be flexible to these variations.

(e) Non-Hierarchical Network

Most of the cost for analog network is composed of those for transmission, metallic cable and switches. Transmission cost is sharply cut down by introduction of an optical cable and SDH transmission technology, so the cost of exchange node largely affects to the total cost.

E.172 of ITU-T describes that a future networks on the basis of a non-hierarchy and IP network is just a non-hierarchy.

(2) Premise Conditions

(a) The simulation of the network plan is carried out based on the traffic forecast from the year 2000 to 2010.

(b) Toll Center is expanded at new places.

The expansion of Toll Centers shall be established considering the situation of subscriber density and transmission route (loop).

(c) The provinces where the Toll Center will be installed are chosen out of HNI, NAN, DNG, BDN, KHA, HCM, and CTO.

(d) In connection with digitization of equipment and a network optimization, transmission cost was reduced sharply in recent years. Therefore, a direct circuit and mesh structure reduce exchange cost, and can build an economical network. However, mesh structure increases the number of circuit groups and causes the demerit on circuit maintenance. Therefore, the improvement of the network administrator in skill and real time network management needs to be promoted. Simplification of the network is important and of course an advancement of maintenance and operation technology are indispensable.

10.1.2 Telephone Switching System

(1) Introduction Policy for Telephone Switching System

A telephone switch should be introduced based on the policies shown below:

(a) The switch to be introduced in the future has ISDN functions and common signaling functions.

(b) Switches should be introduced or expanded based on the demand forecast.
(c) Switches will be introduced or expanded to meet the demand increase for three (3) years after installation.
(d) Unifying manufacturers and models etc. for every area (province) is to be considered for maintainability.

(2) National Transit Switch

National Transit Switch should be built in consideration of efficiency and maintainability of VTN.

National Transit Switches are located in three (3) places at present. National Transit Switch needs to be increased in capacity in connection with expansion of a network. There are two kinds of methods in expansion of capacity. One is the method of expanding capacity in the present three offices, and the other is the method of increasing the number of offices. This master plan recommends the method of increasing the number of offices for the following reasons. First, newly expanded national transit switches shall be introduced considering the compatibility with the newly expanded transmission network which will consists of optical loop structure, and it is more efficient to install Transit Switch for every transmission loop when a transmission system consists of the loop structure. Second, improvement in reliability is also expected.

National Transit Switch is expanded in connection with the traffic increase. In consideration of the traffic increase up to 2010, master plan divides expansion plan into three (3) phases. Phase A is a plan up to 2000, phase B is a plan up to 2005, and phase C is a plan up to 2010. National Transit Switch will be gradually expanded in each phase.

There are two (2) National Transit Switches each in Ha Noi and Ho Chi Minh City at present. These National Transit Switches accommodate the circuits from each province in the accommodation area. This master plan recommends that the decentralization of National Transit Switch to other provinces is necessary when introducing National Transit Switches in the future.

Although many direct route circuits are existing at present, the number of direct route circuits for the future are calculated in order to build a simple network.

The trunk capacity limitation of one Transit Switch is assumed about 50,000 trunks (in both way), and traffic capacity limitation is 20,000Erl considering that the processing capacity of each manufacturer's transit switch is about 25,000 Erl and efficiency is 80%.

(3) Local Tandem Switch

In this case, it is necessary to define the function of Local Tandem Switch first of all. Local Tandem Switch is defined by the master plan as follows:

The switch which accommodates Local Switches in province and handles only local traffic, and does not have the circuits with any National Transit Switch.

There are two (2) switches, which are called Local Tandem Switch, in Ho Chi Minh City at present, and one (1) unit is planned to be installed in Ha Noi.

This master plan recommends that the network should not have any Local Tandem Switch.

(4) Local Switch

According to a demand forecast, new expansion of Local Switch is planned to meet the demand increase for three (3) years after installation. Local switch is installed in the high density area. Remote Subscriber Unit covers a suburban and rural area. The line capacity limitation of one Local Switch is 50,000 lines.

(5) Expansion Plan

An expansion plan of telecommunications network is divided into three phases. These phases are planned based on the medium term traffic forecast and capacity limitation of switching facilities. National telecommunications network will be divided into twelve (12) Transit Switch areas at the end of this plan (in 2010). Especially, Ha Noi and Ho Chi Minh City metropolitan areas will be divided into three (3) and four (4) Transit Switch areas respectively. Transit Switch areas in 2010 are shown in Figure 10.1.2-1.

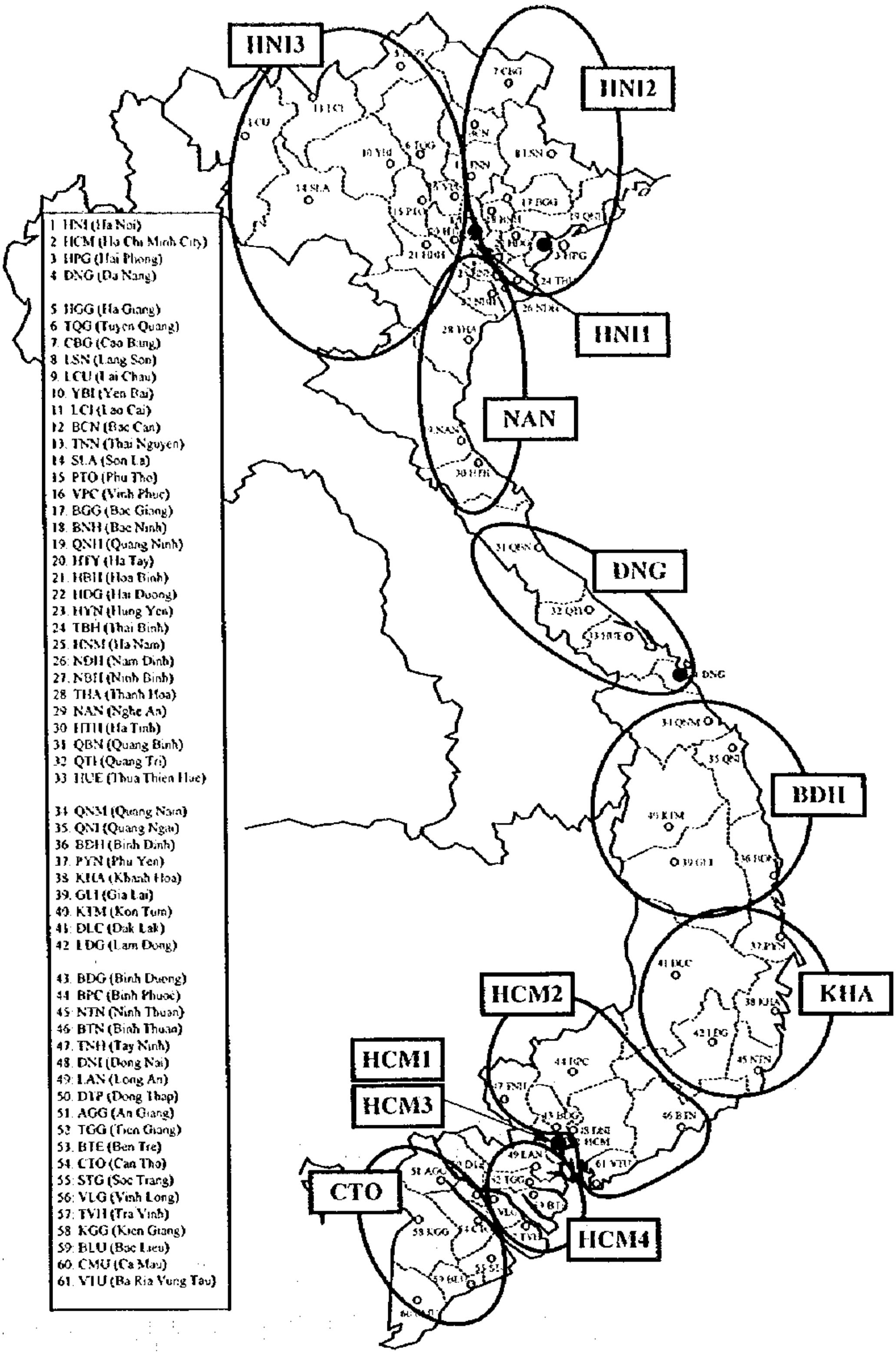


Figure 10.1.2-1 Transit Switch areas at phase C (2010)

10.1.3 New Network Configuration

(1) Circuit Calculation Condition

Circuit calculation was carried out on the following condition:

(a) Digital Modularity: 30 ch

(b) Grade of Service Criterion: 0.01

(c) Additional Trunk Capacity : 0.95 erl

(d) Lower Routing Method Threshold : 150 erl

(e) Higher Routing Method Threshold : 250 erl

(f) Mobile phone, Internet and Data communications (Frame Relay and ATM) : 10% of POTS circuits

Conditions (c) - (e), which are necessary for calculation of direct circuits, are chosen from the study on several parameters in consideration of cost minimizing. Condition (f) is decided based on the experience in Japan.

(2) Network Configuration

Outlines of network expansion phases are as follows:

(a) Phase A (up to 2000)

Nghe An area is divided from Ha Noi area.

Can Tho area is divided from Ho Chi Minh area.

(b) Phase B (up to 2005)

The suburban area of Ha Noi area is divided into east and west.

Khanh Hoa area is divided from Da Nang area.

National Transit Switch is increased to 2 units in Ho Chi Minh City.

(c) Phase C (up to 2010)

Binh Dinh area is divided from Da Nang area.

The suburban area of Ho Chi Minh City area is divided into east and west.

Network configurations of each phase are shown in the following Figure 10.1.3-1 to Figure 10.1.3-4 and circuit matrix is shown in Table 10.1.3-1 to Table 10.1.3- 3.

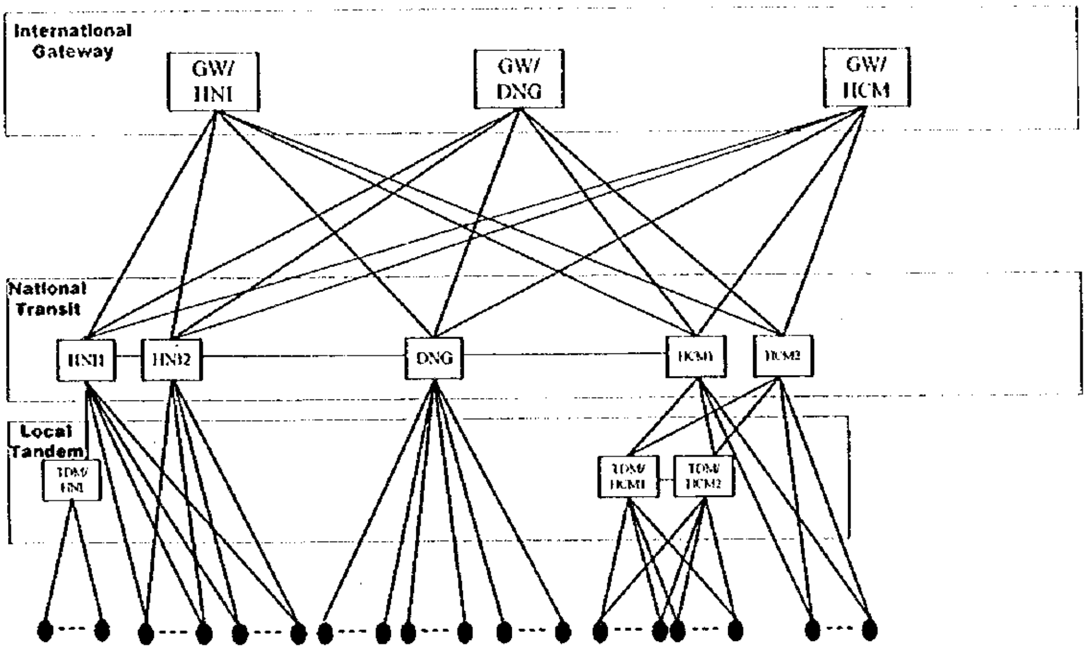


Figure 10.1.3-1 Network Configuration at Present

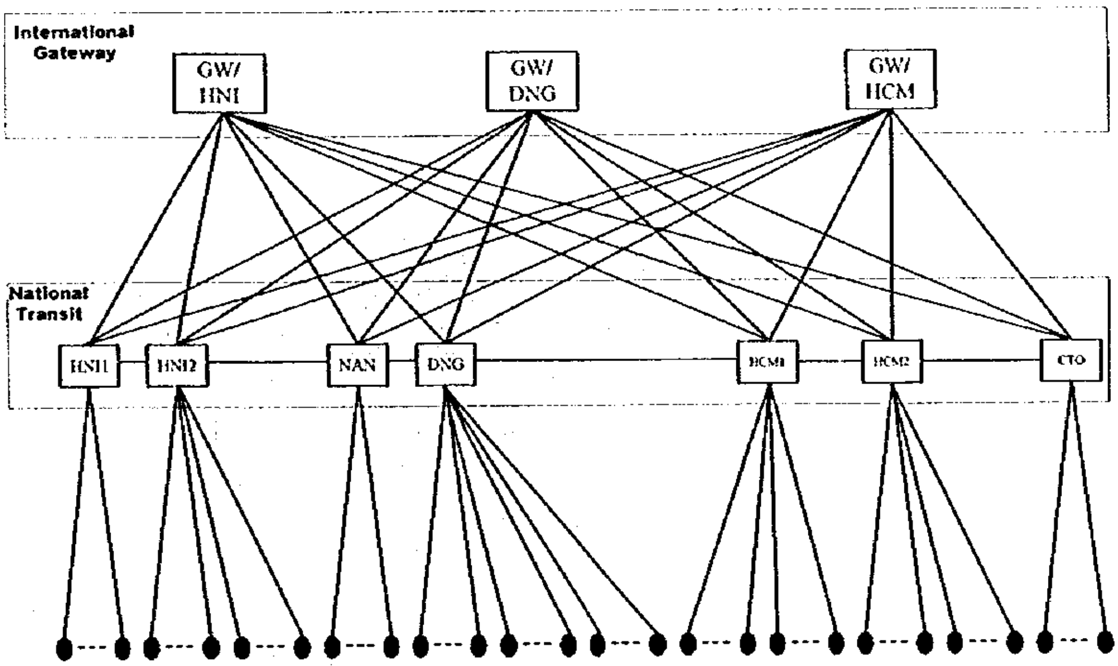


Figure 10.1.3-2 Network Configuration at Phase A (2000)

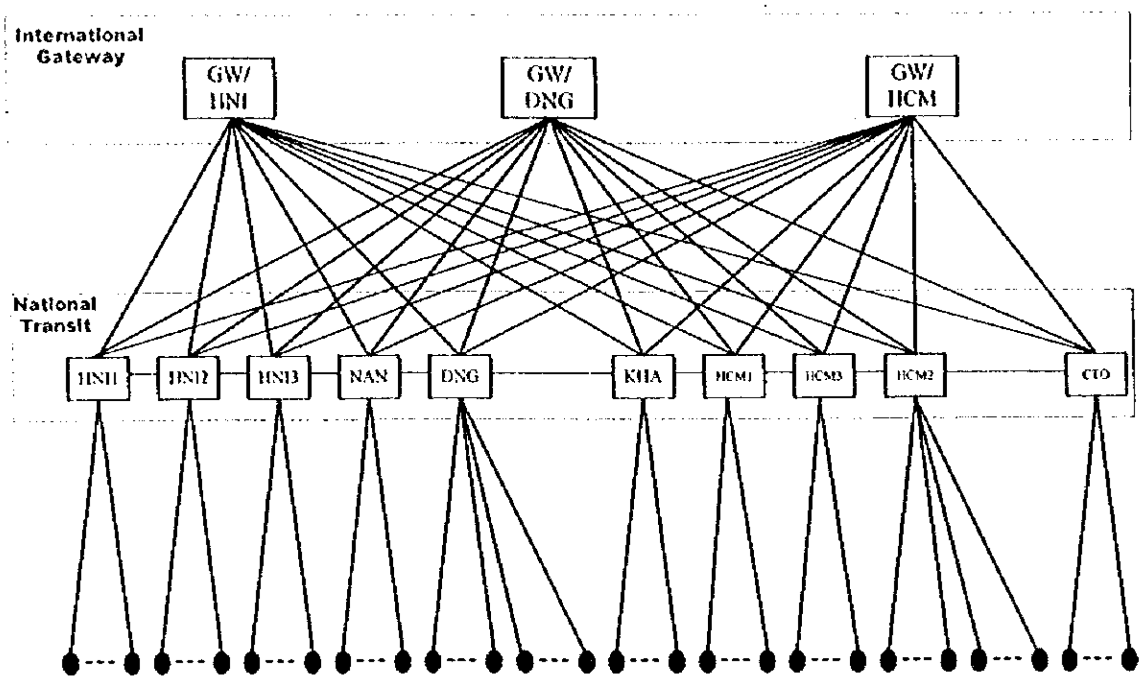


Figure 10.1.3-3 Network Configuration at Phase B (2005)

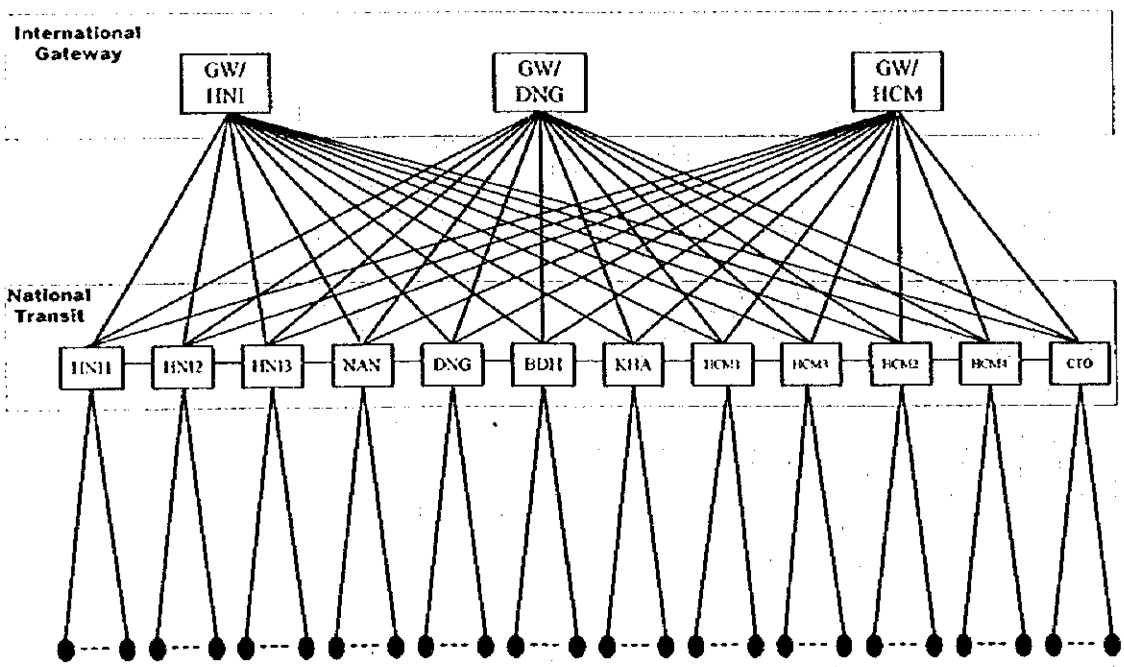


Figure 10.1.3-4 Network Configuration at Phase C (2010)

Table 10.1.3-2 Circuit Matrix at Phase A (2000)

			TS	TS	TS	TS	TS	TS	TS	GW	GW	GW
	SWName	Total	HNI1	HNI2	NAN	DNG	HCM1	HCM2	CTO	HNI	DNG	HCM
	Total	120180	8367	13119	4531	10036	16563	8724	6615	3330	1380	4455
TS	HNI1	8343	0	208	264	417	528	255	225	225	98	285
TS	HNI2	13131	242	0	221	611	741	346	315	315	128	420
TS	NAN	4529	276	229	0	286	248	182	167	150	60	195
TS	DNG	10034	423	619	284	0	764	485	439	255	105	330
TS	HCM1	16497	522	729	262	796	0	58	530	375	158	495
TS	HCM2	8796	255	344	178	475	92	0	524	225	98	315
TS	CTO	6615	225	315	163	431	520	526	0	180	75	240
GW	HNI	3330	225	315	150	255	375	225	180	0	0	0
GW	DNG	1380	98	128	60	105	158	98	75	0	0	0
GW	HCM	4455	285	420	195	330	495	315	240	0	0	0

Table 10.1.3-2 Circuit Matrix at Phase B (2005)

			TS	TS	TS	TS	TS	TS	TS	TS	TS	TS	GW	GW	GW
	SWName	Total	HNI1	HNI2	HNI3	NAN1	DNG	KHA	HCM1	HCM3	HCM2	CTO	HNI	DNG	HCM
	Total	190500	14441	12449	7934	7425	11206	5641	11981	11851	15307	9856	5955	2573	7545
TS	HNI1	14389	0	138	448	219	417	209	377	377	391	359	360	158	450
TS	HNI2	12451	192	0	368	187	432	210	379	378	377	360	360	158	450
TS	HNI3	7936	452	382	0	206	283	150	257	257	256	240	240	105	315
TS	NAN1	7425	201	173	244	0	301	212	306	306	288	288	255	105	330
TS	DNG	11204	423	438	287	299	0	213	506	521	455	439	270	120	345
TS	KHA	5639	211	210	150	208	207	0	278	264	348	302	150	68	195
TS	HCM1	12556	373	371	253	294	484	262	0	465	15	435	345	150	420
TS	HCM3	12449	373	372	253	294	499	276	465	0	15	412	345	150	420
TS	HCM2	15083	389	373	254	282	445	342	15	15	0	399	405	173	510
TS	CTO	9854	361	360	240	282	431	298	435	428	381	0	345	150	435
GW	HNI	5955	360	360	240	255	270	150	345	345	405	345	0	0	0
GW	DNG	2573	158	158	105	105	120	68	150	150	173	150	0	0	0
GW	HCM	7545	450	450	315	330	345	195	420	420	510	435	0	0	0

Table 10.1.3-3 Circuit Matrix at Phase C (2010)

			TS	TS	TS	TS	TS	TS	TS	TS	TS	TS	TS	TS	GW	GW	GW
	SW Name	Total	HNI1	HNI2	HNI3	NAN	DNG	BDH	KHA	HCM1	HCM3	HCM2	HCM4	CTO	HNI	DNG	HCM
	Total	257550	18018	16897	13451	6692	7060	6941	8355	16884	17342	12268	6898	14609	6840	2873	9030
TS	HNI1	17982	0	30	94	174	326	268	330	604	604	360	240	510	450	195	570
TS	HNI2	16703	30	0	332	105	342	284	330	546	576	332	227	497	420	180	570
TS	HNI3	13459	206	328	0	145	237	194	239	394	424	241	166	360	315	128	420
TS	NAN	6688	186	105	125	0	210	211	242	216	248	197	137	303	240	98	315
TS	DNG	7070	334	348	243	210	0	197	257	308	308	167	122	273	150	68	195
TS	BDH	6949	272	286	196	209	193	0	201	280	280	197	137	318	165	68	210
TS	KHA	8355	330	330	241	238	253	189	0	312	312	333	197	333	195	83	255
TS	HCM1	17076	596	534	386	204	292	260	288	0	44	30	296	114	390	165	510
TS	HCM3	17398	596	564	416	232	292	260	288	76	0	26	296	80	390	165	510
TS	HCM2	11912	360	328	239	193	163	193	327	30	34	0	361	462	285	120	375
TS	HCM4	6902	240	223	164	133	118	133	193	304	304	359	0	355	195	83	255
TS	CTO	14641	510	493	360	297	267	312	327	246	100	468	365	0	375	158	510
GW	HNI	6840	450	420	315	240	150	165	195	390	390	285	195	375	0	0	0
GW	DNG	2873	195	180	128	98	68	68	83	165	165	120	83	158	0	0	0
GW	HCM	9030	570	570	420	315	195	210	255	510	510	375	255	510	0	0	0

10.1.4 Development of Signaling Network

(1) Signaling Plan

Signaling plan is studied in Chapter 4 Fundamental Technical Plan(4.3 Signaling System). A common channel signaling network is composed of an associated mode and a non-associated mode of operation in Vietnam. Existing common channel signaling network is shown in Figure 10.1.4-1.

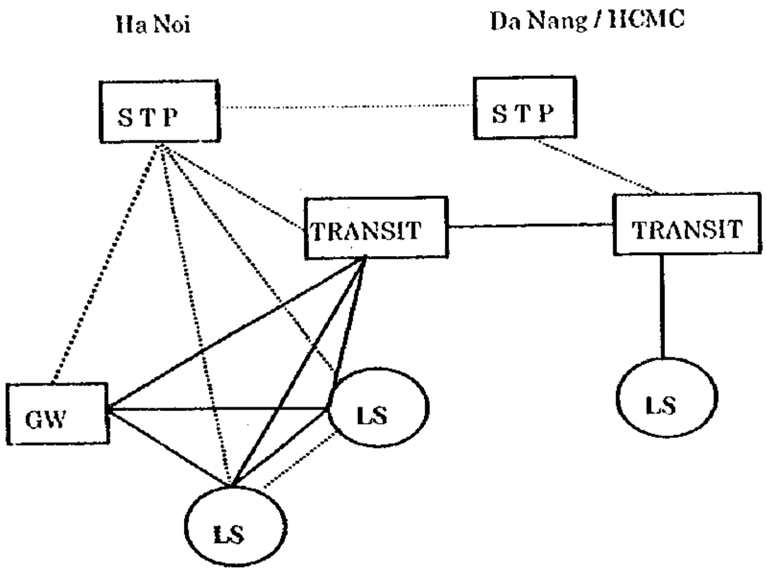
Vietnam is in the process of building up common channel signaling network in its telephone networks in accordance with the ITU-T Recommendation. These signaling networks configured in a non-associated mode of operation to make more efficient use of signaling circuits. Some exchanges have both an associated mode of operation and non-associated mode of operation and in case of a fault in a channel associated signaling system, non-associated signaling system will back up the signaling system for reliability.

In view of it's importance and to ensure reliability, the signaling network is recommended to be mesh in duplicated homing arrangements, which are shown in Figure 10.1.4-2 Proposed Configuration of Basic Mesh Network and Figure 10.1.4-3 Proposed Configuration of Two-plane Network as sample networks.

(2) Development of Signaling Network Up to 2010

STP (Signal Transfer Point) is planned to co-locate with national transit exchanges, because STP processor is integrated with the processor of transit exchanges. In accordance with the development of switching system for each Phase, number of STP will also increase as follows:

- Existing : Transit Exchanges = STPs = 3 Sites with 5 units
- Phase A : Transit Exchanges = STPs = 4 Sites with 7 units
- Phase B : Transit Exchanges = STPs = 6 sites with 10 units
- Phase C : Transit Exchanges = STPs = 7 sites with 12 units



————	Communication Line
....	Signaling Circuit
STP	Signal Transfer Point
GW	Gate way Switch
TOLL	Transit Exchange
LS	Local Switch

Note: STP processor is integrated with the processor of TRANSIT exchanges.

Source : DGPT

Figure 10.1.4-1 Existing Common Channel Signaling Network

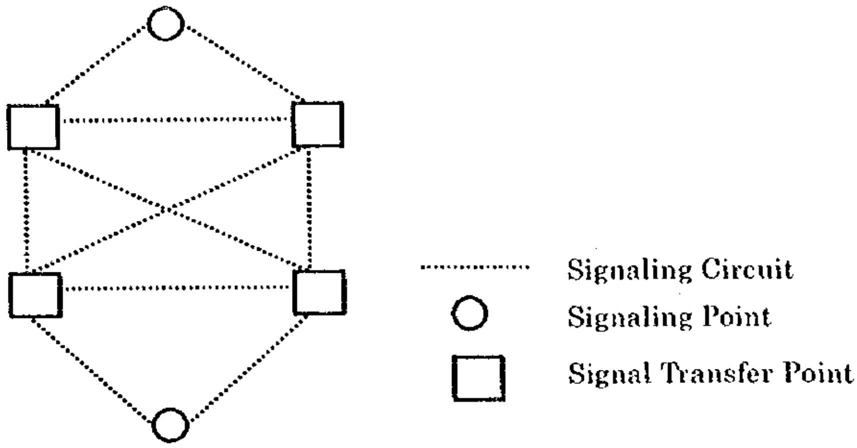


Figure 10.1.4-2 Proposed Configuration of Mesh Network

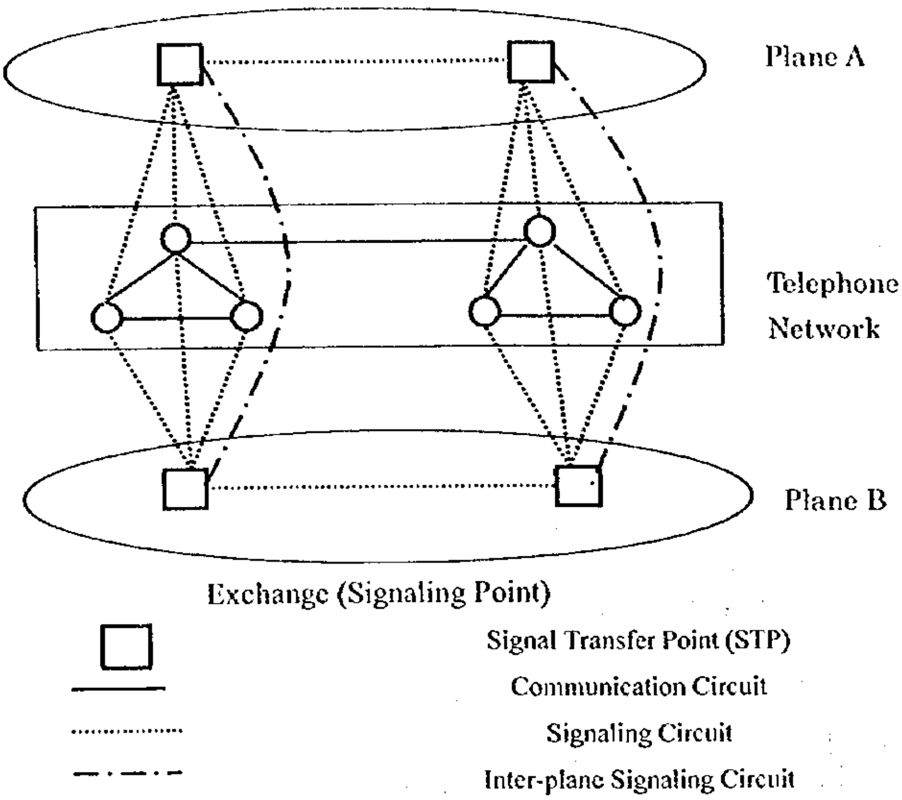


Figure 10.1.4-3 Proposed Configuration of Two-Plane Network

10.2 Transmission Network Plan

Digital transmission system has been intensively introduced and expanded by mainly Radio transmission since 1990s. Consequently, the digitalization ratio of the Transmission network has reached almost 100 % at present. Moreover, SDH OFC (Optical fiber cable) system had been introduced between HNI-HCM as trunk transmission system due to feature of flexibility, reliability and high quality. SDH technology with OFC is trend of the world; however, both Optical fiber cable transmission system and Microwave Radio system may be used continually by utilizing their advantages.

10.2.1 Inter-province Network

(1) Optical Fiber Transmission Network

The SDH OFC (Optical fiber cable system) will be expanded throughout the country by year-2010. Consequently, the most of digital radio systems are replaced by SDH OFC and SDH OFC will play the major role in the Digital Transmission Network Plan due to its advantages.

(a) Analysis of Current Issues of SDH Network to be improved

i) Lack of Optical cable core on 500kv-power line

The 10-core-cable is installed on 500kv-power line, however only 4 cores can be used for VTN due to assignment rule between VNPT and Ministry of Energy and Army.

ii) Flat ring formation

The following 3 out of 4 rings are formed the flat ring on same route.

1) Hanoi - Hai Duong - Hai Phong - Hai Duong - Bai Chay - Hai Duong - Hanoi

2) Hanoi - Ha Dong - Hoa Binh - Hanoi

3) Hanoi - Phu Ly - Nam Dinh - Hanoi

4) Ho Chi Minh - Voung Tau - HCM

iii) Omitted Capital City from current SDH

1) Tanky is excluded from current SDH network, the traffic from Tanky is transmitted to Da Nang via PDH Optical fiber system.

2) Capital cities Kon Tum and Da Lat are neglected from current SDH Backbone Network.

(b) Design Manner to be introduced

i) Introduction of Multi layer-Network (Backbone, Regional, P&T Loop)

Backbone loop is added newly as a top layer of the current SDH network for efficient pass accommodation design. (See Figure 10.2.1-1)

1) Top layer (Backbone Network)

The top layer pick up and transmit the traffic among Hanoi, Vinh, Danang, Q.Nhon, Na Trang and Ho Chiminh.

2) Mid layer (Regional Network)

The Mid layer spreads the SDH Network to the all capital city in province (61 cities).

3) Bottom layer (P&T Network)

The Network pick ups the traffic within the P&T and delivers the traffic to mid layer.

ii) Expansion of Loop formation

The loop formation with SDH OFC technique is a fundamental manner and crucial scheme in digital Network. Additionally, the current flat ring configuration should be improved to enhance the Network availability.

iii) Introduction of higher capacity technology (WDM)

Recently, WDM (Wavelength Division Multiplexing) has been introduced mainly in USA. The system provides higher capacity per fiber, it has a transport capacity of up to 40Gb/s (STM-16 ×16) at present and 400Gb/s-WDM will have been achieved very soon. The advantage of WDM is to add capacity on existing fiber cable without cost of installing new optical cable. If lots of transmission capacity is required on Backbone loop, WDM scheme may be an adequate solution.

iii) Discussion with counterpart from VNPT

The all items described in the Master Plan are subjects to be discussed with counterpart.

(c) Network Planning

Network design tool is full utilized to seek the optimum SDH network, mainly the design tool provides the SDH Path design. So that the design information required to design tool should be prepared before hand.

i) Design information

1) VNPT counterpart and JICA expert have determined the 14-loop-configuration, considering of geographical condition and P&T OFC plan.

2) Design tool uses the Basic Telephone traffic, which included the following contents.
   - Basic Telephone demand required in year-2010.
   - 10% of basic telephone demand as the Data traffic
   - Mobile telephone demand required in year-2010.
   - Internet Demand required in year-2010.

3) The 5 trials are prepared for Design tool for verification

Table 10.2.1-1 Trial for SDH Network

No	Data traffic	Network configuration	SDH type	Tool option Diverse-Routing
1	10%	Backbone and Regional loop	BB: BLSR Regional: BLSR	Planned
2	10%	Regional loop only	Regional: BLSR	Planned
3	10%	Regional loop only	Regional: BLSR	Non
4	10%	Backbone and Regional loop	BB: UPSR Regional: BLSR	Planned
5	20%	Regional loop only	Regional: BLSR	Planned

Note : BLSR : Bi-directional Line Switched Ring
UPSR : Uni-directional Path Switched Ring

ii) Results of the Trials calculated by design tool

1) Trial -1 (Backbone + Regional SDH Loop)

This is most invincible SDH network configuration among the trials, which fits for future NII (National information Infrastructure). Table 10.2.1-2 shows the results of calculation.

The table contains the additional capacity of TV broadcasting as an assumption.

Table 10.2.1-2 Results of Trial-1

Loop No	No of STM-1 (Max. in link)	No of STM-1 (Mini. in link)	Additional TV capacity	Recommended SDH type
B.B	12	11	-	STM-16
1	3	2	-	STM-4
2	3	1	-	STM-4
3	1	0	-	STM-4
4	2	0	-	STM-4
5	5	3	-	STM-16
6	2	1	2	STM-16
7	2	0	2	STM-16
8	2	1	2	STM-16
9	1	0	2	STM-16
10	5	2	2	STM-16
11	2	1	-	STM-4
12	7	5	-	STM-16
13	2	1	-	STM-4
14	8	5	-	STM-16

[Results]

The Transmission capacity on SDH loops seems to be excessive toward the traffic demand in year-2010.

2) Trial -2 & 3 (Regional Loop only)

In case of 1-Layer SDH configuration, the Regional loop in central area have to carry the long distance traffic between HNI-HCM, which will occupy the much capacity of each regional loop 6,7,8,9 and 10.

The difference between Trial-2 & 3 is diverse routing option.

a) Diverse-Routing option

This option gives a complete physical route diversity to all paths on 50%-50% base.

b) Optimum diverse routing option

Design tool designs the optimum path accommodation in loop.

The results are shown in Table 10.2.1-3.

Table 10.2.1-3 Results of Trial-2 and 3

Loop No	No of STM-1 (Max. in link)	No of STM-1 (Mini. in link)
1	3 -> (3)	2 -> (2)
2	3 -> (3)	1 -> (0)
3	1 -> (1)	0 -> (0)
4	2 -> (2)	0 -> (0)
5	5 -> (5)	3 -> (1)
6	12 -> (10)	11 -> (9)
7	10 -> (10)	9 -> (9)
8	11 -> (11)	10 -> (10)
9	13 -> (11)	12 -> (10)
10	14 -> (13)	12 -> (10)
11	2 -> (2)	1 -> (1)
12	6 -> (6)	6 -> (5)
13	2 -> (2)	2 -> (1)
14	8 -> (8)	5 -> (3)

Note : Optimum diverse routing option shows the result inside of ( ).

[Results]

The number of STM-1calculated by "Optimum diverse routing option" is smaller than the value of "Diverse-Routing option", the notable point is the number of STM in loop 6 - 10, some of Loops reduce the STM number up to 2 or 3.

3) Trial -4 (Backbone + Regional SDH Loop)

This is an examination of protection type of UPSR (Unidirectional Path Switched Ring) for Backbone Loop.

The feature of UPSR is descried below as a reference:

a) Protection algorithm is rather simple than BLSR due to simple scheme to implement and does not require a protocol. Consequently, Switching time is faster than BLSR

b) No limitation of 16-ADM number in one(1) loop

However, the sum of the traffic from all the nodes cannot exceed the capacity of a link.

The result of calculation is shown in Table 10.2.1-4.

Table 10.2.1-4 Results of Trial-4

Link on BB	No of E-1 (BLSR)	No of E-1 (UPSR)
HNI - VINH	726	1,000
VINH - DNG	658	1,000
DNG - QNN	691	1,000
QNN - NTR	700	1,000
NTR - HCM	737	1,000
HCM - HNI	736	1,000
Total	4,248	6,000

[Results]

The BLSR has a competent function to design the number of path accommodation. In this case, BLSR can economize on the link capacity about 30%. As a conclusion, BLSR should be utilized in this Master Plan.

4) Trial -5

The percentage of data traffic is increased up to 20% of basic telephone traffic, the trial intends to check the robustness of SDH Network for the fluctuations in traffic. The calculation of STM-1 number of transition from 10% to 20% is shown in Table 10.2.1-5. The TV broadcasting capacity is excluded in this table.

Table 10.2.1-5 Results of Trial-5

Loop No	No of STM-1 (Max. in link)	No of STM-1 (Mini. in link)
1	3 → (4)	2 → (3)
2	3 → (3)	1 → (1)
3	1 → (1)	0 → (0)
4	2 → (3)	0 → (1)
5	5 → (6)	3 → (4)
6	12 → (16)	11 → (15)
7	10 → (14)	9 → (13)
8	11 → (15)	10 → (14)
9	13 → (18)	12 → (16)
10	14 → (19)	12 → (16)
11	2 → (2)	1 → (1)
12	6 → (8)	6 → (7)
13	2 → (2)	1 → (1)
14	8 → (10)	5 → (6)

Note : Result of Trial 5 shows inside of ( )

[Results]

The link capacity from increases up to 33%. It is sure that 1-Layer SDH Network configuration can not meet the traffic demand and it forces to build the 2-Layer SDH Network.

iii) Conclusion of SDH Network planning

From the results of Trials, it is obviously clear that only 1-Layer SDH Network with capacity STM-16 can meet the traffic demand required in year-2010.

However, the Master Plan recommends following two ideas.

① The combination of Backbone and regional Loop (2-Layer configuration) should be planned. (B.B is shown in Figure 10.2.1-2)

In case of 1-Layer configuration, it causes the followings.

- The occupancy rate with TV broadcasting capacity will reach nearly 100%. (see trial 2&3).
- 500E1 are required directly between HNI and HCM, this will occupy the capacity on Loop 6,7,8,9 and 10 respectively.

② Path accommodation design(CH plan) should be planned by trial 2(diverse-routing option) due to the reliability. The Channel plan is prepared by design tool and shown in Appendix I-10-2.

The overall SDH Network is shown in Figure 10.2.1-3 and the detailed diagrams are shown below.

1) Feature of Loop 1 - 5 (see Figure 10.2.1-4)

All traffic in this area is concentrated to Hanoi, especially high demand is expected in Loop 5. Table 10.2.1-6 shows SDH type of loop 1-5.

Table 10.2.1-6 Loop 1 - 5

Loop No	No of STM-1 (Max. in link)	No of STM-1 (Mini. in link)	SDH Type	Notes
1	3	2	STM-4	HTY, SLA, LCT
2	3	1	STM-4	V.Yen, V.Tri, TQG
3	1	1	STM-1	HGG, CBG
4	2	1	STM-4	LSN, BCN
5	5	4	STM-16	HDG, HPG

2) Feature of Loop 6 ~ 10 (see Figure 10.2.1-5)

a) At present, these loops are so-called backbone and carries much traffic between HNI-HCM. In year-2010, the occupancy rate will exceed 80% without TV broadcasting capacity.

b) The current loop(HCM-QNN) is separated into two loops (No. 9 &10) from the following reasons.

- The length of 1,424km is excessive as a regional loop.
- For the sake of insertion of capital city Da Lat ad B.M.Thout into SDH loop formation at point of reliability.

c) The traffic from Da Lat and B.M.thout is led to Nha Tran, so that these nodes are accommodated in Loop 9.

d) Tanky is incorporated with loop 9 from current independent PDH OFC link.

Table 10.2.1-7 Loop 6 - 10

Loop No	No of STM-1 (Max. in link)	No of STM-1 (Mini. in link)	SDH Type	Notes
6	12	11	STM-16	THA, VINH
7	10	9	STM-16	DNG, HUE
8	11	10	STM-16	QNI, Q.Nhon
9	13	12	STM-16	NTR, B.M.Thuot
10	13	10	STM-16	B.Hoa, HCM

3) Feature of Loop 11 ~ 14 (see Figure 10.2.1-6)

a) Transfer 100E1 out of 167E1 assigned "Bien Hoa - HCM" into Loop 11 from Loop 10 to keep the circuit-reliability.

b) High traffic(491 E1) is expected at AGG and is led to HCM via Loop 12.

Table 10.2.1-8 Loop 11 - 14

Loop No	No of STM-1 (Max. in link)	No of STM-1 (Mini. in link)	SDH Type	Notes
11	2	2	STM-4	V TU, B.Hoa
12	6	5	STM-16	Tan An, V.Long
13	2	1	STM-4	BTE, TVH
14	8	6	STM-16	AGG, CTO

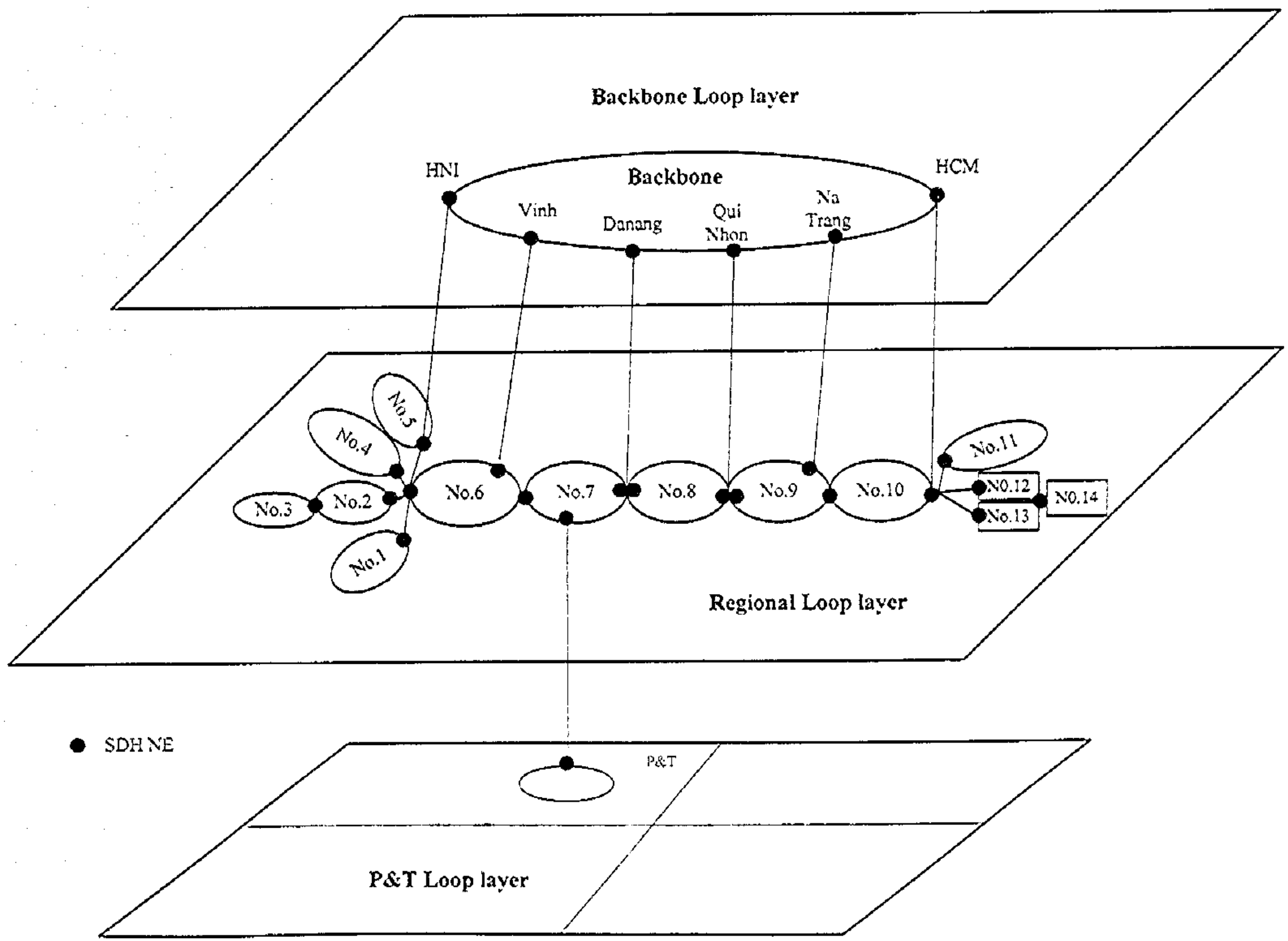
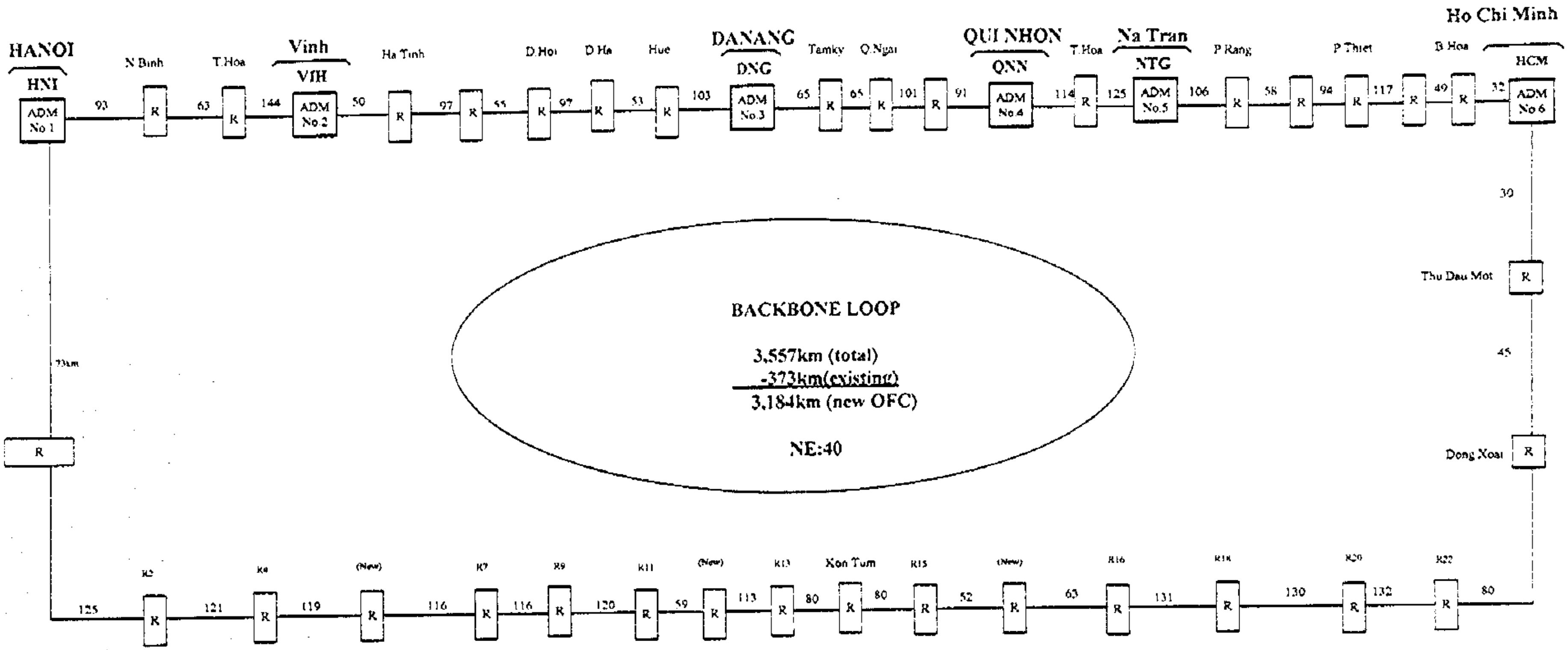


Figure 10.2.1-1 Backbone, Regional and P&T Network Layer



Note.
a. Hanoi - Vinh OFC-24-core (Existing OFC, CSC)
b. Hanoi - Hoa Binh OFC-20-core (Existing OFC)
c. Length of Power Line OFC is 1,557km (44%)

Figure 10.2.1-2 Backbone Loop

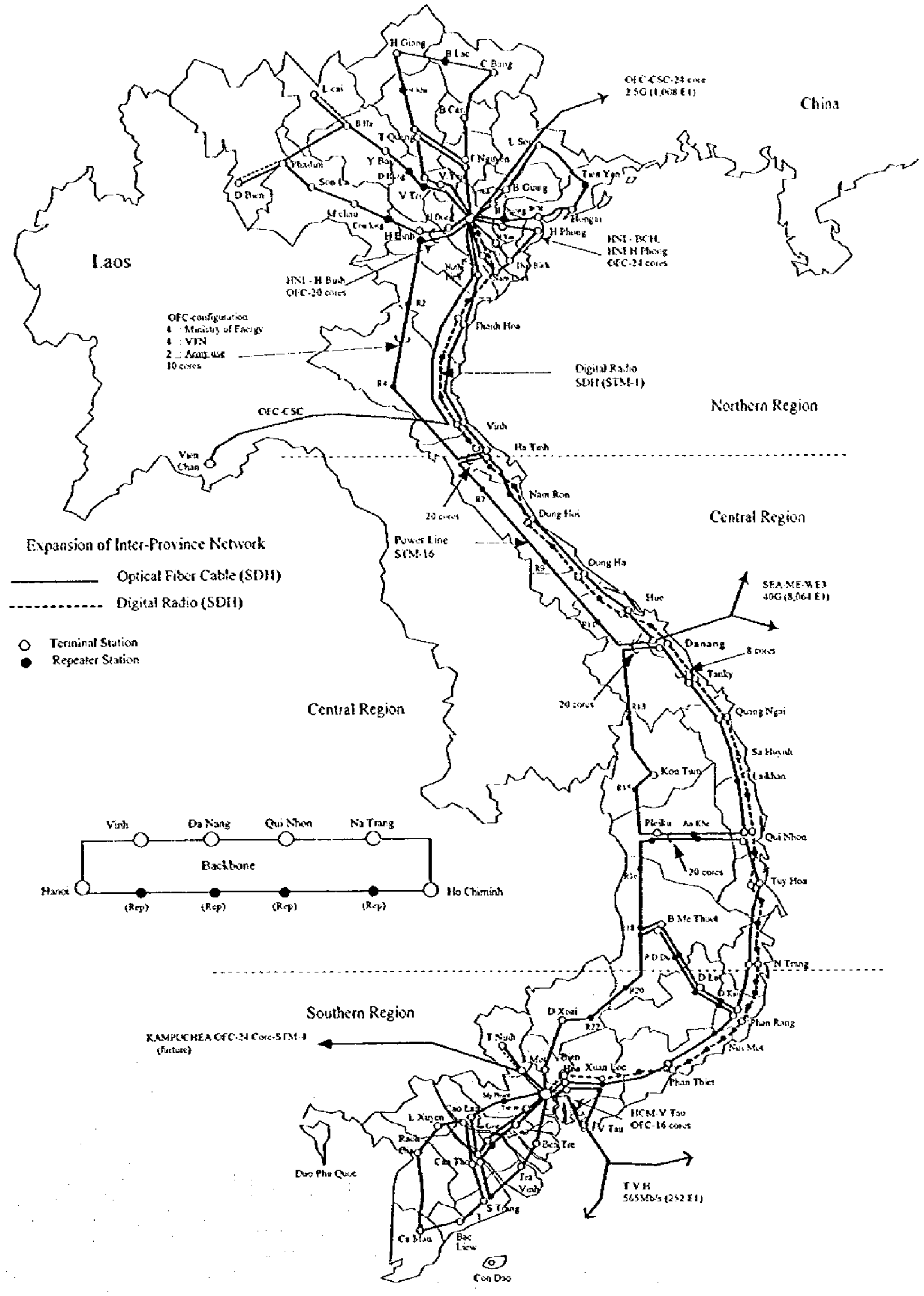
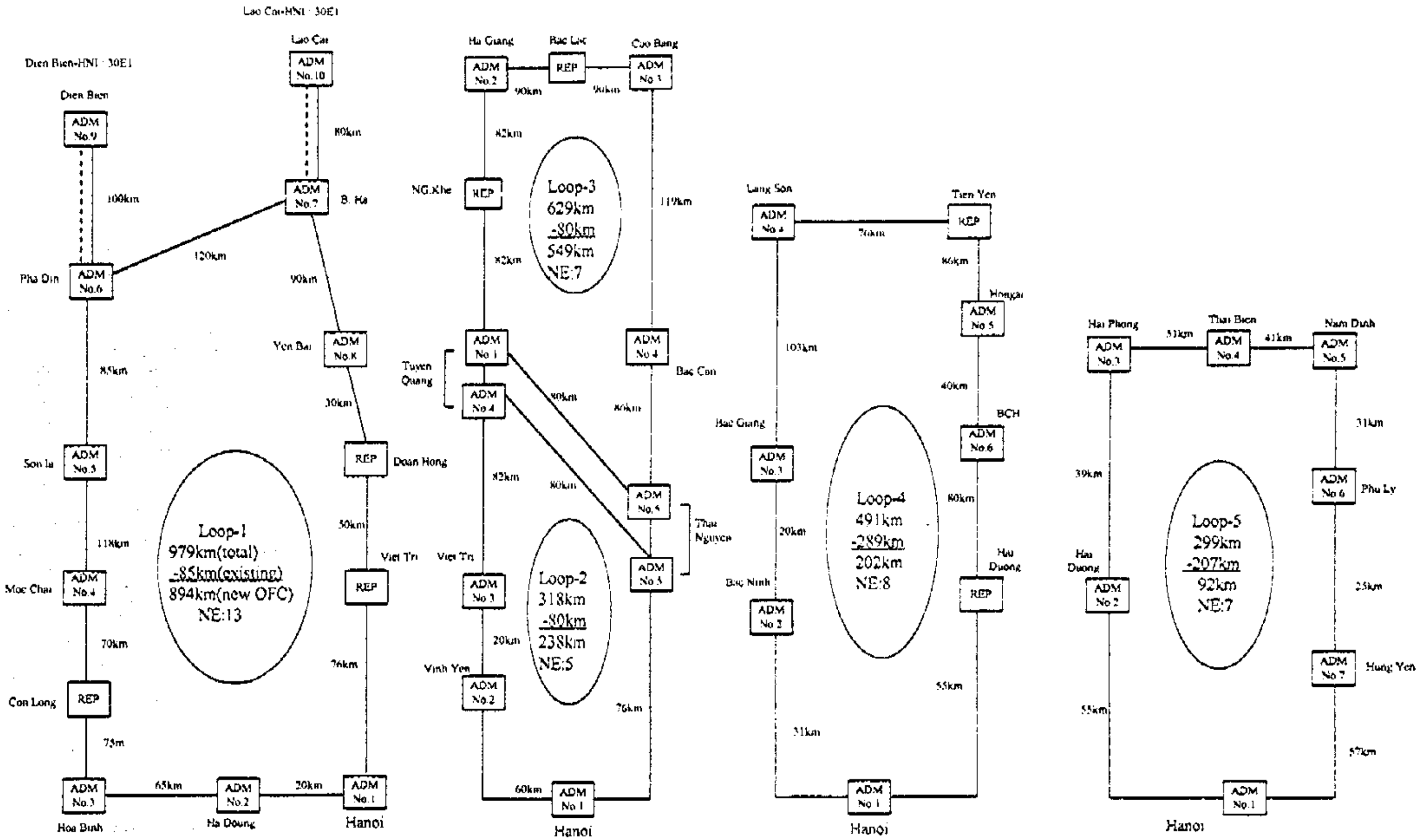


Figure 10.2.1-3 Expansion of Inter-Province Network



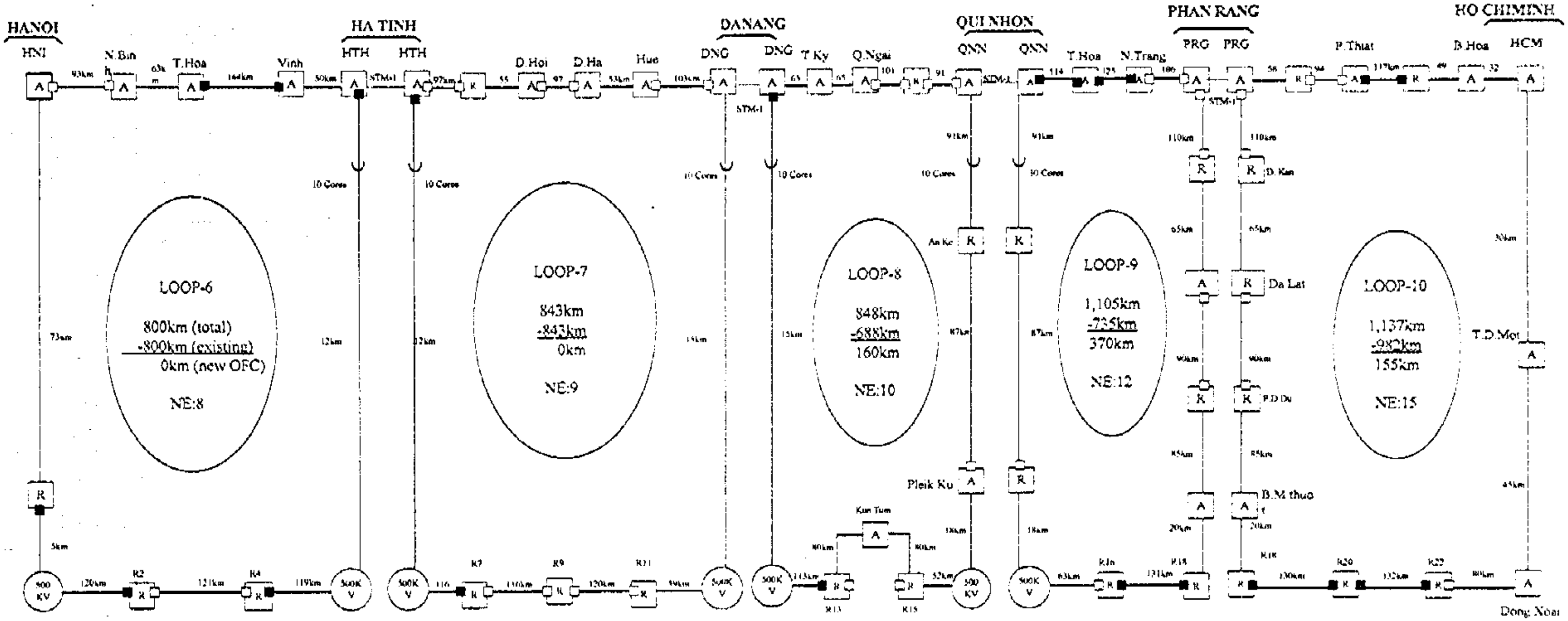
Note (Existing OFC)
a. Hanoi - Hoa Binh OFC-20-core

Note (on-going OFC project)
a. Tuen Quang-Thai Nguyen OFC-24-core

Note (Existing OFC)
a. Hanoi - Lang Son OFC-24-core(CSC)
b. Hanoi - BCH OFRC-24-core
c. OFC route plan
Lang Son - Quan Ninh

Note
a. Hanoi - Hai Phong OFC-24-core(existing)
b. Nam Dinh -Phu Ly OFC-8 core(existing)
c. Hung yen has two spur link due to geographical feature.

Figure 10.2.1-4 Northern Region Loop



Note : Loop-6 (Existing OFC)
a. HNI - Hoa Binh OFC-20-core
b. Vinh - HNI OFC-24-core(CSC)
c. Power line + Route No.1
(4-core) (8-core)

Note. Loop-7
Power line + Route No.1(existing)
(4-core) (8-core)

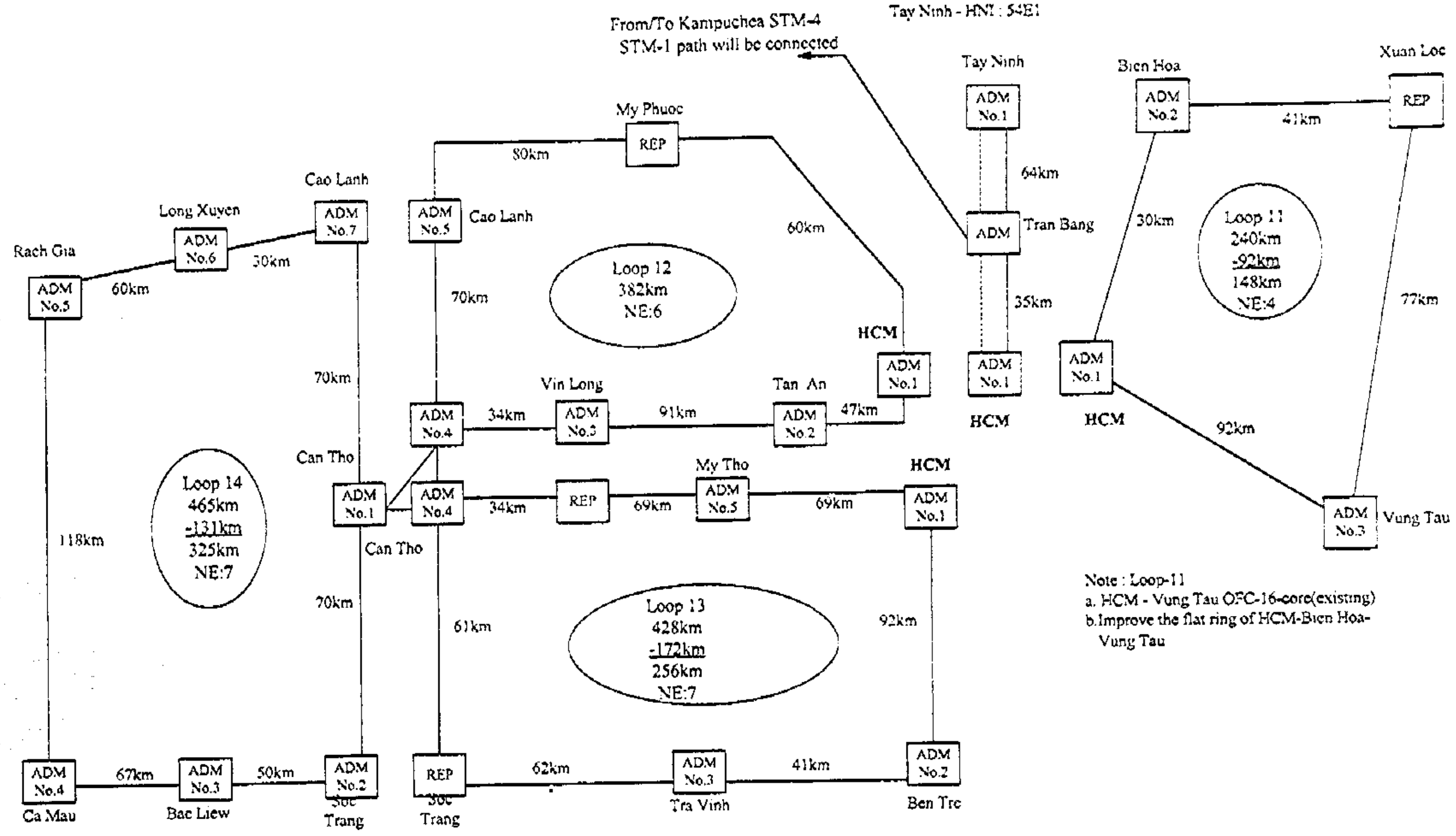
Note : Loop-8
a. Power line + Route No.1(existing)
(4-core) (8-core)
b. Tamky & Con Tum are inserted
(new OFC)

Note : Loop-9 & 10
a. Power line + Route No.1(existing)
(4-core) (8-core)
b.Dalat, B.M.Thuot, D.Xoai & T.D.Mot are inserted(new OFC)

LEGEND

Amplifier15dB
Amplifier10dB
ADM
500 KV Branch point at power line
R Repeater

Figure 10.2.1-5 Central Region loop



Note : Loop-11
a. HCM - Vung Tau OFC-16-core(existing)
b.Improve the flat ring of HCM-Bien Hoa-Vung Tau

Note : Loop-14
a. OFC link Cao Lanh - Soc Trang is installed by Loop 12 & 13.

Note : Loop-13
a. OFC link HCM-Can Tho is installed by Loop 12.

Figure 10.2.1-6 Southern Region loop

(2) Radio Transmission Network

Inter-province network is mainly composed of optical fiber cable systems, and some parts utilize radio transmission systems. However, the utilization of the radio transmission system has several issues to be improved as follows:

(a) Issues to be improved

i) Lack of Capacity

Most of radio transmission systems are PDH systems and their capacities are not so large.

ii) Irregular Utilization of the System

Some radio transmission systems are being irregularly utilized regarding system configuration and frequency utilization.

It is suspected that system configuration does not apply a redundancy system (N (operation) + 1 (standby) system) and radio frequency channels do not apply two-frequency system.

iii) Network Configuration

Optical fiber cable network is almost of loop configuration, on the other hand radio transmission network has no loop configuration in Vietnam.

(b) Radio Transmission Network Plan

In consideration with the above issues to be improved, the radio transmission network plan for inter-province network is established as follows:

i) Replacement by SDH systems

The existing PDH systems with the capacity of 140 Mbps and plural systems of 34 Mbps are planned to be replaced by STM-1 SDH radio/optical fiber transmission systems.

ii) Upgrading systems

Most of the existing radio transmission systems with the capacity of 34 Mbps, 16Mbps, 8 Mbps and 4 Mbps are being irregularly utilized, so these are planned to be upgrading their capacity and replaced by radio/optical fiber transmission systems.

Consequently, Master Plan recommends following Radio Transmission system.

a. Pha Din – Dien Bien	STM-1
b. B.Ha – Lao Cao	STM-1
c. HNI – HCM	STM-16
d. HCM – Tay Ninh	STM-1

10.2.2 Intra-Province Network

The intra-provincial networks (total number of links is about 1,800.) in Vietnam are so complicated and utilized irregularly, and the network configurations and systems have been frequently changed year by year. Therefore, the feasibility study is required to establish in detail the intra-provincial network plan such as priority of project and selection of systems to be applied prior to the improvement of the networks. In the Master Plan, the target of improvement of intra-provincial networks is established that about half of total links should be improved/expanded/upgraded by the year 2000.

(1) Optical Fiber Cable Network

Currently, only a few optical fiber cable systems have been installed in major P&T, for the time being radio transmission system continually keeps the high occupancy rate. However, these small digital radio system will be replaced by SDH OFC little by little. Master Plan forecast that SDH OFC occupancy rate will have been achieved up to 50% by year-2010.

(a) Current Network Condition

i) Current status of SDH OFC installation

At major P&T such as HNI, HCM, DNG and H.Phong. SDH network with loop formation has been introduced and developed, the other side OW system still has been used in the outskirts of major city such as Bac can area.

ii) Network configuration

Loop configuration is mainly introduced in major P&T, however, gradually OFC transmission is introduced in other P&T. (e.g. Can Tho, Ben Tre, Binh Dinh, Vinh, Hoa Binh, An Gian, etc)

(b) Optical Fiber Cable Network Plan

OFC transmission system will introduce intensively in harmony with radio transmission system. The followings are guideline of OFC Network Plan.

i) Promotion of Replacement from radio transmission system

The existing radio transmission system (small capacity) will be replaced by optical fiber cable transmission. The Master plan recommends that about 30 % (520 links) out of total number of intra-provincial networks (1,800 links) will have been replaced by the year 2010. The links to be replaced should be selected and prioritized in detail, and the deployment of

OFC and radio transmission should be scrutinized through the feasibility study including field survey prior to the implementation of projects.

ii) Reliability of Transmission Network

Adequate measure should be taken for network availability of both SDH OFC and radio transmission system such as loop formation, double routing, etc.

iii) Number of optical fiber core to be installed

The adequate number of optical fiber core is prepared for future expansion, 24-core-cable is recommended.

iv) Timing clock for SDH

The timing clock for SDH should be synchronized with PRC according synchronization plan.

(2) Radio Transmission Network

At present, many types of radio transmission systems are used in Vietnam, and their capacity is almost fully utilized (accommodation ratio is approx. 70 %).

Therefore, the radio transmission system has little rest for expansion of channels.

On these conditions, the radio transmission system would rapidly become lack of capacity after the installation of the system, so replacement/upgrading of the system is immediately/frequently required.

(a) Issues to be improved

To solve the above issues, it is required to improve the following items:

i) Improvement of network reliability

Most of the current network is of type of star, so this network does not have high reliability. Therefore, the network structure should be improved to have high reliability and diversity against system failures by applying **loops** and **duplication** of routes. The priority for loop/duplication of routes should be set up from the economical and technical viewpoints through the feasibility study.

ii) Systems to be applied

Large number of types of the radio transmission systems causes inefficient operation and maintenance, because many spare parts are required and skilled staff is required. Therefore, it is better to **limit the number of types** of radio transmission systems.

iii) System capacity to be applied

To avoid frequent/repeated replacement of the system, it is required to apply **higher capacity system** such as by increasing capacity per system and applying N + 1 system. In addition, some of links will be replaced by **optical fiber cable** system with higher capacity.

iv) Extension of provision period

The current system may be designed corresponding to only the current required capacity, which does not include future expansion of capacity or includes too small capacity for expansion, so it is required to apply **longer provision period** than the present ones.

v) Appropriate system configuration

To improve efficiency of the system utilization, the system should be applied a **redundancy system** considering advantage of radio transmission system.

(b) Radio Transmission Network Plan

Based on the above items, the expansion of the radio transmission network should be carried out. The target of radio transmission networks plan is that about 20 % (350 links) of the total intra-provincial networks (about 1,800 links) should be upgrading by the year 2010. The links to be replaced/upgrading should be selected and prioritized in detail, and the system to be applied should be planned through the feasibility study including field survey prior to the implementation of projects.

i) Loop and duplication of route

In parallel with the construction and upgrade of radio transmission systems, the network structure should be improved to apply loop and/or duplication configuration.

ii) Applying standard radio transmission system

The type of radio transmission systems should be limited to a few types, and the standard radio transmission systems should be established.

iii) Application of large capacity system

Corresponding to the introduction/expansion of the telecommunications services, the system capacity should be decided considering the longer provision period and introduction of new services. Also, some of links should be replaced by optical fiber cable systems.

iv) Application of redundancy system

The radio transmission system can easily expand its capacity by adding system, so the system to be used should apply redundancy system and be equipped with switchover function among plural systems.

10.2.3 Synchronization Network Plan

The objective of network synchronization is to keep the rate of controlled slips stipulated in Chapter 4 Fundamental Technical Plan. In year-2010, SDH network will have been extended from north to south in Vietnam. Consequently, accurate synchronized timing clock should be provided to all ADMs to offer the high grade of service for ISDN and other new services.

(1) Design Target

This plan aims to achieve the " network robustness ", which can recover the accurate timing clock when the original trail fails. The followings are essential schemes for "network robustness".

(a) Two (2) SSU in One Loop

Put two (2) SSUs (Synchronization Supply Unit) into one loop, one is Mater clock and another is sub-master clock.

(b) Put SSU between Layers

When timing clock is delivery to other loop, the timing clock is provided from SSU as a reference clock. E.g. from backbone to regional loop and also regional loop to P&T SDH network, SSU should be placed.

(2) National Synchronization Plan

The timing clock is transported by SDH NE with adequate manner and also sufficient number of timing clock ports are provided to other equipment such as Switching facilities, ISDN facilities, etc

(a) Backbone Network

i) Location of Primary reference clock.

Master PRC is placed in Danang VTN center and provides timing clock via backbone loop, Sub-master PRC is prepared in Hanoi and Ho Chi Minh VTN as a standby. The configuration of synchronization plan is shown in Figure 10.2.3.1- 3.

ii) Delivery of timing clock to regional loops

All timing clocks to regional loops are provided via Backbone loop.

(b) Northern Network (Loop 1~5)

i) The timing clock is synchronized by the clock supplied from DNG PRC Via Hanoi ADM.

ii) One (1) SSU is placed in each loop as a sub-master clock to achieve the "network robustness".

The configuration of synchronization plan is shown in Figure 10.2.3-1.

(c) Central Network (Loop 6~10)

i) The timing clock from DNG-PRC is provided to the ADMs via Backbone loop.

ii) SDH Radio System

The north-south PDH radio system will be upgraded to SDH (STM-1) and terminated at Hanoi, Danang and Ho Chi Minh VTN center. The timing clock is supplied at each Line Terminate site. The configuration of synchronization plan is shown in Figure 10.2.3-2.

(d) Southern Network (Loop 11~14 and SDH Radio system)

i) The timing clock is supplied from DNG-PRC via Backbone loop and HCM ADM.

ii) One (1) SSU is placed in each loop as a sub-master clock according to ITU-T G.803.

The configuration of synchronization plan is shown in Figure 10.2.3-1.

(e) P & T Network

i) SSU is placed in each P&T center and it is synchronized by DNG-PRC from the top layer at normal condition.

ii) The all timing clocks used in P&T are supplied through SSU.

iv) One (1) SSU is placed in a loop as a sub-master clock when loop formation is planned.

The typical configuration of synchronization plan is shown in Figure 10.2.3-3.

(3) Synchronization plan for International gateway exchange

The present synchronization timing clock distribution to VTI is described in digested below.

(a) PRC is supplied from VTN to VTI with two (2) synchronization distribution trails at Hanoi, Danang and Ho Chi Minh.

(b) The timing clock supplied to VTI has three (3) alternative clock sources. This scheme is in accordance with ITU-T recommendation, so that the current configuration is kept continuously.

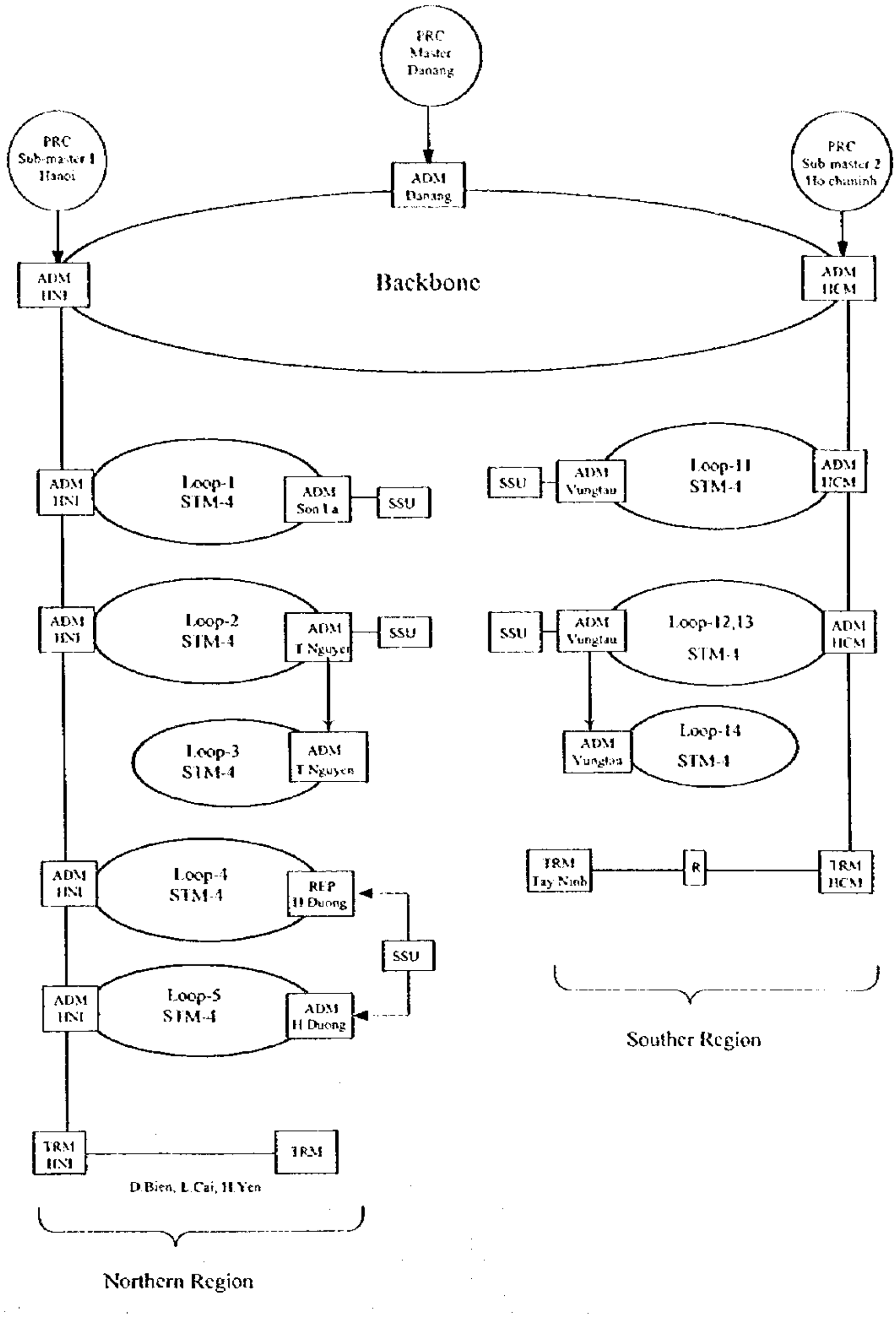


Figure 10.2.3-1 Synchronization Plan for Northern and Southern region

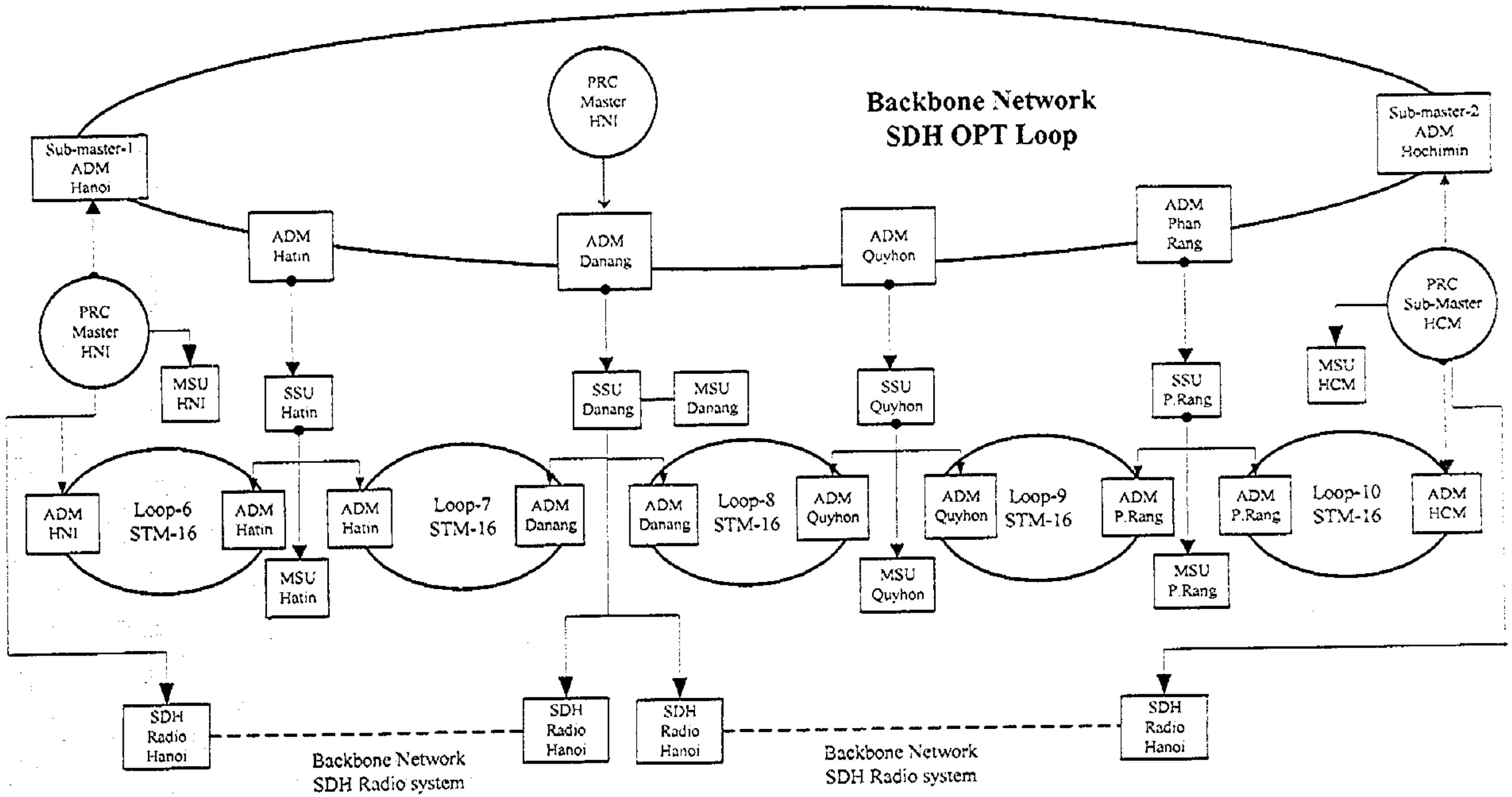


Figure 10.2.3-2 Synchronization Plan for Central region

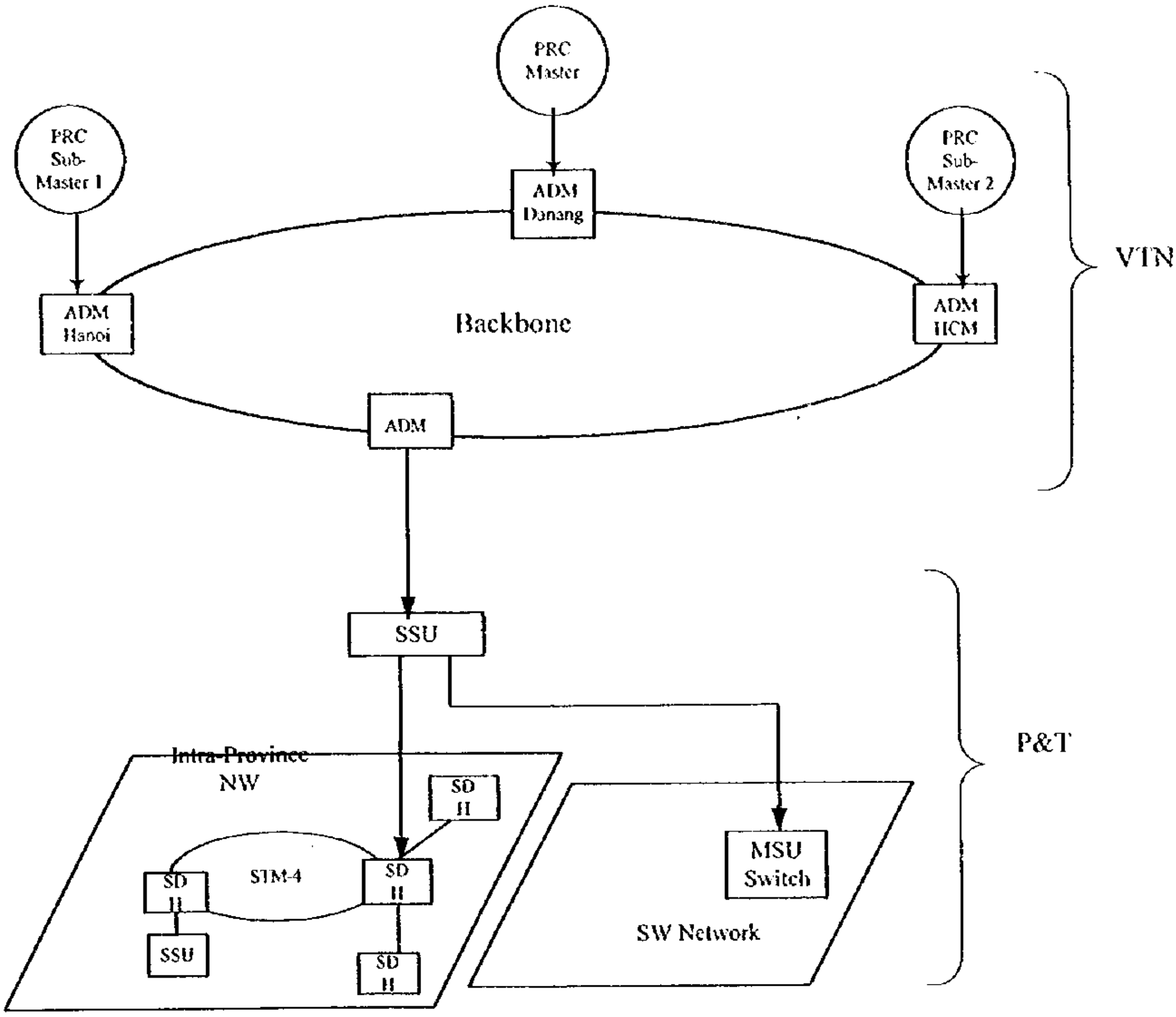


Figure 10.2.3-3 Typical Synchronization Plan for P&T network

10.3 Access Network Plan

Access Network can be defined as a network to enable the telecommunication-user terminals to connect to the service node, i.e. network between users and a service node. To correspond to the increasing demand and requirements of new services, the improvement and expansion of the access network is very important to provide the services smoothly.

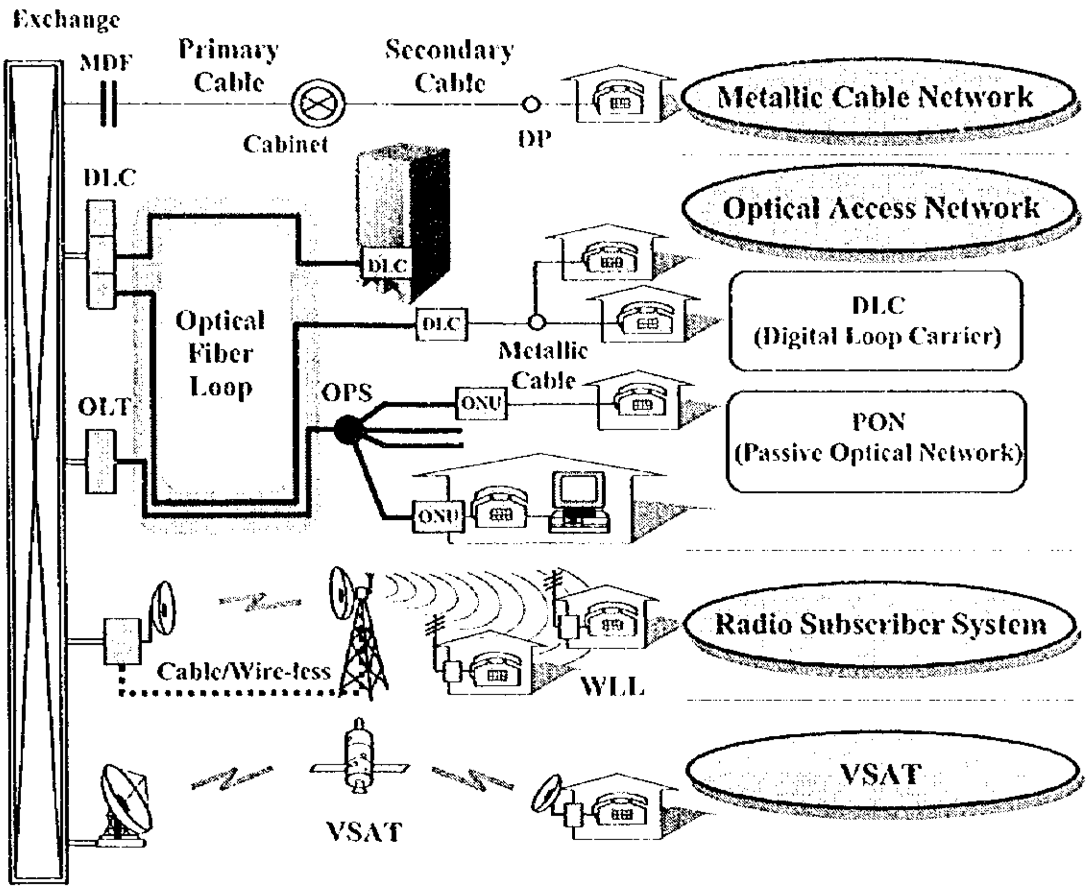
10.3.1 Access Network to be applied

(1) General

There are several types of access networks other than conventional metallic cable network as shown in Figure 10.3.1-1.

- Metallic Access Network
- Optical Access Network
- Radio Subscriber System
- VSAT System

The access network/system shall be selected and determined in a service area with due consideration of the cost comparison, operation/maintenance circumstances, strategic aspects, geographical conditions and so on.



OLT : Optical Line Termination
OPS : Optical Power Splitter
ONU : Optical Network Unit
DP : Distribution Point

Figure 10.3.1-1 Access Network

(2) Metallic Access Network

In the near future in Vietnam, it is expected that the metallic access network can be used for not only plain old telephone service (POTS), but also new digital services of N-ISDN (Narrow-band ISDN) and xDSL (Digital Subscriber Line). The metallic access network is a fundamental access network and it can cover the various services by arranging its network. Therefore, to provide sufficient amount and quality of the networks is important for a variety of services.

(a) Conventional Metallic Access Network

The conventional metallic access network in Vietnam will be mainly expanded with the growth of the POTS demand in the years ahead and it may play major role in access networks.

For the subscriber cable network expansion/maintenance activities in Vietnam, the design policies mentioned in Chapter 9 shall be applied for the purpose of the smooth introduction of the network.

(b) N-ISDN on Metallic Cable Network

The metallic access network can be used for **N-ISDN basic rate access.**

It is presently being required for Vietnam to introduce a new digital access service of N-ISDN by utilizing the current metallic cable networks as a transmission medium. A pair of the local metallic lines is expected to carry bi-directional digital transmission providing ISDN basic rate access between the local exchange and the customer. (Refer to Section 9.4.1 in Chapter 9)

(c) xDSL on Metallic Cable Network

The xDSL can provide broadband service by using metallic access network.

With the recently Internet boom in Vietnam, the dial-up connection to ISP has increased. Although the current internet users may be satisfied with the 56Kbps speed through the voice frequency MODEM (cf. ITU-T V.90), surely in the near future much higher **bit-rate services (broadband services)** will be required in their internet operations, in which high speed transfers of multimedia contents and video data are expected.

For the solution of such requirements, the Optical Access Network, FTTH as a final target, will be the most effective. However, the deployment of the optical access network is not an easy establishment in terms of the cost and the time. Accordingly, the introduction of xDSL technology will be able to cover the requirements for the time being, until OAN establishment. (Refer to Section 9.4.1 in Chapter 9)

(3) Optical Access Network

At present, the broadband services are immature and it is difficult to predict how the new services will grow in the coming years and how many customers will buy them. In the Vietnamese future, however, it will be required to upgrade the access network capabilities to accommodate future evolution of broadband and high-speed multimedia services.

In this point of view, the opticalization of the access network can be a key solution. The Optical Access Network (OAN) can cover all the predictable **broadband and high-speed multimedia services**, so that it has the large-capacity transmission paths.

The OAN can produce not only to cover the high-speed services, but also to expand the customer service area and to facilitate the construction and maintenance works.

The optical access network can provide POTS and/or broadband services. The optical access network is effective and can be applied by combination of the following systems:

(a) DLC system

DLC system for POTS is cost-effective in the field of the distance (CT to RT) over 1.1 km and the demand of approx. 500 customers. (Refer to Table 9.4.2-2 and Figure 9.4.2-6 in Chapter 9) Also DLC system can provide broadband services by changing interfaces.

This system is suitable for middle cluster of demand.

(b) PON System

PON system is suitable for gathering numbers of small demand clusters (several tens of subscribers per cluster). Also PON system can provide broadband services by changing interfaces.

(4) Radio Subscriber System

The radio subscriber systems are being utilized for the following purposes in Vietnam:

- Supplemental access system to cable system
- Main access system in remote and rural areas

The potential systems are selected considering the application types and characteristics of areas to be applied as follows:

(a) Cellular based System (WLL)

The system is required to accommodate a large number of telephone lines in a small area (dense demand), so the potential system is of type of **cellular based system (WLL)** including cordless based system with large capacity and small coverage area (cell). This system is suitable for urban/suburban areas.

(b) TDMA system

In remote and rural areas, total demand is not so large but area size is large (sparse demand). Considering these characteristics, **TDMA (point-to-multipoint) system** is most suitable. In addition, it is better to use the system with repeater function to cover wide areas. This system is suitable for remote and rural area.

(5) VSAT System

(a) Present Situation of Satellite Communications

The satellite communications services have been provided in Vietnam by lending transponder of ASIASAT II, etc. These communications are used for telecommunications in rural area and leased lines as mentioned in Chapter 3.

(b) Features of Satellite Communications System

In the field where is low demand density and far from the exchange, the VSAT system may be cost-effective. The VSAT system is suitable for isolated remote and rural areas demanding a few telephone lines.

The satellite communications are suitable to the utilization for the following purposes:

i) Utilization in remote and rural areas such as isolated area
ii) Utilization for data communications such as leased lines in isolated areas
iii) Utilization for emergency communications

(c) Items to be considered

Prior to the plan and design of the satellite communications system, the following items are to be considered:

i) Network configuration

The network configuration such as **star** or **mesh configuration** influences the specifications of earth stations, so the network configuration should be decided considering the communications styles.

ii) Satellite to be used

Selection of satellite to be used is an important factor from the technical and economic viewpoints. The system parameters such as access method, antenna diameter, etc. of earth stations depend on the satellite to be used, and cost of the satellite communications also largely depends on the satellite to be used.

iii) Transponder (Bandwidth) to be used

Transponder (bandwidth) depends on the required total number of channels (lines) and also the charge for leased transponder(s) depends on the bandwidth.

iv) Number of lines per VSAT station

The number of lines per VSAT station affects the decision of network configuration, antenna diameter and transmitter power, therefore, the number of lines should be carefully decided.

10.3.2 Classification of Objective Areas to be covered

The conditions of telephone services were comprehended district by district and demand has been forecasted as mentioned in Chapter 7.

Two (2) types of of 52 provinces' teledensities were comprehended by the unit of district, i.e., main line / 100 inhabitants in Figure 10.3.2-1 and main lines / km^2 in Figure 10.3.2-2.

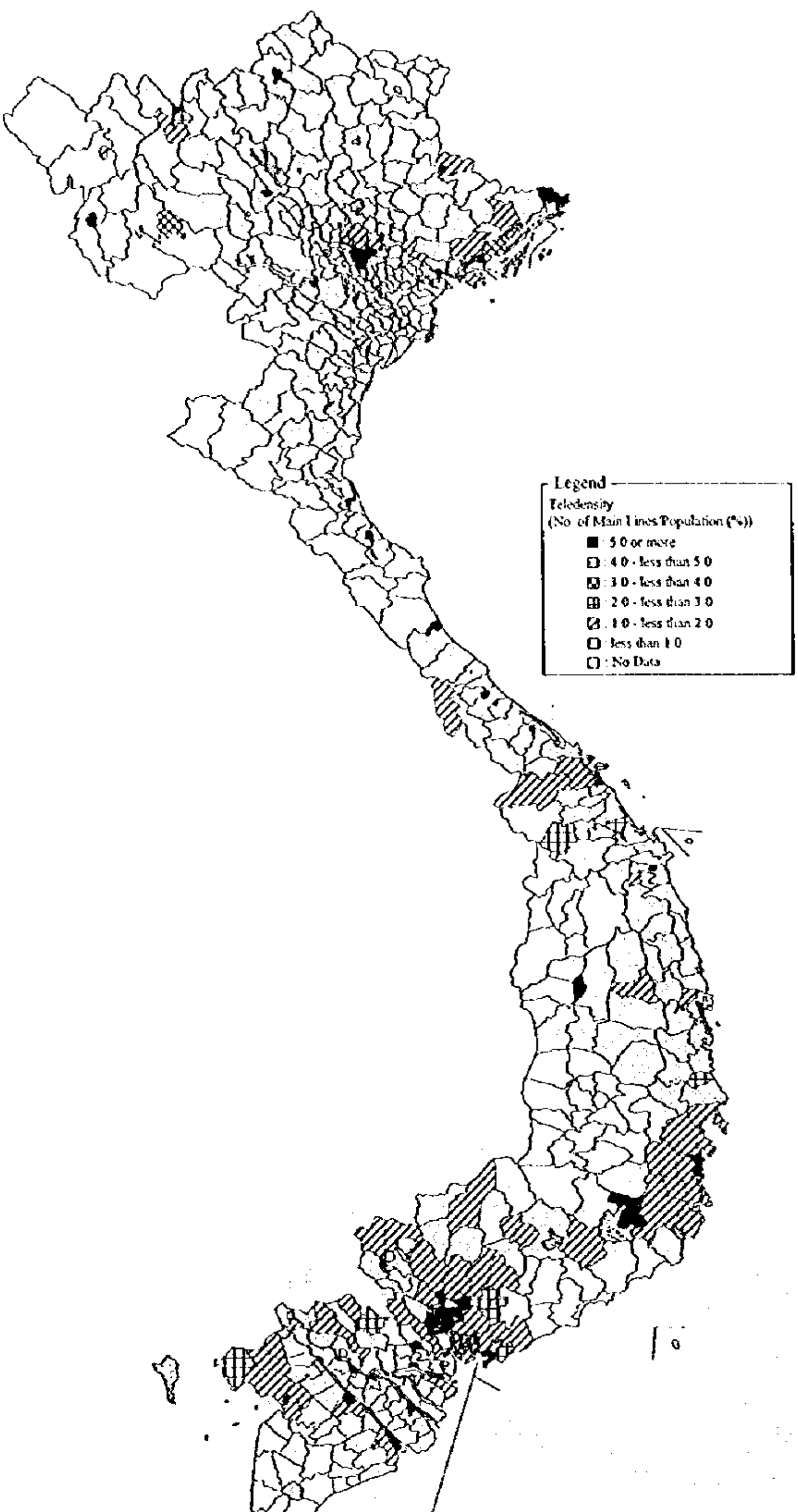


Figure 10.3.2-1 Teledensity (Main Lines / 100 inhabitants)

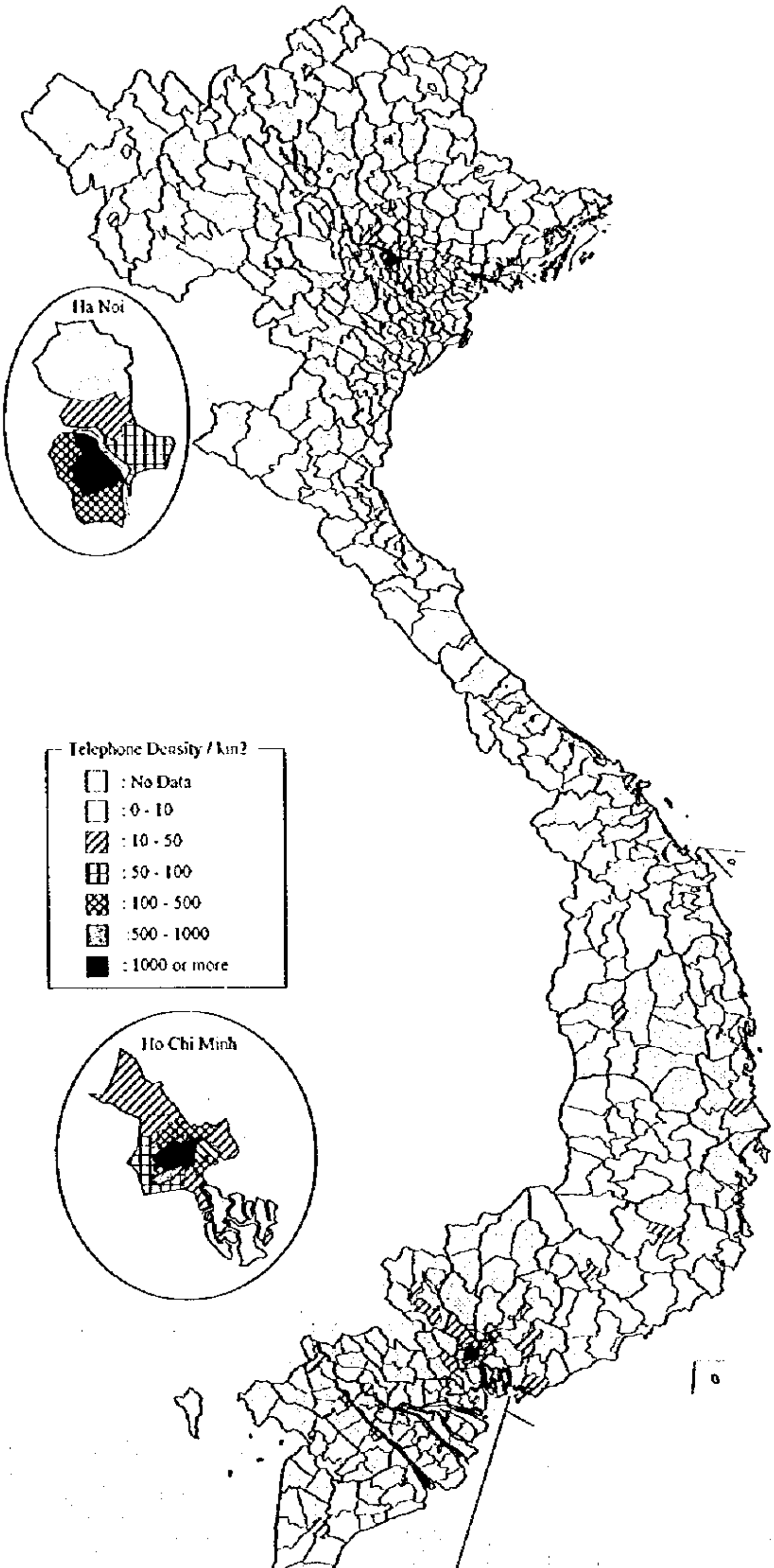


Figure 10.3.2-2 Teledensity (Main Lines / km^2)

The distribution of both types of teledensities is summarized in Table 10.3.2-1 and Table 10.3.2-2.

Table 10.3.2-1 Teledensity (Main Lines/100 inhabitants)

Teledensity (Main Lines / 100 inhabitants)	No. of Districts	%	Remarks
0-1(less than 1)	328	67.2	
1-5	104	21.3	
5-10	45	9.2	
10-15	7	1.4	
15-20	4	0.8	
Total	488	-	

Table 10.3.2-2 Teledensity (Main Lines / km²)

Teledensity (Main Lines / km²)	No. of Districts	%	Remarks
0 - 1 (less than 1)	155	30.9	
1 - 10	243	48.2	
10 - 50	38	7.5	
50 - 100	25	5.0	
100 - 500	27	5.4	
500 – 1,000	3	0.6	
1,000 – 2,000	3	0.6	
2,000 – 3,000	3	0.6	
3,000 – 4,000	0	0.0	
4,000 – 5,000	2	0.4	
5,000 – 6,000	1	0.2	
6,000 – 7,000	1	0.2	
7,000 – 8,000	1	0.2	
Total	502	-	

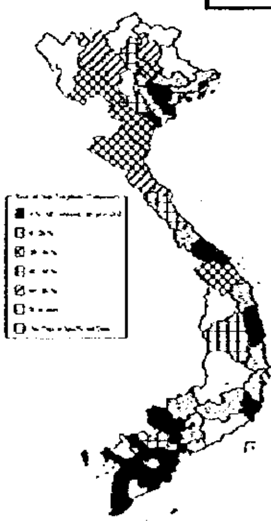


Figure 10.3.2-3 Non-Telephone Communes

In addition to the teledensities, the number of communes with non-telephone in each province is summarized in Figure 10.3.2-3.

As shown in Figure 10.3.2-1 to Figure 10.3.2-3, the telephone service conditions indicate the same tendency and have the specific features area by area.

Based on the above comprehension of the telephone services in Vietnam, the features of telephone services in Vietnam are stated as follows:

(1) In metropolitan areas, i.e., central areas of Ha Noi and Ho Chi Minh,

telephone services have been highly penetrated. Also the teledensity in these areas are superior by far to the other areas.

(2) In provinces, telephone services concentrates in provincial capitals, besides their surrounding areas have extremely lower teledensity. High density areas are almost limited to one (1) or two (2) district(s) in each province.

(3) In mountainous and isolated areas, there are many non-telephone communes.

Considering the feature of telephone services, the objective areas covered by access network can be classified into several categories as shown in Table 10.3.2-3.

Table 10.3.2-3 Classification of Objective Areas for Access Network

Category	Typical Area/Location
Metropolitan Area	Metropolitan areas with high teledensity (central areas of Ha Noi, Ho Chi Minh). Telephone services are provided throughout province, and the main lines/100 inhabitants and main lines/km^2 are very high in these areas. Teledensities are about 10 main lines/100 inhabitants and 1,000 main lines/km^2 or more.
Big City	Big cities with high teledensity such as Provincial capitals. Telephone services are provided throughout city, and the main lines/100 inhabitants and main lines/km^2 are high. Teledensities are about 5 main lines/100 inhabitants and 50 main lines/km^2 or more. About 10 % of districts can be classified into this category.
Country Area	Country areas with medium teledensity located in plain areas. Telephone services are provided within city or town, but the penetration ratio is not so high. Teledensities are around 1 main line/100 inhabitants and 10 main lines/km^2 or less. Nearly 10 % of districts are this category.
Remote and Rural Area	Mountainous and/or isolated areas with very low teledensity (less than 1 main line/100 inhabitants and 1 main line/km^2) or non-telephone such as isolated island and mountainous bordering areas. About 80 % of districts belong to remote and rural area.

10.3.3 Justification of Access Network Application

(1) Justification by Area

The application of the access networks to POTS is justified considering the objective areas and the features of each access network as shown in Table 10.3.3-1.

Table 10.3.3-1 Justification of Access Network Application by Area

	Metallic	OAN	TDMA	WLL	VSAT	Remarks
Metropolitan Areas	◎	◎	△	◎	×	
Big Cities	◎	◎	○	○	×	
Country Area	◎	○	○	○	△	
Remote and Rural Areas	△	△	◎	△	◎	

Note: ◎: Most suitable, ○: Suitable, △: Fair, ×: Not Suitable

The above application shows conceptual advantages in each category, so the actual application of access networks should be considered in detail area by area.

(2) Justification by Service

The access network can also be justified from the viewpoint of service to be provided. The access network shall correspond to the new services such as data communications, therefore, the justification is only carried out regarding the data communications other than POTS.

Table 10.3.3-2 Justification of Access Network Application by Service

		Metallic	OAN	TDMA	WLL	VSAT
Telephone	POTS	◎	◎	◎	◎	◎
Data Communica-tions	up to 64 kbps	◎	○	◎	◎	◎
	64 kbps - 2 Mbps	○	◎	○	△	○
	More than 2 Mbps	△	◎	×	×	△

Note: ◎: Most suitable, ○: Suitable, △: Fair, ×: Not Suitable

10.3.4 Access Network Plan

(1) General

The access network shall be applied based on the above considerations area by area and service by service. In this stage, the conceptual plan is mentioned because of the Master Plan, therefore, the applications such as system, area and size for project implementation should be studied and investigated in detail through the feasibility study including field survey, which would be carried out prior to the project implementation considering the following items:

(a) Scale of Demand

Total number of demand is a important factor to select systems to be applied. The scale of demand shall be considered including trend of demand increasing and future demand.

(b) Service Menu to be required

The access network shall be selected considering the service menu to be required as mentioned above.

(c) Demand Distribution Condition

The distribution conditions of demand shall be considered, i.e., geographical demand distribution and number of demand per location.

(d) Geographical Conditions

Geographical conditions significantly affect to the ease of access network construction, so the suitable access network system shall be selected considering the geographical conditions.

(e) Environmental Conditions

Environmental conditions also affect to selection of the access network system, especially commercial power supply condition and road condition are largely affect not only to construction work, but also to operation and maintenance work. Therefore, the environmental conditions shall be considered carefully.

(2) Metallic Access Network Plan

The metallic access network is applied as the fundamental network, so the other access network may be utilized as a supplemental network.

In general, the metallic access network is applied to the POTS in the areas of "Metropolitan Areas", "Big City" and "Country Area".

Also this network can be applied to the data communications before transition to OAN.

(3) Optical Access Network Plan

Considering the features of the optical access network, the network for POTS is to be applied in specific areas.

The optical access network is applied to the POTS in the areas of "Metropolitan Areas", "Big City" and "Country Area".

Also this network can be applied to the broadband data communications corresponding to the new services.

(4) Network Plan for Radio Subscriber System

The application of radio subscriber systems in Vietnam is established considering the following items:

(a) Cellular based System

At present the radio subscriber systems in Vietnam are utilized as supplemental systems to cable system in urban areas.

DGPT has a plan to introduce CDMA based WLL in Ho Chi Minh City as trial, so the expansion of the cellular based system (WLL) including cordless based system will be carried out reflecting the result of the trial.

The WLL is generally applied to the areas of "Metropolitan Areas", "Big City" and "Country Area" to supplement the cable systems.

In the case of application of the system, the frequency assignment should be carefully carried out considering the re-use pattern of the frequencies (radio channels) because the frequency bands are the same as those for the cellular mobile systems and/or PCS. (refer to Figure 4.2.2-1 and Figure 4.2.2-2 in Chapter 4 of Part II)

This network can be applied to the low speed data communications, so high speed data communications require the other specific system.

(b) TDMA system

There are many communes without telephone services in Vietnam as mentioned above, therefore the radio subscriber systems (TDMA system) can be used effectively in Vietnam. The TDMA system is generally applied to the areas of "Country Area" and "Remote and Rural Areas", where the cable construction is difficult from the economical and construction period's viewpoints.

This network can be applied to the low/medium speed data communications by changing interfaces of the system. Also, the radio frequencies should be assigned to avoid interference between the existing microwave systems and the other radio subscriber systems. (refer to Figure 4.2.2-3 in Chapter 4 of Part II)

For this purpose, about 1,200 communes are a target to be covered by radio subscriber systems, and nearly ten thousands of telephone lines will be provided by the systems.

(5) Network Plan for VSAT System

The VSAT system is suitable to the isolated areas categorized "Remote and Rural Areas". The network plan for VSAT system is carried out as follows:

(a) Network Configuration

The present network is composed of mesh configuration, so the expanded network also apply mesh configuration. If the network configuration apply the star configuration, the communications link is established by two (2) hops. In this case, the delay time becomes large and speech quality also becomes bad.

(b) Number of Lines per VSAT Station

Considering the application of VSAT in remote and rural areas, the number of lines per VSAT station is expected to be small and the current average number of lines per VSAT station is 1.6 lines (24 VSAT stations, 39 lines). Finally the number of lines should be limited to 2 - 3 lines or less per station from the economical and technical viewpoints.

(c) Number of VSAT Stations

According to the target of VSAT system application mentioned in Chapter 9, 10 % of non-telephone communes is planned to introduce VSAT stations, so about 300 VSAT stations will be installed nationwide, especially in the northern region.

(d) Space Segment to be used

The total number of telephone lines provided by VSAT system is approximately 750 lines based on the above consideration (300 VSATs x 2 – 3 lines/VSAT). In this case, a few number of transponders is required for communications.

At present, the VSAT system uses ASIASAT II, so large amount of leased charge for transponder is required to be paid. Therefore, Vietnam has a plan to launch an own satellite, and already requested to keep geostationary orbit (submitting APS4 form for satellite). However, the geostationary orbit is almost fully occupied by the other satellites, so it is difficult to obtain a geostationary orbit for Vietnam own satellite.

If Vietnam could possess own satellite, the leased charge for transponder would be neglected, but the large amount of cost for launching satellite is required. Therefore, the possession of own satellite should be carefully considered from the overall viewpoints including utilization of satellite other than telecommunications such as broadcasting.

10.4 Mobile Communications Network Plan

10.4.1 Cellular Mobile Telephone Network Plan

(1) General

Based on the results of demand forecast mentioned in Chapter 7 and the Study, the network plan of the cellular mobile telephone services is established.
The trend of the forecasted demand by zone is shown in Figure 10.4.1-1 and Table 10.4.1-1.

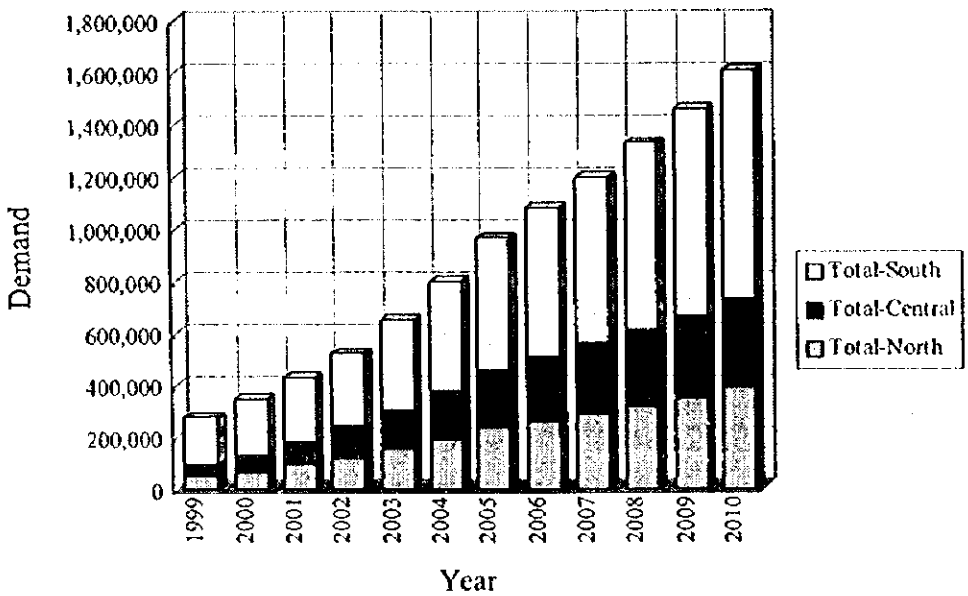


Figure 10.4.1-1 Forecasted Demand by Zone

Table 10.4.1-1 Forecasted Demand by Zone

Year	2000	2005	2010
Northern Region	69,306	233,669	390,771
Central Region	65,855	228,145	338,587
Southern Region	212,268	505,885	878,011
Total	347,428	967,699	1,607,369
No. of Additional Subscribers	142,463	620,271	639,670

Note: No. of Additional Subscribers shows the additional values between 1998-2000, 2001-2005 and 2006-2010.

In Zone 2 (Southern region), the forecasted demand is several times than the other zones, so the network is established considering the above demand distribution.

(2) Expansion of existing Cellular Mobile Network

The analog system (AMPS) provided by Call Link in Ho Chi Minh City will be removed or replaced by the other system such as Digital AMPS (D-AMPS). On the other hand, the existing cellular mobile systems (GSM) can be used for a long time due to its majority in the world, and will be expanded corresponding to the growth of the demand.

To expand the systems and services, the following cellular mobile system is established:

(a) Mobile Switching Center

At present, the mobile switching centers (MSCs) are located in Ha Noi, Ho Chi Minh and Da Nang. Considering the forecasted demand, the capacities of mobile switches will be increased without an addition of mobile switching center.

(b) Base Station Controller

The capacities of the base station controllers (BSCs) will be expanded according to the increasing demand, but no additional stations for BSCs are required.

(c) Base Transceiver Station

Corresponding to the increasing demand and expansion of service areas, base transceiver stations (BTSs) will be added. By adding of BTSs the approach links between BSCs and BTSs will also be introduced.

(3) Introduction of New Systems

In addition to the existing systems, the following systems will be introduced in Vietnam.

(a) Introduction of CDMA

DGPT has a plan to introduce CDMA systems using the frequency bands of 800 MHz and 1900 MHz. These systems may be used not only for mobile service, but also for WLL. CDMA systems using 800 MHz bands will be introduced by VIETEL and Saigon Postel, and **personal communications service (PCS,** CDMA using 1900 MHz band) will be provided by AirTel.

Mobile services by CDMA systems are to be introduced using different frequency bands from GSM, so the existing GSM systems may co-exist with CDMA systems due to its majority in the world.

(b) Introduction of PCS / PHS/PCN

As mentioned above, PCS using CDMA will be introduced in Vietnam. To supplement the cellular mobile services, PCS, PHS and/or PCN which use the different frequency bands from the cellular mobile system, are very useful in specific areas such as urban areas. In addition, PCS/PHS/PCN can provide short message service, so it can supplement the paging services.

(c) Introduction of GMPCS

DGPT approved to perform the two(2) months testing of IRIDIUM, one of **Global Mobile Personal Communications by Satellite (GMPCS)** systems, in Vietnam. Based on a result of testing, GMPCS system may be introduced not only for mobile system, but also for fixed terminals in remote and rural areas. Though the nearest gateway located in Thailand, but they expect to introduce a new gateway in Vietnam, because of ensuring security of communications. However, it is expected that the introduction of a gateway in Vietnam may be too costly and may have some technical problems.

GMPCS will be used only for supplemental service of the terrestrial cellular mobile services, and/or for fixed services in remote and rural areas due to its expensive tariff. To expand the service in Vietnam, the tariff may be most critical issue in Vietnam.

(4) Network Plan

Based on the above consideration, the network for cellular mobile telephone services is planned as shown in Figure 10.4.1-2.

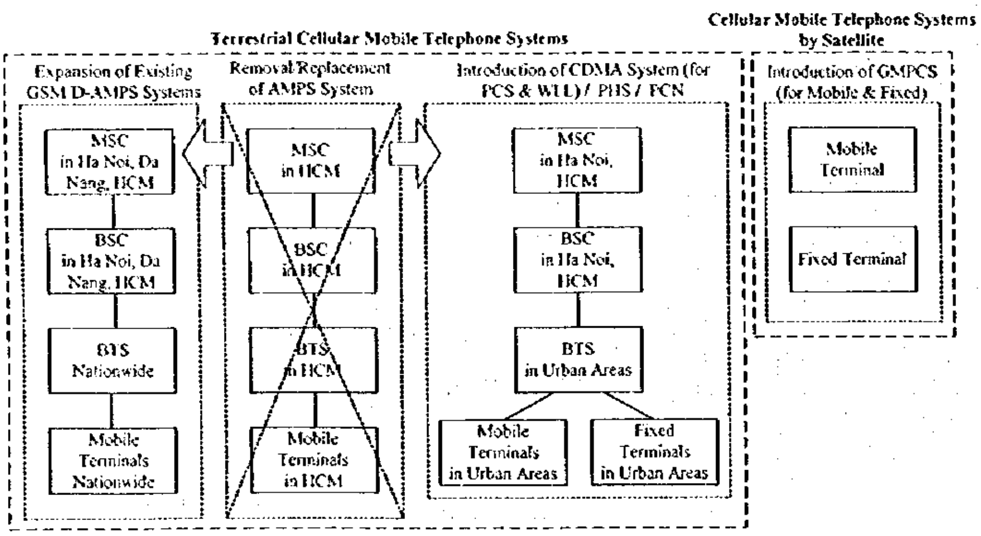


Figure 10.4.1-2 Cellular Mobile Telephone Network in Vietnam

10.4.2 Paging System Network Plan

The demand of paging services would be almost saturated in a few years as shown in Table 10.4.2-1.

Table 10.4.2-1 Forecasted Demand

Year	End of Phase A (2000)	End of Phase B (2005)	End of Phase C (2010)
No. of Subscribers	138,075	139,033	139,040
No. of Additional Subscribers	5,770	958	7

Note: Increasing number shows that compared in 1998.

Therefore, the improvement of the paging services is carried out mainly in quality. To improve the service quality the following items are considered:

(1) Expansion of Service Areas

Paging services cover 21 provinces/cities at present. Based on the forecasted demand, the service areas should be expanded.

(2) Increasing of Radio Channels

Corresponding to the increase of subscribers, the radio channels should be properly added.

(3) Expansion of Service

The service menu provided by paging service should be expanded, and necessary treatments for service provision should be carried out.

(4) Supplement by PCS / PHS / PCN

To supplement the paging services in Vietnam, PCS, PHS and/or PCN can be utilized. These systems will be introduced for the purpose of supplement of both the cellular mobile service, fixed telephone service and paging service.

CHAPTER 11

FACILITIES PLAN

CHAPTER 11 FACILITIES PLAN

This chapter describes the facilities plan for every network element up to 2010 as an integrated network. The facilities plan indicates the number of equipment, which is calculated based on the policy of network plan shown in Chapter 10.

11.1 Switching Facilities Plan

The expansion of switching facilities will be carried out by proper measures in quantity and quality every year. This master plan describes the expansion plan of switching facilities for every province.

11.1.1 National Transit Switch

National Transit Switches are installed in Ha Noi, Ho Chi Minh City and Da Nang at present. In addition to the present three (3) provinces, the new National Transit Switches will be introduced in Nghe An, Binh Dinh, Khanh Hoa and Can Tho provinces by 2010. The number of units and the capacity of National Transit Switches by province in the year 2000, 2005 and 2010 are shown in Table 11.1.1-1, and facilities expansion plan of National Transit Switches by province is shown in Table 11.1.1-2. Average total expansion capacity for every five-year is about 80,000 trunks. National Transit Switches in Nghe An and Da Nang provinces have a spare capacity in the year 2010. These spare capacities can be reused for other provinces.

Table 11.1.1- 1 Facilities Plan of National Transit Switch

National Transit Switch			1998		2000		2005		2010	
No	Province	Abbr.	Units	Capacity	Units	Capacity	Units	Capacity	Units	Capacity
1	HA NOI	HNI	2	19,147	2	43,000	3	69,600	3	96,600
2	Nghe An	NAN	0	0	1	9,100	1	14,900	1	13,400
3	DA NANG	DNG	1	8,136	1	20,100	1	22,500	1	14,200
4	Binh Dinh	BDH	0	0	0	0	0	0	1	13,900
5	Khanh Hoa	KHA	0	0	0	0	1	11,300	1	16,800
6	HO CHI MINH	HCM	2	26,781	2	50,600	3	79,300	4	106,700
7	Can Tho	CTO	0	0	1	13,300	1	19,800	1	29,300
Total			5	54,064	7	136,100	10	217,400	12	290,900

Table 11.1.1-2 Facilities Expansion Plan of National Transit Switch

National Transit Switch			2000		2005		2010	
No	Province	Abbr.	Units	Capacity	Units	Capacity	Units	Capacity
1	HA NOI	HNI	0	23,900	1	26,600	0	27,000
2	Nghe An	NAN	1	9,100	0	5,800	0	-1,500
3	DA NANG	DNG	0	12,000	0	2,400	0	-8,300
4	Binh Dinh	BDH	0	0	0	0	1	13,900
5	Khanh Hoa	KHA	0	0	1	11,300	0	5,500
6	HO CHI MINH	HCM	0	23,900	1	28,700	1	27,400
7	Can Tho	CTO	1	13,300	0	6,500	0	9,500
Total			2	82,200	3	81,300	2	83,300

11.1.2 Local Tandem Switch

There are two (2) Local Tandem Switches in Ho Chi Minh City and one (1) unit is under planning in Ha Noi at present. Existing and planned Local Tandem Switches can be called a Transit Switch functionally, because these switches have circuits to National Transit Switch. This master plan recommends that the Local Tandem function should be integrated into National Transit Switch in order to minimize the facility cost.

11.1.3 Local Switch

The number of units and the capacity of Local Switches by province in the year 2000, 2005 and 2010 are shown in Table 11.1.3-1 and facilities expansion plan of Local Switches by province is shown in Table 11.1.3-2.

Table 11.1.3-1 Facilities Plan of Local Switch

No	Province	Abbr	1998 Units	1998 Capacity	2000 Units	2000 Capacity	2005 Units	2005 Capacity	2010 Units	2010 Capacity
1	HA NOI	HNI	9	359,160	9	434,700	15	748,400	26	1,281,600
2	Hoa Binh	HBH	1	10,880	1	17,900	1	32,100	1	48,200
3	Lao Cai	LCI	1	8,900	1	13,500	1	22,500	1	33,600
4	Lang Son	LSN	1	14,516	1	19,800	1	38,800	2	62,900
5	Bac Ninh	BNH	1	13,888	1	14,100	1	20,600	1	30,100
6	Bac Giang	BGG	1	18,324	1	16,000	1	23,500	1	34,300
7	Cao Bang	CBG	1	6,532	1	5,500	1	8,200	1	11,900
8	Thai Nguyen	TNN	1	18,468	1	28,600	1	50,000	2	81,500
9	Bac Can	BCN	1	3,752	1	3,600	1	6,700	1	11,400
10	Phu Tho	PTO	1	15,671	1	33,000	2	62,200	3	104,300
11	Vinh Phuc	VPC	0	11,662	1	22,000	1	42,500	2	73,900
12	Tuyen Quang	TQG	1	8,434	1	11,500	1	24,800	1	42,900
13	Yen Bai	YBI	1	10,156	1	7,700	1	11,300	1	16,500
14	Son La	SLA	1	9,056	1	15,000	1	29,600	1	46,700
15	Lai Chau	LCU	1	6,110	1	10,700	1	22,100	1	36,900
16	Ha Giang	HGG	1	4,960	1	4,900	1	7,100	1	10,400
17	Ha Tay	HTY	1	32,846	2	71,900	3	131,500	5	206,700
18	Thai Binh	TBH	1	18,106	1	20,000	1	30,700	1	47,000
19	Hai Duong	HDG	1	22,340	2	62,300	3	138,800	6	275,300
20	Hung Yen	HYN	0	11,472	1	28,700	2	69,200	3	142,400
21	HAI PHONG	HPG	1	50,432	2	99,300	4	198,300	7	348,400
22	Quang Ninh	QNH	1	39,580	1	43,000	2	74,100	3	126,900
23	Ha Nam	HNM	1	10,896	1	6,800	1	10,500	1	16,000
24	Nam Dinh	NDH	1	21,456	1	40,900	2	74,200	3	116,800
25	Ninh Binh	NBH	1	10,560	1	15,100	1	27,400	1	43,100
26	Thanh Hoa	THA	1	28,336	2	56,700	3	103,400	4	161,400
27	Nghe An	NAN	1	59,894	2	96,100	4	166,800	6	258,500
28	Ha Tinh	HTH	1	13,088	1	11,000	1	16,900	1	25,800
29	Quang Binh	QBN	1	12,924	1	24,500	1	45,300	2	71,300
30	Quang Tri	QTI	1	13,802	1	13,300	1	20,300	1	31,100
31	Thua Thien- Hue	TTH	1	23,592	1	40,700	2	71,300	3	122,100
32	DA NANG	DNG	2	35,283	2	61,600	3	112,500	4	198,600
33	Quang Nam	QNM	1	19,060	1	19,200	1	32,900	2	56,300
34	Quang Ngai	QNI	1	17,696	1	25,400	1	44,100	2	75,600
35	Binh Dinh	BDH	1	29,972	2	58,200	3	102,000	4	159,200
36	Gia Lai	GLI	1	19,734	1	22,100	1	33,400	1	49,000
37	Kon Tum	KTM	1	6,072	1	7,200	1	10,700	1	15,600
38	Dac Lac	DLC	1	22,580	2	52,100	2	89,500	3	134,100
39	Phu Yen	PYN	1	16,600	1	17,900	1	29,400	1	45,300
40	Khanh Hoa	KHA	1	40,471	2	73,000	3	122,900	4	190,200
41	Lam Dong	LDG	1	33,834	1	40,300	2	62,200	2	95,100
42	Ninh Thuan	NTN	1	14,790	1	18,500	1	29,200	1	44,800
43	HO CHI MINH	HCM	14	415,035	15	708,100	25	1,237,500	43	2,121,200
44	Binh Thuan	BTN	1	28,009	1	39,500	2	64,300	2	99,100
45	Dong Nai	DNI	1	61,104	2	86,400	4	150,800	6	258,400
46	Binh Duong	BDG	1	31,308	2	50,100	3	108,500	5	212,500
47	Binh Phuoc	BPC	0	7,872	1	17,300	1	31,600	2	53,300
48	Tay Ninh	TNH	1	23,668	1	28,200	1	44,200	2	67,700
49	Ba Ria- Vung Tau	VTU	1	34,278	1	46,700	2	80,800	3	138,300
50	Long An	LAN	1	24,341	1	44,900	2	81,400	3	128,700
51	Tien Giang	TGG	1	27,482	1	38,800	2	62,700	2	96,400
52	Ben Tre	BTE	1	26,176	1	32,300	2	65,000	3	119,000
53	Tra Vinh	TVH	1	16,220	1	16,000	1	24,800	1	38,100
54	Vinh Long	VLG	1	15,006	1	27,900	1	47,200	2	73,100
55	Can Tho	CTO	1	37,352	2	54,700	2	90,000	3	139,200
56	Dong Thap	DTP	1	26,484	1	33,100	2	53,800	2	82,800
57	An Giang	AGG	1	40,609	2	80,200	4	181,200	7	316,800
58	Kien Giang	KGG	1	35,826	2	75,500	4	155,800	6	256,400
59	Ca Mau	CMU	1	21,761	1	27,500	1	44,400	2	68,300
60	Bac Lieu	BLU	1	12,714	1	26,000	1	49,500	2	84,500
61	Soc Trang	STG	1	18,757	1	23,600	1	47,000	2	86,200
	Total		80	2,049,88	97	3,141,10	142	5,618,400	216	9,423,700

Table 11.1.3-2 Facilities Expansion Plan of Local Switch

No	Province	Abbr	2000 Units	2000 Capacity	2005 Units	2005 Capacity	2010 Units	2010 Capacity
1	HA NOI	HNI	0	75,600	6	313,700	11	533,200
2	Hoa Binh	HBH	0	7,100	0	14,200	0	16,100
3	Lao Cai	LCI	0	4,600	0	9,000	0	11,100
4	Lang Son	LSN	0	5,300	0	19,000	1	24,100
5	Bac Ninh	BNH	0	300	0	6,500	0	9,500
6	Bac Giang	BGG	0	0	0	7,500	0	10,800
7	Cao Bang	CBG	0	0	0	2,700	0	3,700
8	Thai Nguyen	TNN	0	10,200	0	21,400	1	31,500
9	Bac Can	BCN	0	0	0	3,100	0	4,700
10	Phu Tho	PTO	0	17,400	1	29,200	1	42,100
11	Vinh Phuc	VPC	1	10,400	0	20,500	1	31,400
12	Tuyen Quang	TQG	0	3,100	0	13,300	0	18,100
13	Yen Bai	YBI	0	0	0	3,600	0	5,200
14	Son La	SLA	0	6,000	0	14,600	0	17,100
15	Lai Chau	LCU	0	4,600	0	11,400	0	14,800
16	Ha Giang	HGG	0	0	0	2,200	0	3,300
17	Ha Tay	HTY	1	39,100	1	59,600	2	75,200
18	Thai Binh	TBH	0	1,900	0	10,700	0	16,300
19	Hai Duong	HDG	1	40,000	1	76,500	3	136,500
20	Hung Yen	HYN	1	17,300	1	40,500	1	73,200
21	HAI PHONG	HPG	1	48,900	2	99,000	3	150,100
22	Quang Ninh	QNH	0	3,500	1	31,100	1	52,800
23	Ha Nam	HNM	0	0	0	3,700	0	5,500
24	Nam Dinh	NDH	0	19,500	1	33,300	1	42,600
25	Ninh Binh	NBH	0	4,600	0	12,300	0	15,700
26	Thanh Hoa	THA	1	28,400	1	46,700	1	58,000
27	Nghe An	NAN	1	36,300	2	70,700	2	91,700
28	Ha Tinh	HTH	0	0	0	5,900	0	8,900
29	Quang Binh	QBN	0	11,600	0	20,800	1	26,000
30	Quang Tri	QTI	0	0	0	7,000	0	10,800
31	Thua Thien- Hue	TTH	0	17,200	1	30,600	1	50,800
32	DA NANG	DNG	0	26,400	1	50,900	1	86,100
33	Quang Nam	QNM	0	200	0	13,700	1	23,400
34	Quang Ngai	QNI	0	7,800	0	18,700	1	31,500
35	Binh Dinh	BDH	1	28,300	1	43,800	1	57,200
36	Gia Lai	GLI	0	2,400	0	11,300	0	15,600
37	Kon Tum	KTM	0	1,200	0	3,500	0	4,900
38	Dac Lac	DLC	1	29,600	0	37,400	1	44,600
39	Phu Yen	PYN	0	1,300	0	11,500	0	15,900
40	Khanh Hoa	KHA	1	32,600	1	49,900	1	67,300
41	Lam Dong	LDG	0	6,500	1	21,900	0	32,900
42	Ninh Thuan	NTN	0	3,800	0	10,700	0	15,600
43	HO CHI MINH	HCM	1	293,100	10	529,400	18	883,700
44	Binh Thuan	BTN	0	11,500	1	24,800	0	34,800
45	Dong Nai	DNI	1	25,300	2	64,400	2	107,600
46	Binh Duong	BDG	1	18,800	1	58,400	2	104,000
47	Binh Phuoc	BPC	1	9,500	0	14,300	1	21,700
48	Tay Ninh	TNH	0	4,600	0	16,000	1	23,500
49	Ba Ria- Vung Tau	VTU	0	12,500	1	34,100	1	57,500
50	Long An	LAN	0	20,600	1	36,500	1	47,300
51	Tien Giang	TGG	0	11,400	1	23,900	0	33,700
52	Ben Tre	BTE	0	6,200	1	32,700	1	54,000
53	Tra Vinh	TVH	0	0	0	8,800	0	13,300
54	Vinh Long	VLG	0	12,900	0	19,300	1	25,900
55	Can Tho	CTO	1	17,400	0	35,300	1	49,200
56	Dong Thap	DTP	0	6,700	1	20,700	0	29,000
57	An Giang	AGG	1	39,600	2	101,000	3	135,600
58	Kien Giang	KGG	1	39,700	2	80,300	2	100,600
59	Ca Mau	CMU	0	5,800	0	16,900	1	23,900
60	Bac Lieu	BLU	0	13,300	0	23,500	1	35,000
61	Soc Trang	STG	0	4,900	0	23,400	1	39,200
	Total		17	1,106,800	45	2,477,300	74	3,805,300

11.2 Transmission Facilities

11.2.1 Inter-Provincial Network

(1) OFC Transmission System

(a) Backbone loop

Master Plan requests the installation of new optical fiber cable for all length for Backbone loop except Hanoi-Vinh (373 km). Required Optical Fiber cable specification is as follows;

Cable Type : G.652, 653, 654 and 655

Cable length : 3,184 km

Cable core : 24 cores

(b) Regional loop (Loop 1~14)

The loop formation will have been completed by year-2005. Required cable specification is G.652 - G.655 and core number is also 24 cores.

i) Backbone Loop

New Installation : 3,184 km, 40 NE

Existing (On-going) : 373km (OFC - CSC)

ii) Loop-1

New Installation : 894 km, 13 NE

Existing (On-going) : 85 km (HNI - H.Binh)

Spur link Dien Bien and Lao Cai are included.

iii) Loop-2

New Installation : 238 km, 5 NE

Existing (On-going) : 80 km (T.Quang - T.Nguyen)

iv) Loop-3

New Installation : 549 km, 7 NE

Existing (On-going) : 80 km (T.Quang - T.Nguyen)

v) Loop-4

New Installation : 202 km, 8 NE

Existing (On-going) : 289 km (HNI - LSN, HNI - BHC)

vi) Loop-5

New Installation : 174 km, 7 NE

Existing (On-going) : 125 km (HNI - HPN, N.Dinh - Phu Ly)

vii) Loop-6

New Installation : 0 km, 18 NE

Existing (On-going) : 800 km (Current Backbone)

viii) Loop-7

New Installation : 0 km, 9 NE

Existing (On-going) : 843 km (Current Backbone)

ix) Loop-8

New Installation : 160 km (R13 - Kon Tum - R15), 10 NE

Existing (On-going) : 688 km (Current Backbone)

x) Loop-9

New Installation : 370 km (Phan Rang -Da Lat - B.M.Thuot - R18), 12NE

Existing (On-going) : 735 km (Current Backbone)

xi) Loop-10

New Installation : 155 km (HCM - T.D.Mot - D.Xoai-R22), 15 NE

Existing (On-going) : 982 km (Current Backbone)

xii) Loop-11

New Installation : 148 km, 4 NE

Existing (On-going) : 92 km (Vung Tau - HCM)

xiii) Loop-12

New Installation : 382 km, 6 NE

Existing (On-going) : 0 km

xiv) Loop-13

New Installation : 256 km, 7 NE

Existing (On-going) : 172 km (HCM - C.Tho, installed by Loop 12)

xv) Loop-14

New Installation : 325 km, 7 NE

Existing (On-going) :131 km (C.Lanh-S.Tran, installed by Loop12, & 13)

xvi) Spur link HCM-Tay Ninh : 99 km, 3 NE

(c) Facilities plan

The facilities plan of optical fiber cable transmission is shown in Table 11.2.1-1.

Table 11.2.1-1 Facilities Plan for Optical Fiber Cable Transmission System

	Phase A	Phase B	Phase C	OFC km	
Backbone Loop		O	-	3184	40
Loop 1 ~ 5	-	O	-	2057	40
Loop 6 ~ 10	-	-	-	685	64
Loop 11~ 14	-	O	-	1111	24
Spur link Tay Ninh	-	O	-	99	3
Total Km, NE	0	-	0	7136	171

(2) Radio Transmission System

(a) Backbone

The radio transmission system for the backbone network would be utilized only for back-up system of the cable systems.

The existing 140 Mbps - PDH radio transmission systems (42 hops) between Ha Noi and Ho Chi Minh for backbone network is to be **upgraded to STM-1 SDH systems.**

(b) Other Radio Transmission Systems

Most of the radio transmission systems are to be replaced and upgraded by **optical fiber cable systems** except three (3) links.

The following radio links are planned to be **upgraded to STM-1 SDH systems from PDH systems** in order to improve their reliability by duplicating the links.

i) Bao Ha - Lao Cai

The existing PDH system (3 hops, 2 GHz, 16 Mbps, 1 + 1 systems) is to be upgraded to STM-1 SDH system from Bao Ha (branching station) to Lao Cai.

ii) Phadin - Dien Bien

The existing PDH system (3 hops, 2 GHz, 16 Mbps, 1 + 1 systems) is to be upgraded to STM-1 SDH system from Phadin (branching station) to Dien Bien.

i) Ho Chi Minh - Tay Ninh

The existing PDH system (2 hops, 2 GHz, 34 Mbps, 1 + 1 systems) is to be upgraded to STM-1 SDH system from Ho Chi Minh to Tay Ninh.

(c) Facilities Plan for Inter-Provincial Network

The facilities plan of radio transmission systems for inter-provincial network is established as shown in Table 11.2.1-2.

Table 11.2.1-2 Facilities Plan for Inter-Provincial Network

Year	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Total
Looping by Radio system	-	4 links	-	4 links

11.2.2 Intra-Provincial Network

It is very difficult to establish the facilities plan link by link, because many links (about 1,800 links) and various kinds of systems are used in Vietnam. Also the modification and changing of their configuration are often done.
Therefore, the facilities plan for the intra-provincial network is formulated by the statistical means.

(1) Target and Assumptions

The facilities plan for the intra-provincial network (about 1,800 links) is established based on the following assumptions:

(a) To upgrade half of intra-provincial transmission systems by the year 2010

The upgrading rate should be approximately 5 % per year so as to reach the above target. This upgrading rate can be realized by the following measures:

i) Radio transmission systems would be replaced by optical fiber cable system at the rate of about 3 % per year.

ii) Intra-provincial transmission systems would be upgraded and replaced by the larger capacity systems at the rate of 2 % per year.

(b) Few transmission systems would be newly added for the intra-provincial network based on the switching plan. However, only some transmission systems would be added in order to improve system reliability by looping and duplication of link.

(2) Facilities Plan for Intra-Provincial Network

The facilities plan of transmission systems for intra-provincial network is established as shown in Table 11.2.2-1.

Table 11.2.2-1 Facilities Plan for Intra-Provincial Network

Year	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Total
Replacement by Optical Fiber Cable System	100 links	240 links	180 links	520 links
Upgrading by Larger Capacity System	70 links	160 links	120 links	350 links
Total	170 links	400 links	300 links	870 links

11.2.3 Synchronization Network Fasilities

At present, three (3) PRCs and four (4) SSUs are used at following sites.

Hanoi : 1 PRC + 1 SSU
Danang : 1 PRC + 2 SSU
Ho Chi Minh : 1 PRC + 1 SSU

Newly, the synchronization plan (see Clause 10.2.3) requires the following number of PRC and SSU.

(1) PRC (Primary Reference Clock)

The existing PRCs are utilized continually, additional PRC is not required.

(2) SSU (Synchronization Supply Unit)

(a) Backbone loop

SSU is not required.(Common use with regional loop)

(b) Regional loop

i) Northern loop

Loop 1~5 : 3 SSUs

ii) Central loop

Loop 6~10 : 4 SSUs

iii) Southern loop

Loop 11~14 : 2 SSUs

(b) P&T Network

All provinces: 61 SSUs

(3) Facilities plan for Synchronization Plan (SSU)

The Facility plan for Network synchronization is described in Table 11.2.3-1.

Table 11.2.3-1 Facility Plan for Synchronization Plan

Year	1998 - 2000	2001 - 2005	2006 - 2010	Total
Backbone Loop	-	O	-	0
Loop 1 ~5	-	O	-	3
Loop 6 ~10	-	O	-	4
Loop 11 ~14	-	O	-	2
P & T Network	-	O		61
Total SSU				70

11.3 Access Network

11.3.1 Outside Plant

In this section, the necessary volumes of the outside plant facilities are estimated in conjunction with the demand forecasting results. The POTS demands are forecasted in three scenarios as described in the Chapter 7 and the demand data of the scenario-3 is used for this facility plan.

The planning phases are divided into three as follows ;

- Phase A : until year 2000
- Phase B : year 2001 to year 2005
- Phase C : year 2006 to year 2010

The volumes of the outside plants are represented with the total numbers of the subscriber lines that consist of the primary and the secondary lines.

The estimated numbers of the subscriber lines cover the following planned facilities ;

- The optical transmission systems

  The equivalent capacities of the DLC systems that will be installed in the primary sections are included in the total numbers. Actual deployment plans of the systems shall be studied in the basic design works as described in the section 9.4 in which the cost comparison and the economical application fields are suggested. Taking the unpredictable broadband demand in Vietnam into consideration, the quantitative OAN facility plans are not provided specially in this context.

- The subscriber lines to be planned for the communes with no telephone service, especially in remote and rural areas.

(1) Primary Cable Lines

The numbers of primary cable lines to be newly installed in each phase are estimated with the average ratio of 1.4 (the ratio of the primary lines to the line units). The total new primary cable pairs terminated on MDF are calculated in multiplying the number of the required line units and 1.4 together.

This ratio covers the following margins;

- the directional distribution loss of primary cables
- uniting loss of primary cable cores
- necessary pairs for maintenance.

Table 11.3.1-1 shows the phased total numbers of primary lines to be newly installed nationwide.

Table 11.3.1-1 Facilities Plan of New Primary Lines

	Phase A	Phase B	Phase C
Total Lines (x 1,000)	849	2,984	4,383

The planned new primary lines analyzed in region/province basis are shown in the Appendix I-11-1.

(2) Secondary Cable Lines

The numbers of secondary cable lines to be installed in each phase are estimated with the average ratio of 1.4 (the ratio of the secondary lines to the primary lines). The total new secondary cable pairs terminated to the Cabinets are calculated in multiplying the number of the total new primary lines and 1.4 together. The ratio can be translated into 1.96 as a ratio of secondary lines to line units.

It covers the following margins ;

- the directional distribution loss of secondary cables
- 80% of DP utilization rate (percentage of the planned maximum utilization in the DP capacity)
- the demand difference on the planned provisioning periods for primary and secondary
- necessary pairs for maintenance.

Table 11.3.1-2 shows the phased total numbers of Secondary lines to be newly installed nationwide.

Table 11.3.1-2 Facilities Plan of New Secondary Lines

	Phase A	Phase B	Phase C
Total Lines (x 1,000)	1,189	4,177	6,137

The planned new secondary lines analyzed in region/province basis are shown in the Appendix I-11-1.

11.3.2 Radio Subscriber System

(1) General

Based on the development indicator in Chapter 9 and the network plan of the radio subscriber systems in Chapter 10, the facilities plan of the radio subscriber systems is established category by category, i.e., facilities plan in urban areas and facilities plan in remote/rural areas.

(2) Facilities Plan in Urban Areas

In urban areas, radio subscriber systems apply mainly CDMA-WLL. The systems will be applied based on the following assumptions:

(a) The system is applied to the urban areas (cities) such as Ha Noi, Ho Chi Minh, Da Nang, Hai Phong and the surrounding areas of Ha Noi and Ho Chi Minh, where the demand and demand density are high.

(b) The number of subscriber stations is 20,000 per area.

(c) The number of required lines is one (1) line per subscriber station.

(d) Interconnection with PSTN is carried out at one point in a province.

Table 11.3.2-1 Facilities Plan of Radio Subscriber Systems in Urban Areas

	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Total
No. of Areas to be applied	2	4	6	12
No. of Lines	40,000	80,000	120,000	120,000

(3) Facilities Plan in Remote and Rural Areas

In remote/rural areas, the facilities plan is established including the existing plan in the Central Region.

To expand and improve the telecommunications services in remote and rural areas, point-to-multipoint system using TDMA is to be used. However, the cost per line is very high compared with those in urban areas, due to its sparse demand distribution.

The facilities plan of radio subscriber systems is established based on the following assumptions:

(a) The system is applied to the remote and rural areas, where telephone services have not yet been provided.

(b) Radio subscriber systems are applied to the provinces, where the ratio of communes with no telephone services is more than 80 %, especially in the northern mountainous provinces.

(c) Subscriber stations are introduced in communes, where no telephone line exists. The total number of subscriber stations is targeted to be 1,200 communes.

(c) The number of required lines is 10 lines per subscriber station (per commune).

(d) Interconnection with PSTN is carried out at one or two points in a province, and one system accommodates about 500 lines.

Based on the above assumptions, the facilities plan of radio subscriber systems in remote and rural areas is established as shown in Table 11.3.2-2.

Table 11.3.2-2 Facilities Plan of Radio Subscriber Systems in Remote/Rural Areas

	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Total
No. of Lines	2,000	5,000	5,000	12,000
No. of Base Stations	4	10	10	24
No. of Subscriber Stations	200	500	500	1,200

11.3.3 VSAT System

The facilities plan of the VSAT system is carried out based on the network plan of the VSAT mentioned in Chapter 10.

(1) Space Segment

In proportion with the transponder bandwidth, the leased charge of transponders would be increased and accounts for large parts of VSAT system cost.

(2) VSAT Stations

About 300 VSAT stations are to be introduced in isolated areas with no telephone services according to the target mentioned in Chapter 10.

(3) Hub Station

The hub station in Ho Chi Minh City should be expanded in capacity corresponding to the number of additional VSAT stations/ lines.

Table 11.3.3-1 Facilities Plan of VSAT System

Item	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Total
No. of Additional Lines	125	313	313	751
Additional Transponder Bandwidth	About 1/3 transponder	About 1 transponders	About 1 transponders	About 2 + 1/3 transponders
VSAT Stations	50 stations	125 stations	125 stations	300 stations
Hub Station	Expansion in capacity	Expansion in capacity	Expansion in capacity	Expansion in capacity

11.4 Mobile Communications Facilities

11.4.1 Cellular Mobile Telephone Facilities

According to the network plan of the cellular mobile systems and the forecasted demand, the facilities plan of the cellular mobile telephone systems is established as follows:

(1) Expansion of existing Cellular Mobile Network

The expansion of the existing cellular mobile systems is carried out from the viewpoints of expansion of service areas and expansion of the capacities in MSC, BSC and BTS.

(a) Removal of AMPS

The analog cellular mobile system (AMPS) will be removed or replaced by the other cellular mobile system such as digital AMPS (D-AMPS).

(b) Expansion of Mobile Switching Center

According to the demand, the capacities of the facilities of the mobile switching centers (MSCs) are expanded.

(c) Expansion of Base Station Controller

The capacities of the base station controllers (BSCs) are expanded according to the number of additional base transceiver stations (BTSs).

(d) Expansion of Base Transceiver Station

Corresponding to the increasing demand and expansion of service areas, BTSs will be added.

(e) Introduction of Approach Links

By adding of BTSs the approach links between BSCs and BTSs are also added in proportion with the number of BTSs.

(2) Introduction of New Systems

The new cellular mobile systems are planned to be introduced in Vietnam based on the network plan of cellular mobile systems mentioned in Chapter 10.

(a) Introduction of CDMA based PCS, PHS and PCN

To supplement the existing cellular mobile services, CDMA based PCS, PHS and/or PCN are introduced in the major cities such as in Ha Noi and Ho Chi Minh. Also CDMA based WLL is to be introduced in urban areas, so the facilities plan of CDMA should be formulated considering both systems.

(b) Introduction of GMPCS

GMPCS is to be introduced as supplemental system of terrestrial cellular mobile systems, but GMPCS is mainly used for fixed telecommunications in remote and rural areas rather than supplemental system of terrestrial cellular systems due to its expensive charge. Therefore, the number of subscribers is expected to be small, and a gateway station in Vietnam would not be introduced considering the economical and technical viewpoints.

(4) Cost of Cellular Mobile System

(a) Facilities Plan

The above facilities plan is summarized in Table 11.4.1-1.

Table 11.4.1-1 Facilities Plan of Cellular Mobile System

Items	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Total
No. of Additional Subscribers (x 1,000)	140	621	640	1,401
Item to be required	Expansion of GSM (MSC in HCM, BSC, BTSs) Removal of AMPS Introduction of CDMA	Expansion of GSM (MSCs in Da Nang and Ha Noi, BSCs, BTSs) Expansion of CDMA Introduction of GMPCM	Expansion of GSM (MSCs in HCM, BSC, BTSs) Expansion of CDMA Expansion of GMPCS	-

(b) Unit Price of Cellular Mobile System

The unit price of cellular mobile system could not obtained in Vietnam, so the unit price is estimated based on those in other countries.

Table 11.4.1-2 Unit Price of Cellular Mobile System

Items	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Remarks
Cost / Subscriber (US$)	870	780	740	Excluding terminal

Note: Cost excludes the cost of PSTN exchange.

(c) Investment Cost for Cellular Mobile Systems

The investment cost is estimated on the above assumptions as shown in Table 11.4.1-3.

Table 11.4.1-3 Construction Cost of Cellular Mobile System

Items	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Total	Remarks
Construction Cost (Million US$)	122	484	474	1,080	Excluding terminals

Note: Cost excludes the cost of PSTN exchange.

11.4.2 Paging System

(1) Facilities Plan of Paging System

The facilities plan of the paging systems can be established based on the network plan mentioned in Chapter 10. Some parts of paging service will be supplemented by the CDMA based PCS and/or PHS.

(2) Cost of Paging System

(a) Facilities Plan

The facilities plan for paging systems is summarized in Table 11.4.2-1.

Table 11.4.2-1 Facilities Plan of Paging System

Items	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Total
No. of Additional Subscribers	6,000	1,000	100	7,100
Item to be required	Expansion of Paging	Expansion of Paging	Expansion of Paging	

(b) Unit Price of Paging System

The detailed data/information regarding present situation and unit price of paging systems could not be obtained in Vietnam, therefore, the following unit price of paging system is applied to the Study referring the those in other countries.

Table 11.4.2-2 Unit Price of Paging System

Item	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Remarks
Paging System/Subscriber (US$)	300	270	250	Excluding pager

(c) Investment Cost

The construction cost of the paging system is summarized based on the demand forecast and plan.

Table 11.4.2-3 Construction Cost of Paging System

Items	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Total	Remarks
Construction Cost (Million US$)	2	1	1	4	Excluding Pager

11.5 Summary of Cost Estimation

11.5.1 Unit Price

The unit price (budgetary price) per line other than those of mobile communications for this Study is established based on the discussion between the DGPT and the Study Team as follows:

Table 11.5.1-1 Unit Price (per Line)

Phase	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010
Unit Price	US$ 900	US$ 800	US$ 750

11.5.2 Summary of Cost Estimation

Based on the facilities plan and cost estimations on each system, the investment costs are summarized as shown in Table 11.5.2-1 and Figure 11.5.2-1.

Table 11.5.2-1 Summary of Investment Costs

Unit: Million US$

Item	Phase A 1999 - 2000	Phase B 2001 - 2005	Phase C 2006 - 2010	Total	Remarks
Fixed Telephone System (POTS, Radio Subscriber Systems, VSAT)	546	1,705	2,348	4,599	
Mobile Communications	124	485	475	1,084	
Cellular Mobile System	(122)	(484)	(474)	(1,080)	
Paging System	(2)	(1)	(1)	(4)	
Total	670	2,190	2,823	5,683	

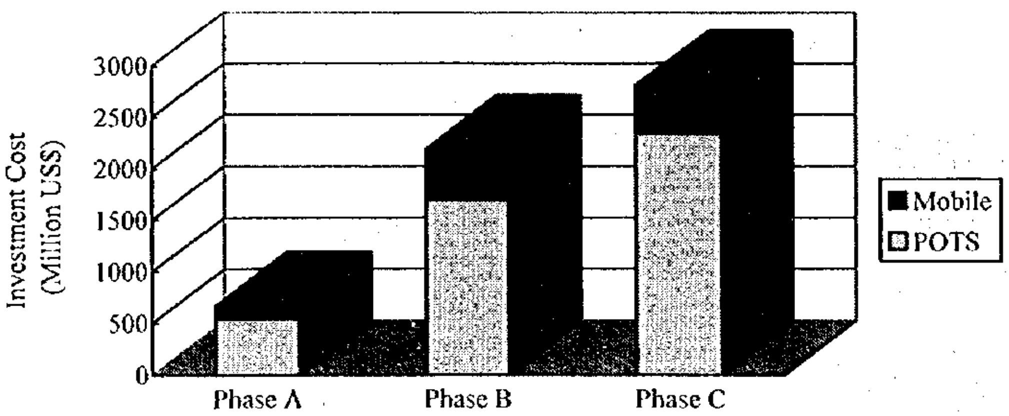


Figure 11.5.2-1 Summary of Investment Costs