No. 9

JAPAN INTERNATIONAL COOPERATION AGENCY

DEPARTMENT OF TRANSPORTATION
AND COMMUNICATIONS
THE REPUBLIC OF THE PHILIPPINES

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR ESTABLISHMENT OF
EMERGENCY TELECOMMUNICATIONS SYSTEM
IN
THE REPUBLIC OF THE PHILIPPINES

MARCH 1993

NTT INTERNATIONAL CORPORATION

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PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a basic design study on the Project for the Establishment of Emergency Telecommunications System and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team headed by Mr. Takao Yamazaki, Telecommunication Development Specialist, Institute for International Cooperation, JICA, and constituted by members of NTT International Co., from August 24 to October 13, 1992.

The team held discussions with the officials concerned of the Government of the Philippines, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to the Philippines in order to discuss a draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the teams.

March, 1993

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

Mr. Kensuke Yanagiya,
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design report on the Project for Establishment of Emergency Telecommunications System in the Republic of the Philippines.

This study has been made by NTT International Co., based on a contract with JICA, from August 17, 1992 to March 26, 1993. Throughout the study, we have taken into full consideration of the present situation in the Philippines, and have planned the most appropriate project in the scheme of Japan's grant aid.

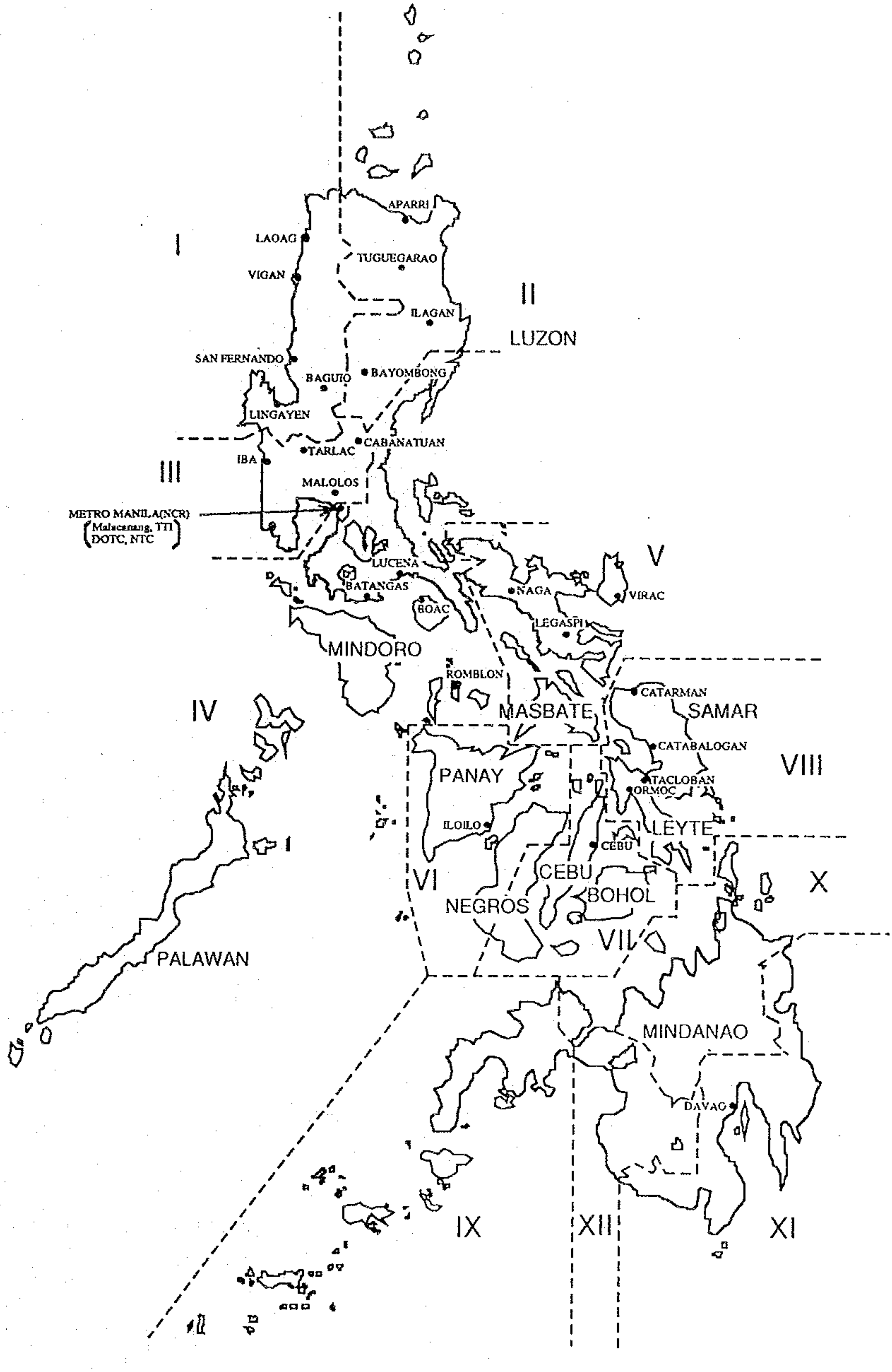
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Posts and Telecommunications. We also wish to express our deep gratitude to the officials concerned of the Department of Transportation and Communications, the JICA Philippine Office and the Embassy of Japan in the Philippines for their close cooperation and assistance during our study.

At last, we hope that this report will be effectively used for the promotion of the project.

Very Truly Yours,

Seiki Ogawa

Project Manager, Seiki Ogawa
NTT International Co.
Basic design study team on
the Project for Establishment of
Emergency Telecommunications System



LOCATION MAP OF VSAT STATIONS

SUMMARY

SUMMARY

The Republic of the Philippines suffers from immense damages due to natural disasters year by year. Even only to observe the latest years, 3 major natural disasters are counted in the Philippines. The killer earthquake that hit central part of Luzon on July 16, 1990, caused such personal injuries as more than 1,600 confirmed dead and missing and 100 thousand totally or partially damaged houses. Its loss is now estimated to be 12 billion pesos approximately. Typhoon "Ruping" which followed the earthquake in November of the same year, is reported to have killed more than 500 people. The eruption of Mt. Pinatubo in 1991, which continues up to the present, has been affecting over 1.2 million people.

Needless to say, the loss of human life due to natural disasters can not be deplored too much. In addition, heavy expenditures necessary for relief and restoration from a disaster are an enormous burden to the Government and to the private sector. Reduction of damages due to a disaster is, in this sense, one of the major problems to be solved for serenity of nation and economic growth.

To minimize damages caused by natural disasters, the Government of the Philippines established National Disaster Coordinating Council and Local Disaster Coordinating Councils. Although the Councils functioned effectively upon occurrences of disasters afterwards, analyses of the result of disaster operations clarified the necessity and importance of an emergency telecommunications system between the governmental organizations and disaster affected areas with effective rapidity and stability.

To meet the above need as a member of the Council, the Department of Transportation and Communications (hereinafter referred to as "the DOTC") , formulated a project for the establishment of an emergency telecommunications system (hereinafter referred to as "the Project") and through the Government of the Philippines, requested the Government of Japan the realization of the Project under Japan's Grant Aid Scheme.

In response to the request, the Government of Japan decided to conduct a preliminary study on the Project and the Japan International Cooperation Agency (hereinafter referred to as "JICA") sent a preliminary study team to the Philippines from March 31 to April 16, 1992. The team studied the background and contents of the request, operation structure, etc. and, as a results of the study, the team confirmed the viability of the Project.

The contents of the request are to establish a satellite telecommunications network using an Indonesian satellite PALAPA. The network consists of a Hub station in Metro Manila,

seventy (70) transportable Very Small Aperture Terminal (hereinafter referred to as "VSAT") stations, in Metro Manila and fifty-three (53) cities/municipalities throughout the country, a PABX at the Hub station to connect VSAT stations with each other, and terminal equipment consisting of a telephone set and a facsimile machine for each VSAT station.

On the basis of the results of the preliminary study and decision of the Government of Japan, JICA dispatched a basic design study team to the Philippines from August 24 to October 13, 1992. The team studied contents and scale of the Project and obtained necessary data and information for the basic design of the Project. After returning from the Philippines, the team continued the study to re-confirm the viability and technical feasibility of the Project, and to consolidate the scale and contents of the Project, related operation and maintenance plan, project implementation plan, etc. As the result of the study, the team prepared the draft report of the basic design study for the Project. JICA sent a mission for the explanation and discussion of the report to the Philippines from February 4 to February 13, 1993, and came to an agreement concerning the contents of the Project.

To reduce damages caused by natural disasters, it is indispensable to be prepared against them when they occur. The decision of the Government of the Philippines for their preparedness is considered to have to be fully supported from the above points of view.

The preparedness includes establishment of disaster damage prevention facilities, promotion of land protection, establishment of emergency telecommunications systems, etc. Of all the preparedness measures mentioned above, the emergency telecommunication systems are confirmed to share really an important role in quick and accurate information collection, adequate warning and directions by the Government, in executing relief operations such as evacuation, rescue activities, etc., and restoration work of important facilities.

The objective of the Project is to ensure quick and efficient disaster control operations of such governmental activities as information collection, warning, relief, and restoration works in a disaster affected area, by establishing a satellite communications system with a Hub station in Metro Manila and transportable VSAT stations in cities/municipalities throughout the country. The results of the study concerning the scale and contents of the Project are as follows:

(1) Although the Government of the Philippines requested 53 VSAT stations to be installed, the installations of VSAT stations are reduced to 31, in which Cebu, Iloilo and Davao are included, as the result of the study. The reasons of the reduction are first to assure the performance and operational effectiveness of the system

beginning from areas which have suffered from large numbers of disasters in the past, and second, the system itself has in built flexibility allowing for the easy addition of VSAT stations. It is preferable to undertake system expansion after the effect and performance of the system are confirmed.

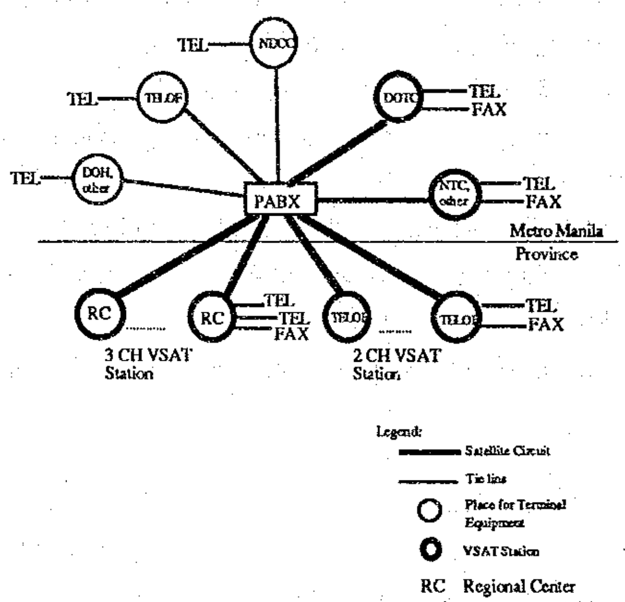
(2) In the initial request, the number of telephone circuits to be accommodated in a VSAT station was two (2). However, as importance of regional centers in delivering information and relief activities is recognized, specific VSAT stations, which are marked (*) in the following table, are decided to accommodate three (3) telephone circuits.

(3) Regarding the installation sites of terminal equipment in Metro Manila, seven (7) government offices which are involved in disaster preparedness, are selected as shown in the following table. The preparation of the tie lines between the Hub station and relevant offices, and the installation of the terminal equipment are a responsibility of the Philippines.

(4) This system composes a closed network only for limited use within relevant government offices. They are accommodated in a PABX network centered at the Hub station as remote subscribers. The services provided by the system are telephone and facsimile (G3 type) service through voice grade circuits.

(5) The telephone and facsimile circuits are automatically connected among stations in the system through a PABX to be installed in the Hub station.

The outline of the Project is shown in the following Table.

Item		Contents
Location of Earth Stations	Hub Station	TELOF, Metro Manila
	VSAT Station *: 3 CH station	NCR DOTC, NTC, Malacañang, TTI Region 1 Baguio, Laoag, Lingayen, S. Fernando* Vigan Region 2 Tuguegarao*, Aparri, Ilagan, Bayombong Region 3 Malolos*, Iba, Tarlac, Cabanatuan Region 4 Batangas*, Boac, Lucena, Romblon Region 5 Legaspi*, Virac, Naga Region 6 Iloilo Region 7 Cebu Region 8 Tacloban*, Catarman, Ormoc, Catbalogan Region 11 Davao
Place of Terminal Equipment	Hub Station	Telecommunications Office National Disaster Coordinating Council Department of Health Department of Public Works and Highways Department of Social and Welfare Development Department of Interior and Local Government Philippine national Red Cross
	3 CH VSAT Station	Regional Center
	2 CH VSAT Station	DOTC, TELOF, NTC, Malacañang, TTI
Network Configuration		
Satellite Communication Method	Satellite to be used (Bandwidth)	PALAPA owned by PT. TELKOM (Equivalent to 1/8 of a transponder)
	Communication Method	Single Channel Per Carrier
	Radio Channel Assignment	Demand Assignment Multiple Access
	Coding	32 Kbps ADPCM

The Project is to be carried out by the Department of Transportation and Communications (DOTC) and the maintenance and operation of the system is to be performed by the Telecommunications Office (TELOF).

The costs to the Philippines side are estimated to be 3.05 million pesos for the installation works and 7.38 million pesos/year for operation of the System including lease charge for 1/8 of the transponder.

The necessary periods for the detailed design and facilities installation are planned to be four (4) months and twelve (12) months, respectively.

The implementation of the Project is considered to create the following effects by reducing the delay of communications which comes from insufficient telecommunications networks.

Present situation	Measures taken in the Project	Effects of the Project
Difficult to communicate with disaster affected area due to the insufficient telecommunications network.	Telecommunication circuits to the related organizations in Metro Manila, etc. are established by installation of transportable VSAT stations at disaster affected areas.	By obtaining accurate information quickly from disaster affected areas, fast and efficient operations such as relief and rehabilitation activities can be expected.
The possibility exists of losing contact with the outside world due to the interruption of communications by a disaster.	It is planned to install VSAT stations using the satellite in 27 cities which have suffered from natural disasters of frequent occurrence.	By always securing the stable telecommunication circuits, the fear of isolation of the area disappears. It is possible to suppress the damage and hardship caused by the lack or delay of communications.
Difficult to secure emergency communications of governmental organizations during a disaster period due to the congestion of public telecommunication circuits	The system is used exclusively by the governmental organizations.	By always securing telecommunication circuits for governmental organizations, necessary communication can be expedited.

From the above mentioned effects, the realization of the Project is considered to decrease damages to both human life and property, and to prevent the slowdown of social and economic activities caused by natural disasters. Furthermore, a large number of Philippine people can gain benefit from the Project, while the project itself can not be profitable because the system is used only for internal communications within the governmental organizations.

Considering the above mentioned points of view, it is recommendable to realize the Project under Japan's Grant Aid Scheme.

The smooth and effective execution of the Project requires accomplishment of following recommendations:

(1) To improve the technical skill of a staff member who engages in the operation and maintenance of the system through training in Japan

(2) To prepare operation manuals which describe action plans to be followed when a disaster occurs, and to establish an effective operation systems to carry out the emergency operation quickly.

(3) To plan and execute training exercises to enhance the abilities of related personnel for quick action when disaster occurs

(4) To keep stable utilization of the satellite transponder to secure necessary satellite communications channels.

(5) To secure the necessary budget for the implementation, and the operation and maintenance of the Project.

(6) To secure the availability of tie lines for the related government organizations before the end of the construction work of the Project

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CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

The Republic of the Philippines is an archipelago which is crisscrossed by large fractures, and thus, is prone to earthquakes. Moreover, it belongs to the north-south arc along the western Pacific Ocean, where volcanic activity is known to be prevalent. There are 106 volcanoes in the Philippines, of which 16 are still active. Even the rest of the volcanoes, although they are classified as inactive, are said to have possibility of eruption. The archipelago is composed of three main island groups, which are Luzon, Visayas and Mindanao. The Luzon and Visayas groups, and eastern and northern parts of Mindanao group are located in the passage of typhoons. In addition, the world maximum 24-hour rainfall rate was recorded in the Philippines in 1911.

The above mentioned imply vulnerability of the country to natural disasters. To minimize damage caused by natural disasters, the Government of the Philippines established National Disaster Coordinating Council and Local Disaster Coordinating Councils. At the same time, the Government launched extensive disaster preparedness programs including national land preservation work such as the forestry conservation, flood control and landslide prevention, the construction of disaster-proof facilities, the establishment of forecasting and warning systems, the preparation of relief and rehabilitation materials, the establishment of emergency communications systems, and so on.

The councils functioned effectively upon occurrence of disasters after their establishment, and their analyses upon the results of disaster operations clarified the necessity and importance of an emergency telecommunications system enabling communication between the governmental organizations and disaster affected areas with effective rapidity and stability. As a result, the effectiveness of an emergency telecommunications system, especially in executing such disaster operations as data collection, warning, evacuation, rescue and restoration, etc., has been recognized by the related authorities in the Government of the Republic of the Philippines.

To meet the above need as a member of the National Disaster Coordinating Council and the responsible organization for telecommunications, the Department of Transportation and Communications (hereinafter referred to as "DOTC") formulated a project (hereinafter referred to as "the Project") for establishment of an emergency telecommunications system (hereinafter referred to as "the System"), which ensures a stable liaison between relevant governmental organization and disaster affected areas by means of satellite communications, and, through the Government of the Philippines, requested the Government of Japan the realization of the Project under Japan's Grant Aid Scheme.

In response to the request, the Government of Japan decided to conduct a preliminary study and the Japan International Cooperation Agency (hereinafter referred to as "JICA") sent a preliminary study team headed by Mr. Masayoshi Kono, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, to the Philippines from March 31 to April 16, 1992. The team studied the background and contents of the request including confirmation of the Project sites, operational structure of the requested system, etc. And, as the results of the study, the team confirmed viability of the realization of the Project to Japan's Grant Aid Scheme and technical feasibility of the Project.

On the basis of the results of the preliminary study and decision of the Government of Japan, JICA dispatched a basic design study team, headed by Mr. Takao Yamazaki, Institute for International Cooperation, JICA, to the Philippines from August 24 to October 13, 1992 for the study in field. The team studied contents and scale of the Project and obtained necessary data and information for the basic design of the Project during their stay in the Philippines.

After returning from the Philippines, the team continued the study to re-confirm viability of the realization of the Project to Japan's Grant Aid Scheme and technical feasibility of the Project, and to consolidated the scale and contents of the Project, related operation and maintenance plan, project implementation plan, etc.

This report describes the results of the basic design study for the Project performed by the team on the basis of the discussions and agreements with related officials of the Government of the Philippines, analyses in Japan of data and information collected in the Philippines.

JICA Study Team Member, Study Schedule of Work in the Philippines, List of Interviewees and Minutes of Discussions are attached as Annexes 1 to 4 to this report.

CHAPTER 2

BACKGROUND OF THE PROJECT

CHAPTER 2 BACKGROUND OF THE PROJECT

2.1 Background of the Project

The Republic of the Philippines is located in the south-east Asia and consists of about 7,100 islands, which are scattered along the northern edge of the East Indies. The total area of the Philippines is approximately 300,000 Km^2, and the population is about 60.86 million as of 1990.

Natural disasters such as earthquakes, typhoons, volcanic eruptions and floods have damaged the Philippine economy and social system.
Recently, the damage has been caused by a strong earthquake in central Luzon on July 16, 1990, Mt. Pinatubo eruption in 1991, and several typhoons. In particular, the Mt. Pinatubo eruption resulted in more than one thousand dead or injured, and affected more than 1.2 million persons.

Table 2.1 shows the occurrence of the natural disasters from 1980 to 1991.
Deaths from natural disasters have totaled more than 1,000 persons, and the cost of damage is over 5 billion pesos per year, which is 0.5 % of the gross national product (GNP).

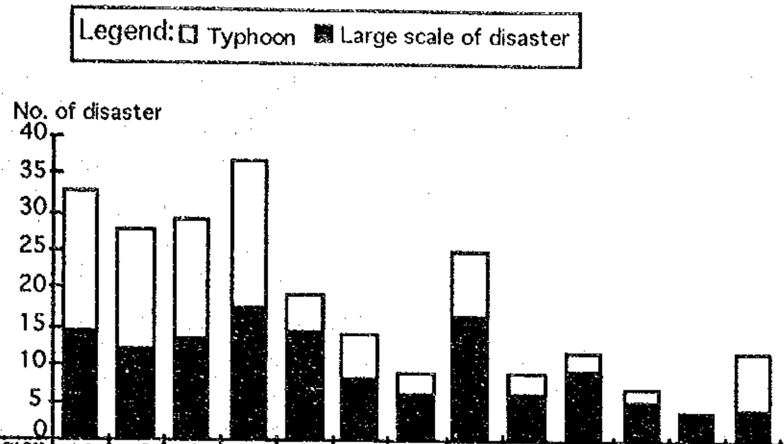
Figure 2.1 shows the situation of natural disasters in each Region. The column of large scale of disaster shows the number of damages which caused by large scale of typhoons, floods and earthquakes occurred from 1976 to 1990. In the column of Typhoon, it is indicated that the number of typhoons hit from 1983 to 1991 (except the number indicated in column of large scale of disaster).
It may be seen that the disasters occur frequently in Regions 1 to 5 and Region 8.

Table 2.1 Occurrence of Natural Disasters

Unit: Amount of damage (Million Peso)
Number of victims (1,000 persons)

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Total
Typhoon	Number of occurences	5	5	6	4	6	4	3	5	5	7	7	6	63
	Number of deaths	143	484	337	126	1,979	211	171	1,020	429	382	670	5,199	11,151
	Amount of damage	1,465	1,274	1,659	522	5,869	2,725	1,776	4,083	8,676	4,494	12,678	4,584	49,805
	Number of victims	1,666	1,472	1,569	747	4,049	1,643	1,414	3,882	6,082	2,583	6,661	759	32,527
Earthquake	Number of occurences	18	8	5	15	10	2	3	12	6	4	16	6	105
	Number of deaths	51			19		14		7		1	1,302		1,394
	Amount of damage	3			15					15		12,452	9	12,494
	Number of victims	50			3		1		6	69	1	1,328		1,458
Flood	Number of occurences	1	2	2	1	3	6	5	2	4	6	5	4	41
	Number of deaths	336	25	27	41		73	3	2	15	94	39	7	662
	Amount of damage	346	4	116	13	3	5	11			337	62	30	927
	Number of victims	736	6	533	33	33	81	23	1	3	459	19	4	1,931
Landslide	Number of occurences	3	6	5	3	4	5	3		8	10	8	4	59
	Number of deaths		1		14	18	64			60	44	16	35	252
	Amount of damage		0	0		1		0		0				1
	Number of victims		0	1	0	0		0		0	14	0	2	17
Tornado	Number of occurences	7	1		4		2	2	3	2	5	12	3	41
	Number of deaths	8	0		2		1	1			7	6	7	32
	Amount of damage	1	4		1		1	1		0	0	12	10	30
	Number of victims	2	0		1		2	3	1	0		1	1	11
Total	Number of occurences	34	22	18	27	23	19	16	22	25	32	48	23	309
	Number of deaths	538	510	364	202	1,997	363	175	1,029	504	528	2,033	5,248	13,491
	Amount of damage	1,815	1,282	1,775	551	5,873	2,731	1,788	4,083	8,691	4,831	25,204	4,633	63,257
	Number of victims	2,454	1,478	2,103	784	4,082	1,727	1,440	3,890	6,154	3,057	8,009	766	35,944

Source: Office of Civil Defense



Items \ Region	1	2	3	4	5	6	7	8	9	10	11	12	NCR	Tota
Large scale of disaster	14	12	13	17	14	8	6	16	6	9	5	4	4	128
Typhoon	19	16	16	20	5	6	3	9	3	3	2		8	110
Total	33	28	29	37	19	14	9	25	9	12	7	4	12	238

NCR: National Capital Region

Figure 2.1 Situation of Natural Disasters in Region

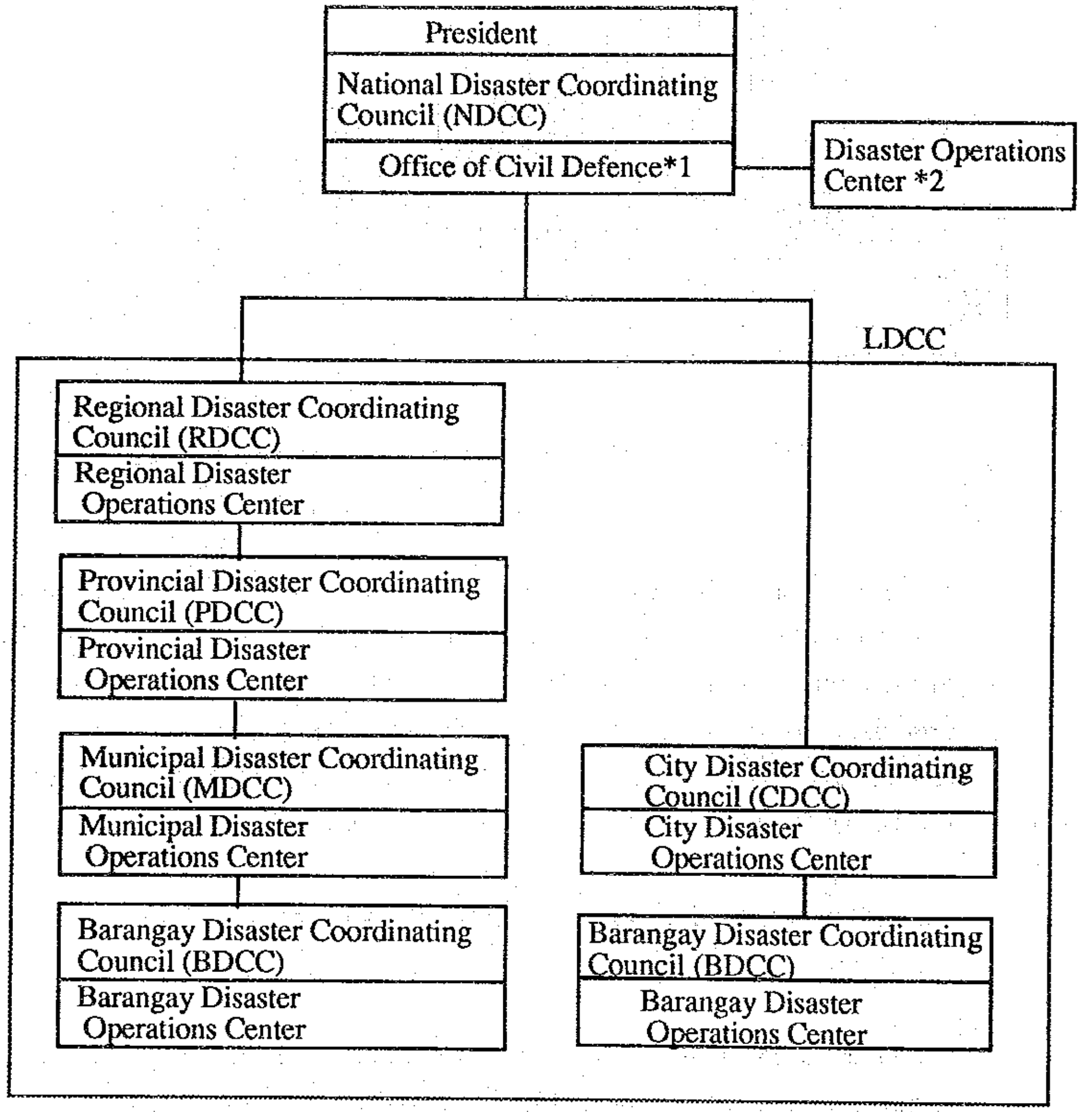
The measures to be taken to prevent damages due to natural disasters by governmental organizations are stipulated in the " Calamities and Disaster Preparedness Plan" issued in August 1988, and as relevant coordinating organizations in the event of natural disasters, Disaster Coordinating Councils (DCC) have been established nationally and regionally, and at the province and city levels. The organization chart is shown in Figure 2.2.

According to the plan, the NDCC has the following role in disaster control operations:

- Advise the President on the status of disaster preparedness programs, disaster operations and rehabilitation efforts undertaken by the government and the private sector
- Establish policy guidelines on emergency preparedness and disaster operations involving rescue, relief and rehabilitation
- Establish priorities in the allocation of funds, services, disaster equipment and relief supplies
- Advise the lower-level Disaster Coordinating Councils through the Office of Civil Defense in accordance with the guidelines on disaster management
- Recommend to the President the declaration of state of calamity in areas

extensively damaged and submit proposals to restore normalcy in the affected areas

- Create an Action Group composed of permanent representatives from the member-departments and other government agencies with the Executive Officer as head



Note: *1 : Excutive office of NDCC

*2 : Operation agency of disaster coordination

Figure 2.2 Organization Chart of DCC

The public telephone network in the Philippines is insufficient, both in terms of quantity and quality. In particular, telephone density in rural areas is very low, and automatic dial connection service have only been introduced in a small number of cities/municipalities. As a result, subscribers are forced to wait for lengthy periods to place long- distance calls. Even if automatic dial connection is introduced, the insufficient lines currently available will still lead to unacceptable congestion in the event of a disaster.

At present, organizations involved in relief operations activities use HF/VHF/UHF radio systems for maintaining the necessary minimum emergency communications. However, these systems are unstable due to interference, fading and press - talk operation, and are insufficient for emergency communications.

NDCC studied and recognized the problems, and the action required to improve existing systems on the basis of experiences obtained from typhoon "Ruping" of November, 1990 and an earthquake which hit Luzon island in July 16, 1990. The major items to be improved are as follows:

(1) Regarding Typhoon "Ruping"

- Technical assistance from the national government to facilitate early restoration of power and communications was delayed.
- Generation of relief goods from benevolent sources was very slow.
- Housing funds were not promptly allocated.
- The lack of sea transport facilities adversely affected delivery of relief services in heavily affected island balangays.
- The shortage of construction materials, due to increased demands, greatly hampered reconstruction and repair of totally and partially damaged infrastructures.
- The low supply of basic commodities because of limited transportation from Cebu and Manila triggered price increases.
- The submission of reports by the local DCCs was delayed, particularly in the Central Visayas (Region VII), due to communications and power interruptions as transmission lines, antennas and wiring were swept by strong winds.
- The ineffective communication facilities both government and private resulted in the isolation of worst hit areas in Region VII.

(2) Regarding the earthquake in Luzon island

- The deplorable condition of the seismic monitoring and warning equipment was observed.

- Laxity in the implementation of the National Building Code as well as other national laws and ordinances on land zoning had considerable effects.
- Proper education about the nature of earthquakes and other forms of disaster, their ill-effects and counter-measures, must be conducted.
- The need to enhance DCCs response capabilities, especially in terms of rescue, evacuation, relief and medical resources and equipment was evident.
- The absence of a truly reliable and effective communications system delayed the immediate reaction from concerned agencies throughout many of the affected areas.

As a summary, one of the major reasons for the large scale damage is said to be mainly the interruption of the communications lines and insufficient public communications networks. These cause delays in weather and disaster information. As a result, activities for prevention of damages, relief and restoration are disturbed.

2.2 Outline of the Request

To improve the above conditions, the Government of the Philippines has recognized that the establishment of a reliable communications system is a most important and urgent matter for life and property in preventing damages by natural disasters, and has planned the introduction of an emergency telecommunications system using a satellite communications. On the basis of above consideration, the Government of the Philippines has requested to the Government of Japan the realization of the above project under Japan's Grant Aid Scheme.

The facilities and equipment were requested considering the occurrence frequency/scale of past natural disasters, access conditions from the main cities/municipalities and estimated damages to existing telecommunications facilities in natural disasters. In addition, the priority of order of introduction of the VSAT (Very Small Aperture Terminal) station was also requested based on the occurrence frequent of large scale natural disasters and present conditions of telecommunications facilities.

The contents of the request are as follows:

- Network configuration : Communications link between the Hub station and VSAT station by Star network using PALAPA (Indonesian satellite) as shown in Figure 2.3.

- Hub station : One station in Metro Manila
- VSAT stations : Seventy (70) stations, in Metro Manila and fifty-three (53) cities/municipalities as shown in Figure 2.4
- VSAT station antenna : 1.8 m diameter
- Number of circuits : Two (2) voice grade circuits per VSAT station
- Terminal equipment : Telephone set and facsimile machine per VSAT station
- Switching function : All of the circuits will be connected with PABX (Private Automatic Branch Exchange) at the Hub station, and exchanged automatically.
- Locations and their priorities : As shown in Table 2.2

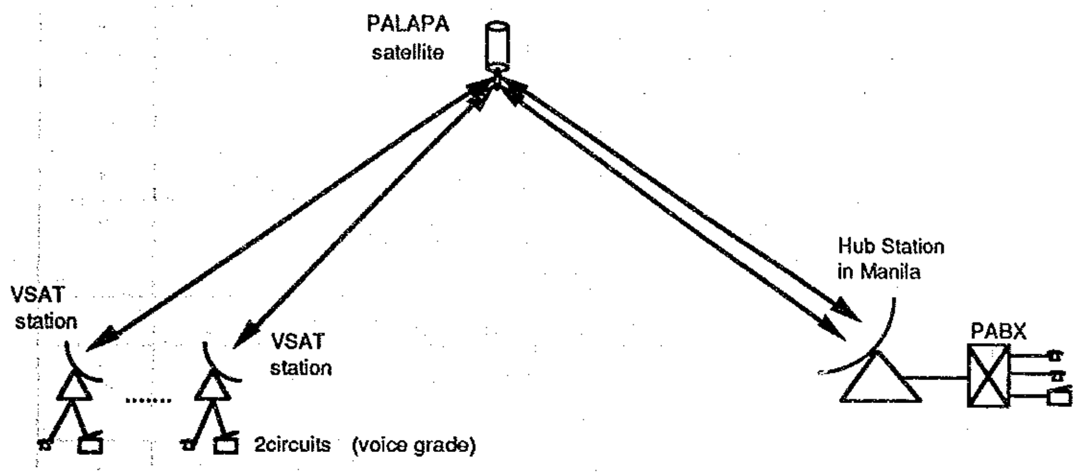


Figure 2.3 Outline of the requested Emergency Telecommunications System

Table 2.2 Volume of the Request

Region	Hub/VSAT	Priority	Sites	No. of Sets
NCR	Hub		Metro Manila	1
NCR	VSAT	A	DOTC, NTC, Malacañang	4
1	VSAT	A	Baguio, Laoag, Vigan, San Fernando, Lingayen	6
2	VSAT	A	Tuguegarao, Aparri, Ilagan, Batanes (Basco), Bayombong	6
3	VSAT	A	Malolos, Iba, Tarlac, Cabanatuan	5
4a	VSAT	A	Batangas, Infanta, Boac, Baler, Lucena, Romblon	7
4b	VSAT	B	P.Princesa, Mamburao, Calapan	4
5	VSAT	A	Legaspi, Virac, Naga, Masbate, Daet, Irosin	7
6	VSAT	B	Iloilo, Kalibo, Bacolod, San Jose	5
7	VSAT	B	Cebu, Dumaguete, Tagbilaran, Siquijor	5
8	VSAT	A	Tacloban, Maasin, Catarman, Ormoc, Borongan, Catbalogan	5
9	VSAT	C	Zamboanga, Jolo, Pagadian	4
10	VSAT	B	Cag.de Oro, Oroquieta, Surigao	4
11	VSAT	C	Davao, Mati	3
12	VSAT	C	Cotabato, Gen. Santos	3
Total			Hub station: 1, VSAT station: 70	

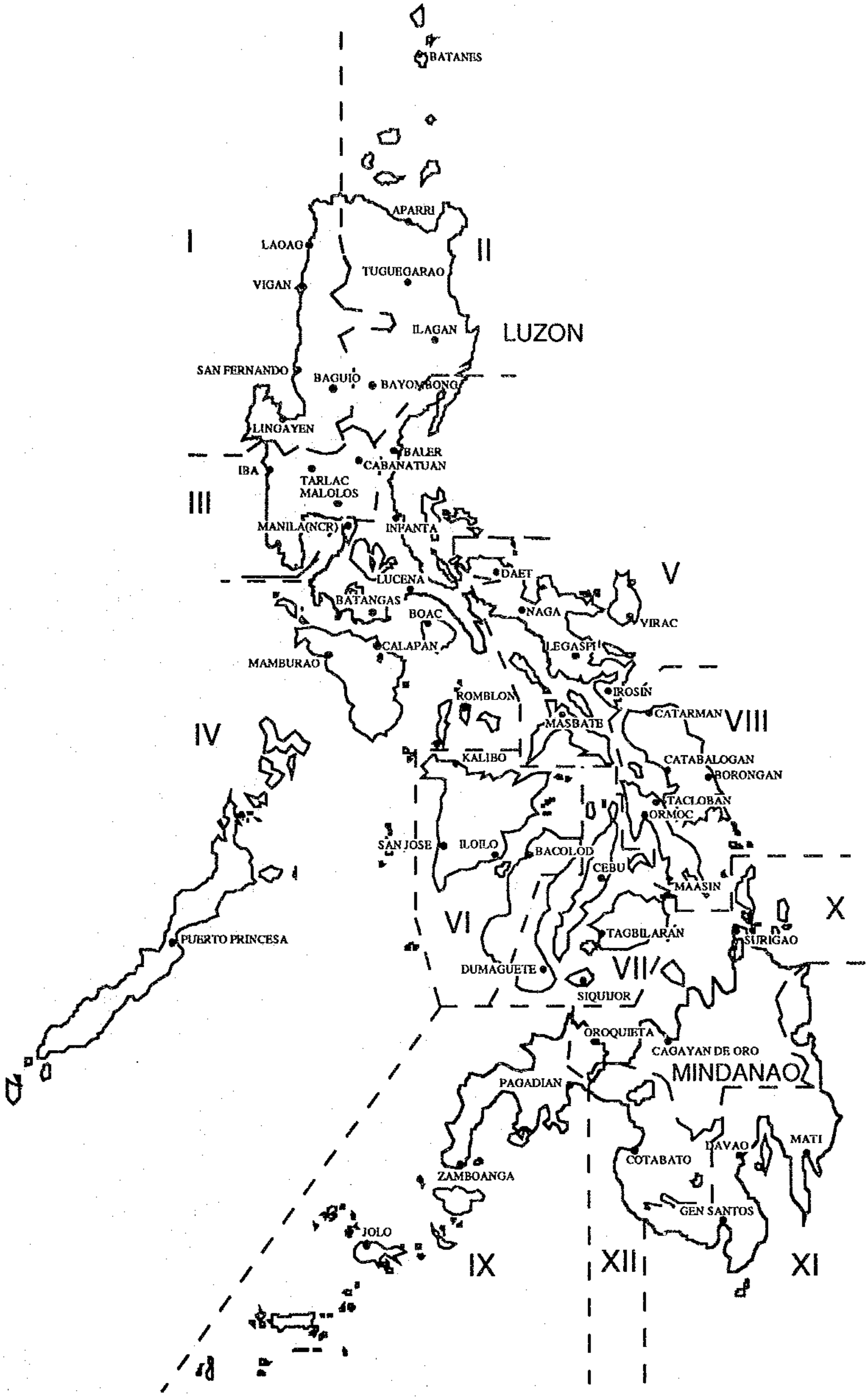


Figure 2.4 Subject Locations for VSAT Stations

CHAPTER 3

OUTLINE OF THE PROJECT

CHAPTER 3 OUTLINE OF THE PROJECT

3.1 Objective

The objective of the Project is to secure the minimum telecommunications among the related government organizations, to achieve disaster control operations quickly and to reduce the damage, by establishment of the satellite communications network with the Hub station in Metro Manila and transportable VSAT stations in cities/municipalities where disasters occur frequently.

In existing telecommunications networks, 70 % of its facilities are concentrated in Metro Manila, and the conditions in rural areas are insufficient. Even if telecommunication facilities exist, there are cases where the telecommunication circuit itself is interrupted by the damage in the disaster or the telephone call can not be connected quickly because of increased traffic of public communications during disaster period. Therefore, it is very hard to communicate with disaster affected areas.

3.2 Study and Examination on the Request

3.2.1 Justification of the Project

In the Philippines in 1991, over 5,000 people died due to natural disasters. Damages totaled more than 4.6 billion pesos, or 0.5 % of the Gross Domestic Product (GDP).

The telecommunications situation is insufficient and the telephone penetration ratio is low compared with other ASEAN countries; the telephone density in the Philippines is still 0.99 per 100 people. In particular, in the country side, there are regions where the density is less than 0.2. There are many cities/municipalities where telephone subscribers have to wait for a long time to use toll circuits due to manual operation and lack of circuits.

There are many kind of disasters in the Philippines such as typhoons, earthquakes, and volcanic eruptions. Once a disaster occurs, an area affected by it tends to be wide, and its damages usually count very high. It is not desirable for emergency communications to rely only on the terrestrial transmission systems, because they are apt to be severely damaged and take a long time to be restored when disasters strike.

HF and VHF radio systems are now used during disasters. However, their capacities and qualities of services are not suitable for stable and reliable emergency communications. To ensure emergency communications, the introduction of a satellite communications system is considered the most desirable one.

There have been some satellite systems introduced in the Philippines by private operators. However, these systems are permanently installed in major cities and operated as dedicated circuits between banks and specific companies. Therefore, it is not possible to transport and use these systems at a disaster affected area as an emergency communications system between government agencies.

In order to perform quick and efficient disaster control operations, it is essential to introduce a system which can directly exchange information between government agencies and the disaster site for the emergency telecommunications.

The requested system utilizes a satellite system which is not affected by disaster. In case of emergency, VSAT facilities which are installed in certain rural areas are transferred to a disaster site and establish communication circuits as a dedicated emergency network for government agencies. It is anticipated therefore that the system is very useful for the provision of timely and efficient disaster control operations.

3.2.2 Relevant Telecommunications Plan

Several government agencies currently have similar telecommunications plans. However, these plans will be used as dedicated networks of each government agency using HF and/or VHF radio systems. Therefore, the objectives of these systems are different from that of the Project, because this system utilizes a satellite to secure communications between related government agencies.

Although, the plan of the Office of Civil Defense (OCD) seems similar to the Project, it does not compete with the Project because it is a closed network only for OCD, and the schedule and scale of this plan has not yet been decided in detail.

3.2.3 Study of Requested Facilities

(1) Information Flow

The main objective of the System is to transmit accurate information at first from a disaster site to the government agencies. The LDCCs and related organizations in Manila, Regions and Provinces must collect information on a disaster and take appropriate countermeasures as soon as possible.

An emergency communication system, therefore, shall be established between a disaster site and these organizations. The information flow in the event of natural disaster is shown in Figure 3.1 and the following communications shall be secured:

(i) Communications between a disaster site and the relevant organizations in Metro Manila, such as the National Disaster Coordinating Council (NDCC) to appropriately direct and carry out relief operations quickly

(ii) Communications between a disaster site and relevant organizations such as LDCC in provinces

(iii) Communications between Manila and Provinces or Regions to exchange necessary information, such as weather forecast, evacuation advice, and coordination or instruction of the operations

(iv) Communications between Manila and Provinces or Regions not only during disasters, but under normal conditions, of general matters regarding disaster control operations

(v) Communications between Manila and other Regions, not affected by a disaster, to exchange information for relief operations, because help from other non-affected areas may be required during times of major disaster.

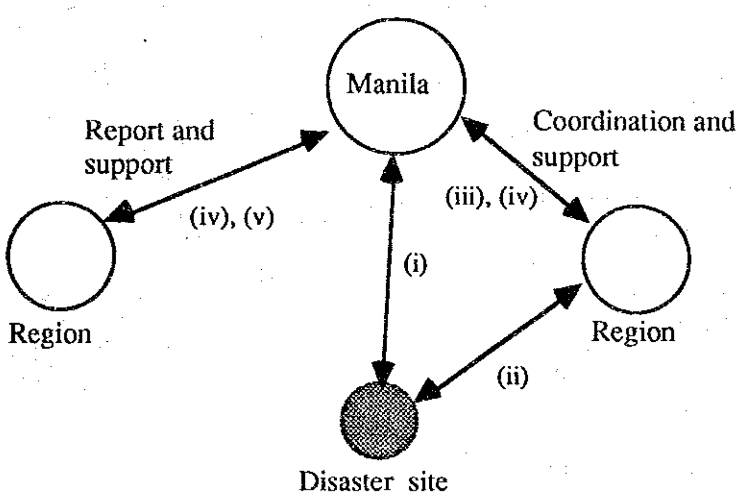


Figure 3.1 Information flow in the disaster situation

(2) Selection of Hub Station

Taking into consideration the above information flow, and maintenance/ management of the System, it is preferable that the Hub station, as a center of the network and control station, be established in Metro Manila.

The result of the site survey for the Hub station is shown in Table 3.1. Telecommunications Office (TELOF) in Quezon city was selected as the Hub station based on consideration of required installation space for antenna and facilities/equipment, efficient utilization of existing facilities and conditions of maintenance.

Table 3.1 Comparison of Proposed Hub Station Sites

Item	Site Proposed				
	TELOF	DOTC	Maritime O&M C.	NTC	Malacañang
Building	On going (*1)	Exist. (*2)	On going (*3)	Exist.	Exist.
Antenna Mounting	Roof	Ground	Ground	Ground	Ground
Space Availability:					
Antenna	O	X	Δ	X	Δ
Radio Equip.	O	Δ	Δ	X	Δ
Power Supply Equip.	O	X	Δ	X	Δ
Utilize existing facilities	O	X	O	X	X
Antenna Elevation angle and Azimuth	O	O	O	O	O
Interference with terrestrial routes	None	None	None	None	None
Ease of operation and maintenance	O	Δ	Δ	Δ	Δ
Overall Suitability	O	X	Δ	X	Δ

O : Good Δ: Possible X : Not acceptable

(Note) *1: To be completed within 1993

*2: Privately owned

*3: To be completed within 1993

O&M C. : Operation and Maintenance Center

(3) Selection of VSAT Stations

The impact of the Project will be indicated how to use the System effectively and efficiently when a disaster occurs. DOTC/TELOF is going to establish an operational structure of the System. The System has expandability, enabling the easy addition of VSAT facilities.

At the first stage, the System will be introduced in areas where disasters frequently occur. It would be preferable to undertake system expansion after the effect and performance of the System are confirmed. The study team has selected VSAT station sites through discussions with DOTC, and analysis based on the site satisfying both of the following disaster occurrence conditions:

(i) A region where the total number of major natural disasters occurring between 1976 and 1990 together with the number of typhoons between 1983 and 1991 has exceeded 17, and

(ii) A province where the number of natural disasters resulting in deaths has exceeded 7 between the years 1981 and 1991.

Notwithstanding the above,

(iii) Locations experiencing peace and order problems are excluded.

(iv) If a Regional Center satisfies condition (i), but does not satisfy condition (ii), the Regional Center is still selected as a VSAT station site should it be considered of sufficient importance in terms of being a central city of Region.

(v) If a Province in a Region satisfies condition (i), but does not satisfy condition (ii), the Province is still selected as a VSAT station site should it be considered suitable upon consideration of geographical and transportation factors.

(vi) Cebu, Iloilo and Davao cities are included as VSAT station sites despite non-compliance with the above, for the following reasons:

Cebu: The center of the southern part of the Philippines, Cebu has extensive harbor facilities. Equipment and materials for disaster operations in the southern Philippines are carried to disaster area via this city. The number of disasters occurring in Cebu is not few.

Iloilo: Iloilo is located in a rice-growing area and a trading port for agricultural products. The role in disaster operations of the city is important. The number of disasters occurring in Iloilo is not few.

Davao: Although the number of disasters occurring in Davao is few, Mindanao Island has experienced a large number of disasters. As the largest city in this island, Davao plays an important role in disaster operations.

Locations of VSAT stations selected are shown in Table 3.2.

Table 3.2 Locations of VSAT Stations Selected

Requested Locations	Regions	Priority	(i)		(ii)		(iii)	(iv)	(v)	(vi)	Judgement
DOTC	NCR	Sellected as relevant organizations for relief operations in Metro Manila and as the training site									
NTC	NCR										
Malacanang	NCR										
TTI	NCR										
Baguio	1	A	33	O	10	O					O
Laoag	1	A	33	O	11	O					O
Lingayen	1	A	33	O	14	O					O
San Fernando	1	A	33	O	11	O					O
Vigan	1	A	33	O	12	O					O
Tuguegarao	2	A	22	O	12	O					O
Aparri	2	A	28	O	10	O					O
Ilagan	2	A	28	O	7	O					O
Basco	2	A	28	O							
Bayombong	2	A	28	O	6				O		O
Malolos	3	A	29	O	11	O					O
Iba	3	A	29	O	8	O					O
Tarlac	3	A	29	O	4				O		O
Cabanatuan	3	A	29	O	10	O					O
Batangas	4-a	A	29	O	8	O					O
Infanta	4-a	A	29	O	8	O	x				
Boac	4-a	A	29	O	8	O					O
Baler	4-a	A	29	O	4						
Lucena	4-a	A	29	O	10	O					O
Romblon	4-a	A	29	O	5				O		O
P.Princesa	4-b	B	9		4						
Mamburao	4-b	B	9		5						
Calapan	4-b	B	9		6						
Legaspi	5	A	19	O	8	O					O
Virac	5	A	19	O	4				O		O
Naga	5	A	19	O	11	O					O
Masbate	5	A	19	O	3						
Daet	5	A	19	O	4						
Ilosin	5	A	19	O	9	O	x				
Iloilo	6	B	14		6					O	O
Kalibo	6	B	14		4						
Bacolod	6	B	14		3						
San Jose	6	B	14		3						
Cebu	7	B	9		7	O				O	O
Dumaguete	7	B	9		3						
Tagbilaran	7	B	9		5						
Siquijor	7	B	9		1						
Tacloban	8	A	25	O	6			O			O
Maasin	8	A	25	O	4						
Catarman	8	A	25	O	7	O					O
Ormoc	8	A	25	O	5				O		O
Borongan	8	A	25	O	7	O	x				
Catbalogan	8	A	25	O	4				O		O
Zamboanga	9	C	9		3						
Jolo	9	C	9								
Pagadian	9	C	9		2						
Cag. De Oro	10	B	12		5						
Oroquite	10	B	12		1						
Surigao	10	B	12		5						
Davao	11	C	7		2					O	O
Mati	11	C	7								
Cotabato	12	C	4								
Gen.Santos	12	C	4		1						

Note: ( ) shows order of selection

(4) Installation Site of VSAT Station facilities

Basically, the facilities are installed at TELOF offices (telephone exchanges, telegraph offices, repeater stations), considering such factors as ease of maintenance, operation and security.

For VSAT station facilities in Metro Manila, DOTC, NTC and Malacañang is the VSAT sites for securing at least minimum communications when a disaster occurs in Metro Manila and terrestrial communications facilities for government agencies are damaged.

After completion of the System, the Telecommunications Training Institute (TTI) plans training of TELOF personnel not only in operation and maintenance of the System but also in satellite communication technology. Hence, one set of VSAT facilities is installed at TTI as requested.

(5) Circuit configuration in Metro Manila

If direct communications between each relevant government office and the disaster site can be secured, relief operations will be done speedily and efficiently. Therefore, a circuit is connected from the Hub station to the seven (7) relevant agencies such as NDCC, DPWH etc., using dedicated circuits, ensuring the effective operation of the System.

(6) Terminal Equipment

Telephone sets and facsimile machines are connected with the System. The circuits which connect facsimile machines are able to be used as telephone circuits.

(7) Number of Circuits for VSAT Stations

In general the number of circuits per VSAT station are two (2) voice-grade circuits to carry out the emergency communications effectively, one for telephone set and another for facsimile machine. However, the traffic at Regional Centers is expected to increase during disaster periods. Therefore, the VSAT station at Regional Center accommodates three (3) telephone circuits.

(8) Satellite to be used

A PALAPA satellite owned by an Indonesian company is planned to be used for the System, taking into account the requirements by the Government of the Philippines, actual state of the satellite utilization by private companies in the Philippines, and operation performance of the satellite.

3.3 Project Description

3.3.1 Executing Agency and Operational Structure

(1) Executing Agency

For executing and operating the Project, DOTC is in charge of planning and management of the System, including transponder lease; TELOF carries out operation and maintenance (O & M) work for the System. The outline of the executing agencies for the System are as follows:

(a) DOTC

DOTC is a supervising authority for transportation and communications. It consists of four internal departments and four operation offices.

In addition, DOTC has TELOF as a telecommunications operator, and National Telecommunications Commission (NTC) for the control of all telecommunications services including frequency management. The organization chart is indicated in Figure 3.2.

DOTC staff numbers 536 personnel. As a supervising agency of transportation and communications, an appropriate number of telecommunications engineers are dispatched to planning / project departments and relevant offices.

For the implementation of the Project, a special project management office is planned to be established under the Communications Project Management Office.

(b) TELOF

TELOF, a telecommunications operator under DOTC, is the biggest government telecommunications operator. It provides telephone and telegraph services mostly in provincial areas.

The organization chart and number of personnel in TELOF are indicated in Figure 3.3 and Table 3.3, respectively.

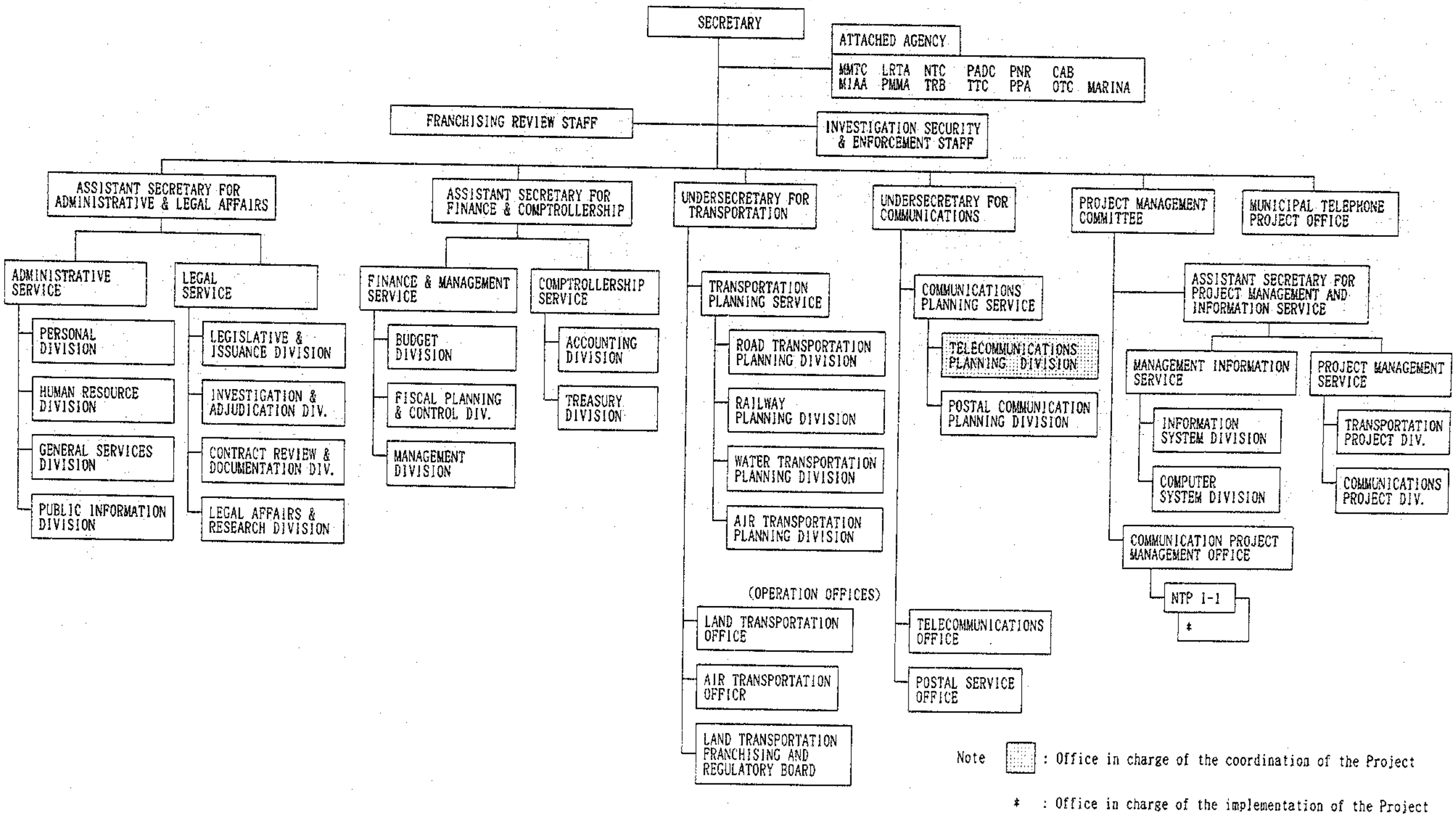


Figure 3.2 DOTC Organization Chart

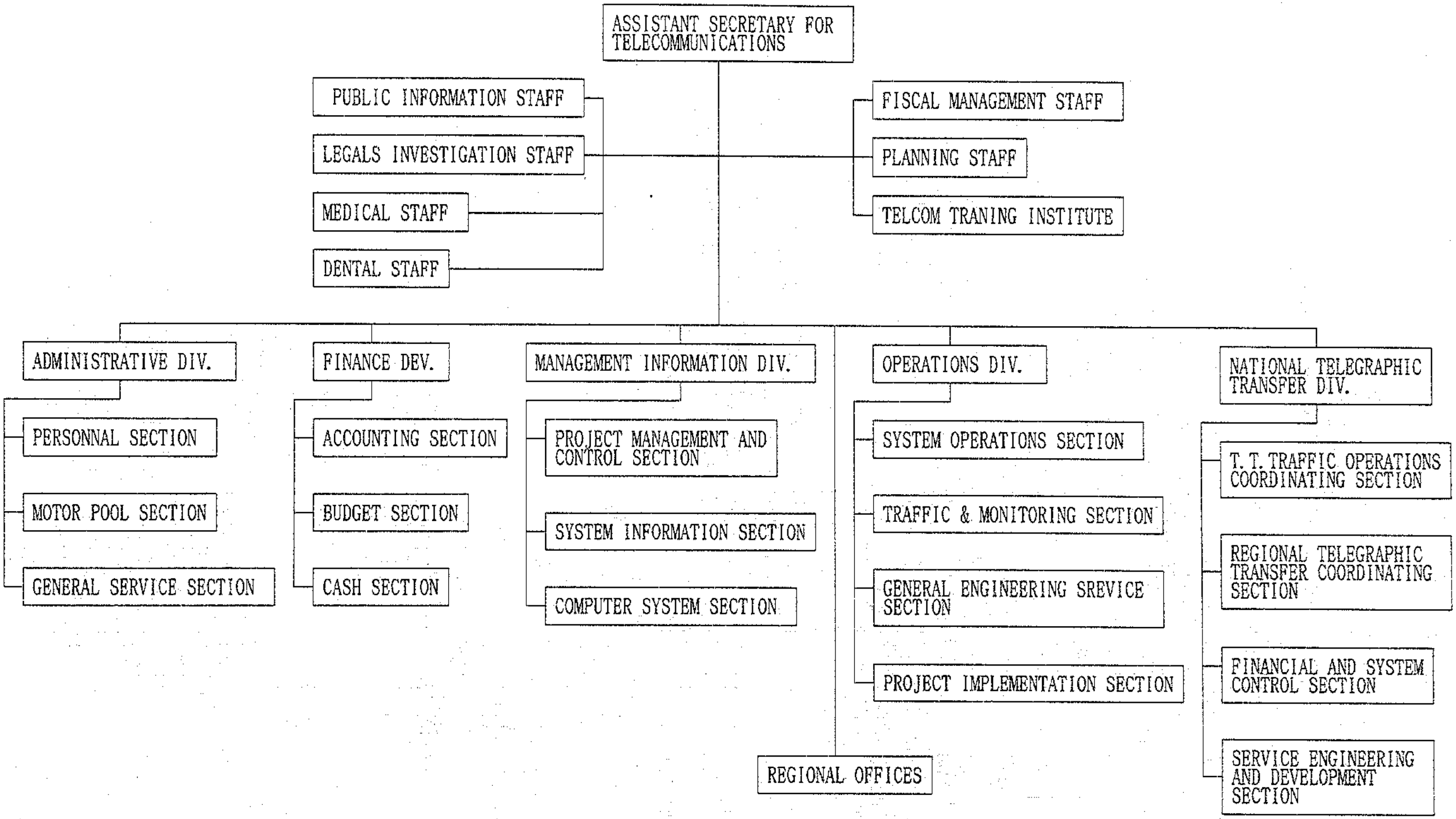


Figure 3.3 TELOF Organization Chart

Table 3.3 Number of TELOF Personnel

Region	Engineer	Technician	Management Div.	Total
Headquarters	93	479	839	1,411
NCR	16	521	256	793
1	32	336	64	432
2	18	263	86	367
3	16	285	100	401
4	16	560	147	723
5	16	347	93	456
6	16	344	90	450
7	16	360	101	477
8	16	364	91	471
9	17	182	90	289
10	16	254	125	395
11	16	189	81	286
12	16	150	85	251
Total	320	4,634	2,248	7,202

(2) Operational Structure

(a) Users of the System

The System is planned to be used not only by the above organizations, but related government organizations concerned with disasters.

As a result of discussions with the Philippine Government, the below mentioned organizations use the System and their functions are as follows:

- DOTC
  An authority for transportation and communications, and a responsible agency for the System
- TELOF
  An agency that maintains and manages the System
- NTC
  An organization that manages overall telecommunications
- Malacañang (Presidential Communication Unit)
  An agency that maintains the communications for Presidential offices
- National Disaster Coordinating Council (NDCC) and LDCC
  Agencies that coordinate disaster control operation and center of relief operations and restoration
- Department of Health (DOH)
  An agency that manages and controls preservation of health, and hospitals and has an important role during disasters
- Department of Public Works and Highways (DPWH)
  An agency that maintains public facilities such as roads, bridges.

- Department of Social Welfare and Development (DSWD)
  An agency that has responsibility for distribution of relief materials and performing rescue operations
- Philippine National Red Cross (PNRC)
  An agency that distributes materials/medicines and performs rescues during disasters
- Department of Interior and Local Government (DILG)
  An agency supervising local governments and controlling local committees concerned with disaster control

(b) Operation method

As mentioned above, many organizations use the System, therefore, a committee organized by the above members is necessary to ensure smooth operation in case of emergency. The DOTC is to coordinate the operations such as transportation of the VSAT equipment, use of circuits etc., between the organizations.

- Transportation method to disaster site and setting of the System
  Personnel of TELOF Regional Center and VSAT station transport VSAT facilities to a disaster site by tracks and/or helicopter prepared by the Philippines, and set up the System at the disaster site. Therefore, an operational practice for the transportation and setting of the System are required.

- Operation method at VSAT station in non-emergency
  In non-emergency situations, Regional Center and/or VSAT station are to be the communication base station for government agencies.

3.3.2 Contents of the Project

As a result of the clause 3.2.4, contents of the Project are as follows:

(1) Hub Station

The Hub station is installed at the TELOF office in Metro Manila.

(2) Organizations to be connected with the Hub Station

The following organizations are connected with the Hub station using tie lines constructed by the Philippine side.

- TELOF (Hub station)
- National Disaster Coordinating Council

- Department of Health
- Department of Public Works and Highways
- Department of Social Welfare and Development
- Philippine National Red Cross
- Department of Interior and Local Government

(3) VSAT Station

The locations of VSAT stations and the number of circuits are shown in Table 3.4. The tie lines between the relay station and Regional Office and the installation of terminal equipment at Tacloban are the responsibility of the Philippines.

ANNEX 5 and 6 show survey results for the VSAT station sites.

Table 3.4 Locations of VSAT Station

Region	Location		Site of VSAT installation				No. of CH	Regional Center
			TELOF			Gov. Office		
	Name of Province	Regional Office	Teleph. Office	Teleg. Office	Other			
NCR	DOTC					o(*2)	2	
	NTC					o	2	
	Malacañang					o	2	
	TTI				o(*3)		2	
1	Baguio	o			o(*1)		2	
	Laoag		o				2	
	Lingayen		o				2	
	S. Fernando		o				3	o
	Vigan			o			2	
2	Tuguegarao	o			o(*1)		3	o
	Aparri			o			2	
	Ilagan			o			2	
	Bayombong			o			2	
3	Malolos	o			o(*1)		3	o
	Iba		o				2	
	Tarlac			o			2	
	Cabanatuan		o				2	
4	Batangas	o			o(*1)		3	o
	Boac		o				2	
	Lucena			o			2	
	Romblon			o			2	
5	Legaspi	o			o(*1)		3	o
	Virac		o				2	
	Naga			o			2	
6	Ilollo	o			o(*1)		2	
7	Cebu	o			o(*1)		2	
8	Tacloban	o			o(*4)		3	o
	Catarman		o				2	
	Ormoc			o			2	
	Catbalogan		o				2	
11	Davao	o			o(*1)		2	

Note: (*1) TELOF Regional Office
(*2) Private Building
(*3) Telecommunications Training Institute (TTI)
(*4) TELOF Relay Station

3.3.3 Locations and Conditions of Project Sites

(1) Hub Station

The location for the Hub station is on Roces Avenue, Quezon City in Metro Manila, and is on the same site as the regional office of NCR. Under the NTP I-1 project, a building and telecommunications facilities are now being constructed. The Hub station facilities are to be accommodated in this building.

(2) VSAT Stations

The features of the selected locations for the VSAT stations are indicated in Table 3.5 and Figure 3.4.

Table 3.5 Features of VSAT Station Sites (1/3)

Region	Location	Features	Population x1000	Penetration Ratio
NCR	Malacañang	Malacañang (Presidential Communication Unit) is on the Pasig River, opposite the Malacañang Palace. This organization has responsibility for governmental communications.	7,829	6.68
	DOTC	DOTC is a supervising authority for telecommunications and transportation and is on Ortigas Avenue, Pasig.		
	NTC	NTC is on EDSA corner, Times St. , Quezon City		
	TTI	TTI (Telecommunication Training Institute), which is the training center of TELOF, is located in Valenzuela, Metro Manila.		
1	Baguio	Baguio is located on a highland (elevation : 1600m above sea level) and is a major city in Region 1 and CAR (Cordillera Autonomous Region).	183	3.48
	Laoag	Laoag is located in the north-west of Luzon island and is the capital of the Ilocos Norte Province. Laoag is a commercial center.	84	1.55
	Lingayen	Lingayen is the capital of the Pangasinan Province.	78	0.14
	San Fernando	San Fernando is the capital of the La Union Province and an economic center in this province. This is a typical resort area in northern Luzon. San Fernando is a major city in Region 1.	85	2.97
	Vigan	Vigan is the capital of the Ilocos Sur Province.	39	3.59
2	Tuguegarao	Tuguegarao located between the bends of the Cagayan River is the capital of the Cagayan Valley Province and a commercial center in Region 2.	95	1.21

Table 3.5 Features of VSAT Station Sites (2/3)

Region	Location	Features	Population x1000	Penetration Ratio
2	Aparri	Aparri in the Cagayan Province is the most northern of the project site. Aparri is located at the mouth of the Cagayan river and is a port town for fishing and commerce.	52	0.30
	Ilagan	Ilagan is the capital of the Isabela Province, and a trading center for rice, corn, tobacco and so on in this region. The town is located at the intersection of the Magat, Ilagan, Siffu and Mallig Rivers.	99	0.26
	Bayombong	Bayombong is the capital of the Nueva Vizcaya province.	40	1.29
3	Malolos	Malolos, which was the capital of the Philippines at the beginning of independence, is the capital of the Bulacan Province.	125	1.35
	Iba	Iba, which is the capital of the Zambales Province, is located on the western coast of Luzon island. The western seashore of the province has been affected by the lahar (mud flow) of Mt. Pinatubo.	29	0.52
	Tarlac	Tarlac is the capital of the Tarlac Province. The lahar (mud flow) from Mt. Pinatubo has also affected this province.	209	1.38
	Cabanatuan	Cabanatuan is the capital of the Nueva Ecija Province, and was damaged by the earthquake in July 1990.	173	1.10
4	Batangas	Batangas is the capital of the Batangas Province and also the center of Region 4. Batangas is a port town for ferries and fishing, fronts the Batangas Bay, and is an entrance to Mindoro island. In this city, there are factories for lumber, etc., and its economic conditions are active.	184	1.18
	Boac	Boac is the capital of the Marinduque Province. Boac , near the Laylay port, is a commercial center along the Boac river.	41	0.53
	Lucena	Lucena is the capital of the Quezon Province and an important town for transportation. There are a number of copra processing plants in this town.	151	2.26
	Romblon	Romblon is the capital of the Romblon Province, which consists of three main islands: Romblon, Tablas and Sibuyan island.	30	0

Table 3.5 Features of VSAT Station Sites (3/3)

Region	Location	Features	Population x1000	Penetration Ratio
5	Legaspi	Legaspi is the capital of the Albay Province and a main city of Region 5. This city is a commercial center with a number of department stores and banks. Mt. Mayon, which is a volcanic mountain, is located near the city. This city is often damaged by typhoons.	121	0.68
	Virac	Virac is the capital of the Catanduanes Province.	46	0.77
	Naga	Naga is the capital of the Camarines Sur Province and is surrounded by rice fields along the Bicol River in the Bicol Plain. Naga is the second largest city, smaller than Legaspi, for commercial and transportation in the Bicol region.	115	2.51
6	Iloilo	Iloilo is the capital of the Iloilo Province and also the industrial/economic center in Region 6. Iloilo is the trading center for agriculture products such as rice and sugar cane, from the surrounding areas.	310	3.41
7	Cebu	Cebu city is the capital of the Cebu Province and main city of Region 7. Cebu is the most famous resort in the Philippines and also functions as the center for approximately 90 % of sea transportation.	610	5.35
8	Tacloban	Tacloban is the capital of the Leyte Province and the commercial, industrial, cultural and transportation center in Region 8 (the eastern Visaya). The city is a main port of copra, abaca, fish and wood in the province.	137	2.19
	Catarman	Catarman is the capital of the Northern Samar Province and a commercial town in the northern Samar.	51	0.46
	Ormoc	Ormoc is the main ferry port and commercial town, which is located on the western seashore of the Leyte Province.	129	0.58
	Catbalogan	Catbalogan is the capital of the Western Samar Province, and a fishing port and commercial town.	70	0.52
11	Davao	Davao is the capital of the Davao Del Sur Province and the main city in the Mindanao island, which is the second largest island in the Philippines. Also, Davao is the second largest city in the Philippines.	850	1.37

Source: Population: 1990, Census, Penetration Ratio : NTC data

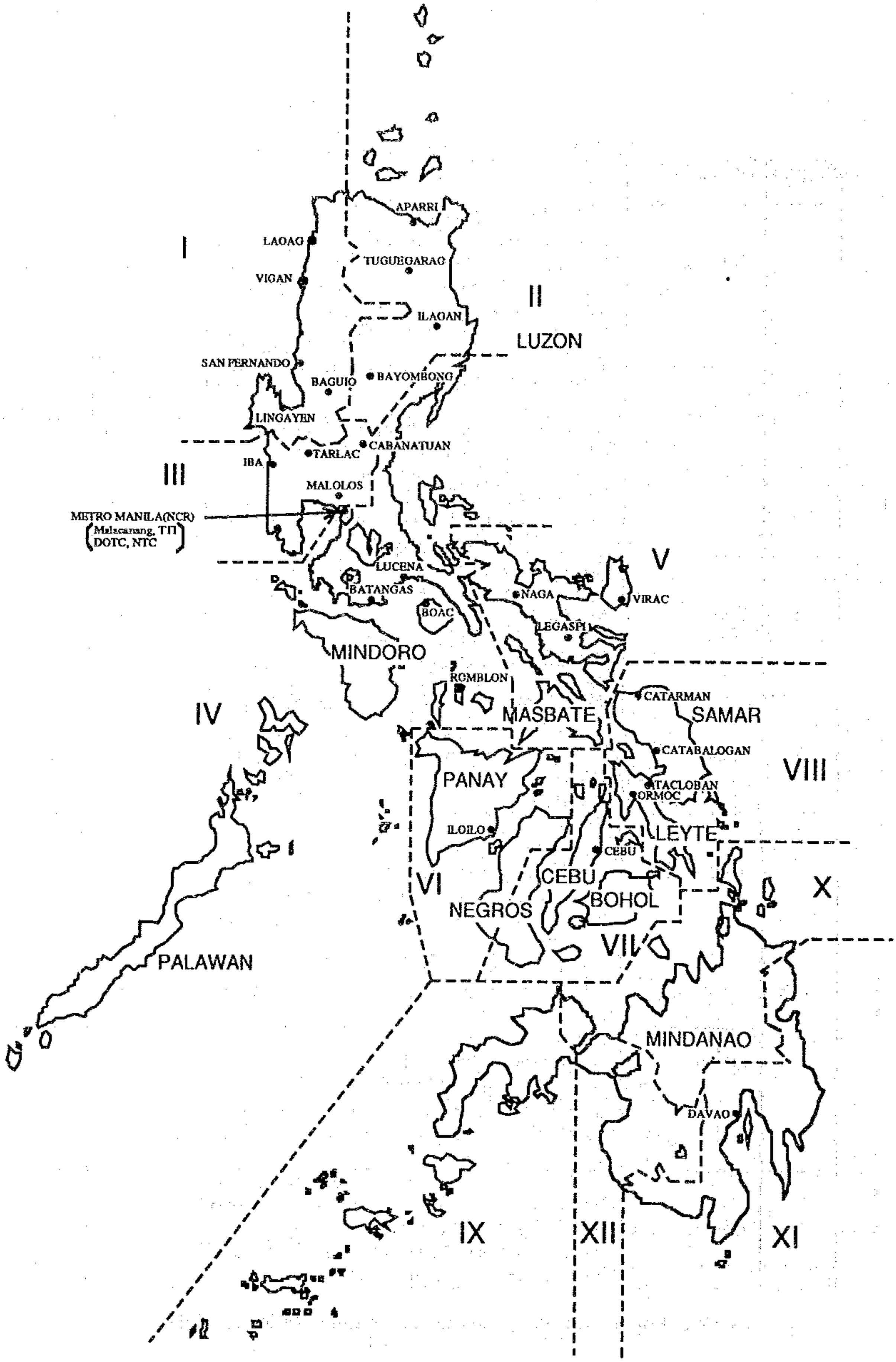


Figure 3.4 Locations of Selected VSAT Stations

3.3.4 Outline of Equipment

The main equipment and the function of the System is shown in Table 3.6 and the configurations are shown in Figure 3.5.

Table 3.6 Main Equipment and Function

	Main Equipment	Function
Hub Station Equipment	The station has the supervision and control functions of VSAT stations as the center of the System.	
	(1) Antenna	Equipment to transmit and receive 4/6GHz radio waves.
	(2) Radio Equipment	Equipment to control the network and supervise all the VSAT stations, and consists of TRx, SV and interface board with PABX.
	(3) PABX	Be installed at the Hub station and able to connect related government agencies with each others.
	(4) Power Supply Equipment	Supplies stable AC power to the equipment in case of power failure and low level of commercial power, and consists of uninterrupted power supply and engine generator.
VSAT Station Equipment	This is the radio terminal equipment of the System and connects with telephone sets and a facsimile machine to communicate between the Hub and/or VSAT stations.	
	(1) Antenna	Equipment to transmit and receive 4/6GHz radio waves.
	(2) Radio Equipment	Equipment to connects terminal equipment and change voice signal to radio waves, and consists of outdoor unit and indoor unit.
	(3) Power Supply Equipment	Supplies stable AC power to the equipment in case of power failure, low level of commercial power and in the disaster area, and consists of uninterrupted power supply and portable engine generator.
Terminal Equipment	(1) Telephone set (2) Facsimile machine	Customer premises equipment

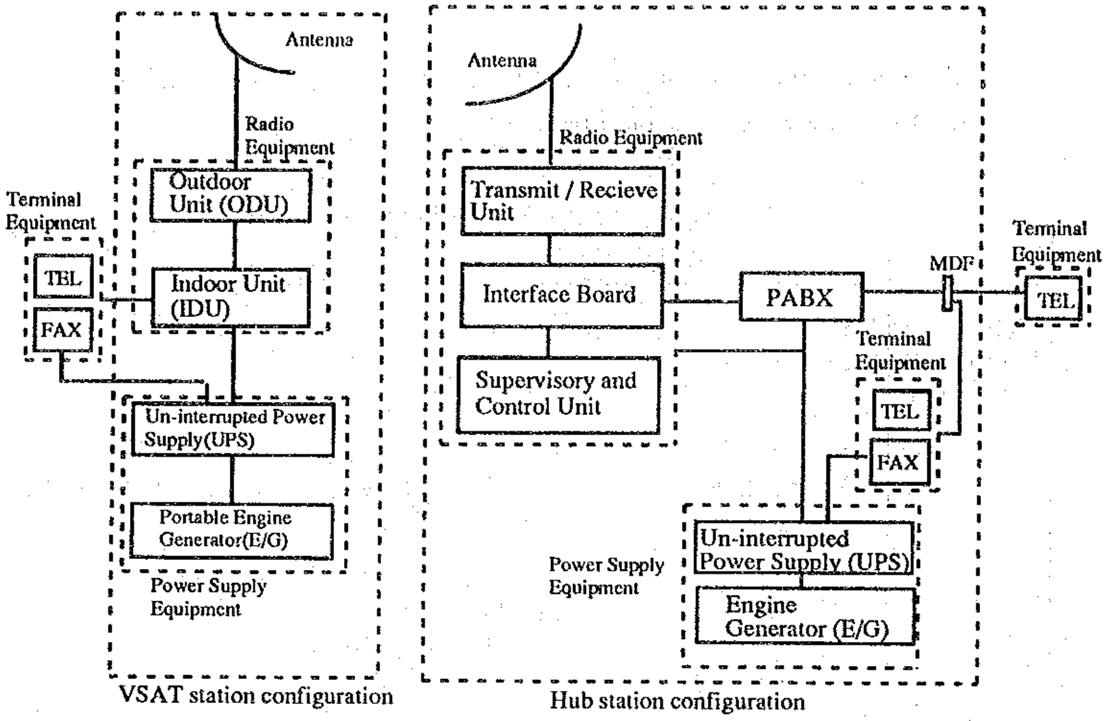


Figure 3.5 Configurations of the Hub and VSAT stations

3.3.5 Operation and Maintenance Plan

(1) Organization for Operation and Maintenance

Organizations for operation and maintenance (O & M) of the System are planned to be DOTC and TELOF. The TELOF Regional Office and Telephone Office have several engineers and technicians. Other than these, TELOF organizations such as the Telegraph Office and the Message Center have few staff for the O & M of the System.

Therefore, at the initial stage of the introduction of the Project, it is necessary to train a staff engineer as a key person for the O & M in the Hub station. The key person is to be nominated among engineers who are now engaged in the management or O&M of a radio system or have completed a training course of the radio system.

The engineer is required to have sufficient technology and skill not only for maintenance, but also for operation in emergencies. Although DOTC is responsible for the System and establishes the organization of O&M and prepares operation manuals for the System, the engineer is also to play an important role in these works.

Apart from the above, personnel for O&M of the System are to be assigned to take part in the construction of the System. After that, they will engage in the operation and maintenance of the System. They are nominated among engineers or technicians who have a basic knowledge of radio systems.

(a) DOTC

DOTC is in charge of general coordination of the System. The major work items for DOTC are mentioned below:

- Plan of utilization of the System

  DOTC controls and plans the utilization of the System through discussions with the relevant organizations. DOTC also prepares the strategy for the emergency operation of the System in cooperation with the Hub station. The strategy includes drill plans for transportation of the equipment.

- Preparation of Transponder

  The System requires some portion of a transponder. Thus, DOTC must take budgetary measures and investigate necessary circumstances regarding lease conditions of the PALAPA transponder.

(b) Hub Station

The Hub Station plays an important role for the O & M. Therefore, full-time personnel are hired for the work and the major work items are shown below:

- Plan of operation

  The personnel are to plan a schedule of operation such as practice of transportation of the System, through discussions with DOTC personnel.

- Management of all facilities

  The personnel manage all of the System, not only the facilities in the Hub station, but also those in VSAT stations.

  All spare parts/units for the System are stored and managed at the Hub station.

  The personnel respond to failures at the Hub/VSAT stations and perform repair work. Also, the periodical examination and test of the facilities are carried out through the supervisory & control unit or a patrol by the personnel.

- Network Management and Control

  In non-emergency situations, the Hub station works as a maintenance center and manages/controls the network.

In the event of an emergency , the Hub station directs the transported VSAT stations to set up the links.

For the smooth operation of the System, the key person prepares operation manuals for emergency/non-emergency use in coordination with personnel in DOTC.

- O & M of the Facilities

  The personnel maintain and operate the facilities in emergency and non-emergency for smooth operations.

(c) Regional Centers

The Regional Center has responsibility not only for the O & M of its VSAT facilities, but also for management and support of the VSAT stations in the same Region. In emergencies, the Regional Center contacts the Hub station and support the transportation and operation of VSAT stations. Personnel are required to be in attendance 24 hours per day at the Regional Center.

(d) VSAT Stations

Manpower at a VSAT station is not required to the same level as at the Hub station, because it is a maintenance-free facility. The personnel at the station are assigned to operation and simple maintenance such as temporary repairs, following directives in manuals or instructions from the Hub station.

In addition, the VSAT facilities are used at various locations, so the personnel who are responsible for relocation, transportation, and set-up of the facilities are designated in advance. Personnel are required to be in attendance 24 hours per day at the VSAT stations.

(2) Personnel Plan

For the establishment of the above mentioned organization, the following personnel are to be assigned:

(a) DOTC

Personnel at DOTC are designated and work for coordination of the whole System and relevant organizations. These personnel carry out such work as well as performing other tasks.

- Coordination of the whole System : 2 persons

(b) Hub Station

Personnel are assigned to carry out the work described in item (1), (b) "Hub Station". A shift system is utilized to ensure 24 hour coverage.

- Network management and the O & M : 6 persons

(c) Regional Centers

The attendance at the Regional Center is a 24 hours shift system. Required personnel are assigned to this shift system as well as to their other tasks.

- Personnel for the management and support : 2 persons
- Personnel for transportation of the equipment and operation: 6 persons

(d) VSAT Stations

The personnel for a VSAT station are assigned not only to operate, but also to perform other tasks. Operation at the VSAT stations is 24 hour shift system.

- Personnel for transportation of the equipment and operation: 6 persons

(3) Expenses

To maintain and manage the System, budgetary measures for the following expenses are taken and the breakdown is shown in ANNEX 8.

(a) Running Costs (Total 6,818 thousand pesos / year)

- Lease charge for transponder and tie lines
- Running cost for the System

  The running costs for electric power, fuel, consumable materials and repair are allocated.
- Expense for transportation

  For emergencies and practices, the expenses for relocation, transportation, and set-up are allocated.

(b) Manpower Costs (Total 446 thousand pesos / year)

Manpower cost for O & M of the System are allocated.

(c) Other (Total 113 thousand pesos / year)

- Costs for training

  For the smooth/effective utilization of the System, costs for training are allocated.

3.4 Technical Cooperation

3.4.1 Necessity of Technical Cooperation

TELOF, which is to maintain and manage the System, currently maintains existing radio systems such as HF, VHF, UHF and microwave systems, and also plans to train its personnel in TTI. Another small scale VSAT system has been introduced under the MTPO (Municipal Telephone Projects Office) project, so personnel in TELOF are expected to have some experience in the operation of a satellite communications system.

However, as the System is to cover and be used all over the country for the purpose of emergency telecommunications, the present technical level in TELOF may not be sufficient for the O & M of the System. Therefore, to improve the efficiency of the Project, it is prudent to provide technical cooperation for O & M.

3.4.2 Required Technology and Skills

The System excluding the Hub station facilities, does not require specific, high-level technological skills, because the VSAT facilities are designed to be maintenance-free. However, it is the first time to introduce the Hub station facilities into TELOF.

For the TELOF personnel who will be engaged in the O & M of the System, it is necessary that training in the required technology and skills be performed at the appropriate times.
The major items for the training are as follows:

- Technology and skills of satellite communications systems
- Technology and skills for the maintenance of the System
  [Hub station personnel]
    Technology and skills for repair of the Hub station facilities
    Technology and skills for repair of the VSAT station facilities
  [VSAT station personnel]
    Technology and skills for temporary repair of the VSAT facilities according to manuals and/or in accordance with directions from the Hub station
- Network management for the System
- Technology and skills for transportation of the equipment and operation in emergencies

3.4.3 Method of Technical Cooperation

For the purposes of improvement of technology and skills of TELOF personnel, the following methods under Japanese technical cooperation can be considered:

-Training in Japan

It is understood that training of the key person for maintenance in non-emergencies and operation in emergencies in Japan. Training in Japan will consist of training in the operation and maintenance skills necessary to implement the System. After the training in Japan, the key person is to train other staff for the System.

Also, the key person is to play an important role in the preparation of the manuals for O & M as well as transportation of the System.

-Advice by JICA experts

As a part of the technical cooperation in the Philippines, JICA experts can advise the staff for the System. At present, a few JICA experts in telecommunications have been assigned to the Philippines. Therefore, by appropriate job assignments to present JICA experts, the necessary technical cooperation for the System can be carried out under the present technical cooperation scheme.

CHAPTER 4

BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4.1 Design Policy

The Project establishes an emergency telecommunications system using a satellite communications system to ensure at least the minimum telecommunications necessary for government offices in case of disasters. The Design Policy for the System is as follows:

(1) Scale of the System

As mentioned in clause 3.3.2, the scale of the System is able to accommodate 31 VSATs. Considering future expansion of the System, the capacity of the Hub station facilities is equal to the total number of VSAT stations requested by the Philippines.

(2) Transmission Standards and Circuit Quality

The System is not connected to the Public Switched Telephone Network (PSTN), but is a closed network for the government offices. The transmission standards and quality of the circuits for emergency relief operations need not necessarily be of the high quality recommended by CCIR, but a Bit Error Rate (BER)= 10^{-3} or Signal to Noise Ratio (S/N)=30 dB* have to be maintained. The grade of circuit quality such as transmission loss (RE=28 dB) and call loss probability (0.02), for the System design is made to ensure at least the necessary minimum quality of the communications.

*: Ref. CCIR Rep. 554-4: The use of small earth stations for relief operation in the event of natural disasters and similar emergencies

(3) Satellite Technology

In order to ensure rapid manufacture and ease of maintenance, existing technology of satellite communications system is applied and thus development of a new system is not necessary.

(4) Utilization of Existing Building and Facilities

An existing TELOF building and facilities such as air conditioning equipment and cable racks are utilized in the Project to reduce construction costs and the implementation period.

(5) Facilities of the Hub Station

Redundant configuration of the radio units for radio frequency and power supply parts shall be applied for stability and reliability of the System. It is preferable that the equipment be fully solid state to reduce running cost of the System.

Switching equipment is installed to ensure communications between terminal equipment connected to the Hub and VSAT station equipment.

(6) Facilities of VSAT Stations

It is desirable that VSAT facilities is to be transportable for relief operation activities.

(7) Power Supply System

The commercial power conditions in the Philippines are poor. Especially in the dry season, power failures frequently occur and the duration is long (survey result: 0.5~2 hours/failure). Therefore, a stand-by Engine Generator (E/G) and Un-interrupted Power Supply (UPS) are to be installed.

(8) Miscellaneous Equipment and Materials

Spare parts and measuring equipment are to be stored in the Hub station, and the kinds of necessary spare parts and measuring equipment are decided considering for the former the reliability of the System, and for the latter the operation and maintenance of the System.

In addition, consumable materials are to be stored in each station, and are of necessary number for two (2) years operation and maintenance of the System.

(9) Structure Conditions

Antenna strengths considering Philippine weather conditions are to be as follows:

(a) Survival 80m/s

(b) Operational 45m/s

The building and antenna foundation design take into account the above values.

(10) Implementation Schedule

The Implementation Schedule is shown in Figure 5.2 (4 months for detailed design and the Bidding/Contract , 12 months for the equipment supply and its installation).

4.2 Study of Design Conditions

4.2.1 Required Number of Circuits

The required number of circuits for the System is calculated using the following conditions. Calculations are based on the expected traffic through the System from all VSAT stations, and terminal equipment in Metro Manila.

- The disaster or emergency area is not nation-wide (it will hit mainly 1 or 2 Regions).
- Two Regional Centers (RC) and six VSAT stations are present at the disaster area.
- A total of 30 calls/day is made from stations in the disaster affected area and Manila. The length of each call is considered 5 minutes. Concentration ratio to busy hour is considered to be 0.125.
- Call numbers and length in other areas are as follow:

Regional Centers	20 times/day, 5 minutes/station
VSAT stations	10 times/day, 5 minutes/station

- Under normal conditions, the traffic is lower than that in emergencies. Hence, the number of circuits is calculated using the busy hour traffic in emergency.

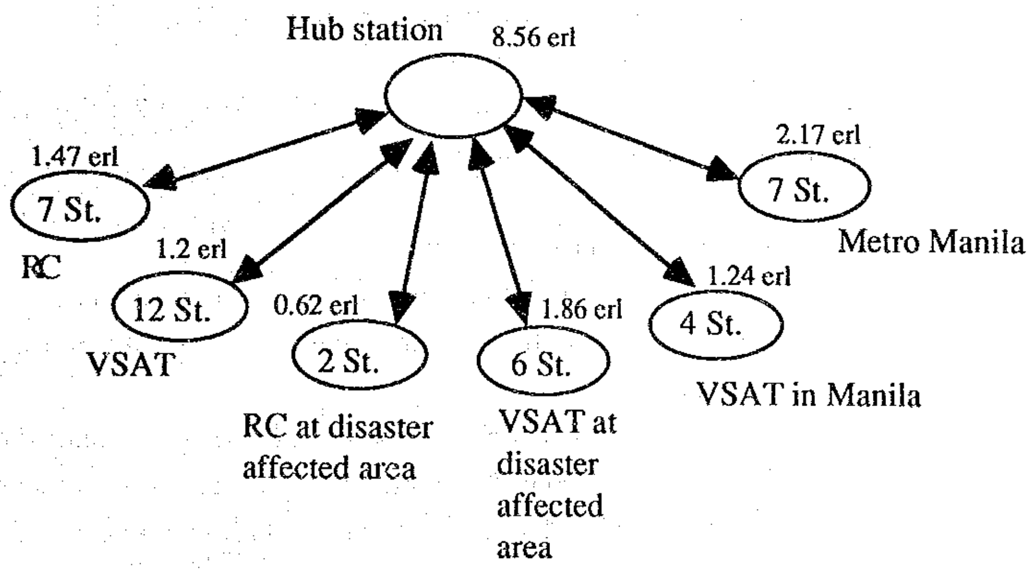


Figure 4.1 Traffic at each Station

Fifteen (15) telephone circuits are required in the System based on the above total traffic intensity.

The Hub station can control the traffic, giving preference to disaster communications between Manila, the Regional Center, and disaster sites, if the above conditions are exceeded.

4.2.2 Radio System

(1) Communication Method

In general, there are three types of communications method: Frequency Division Multiplex -Frequency Modulation (FDM-FM), Pulse Code Modulation-Time Division Multiplex (PCM-TDM) and Single Channel Per Carrier (SCPC). For the System which is of small system capacity, SCPC is to be applied to guarantee at least minimum levels of communications between government offices. SCPC is to use one radio channel per one communication circuit, and the features of SCPC are as follow:

- The equipment can control each radio channel.
- Easy to change communication destination and number of circuits at each station.
- Easy to select an earth station type (Antenna size, Transmit power etc.) based on the transmission capacity.
- Satellite power can be distributed efficiently to the different type of the earth station if the power is set channel by channel.
- Economical for small capacity system, because MODEM, CH unit etc. are required on a channel by channel basis.
- By using Demand Assignment Multiple Access (DAMA), switching and circuit concentration functions can be made available.

(2) Modulation and Coding Method

Modulation and coding method of the System is decided based on the aim of the System, service menu, transponder efficiency, output power of the transmitter and required circuit quality.

There are two types of modulation methods for the satellite system: Frequency Modulation (FM) and Phase Shift Keying (PSK). Among PSK, Quadrature Phase Shift Keying (QPSK) has an advantage compared with Binary Phase Shift Keying (BPSK) from view points of necessary bandwidth and effective use of transponder. To use PSK, the baseband voice signal which is analog, is to be coded to a digital because PSK can handle only digital signals. For the coding method, 64 Kbps standard Pulse Code Modulation (PCM) and Adaptive Differential PCM (ADPCM) are applicable for this System. Therefore, FM, and PCM and ADPCM using QPSK are studied for the modulation methods and coding of the System.

The main points in determining the most appropriate modulation and coding method for the System are as follows:

(a) The need to narrow the transponder bandwidth to reduce lease charge
(b) The necessity of using a small VSAT antenna for transportability

It is preferable that 32 Kbps ADPCM using QPSK is to be applied to the System, considering satellite transponder bandwidth, required earth station power (EIRP), encryption, interference, as shown in Table 4.1.

Table 4.1 Comparison of Modulation and Coding

Item	CFM	QPSK	
		32Kbps ADPCM	64Kbps PCM
Satellite Transponder Bandwidth (Transmission channel capacity)	o	o	x
Earth Station EIRP	Δ	o	Δ
Satellite EIRP	Δ	o	Δ
Quality for Voice Circuit	o	o	o
Quality for Facsimile	o	o	o
Quality for Still Camera	o	o	o
Voice Band Data Transmission	o	Δ	o
Encryption	x	o	o
Error Correction	-	o	o
Interference from other Networks	x	o	o
Overall Suitability	Δ	o	Δ

o: Good Δ: Acceptable x: Not acceptable

(3) Radio Channel Assignment

There are two methods of radio channel assignment as follows:

- Pre-Assignment (PA)

Satellite channels between the Hub station and a VSAT station (terminal line) are assigned permanently corresponding to the terminal lines. The satellite channels are of the same number as the terminal lines, and are assigned independently of usage conditions of the circuits. Therefore, the efficiency of the utilization of the satellite channels is low for low traffic circuits.

- Demand Assignment Multiple Access (DAMA)

  A communications path between the Hub station and a VSAT station is established on a demand basis by selecting an un-occupied satellite channel among the pooled satellite channels through a centralized supervision and control of the satellite channels. Hence, the number of satellite channels is less than that of terminal lines, and the required bandwidth of a transponder can be reduced. The number of satellite channels is decided considering the required traffic of these circuits.

DAMA which requires less earth station equipment and can use a narrower transponder bandwidth than PA, is to be applied. PA of circuits between the Hub and VSAT stations is also possible.

4.2.3 Satellite Circuit

(1) Number of Radio Channels

Based on clause 4.2.1, the required number of radio channels for the System is thirty-two (32), including two control channels for DAMA operation.

(2) Required Transponder Bandwidth

There are two factors to determine the transponder bandwidth for a VSAT system which uses a small antenna:

(a) The Bandwidth limit based on the number of satellite radio channels

(b) The Satellite power limit based on the required circuit quality

The transponder bandwidth for the System concerning item (a) is 1,600 KHz in case of 50 KHz channel separation.

Concerning item(b), the power (EIRP) of the satellite is limited and it becomes low per one carrier if many radio channels are used. The antenna of the VSAT station also has to be small for transportability, and hence the receiving level becomes low due to small antenna gain. Therefore an equivalent bandwidth of 1/8th of the transponder is required to satisfy the number of channels and the circuit quality.

(3) Antenna Diameter

The antenna diameter shall be as follows:

(a) Hub Station Antenna

As the Hub station's antenna is planned to be installed on the roof of the existing TELOF building, the antenna diameter of the Hub Station is to be less than 7.6 meters considering antenna mounting space, strength of the existing building and circuit quality.

(b) 2 CH VSAT Station

The antenna diameter of the VSAT station is to be 1.8 meters to satisfy the requirements of transportability and circuit quality.

An antenna diameter of less than 1.8m, is not possible for the following reasons:

As mentioned above in item (2), the earth station power has to be increased to keep the circuit quality (Inbound circuit: from VSAT to Hub stations) and Satellite transmitter power has to be increased due to the low receiving level due to small antenna gain (Outbound: from Hub to VSAT stations). This means that the transponder bandwidth has to be increased.

Furthermore, the antenna directivity is lessened, and hence, interference to/from adjacent satellites increases and is not satisfy the specified value of antenna design and maximum permissible level of interference in CCIR recommendations 465-3 and 580-2 respectively, unless the antenna diameter is 1.8 meters or greater.

(c) 3 CH VSAT Station

If the number of channels is increased, the output power of the VSAT station per carrier becomes small, and hence the antenna diameter must be large to keep the required circuit quality.

The antenna diameter for the three telephone circuits is to be 2.4 meters.

(4) Elevation angle and Azimuth to the PALAPA Satellite

No problem exists for antenna receiving performance due to elevation angle, as all sites have over 60 degrees of elevation.(Ref. ANNEX 7-1)

(5) Interference with Terrestrial Routes and Other Satellite Systems

As the result of site survey and the study, the interference with terrestrial microwave systems and adjacent satellites is negligible, as mentioned in the above item (4). The azimuth difference between adjacent satellites is more than 10 degrees and therefore, due to antenna directivity, circuit quality of the System is not influenced by them .

(6) PALAPA Satellite Footprint

PALAPA satellite receiving and transmitting performance are shown in ANNEX 7-2.

(7) Example of C/N Budget Calculation

The C/N budget is shown in ANNEX 7-3.

4.2.4 Switching Equipment

(1) Type of Exchange

A digital Private Automatic Branch Exchange (PABX) is used for the System upon consideration of the following items:

- The variety of functions available such as 4W exchange and easy expansion
- The small installation space required
- The ease of installation

(2) Basic Function

The PABX for the System has the following features:

- Communications between extension lines
- Transfer function of calls
- Interface with radio equipment
- Connection with terminal equipment installed in a distant place

Where considerable distance exists between the Hub station and a related government site, the tie lines can be accommodated in specially arranged trunks or in-band ringer (IBR).

The allowable cable conditions of the tie lines for specially arranged trunks are as follows:

Loop resistance	: 1,200 Ω	(PB signal)
	: 3,000 Ω	(DP signal)
Cable loss	: maximum 12 dB at 1,500 Hz	

In-band ringer can be used for the terminal equipment at a distant place if the loop resistance and signaling level are insufficient.

(3) Numbering Plan

As mentioned in clause 4.1, closed numbering is applied within the System. Considering future expansion and ease of operation for the System, a number capacity of four (4) digits is utilized.