社会開発協力部報告書

No. 8

THE ARAB REPUBLIC OF EGYPT
FEASIBILITY STUDY REPORT
ON
CAIRO-ASWAN-ABU SIMBEL
MICROWAVE NETWORK
CONSTRUCTION PROJECT

FEBRUARY, 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

THE ARAB REPUBLIC OF EGYPT

FEASIBILITY STUDY REPORT

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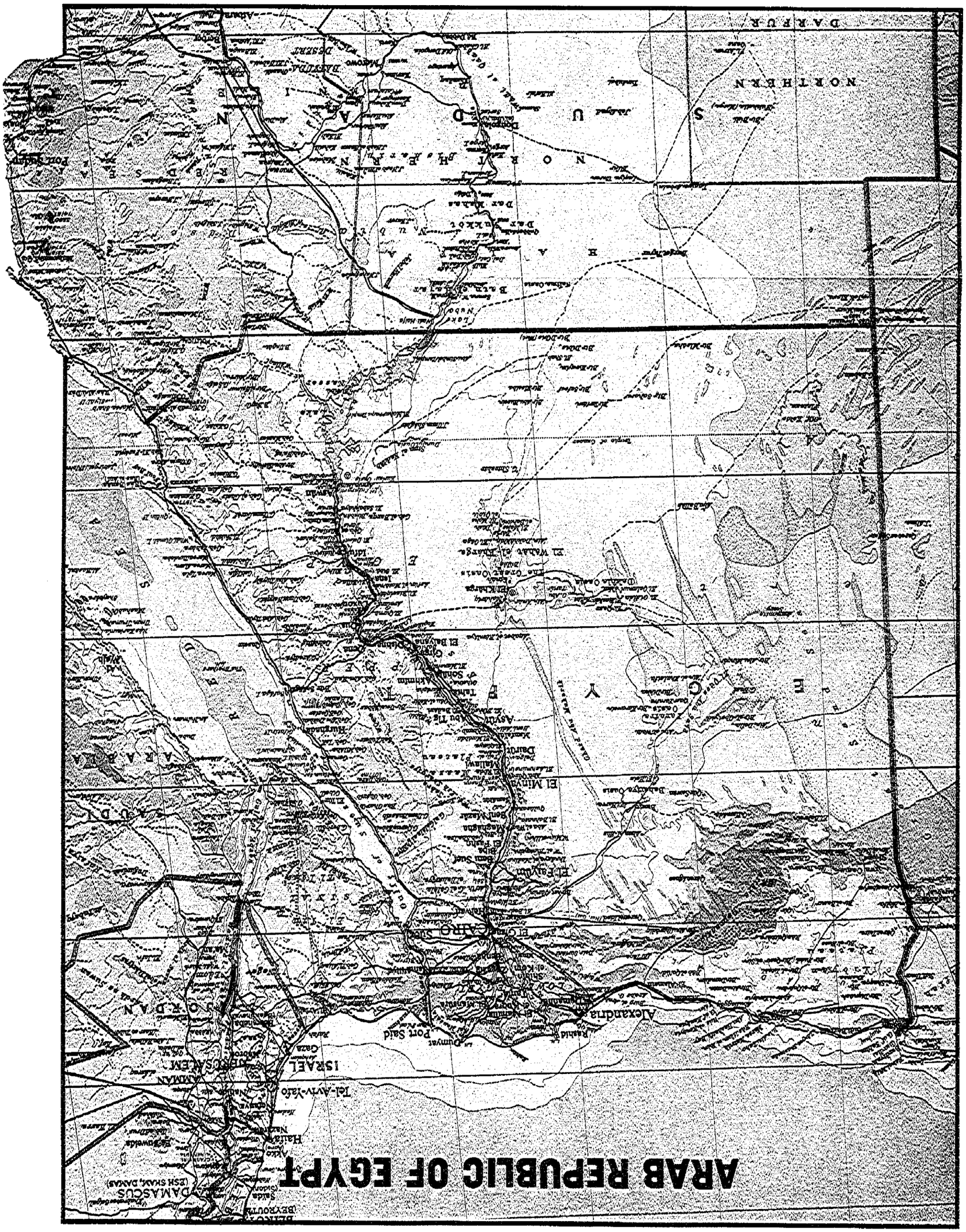

ARAB REPUBLIC OF EGYPT

PREFACE

In response to the request of the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct a feasibility study on the Microwave Network Construction Project between Cairo - Aswan - Abu Simbel and entrusted the study to the Japan International Cooperation Agency (JICA).

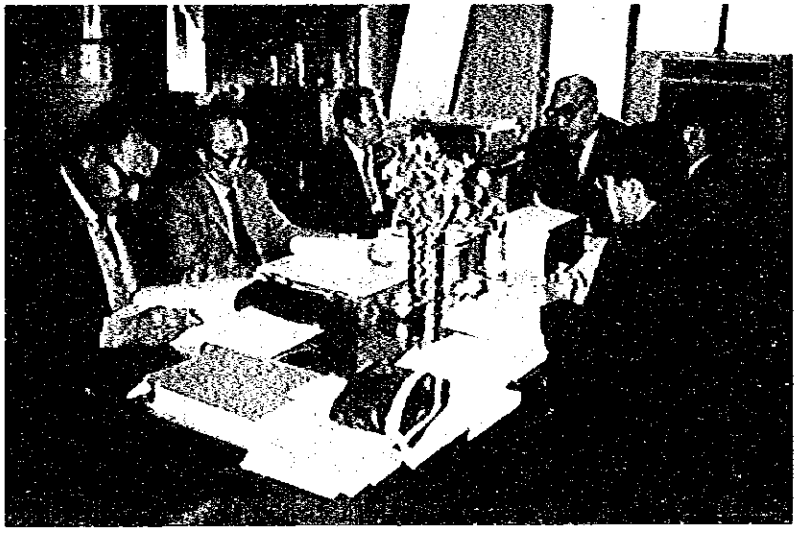
The JICA sent to Egypt a survey team headed by Mr. Hirokazu Omura, Deputy Director, Land Division, Radio Communications Department, Radio Regulatory Bureau, Ministry of Posts and Telecommunications, from September 12 to October 31, 1982. The team had discussions on the Project with the officials concerned of the Egyptian Government and the Arab Republic of Egypt National Telecommunications Organization (ARENTO) and conducted a field survey of the route from Cairo to Abu Simbel through Aswan.
After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.
I wish to express my deep appreciation to the officials concerned of the Government of Egypt for their close cooperation extended to the team.

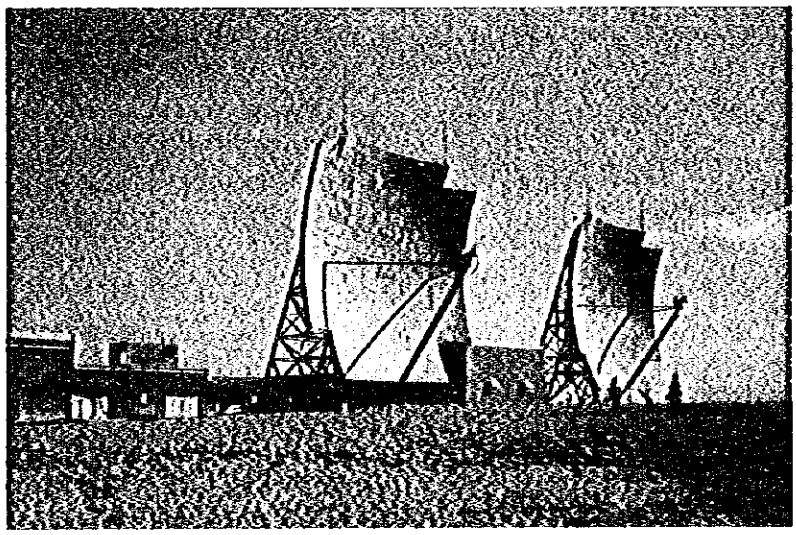
February 1983

Keisuke Arita

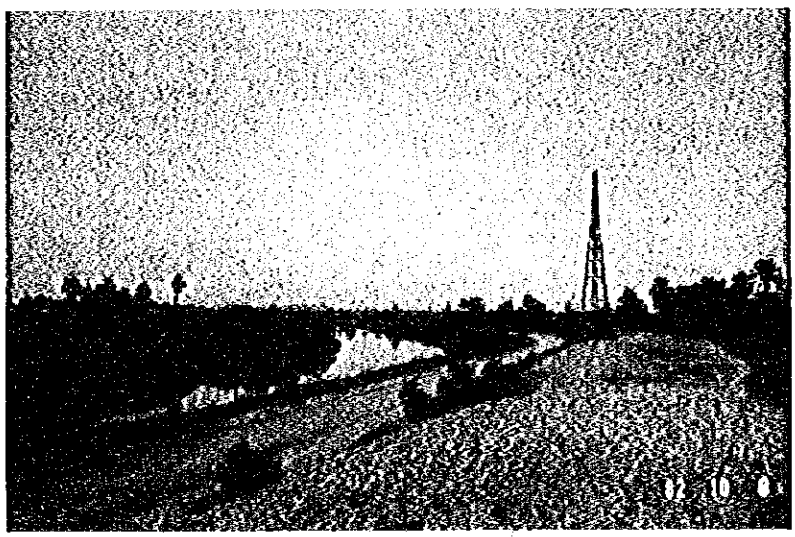
Keisuke Arita
President
Japan International Cooperation Agency



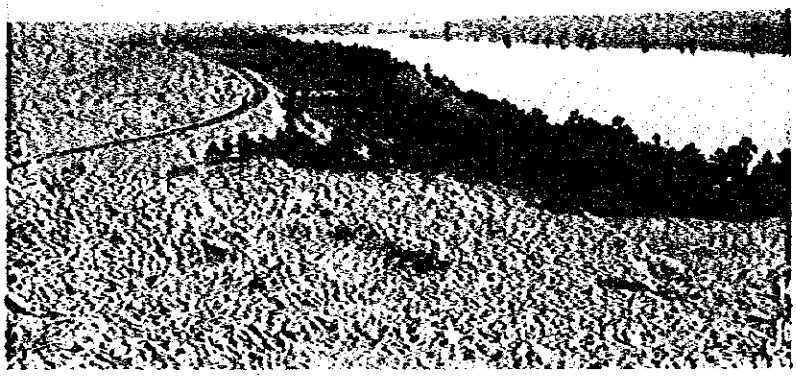
Meeting of the Draft Final Report on Feasibility Study



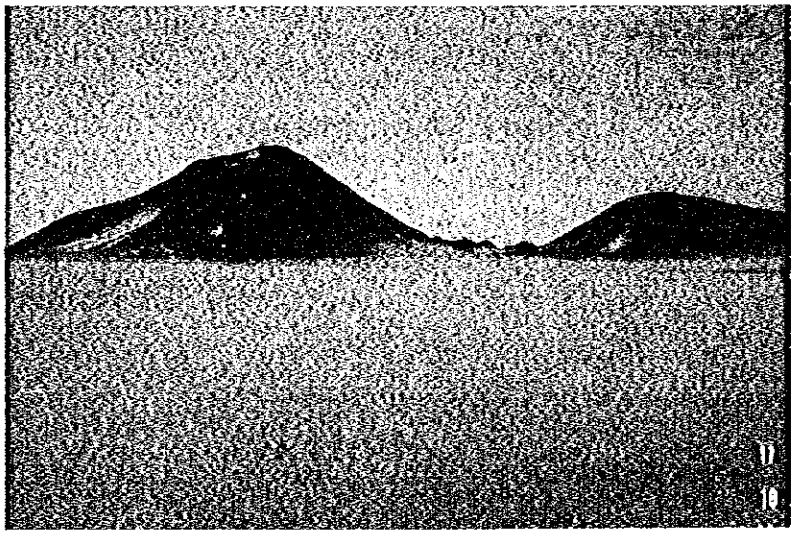
Troposcatter station at Aswan
(for Wadi-Halfa : Sudan)



R_{12} (NAG KHAMIS) Through Repeater



R_{15} Through Repeater



Desert area in Aswan-Abu Simbel

Toll swiching desk in Luxor Exchange

Contents

SUMMARY AND RECOMMENDATIONS

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Upon request of the Arab Republic of Egypt, the feasibility study was carried on Cairo-Aswan-Abu Simbel microwave construction project. The summary and recommendations are as follows;

Summary and Recommendations

Summary

1. Telecommunications Demand and Traffic Forecasts

1-1 Demand Forecast

Demand forecast is made with emphasis on telephone service demand forecast. Forecast method is to obtain forecasted demand values from correlations between GDP per person and telephone density. Forecasted demand values obtained follow:

(1) Initial forecast year: 1991

Forecasted demand in all Egypt: approx. 2,016 thousand telephones

(2) Final forecast year: 2001

Forecasted demand in all Egypt: approx. 4,338 thousand telephones

1-2 Traffic Forecast

Based on forecasted demand values, traffic forecast for the whole period of this project is made. Gross toll traffic is forecasted in the form of originating toll calling rate estimate and by the method stated in CCITT GAS-5. Forecast results follow:

(1) Initial forecast year: 1991

Forecasted gross toll traffic: approx. 2,030 Erlangs

(2) Final forecast year: 2001

Forecasted gross traffic: approx. 4,380 Erlangs

1-3 Calculation of Required Toll Circuits

With the forecasted traffic values and the possible future size of toll service network taken into consideration, the following number of toll circuits are required:

(1) Year of circuit installation (1991):

Maximum:	approx.	2,560 circuits
Minimum:	approx.	290 circuits
Gross:	approx.	3,750 circuits

(2) Final forecast year (2001):

Maximum:	approx.	3,970 circuits
Minimum:	approx.	380 circuits
Gross:	approx.	5,040 circuits

2. Outline of Microwave System

2-1 Number of Stations

Microwave system will be composed of 9 attended terminal and 22 unattended stations.

In 6 out of 9 attended terminal stations, radio equipment and carrier terminal equipment will be installed at different places. Reasons are: first, land space available for tower erection is restricted; second, carrier terminal equipment is to be installed in the existing coaxial cable system station so that it can take over the cable system in case of emergency. Locations of attended terminals and unattended stations are shown in Fig. 1.

2-2 System Configuration

Between Cairo and Aswan, four RF channels are required, and each holds transmission capacity for 1,800 channels. Four RF channels consist of one for domestic telephone service, one for international telephone service, one for international TV service and one for standby purpose.

Between Aswan and Abu Simbel, three RF channels are required, and each holds transmission capacity for 960 channels. Out of the three, one is for national and international telephone service, one for international TV service and one for standby purpose.

2-3 Outline of Major Amount of Equipment

1.	Radio Equipment	
	(1) 6GHz Radio Equipment (1800 ch)	23 hops (8 terminals and 16 unattended stations)
	(2) 6GHz Radio Equipment (960 ch)	7 hops (2 terminals and 6 unattended stations)
	(3) 15GHz Radio Equipment (2700 ch)	2 hops (4 terminals)
2.	Multiplex Carrier Equipment	11 terminals
3.	Power Supply Facility	
	(1) Station where commercial power is available	25 stations
	(2) Station where commercial power is unavailable.	
	1) Engine-generator system	4 stations
	2) Solar battery system	6 stations
4.	Tower	
	(1) Self-supported type	20
	(2) Guyed type	10
5.	Building	
	(1) Existing building	9
	(2) New building	
	1) Shelter for equipment	28
	2) Shelter for power	27

2-4 Other System Features

(1) Use of Solar Battery

At unattended stations between Aswan and Abu Simbel, where power consumption is small, solar battery is used as power supply source.

(2) Shelter-type building

For station buildings, shelter-type buildings will be used, and their construction cost will be disbursed from the foreign currency budget. This arrangement is to reduce the work period as much as possible.

3. Project cost Estimate

Total gross cost on turn key basis of microwave system construction consists of:

Foreign currency portion:		10,122 million Japanese yen
Local currency portion	:	4.172 million Egyptian pounds (equivalent to 1,168 million Japanese yen)

For further details, refer to Table 1 attached hereto that presents the breakdown of project cost estimate.

4. Project Implementation Time Schedule

A period of 13 months is required up to the completion of preparations for international tender by the Consultant, and subsequent 24 months from contract signing with successful tenderer, through construction work, to system service commissioning. Further details appear in Table 2 attached.

5. Economic Evaluation

By means of the rate of return analysis, the financial internal rate of return of the project is estimated on the assumption that the project will be completely realized as scheduled.
More precisly:

Rate of Return	With Subsidy Grant(*) from Government of Egypt to Project	Without Subsidy to Project
(1) Financial Rate of Return	10.4%	7.2% (8%)(**)
(2) Profit Ratio to Net Worth	-	24.4%
(3) Economic Internal Rate of Return	-	8 - 10%(***)

(*) Subsidy grant to ARENTO from the Government of Egypt based on its welfare policy will assist sound operation of ARENTO as a public corporation.

It is desirable that the subsidy grant by awarded to ARENTO during the implementation of this project. The subsidy amount can be, for instance, 4 million pounds in the initial year of the project implementation and another 4 million pounds in the second year.

(**) All rates of return mentioned above are the estimates on the assumption that ARENTO does raise the present telephone tariff by 10 percent during two years to come. The figure in parentheses is in the case of tariff increase by 11 percent.

(***) Economic rate of return will reach 8 - 10 percent according to the financial analysis.

Profit ratio to net worth of ARENTO becomes 24 percent, provided that the necessary funds for procurement of materials by foreign currency budget be prepared on conditions of interest rate of 5 percent per annum, grace period of 7 years, and repayment period of 25 years.

Considering the opportunity cost of ARENTO funds on hand, it will be feasible to reserve re-investment funds out of the profit from the project implementation.

Figures used in all the above analyses were obtained through the study of the following factors:

(1) Operation efficiency of ARENTO

(2) Re-evaluation of tariff system

(3) The number of circuits planned based on farecasted telecommunication demand and traffic

Recommendations

In the project implementation, the study and decision concerning the following items are recommended:

1. Radio Propagation Test

In this survey, radio propagation test data could not be obtained. However, the fact remains that, in Upper Egypt, the topography is featured in smooth spherical ground, and this fact, together with the Nile humidity, may cause abnormal radio propagation to take place.

Therefore, in the system design based on this survey, full safety margin is considered in order to ensure the desired radio system transmission performance. If a long term continuous recording of receiving input power voltage is made, utilizing the existing microwave system of Egyptian Broadcasting Association (OBTF), full data required for final system design can possibly be obtained. In this connection, it is recommended that the receiving input power voltage measurement be carried out in several representative sections of the proposed transmission route.

Depending upon the findings in such radio propagation tests, a better system design in terms of engineering economy can possibly be produced, contributing a great deal to project implementation cost curtailment.

2. Radio System for Short Link

Although the use of 6 GHz band stated in CCIR Rec. 384-2 for a backbone circuit in this project is decided, the additional use of 15 GHz band stated in CCIR Rep. 607-1 is recommended for Opera - Ramses, Cairo, section and Aswan Branch - Aswan section.

About the said 15 GHz band, the following points are neteworthy:

1) At present, this frequency band is not used. Therefore, it can be used without interference hazards to/from existing systems.

2) This frequency band is weak to rainfall. However, in Egypt, rainfall is extremely scarce.

3) This frequency band can do with small diameter antenna. This fact allows simple tower structure.

3. Shelter Type Building for Equipment

In order to reduce construction work period, shelter type buildings are to be adopted for all equipment buildings.

For housing for staff personnel, ARENTO is recommended to construct separate buildings. ARENTO is further recommended to modify part of existing buildings so that they can be used in this project, and to construct roads (1.5 km at maximum) where necessary.

4. Economic Evaluation

In order to realize desirable status of finance for sound project implementation and system operation thereafter, it is recommended that ARENTO does take the following actions:

1) Adjustment of present telephone tariff system

2) Procurement of subsidy grant for the project

3) Procurement of low interest, long term soft loan from foreign financial institution.

(1) As far as is estimated from the financial earning power of the project, it is desirable that the present telephone tariff by at least 10 percent during two years in the nearest possible future.

(2) It is essential that the Government of Egypt does provide subsidy grant amounting to 8 million pounds to ARENTO for sound project implementation and system operation thereafter.

(3) In order to secure the internal reserve position of ARENTO and to stabilize its repayment capability it is desirable that the Government of Egypt does obtain low interest, long term soft loan for ARENTO from foreign financial institution.

Table 2 Implementation Schedule of the Project

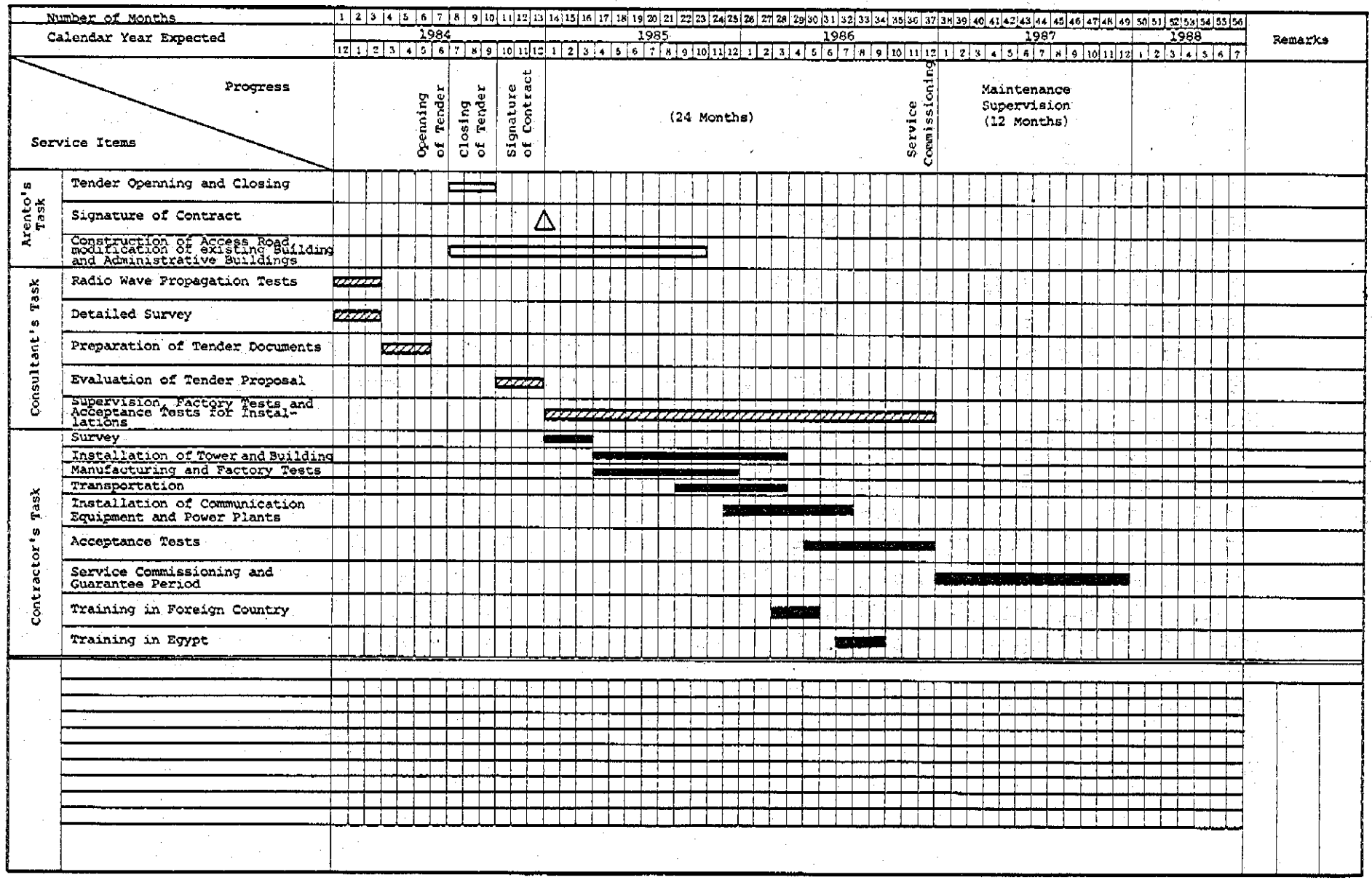


Table 6-1 Project Cost Estimate

Unit: Million Yen

No.	Item \ Currency	Foreign Currency	Local Currency	Total
1	System Facilities Cost			
	1) Equipment	4,763	-	4,763
	2) Installation Materials	254	-	254
	3) Maintenance Facilities	139	-	139
	4) Demonstration Equipment for Training	127	-	127
	5) Spares	189	-	189
	6) Shelters	638	-	638
	FOB Total	6,110		6,110
	CIF Total	6,415	-	6,415
2	Inland Transportation & Customs clearance		119 (425)	119
3	Installation cost of Main Equipment	1,018	113 (403)	1,131
4	Training	120	100 (357.1)	220
5	Cost for civil work			
	1) Tower	830	200 (714.2)	1,030
	2) Shelter	299	70 (250)	369
	3) Access road		167 (596.4)	167
	4) Cable Trenching	90	48 (171.4)	138
	5) Building Modification		101 (369.7)	101
6	Consultancy Service	430	144 (5.4.2)	574
7	Contingency	920	100 (378.5)	1,026
8	Total	10,122	1,168 (4,171.4)	11,290

Note: Figures shown in parentheses express thousand Egyptian Pounds (LE).

1 LE = 280 Japanese Yen

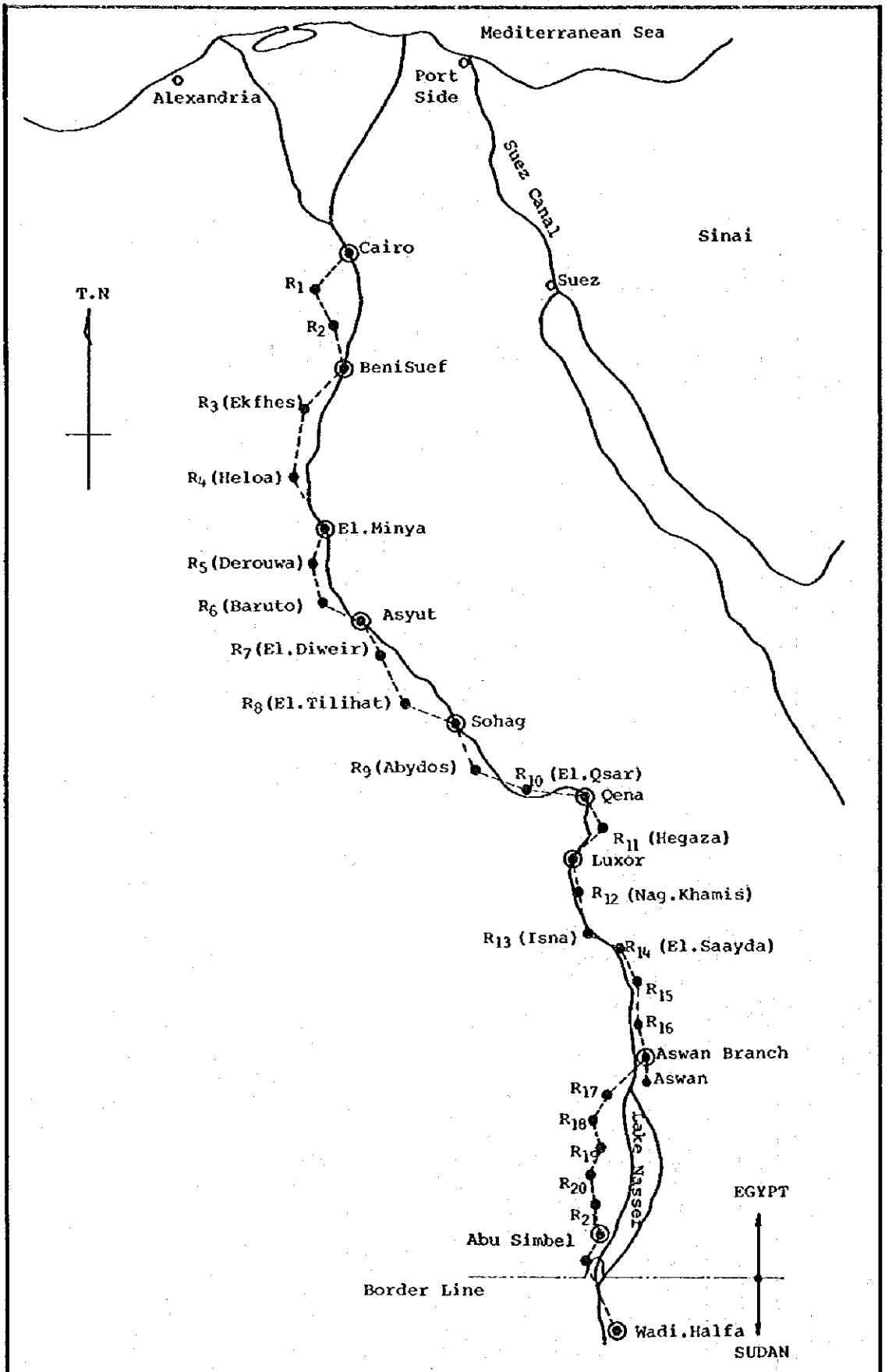


Fig.-1
Location of Terminal & Unattended Stations

CHAPTER 1

INTRODUCTION

Chapter 1 Introduction

1-1 Objective of Study

The objective of this study is to check and determine the technical and economic feasibility of Cairo - Aswan - Abu Simbel FDM Microwave Communication Network Construction Plan. The study is made at the request of the Government of the Arab Republic of Egypt.

1-2 Executive Policy

On July 8, 1982, Scope of Work providing for the range of study activities was signed between ARENTO and the prelinary study team. Based on this Scope of Work, Inception Report was made. Then, on September 18, 1982, Minutes of Meeting placing on record the in-depth executive policy for the study was signed.

The executive policy specifies the following work items:

1-2-1 Collection of Data and Information

Data concerning telecommunication development plans could not be obtained because ARENTO refused to supply those data. Data used in the study, this time, are the data obtained in the feasibility study of March 1981 for Alexandria PCM Microwave Network Construction Plan.

Maps of 1/100,000 scale could be obtained for all route sections where the study was to be made. However, for Aswan - Abu Simbel section, maps obtained were not useful because the topography in most part of the section changed due to submersion during Aswan High Dam construction. New map based on the existing topography was not available.

1-2-2 Telecommunication Demand and Traffic Forecasts

(1) Demand Forecast

Demand forecast is mainly telephone demand forecast. By the forecast method used by CCITT, i.e., from the correlations between GDP per capita and telephone density, the forecasted demand size was obtained for the years 1991 and 2001.

(2) Traffic Forecast

By use of data clarified in Chapter 3, Paragraph 3-1, the originating toll calling rate was estimated and, based on this estimate, area by area toll originating traffic was forecasted. Inter-city traffic was calculated by GAS-5 method of CCITT.

(3) Number of Circuits Forecast

Based on forecasted inter-city traffic, the number of circuits required as of the forecast years, 1991 and 2001, was calculated by Erland B formula.

1-2-3 Technical Standards of Project

In this project, FDM/FM microwave system is applied. Technical standards of the system are formulated, based on up-to-date related technology, relevant CCITT and CCIR recommendations, and Minutes of Meeting agreed upon between ARENTO and study team.

1-2-4 Service, Revenue and Expenditure

Study was made concerning expected telecommunication service after the completion of Cario - Aswan - Abu Simbel microwave network and about expected service revenue and expenditure. Study result is used in the economic evaluation of this project.

1-2-5 Existing Tariff System

Existing telecommunication tariff system was studied. This study was a means of expected service revenue estimate after the system commissioning.

1-2-6 Network Design

System design details of the projected microwave network appear in Chapter 3. A gist of system design follows:

(1) Site Selection

All station sites selected belong to the Government owned land.

(2) Frequency Plan

Main system: CCIR Rec. 384-2 (6,430 - 7,110 MHz)

Spur system: CCIR Rep. 607-1 (14,400 - 15,230 MHz)

(3) RF Channels

Cairo - Aswan (4 RF channels)

National telephone RF CH ..... 1,800 CH x 1

International telephone RF CH .... 1,800 CH x 1

International TV RF CH ..... color CH x 1

Standby RF CH ..... each above x 1

Aswan - Abu Simbel (3 RF channels)

National and international RF CH . 960 CH x 1

International TV RF CH ..... color CH x 1

Standby RF CH ..... each above x 1

(4) Tower Height

Self-Supporting Type	Guyed Type
45 m x 1	50 m x 1
50 m x 3	60 m x 1
70 m x 3	80 m x 6
75 m x 3	85 m x 1
80 m x 2	100 m x 1
85 m x 1	
90 m x 1	
95 m x 2	
100 m x 4	

(5) Transmission Performance

Telephone circuit: As per CCIR Rec. 395-2

TV circuit: As per CCIR Rec. 555, 567 and 402-2 and CCIR Rep. 289-3

(6) Power Supply System

Stations where commercial power supply is available:

Full floating system by storage batteries, with standby Engine generator

Stations where commercial power supply is not available:

Full floating system by storage batteries, with dual Engine generators

Stations in Aswan - Abu Simbel Section:

Solar battery system for each unattended station where power consumption is small and which can be maintained economically. Holding time of solar battery system is 10 days.

(7) Equipment Housing

Shelter-type housing will be used. this is to reduce construction work period and to comply with strong request from ARENTO.

1-2-7 Maintenance and Training

The basic maintenance philosophy is described in Chapter 4. Also described are the required maintenance staff size and the maintenance staff training procedures.

Training is divided into 3 categories. First is the overseas training of technical leaders. This training is administered for 40 personnel and for 3 months. Second is the domestic technical training. This training is given to 40 personnel for 3 months. Third is the administration staff training. this training is one month training for 18 personnel.

For instructors at domestic technical training, technical leaders who have finished their overseas training will be assigned.

1-2-8 Project Implementation Plan

The project implementation time schedule consists of 13 months for implementation preparations by the Consultant and 24 months from contract signing to system commissioning. One year after service-in is reserved for maintenance guidance by the Contractor.

1-2-9 Project Cost Estimate

Gross cost of project implementation is estimated at 10,122 million Japanese yen in foreign currency portion and 4.172 million Egyptian pounds (equivalent to approximately 1,168 million Japanese yen) in local currency portion. Both combined, the project cost totals 11,290 million Japanese yen.

1-2-10 Economic Evaluation

Data used in the economic evaluation of this project are the following four categories:

(1) Project cost estimate

(2) Annual preservation cost and maintenance cost

(3) Operating revenue estimate based on traffic forecast and telecommunication system capacity

(4) Others

1-3 Scope of Study

Scope of study includes;

(1) Field survey

- Investigation of telephone demand
- Design of telephone and international television network plan
- Investigation of site procurement possibility and radio path conditions of the Project
- Investigation of buildings and tower
- Collection of data and information on economic and financial analyses

(2) Report

Preparation of final report on feasibility of both technical and economic status of the Project.

1-4 Background of Feasibility Study

Diplomatic relations between the Arab Republic of Egypt and Sudan are becoming more and more intimate. In October 1982, the two countries signed the United Charter intended to strengthen their social, cultural, economic, military and political relationships.

However, for the terrestrial communication system between the two countries, the 12-channel Aswan - Wadi Halfa over-horizon system is the sole existing system. The ever-growing communiation demand cannot be fully catered for by this sole system.

Between Cairo and Aswan, the coaxial cable system exists. However, because of no alternative communication media to replace this system when it fails, Upper Egypt may possibly be isolated in the worst case.

The Pan-African Telecommunications Network Plan (PANAFTEL) proposed by ITU (International Telecommunications Union) has not yet been implemented. Hence, for Egypt itself, there is need to hasten completion of toll telephone network.

In view of the foregoing state of affairs, the Government of the Arab Republic of Egypt planned to construct Cario - Aswan - Abu Simbel microwave communication network, and requested the Japanese Government for technical cooperation.

The Japanese Government consented to the request and dispatched a five-member preliminary survey team to Egypt for a period from June 20 through July 10, 1982.

The feasibility study, this time, was carried out, based on Scope of Work formulated through joint discussions by the preliminary survey team and ARENTO that belongs to the Ministry of Transport and Communication of the Arab Republic of Egypt. Main study items were radio route palnning including field survey and station site selection, system design, demand forecast consisting of national and international communication demand estimate, as well as financial and economic evaluations of project implementation.

Analysis of study results indicates that this project is thoroughly feasible from both technical and economic viewpoints.

1-5 Organization of the Study Team and Responsibility Areas of Team Member

The study team was composed of twelve (12) members including one domestic member. The names and responsibility areas are listed below.

Name	In Charge of	Affiliated to
Mr. Hirokazu OMURA	Team Leader, Head of Advisory Committee	Deputy Director, Land Division, Radio Communications Department, Radio Regulatory Bureau, Ministry of Posts and Telecommunications
Mr. Kazutomo OSAWA	Sub leader, Advisory Committee	Senior Staff Engineer International Affairs Bureau, NTT (Nippon Telegraph and Telephone Public Corporation)

Name	In Charge of	Affiliated to
Mr. Michio SUZUKI	Architectural Planning	Senior Staff Engineer Building Engineering Bureau, NTT
Mr. Iwao USHIODA	Chief of Survey, Radio Engineering	Assistant to General Manager, International Operating Division, NTC (Nippon Telecommunications Consulting Co., Ltd.)
Mr. Yasuo NAGASAKI	Transmission Engineer	Senior Engineer, International Operating Division, NTC
Mr. Kiyoshi HORI	Radio Engineering	Senior Engineer, Communication Engineering Division Nagoya Branch, NTC
Mr. Yoshio MORITOMO	Radio Engineering	Senior Engineer Communication Engineering Division, NTC
Mr. Takahiko ADACHI	Traffic & Network Engineering	Senior Engineer International Operating Division, NTC
Mr. Hidemasa TOYAMA	Radio Engineering	Senior Engineer Interniatonal Operationg Division, NTC
Mr. Tadashi ICHIGE	Transmission Engineering	Engineer Communication Engineering Division, NTC
Mr. Tetsuyuki TAKADA	Economic Evaluation	Economist International Operating Division, NTC

Name	In Charge of	Affiliated to
Mr. Norimoto OHTAKE	Coordinator, Advisory Committee	Special Assistant to Director, Social Development Department, Japan International Cooperation Agency (JICA).

1-6 Itinerary of Study

The itinerary of study at Cairo - Aswan - Abu Simbel appears Table 1-1.

TABLE 1-1 ITINERARY OF FEASIBILITY STUDY IN CAIRO-ASWAN-ABU SIMBEL

Date	Day	Place Visited	Activity
1982 12 Sept.	Sun		Leaving from Tokyo
13 Sept.	Mon		Arriving at Cairo
14 Sept.	Tue	ARENTO, Cairo	Discusion for survey
15 Sept.	Wed	ARENTO, Cairo	Discusion on inception report
16 Sept.	Thr	OBTF and ARENTO, Cairo	Discusion on the existing facilities
17 Sept.	Fri	Cairo	Preparation of survey
18 Sept.	Sat	ARENTO, Cairo	Preparation of survey
19 Sept.	Sun	Beni Suef ARENTO, El Minya	Investigation of Beni Suef Cox Terminal
20 Sept.	Mon	Team-A 2 Repeaters	Site selection of 2 repeaters between Beni Suef and El Minya
		Team-B El Minya	Investigation of El Minya Cox station
21 Sept.	Tue	Team-A 2 Repeaters	Same as yesterday
		Team-B El Minya	

Date	Day	Place Visited	Activity
22 Sept.	Wed	Team-A 2 Repeaters	Same as yesterday
		Team-B Asyut	Investigation of Asyut Cox station
23 Sept.	Thr	Team-A 2 Repeaters	Site selection of 2 repeaters between Beni Suef and Cairo
		Team-B Beni Suef	Investigation of Beni Suef Cox station
24 Sept.	Fri	Cairo	Data analyses
25 Sept.	Sat	ARENTO, Cairo	Interim report of survey to ARENTO
26 Sept.	Sun	Cairo	Data analyses
27 Sept.	Mon	Alexandria	Observation on existing tower between Cairo and Alexandria
28 Sept.	Tue	Alexandria	Same as yesterday
29 Sept.	Wed	Cairo	Data analyses
30 Sept.	Thr	Cairo	Data analyses
1 Oct.	Fri	Cairo	Data analyses
2 Oct.	Sat	ARENTO, Cairo	Data and maps collection
3 Oct.	Sun	El Minya	Investigation of El Minya Cox station
4 Oct.	Mon	Team-A: 2 Repeaters	Site selection of 2 repeaters between Asyut and Sohag
		Team-B: Sohag	Investigation of Sohag Cox station
5 Oct.	Tue	Team-A & B: Sohag and 1 Repeater	Site selection of Sohag and one repeater between Sohag and Nag Hamady

Date	Day	Place Visited	Activity
6 Oct.	Wed	Team-A: 1 Repeater	Site selection of one repeater between Nag Hamadi and Qena
		Team-B: Qena	Investigation of Qena Cox station
7 Oct.	Thr	Team-A: Qena and 1 Repeater	Investigation of Qena and site selection of 1 repeater to Luxor
		Team-B: Luxor	Investigation of Luxor Cox station
8 Oct.	Fri	Team-A & B	Data analyses
9 Oct.	Sat	Team-A: 1 Repeater	Site selection of 1 repeater between Luxor and Iduf
		Team-B: 2 Repeaters	Site selection of 2 repeaters between Luxor and Iduf
10 Oct.	Sun	Team-A & B: Luxor	Investigation of Luxor site
11 Oct.	Mon	Team-A & B: 2 Repeaters	Site selection of 2 repeaters between Luxor and Aswan
12 Oct.	Tue	Team-A: Aswan	Site selection of Aswan
		Team-B: Aswan	Profile making
13 Oct.	Wed	Team-A & B: Aswan	Same as yesterday
14 Oct.	Thr	Team-A: 2 Repeaters	Site selection of 2 repeaters between Aswan and Iduf
		Team-B: Aswan	Preparation of crossing Abu Simbel desert
15 Oct.	Fri	Team-A & B: Aswan	Same as yesterday

Date	Day	Place Visited	Activity
16 Oct.	Sat	Team-A: Aswan	Searching of 4 wheels driving cars
		Team-B: Abu Simbel	Moving to Abu Simbel by plane and site selection
17 Oct.	Sun	Team-A: Abu Simbel	Crossing the desert
		Team-B: Alu Simbel	Study of Abu Simbel site
18 Oct.	Mon	Team-A & B: Abu Simbel	Investigation of Abu Simbel site
19 Oct.	Tue	Team-A: Aswan	Moving to Aswan by plane
		Team-B: Aswan	Crossing the desert
20 Oct.	Wed	Team-A & B: Aswan	Moving to Cairo by train
21 Oct.	Thr	Team-A & B: Cairo ARENTO	Report to ARENTO on results of survey
22 Oct.	Fri	Team-A & B: Rl repeater	Confirmation of Rl repeater
23 Oct.	Sat	ARENTO, Cairo	Meeting with ARENTO and data analyses
24 Oct.	Sun	Ramses, Cairo	Investigation of Ramses station
25 Oct.	Mon	ARENTO, Cairo	Making of progress report
26 Oct.	Tue	ARENTO	Making of progress report
27 Oct.	Wed	ARENTO	Study with ARENTO on results of survey
28 Oct.	Thr	ARENTO	Submitting of progress report and explanation
29 Oct.	Fri	Cairo	Investigation of Mokattamhill
30 Oct.	Sat	ARENTO	Preparation of minutes of meeting and signification. Leaving from Cairo
31 Oct.	Sun	Tokyo	Arriving at Tokyo

CHAPTER 2

TELECOMMUNICATIONS DEMAND AND TRAFFIC FORECASTS

Chapter 2 Telecommunications Demand and Traffic Forecasts

This chapter is for national and international telecommunications service demand and traffic forecasts by years. The objective of forecasts is to determine the number of channels to be installed in Cairo - Aswan - Abu Simbel microwave system which this project is to realize.

2-1 Overview

Presently in Egypt, by far the most part of national telecommunications service is the telephone service. In terms of operating circuits, the telephone service overwhelmingly predominates over non-voice communication services (telex, telegraph and data services) at the rate of 100 to 1 or even less.

Consequently, in the national service demand forecast, this time, telephone demand forecast is the main theme. For non-voice communication services, a certain proportion of telephone circuits to be installed, based on the demand forecast, is to be set aside. The proportion of circuits to be set aside to fill the demand for non-voice communication services is 20% of telephone circuits. This 20% proportion reflects the worldwide uptrend of demand for non-voice communication services and complies with the strong request from ARENTO.

Telephone demand and traffic forecasts are made as of 1991 and 2001. This arrangement is on the assumption of system service commissioning in 1987 and in consideration of service life of installed equipment. That is to say, the year 1991 is five years after the system service commissioning and the year 2001 follows suit by 15 years.

2-2 National Telephone Service Demand Forecasts

The microwave system to be constructed by this project will provide a backbone communication system in Upper Egypt. At the same time, along with Cairo - Tanta - Alexandria, Cairo - Ismailia and other backbone systems, it will constitute the key transmission network covering the whole of Egypt.

Hence, the telephone demand forecast, this time, is made, based on the macroscopic demand forecast for the entire Egypt.

2-2-1 Forecast Methodology

The macroscopic telephone demand forecast methodology comprises the following classifications:

1) To forecast the future demand size from the histrical data;

2) To forecast the future demand size from demand correlations with collateral statistical data, e.g., GDP;

3) To forecast the future demand size from demand behavior comparison with other countries or other municipalities;

4) To forecast the future demand size by means of combined use of part or whole of each foregoing method.

The macroscopic telephone demand forecast method most commonly adopted in the world at present is the method used by CCITT that is patterned after the classification 4) above. This method is to forecast the future demand size from correlations between the number of main telephones per 100 persons and GDP per capita.

To be sure, the CCITT method is most rational and adequate out of all methods available. Hence, for the telephone demand forecast, this time, the guideline is the CCITT philosophy while the working processes are:

1) To forecast future population growth in Egypt;
2) To forecast future GDP of Egypt;
3) To analyze correlations between telephone density and GDP per capita in the world;
4) To analyze status quo of telephone subscriber distribution in Egypt;
5) To finalize demand forecast formula and to forecast demand by years.

2-2-2 Population Forecast

The movement of population in Egypt from 1970 through 1980, based on Statistical Year Book, 1981 edition, appears in Table 2-2-1 and Fig. 2-2-1.

The population growth rate in Egypt during the past 10 years, as seen from Table 2-2-1, is 2.4% in annual average.

Regression formulas of two major correlation coefficients, resulting from regression analysis of the past movement of population, are:

1) Linear regression Formula

$$Y = 32{,}593 + 922.11\,X \qquad R = 0.99$$

2) Exponent regression Formula

$$Y = 32{,}849 \cdot e^{1.025X} \qquad R = 0.98$$

where

X : Year of forecast (1971: "1")

Y : Estimate population (x 1,000)

R : Correlation coefficient of X and Y

Forecasted populations by years, obtained by the above formulas, are given in Table 2-2-2 and the growth curve in Fig. 2-2-2.

On the other hand, the World Development Report 1981 compiled by the World Bank indicates that the movement of population in Egypt henceforward will draw a logistic curve, numbering approximately 60 million in the year 2000 and reaching the ceiling of 104 million in the year 2080.

Table 2-2-1 Population Growth (1970 - 1980) in Whole Egypt

Year	Number of Population (x1000)	Increase (x1000)
1970	33,053	737
1971	33,807	754
1972	34,578	771
1973	35,366	788
1974	36,172	806
1975	36,997	825
1976	37,841	844
1977	38,794	953
1978	38,819	1,025
1979	40,983	1,164
1980	42,289	1,306

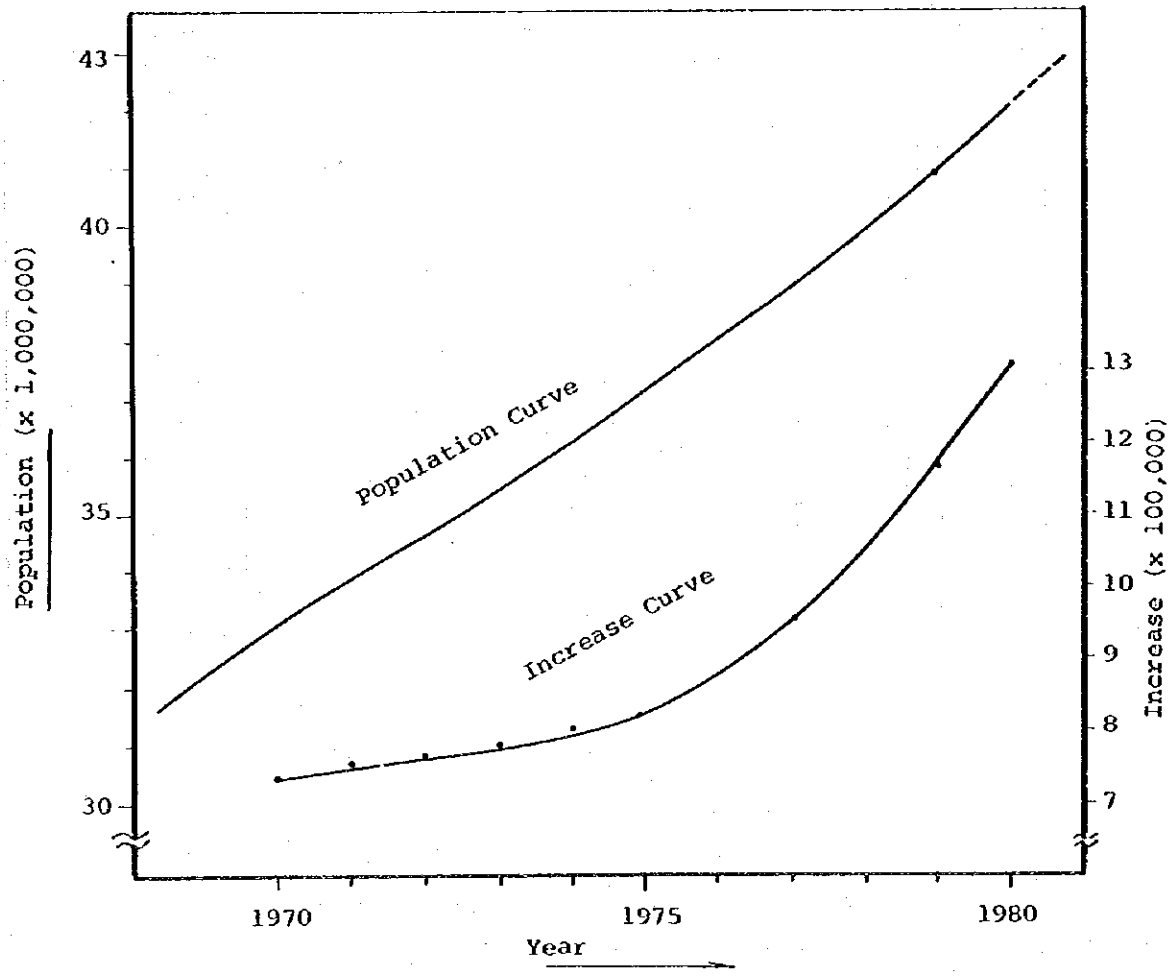


Fig. 2-2-1 Population Growth (1970-1980)

Table 2-2-2 Forecast of Population Growth

Year	1	2
1981	42,736	42,973
2	43,658	44,035
3	44,580	45,124
4	45,503	46,240
5	46,425	47,383
6	47,347	48,554
7	48,269	49,755
8	49,191	50,985
9	50,113	52,245
1990	51,035	53,537
1	51,957	54,861
2	52,879	56,217
3	53,802	57,609
4	54,724	59,031
5	55,646	60,491
6	56,568	61,986
7	57,490	63,519
8	58,412	65,090
9	59,334	66,098
2000	60,256	68,347
1	61,178	70,037

(x1000)

Note: 1 $y = 32,593 + 922.11\ x$ (R=0.99)

2 $y = 32,849.e\ 1.025\ x$ (R=0.98)

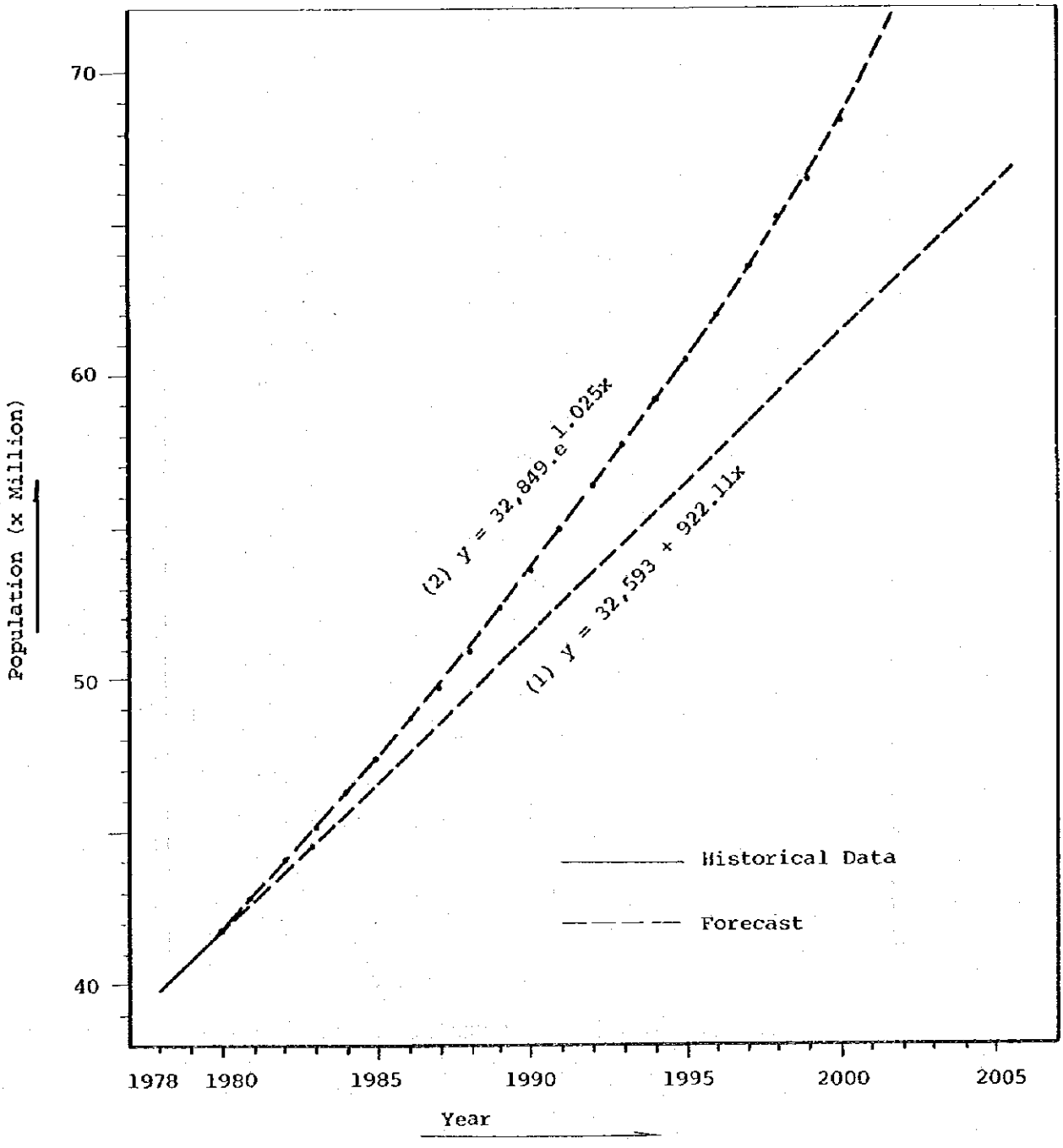


Fig. 2-2-2 Forecast of Population Growth

Considering the downtrend of birth rate per population of 1,000 in Egypt and the expected social changes of all kinds (i.e. improvement of the medical systems), the safe assumption is that for the medium term population forecast up to the year 2001, the result of forecast by the primary formula will be most reliable. Hence the adoption of Formula (1) above for population forecast this time.

2-2-3 GDP Forecast

According to the aforementioned World Development Report 1981 by the World Bank, real GDP of Egypt amounts to US$17,050,000,000 as of 1979. Average annual growth rates in the past are 4.2% for 1960 - 1970 and 7.6% for 1970 - 1979.

The world economy is presently in recession. Hence, in all countries, not excluding the U.S. and European countries, the growth rate of GDP is on downtrend, posing an international problem. Difficulty of attaining the planned GDP growth rate commensurate with the growth of national economy is common to all countries. The economic stagnation trend is reported to be greater in developing countries and oil producing countries than in others.

Thus, in World Development Report 1981, the World Bank forecasts a 5.7% average annual growth rate of GDP for all countries except industrial market economies (North America, Western Europe and Japan). (Refer to Table 2-2-3 and 2-2-4) This forecast indicates difficulty for Egypt to maintain the average annual growth rate of GDP in the past 10 years, i.e., 7.6%.

At the same time, based on the foregoing analysis and in consideration of oil production possibility resulting from regional development of Sinai, the average annual growth rate of Egyptian economy henceforward is estimated at 6.5%.

As a result, the forecasted value of GDP of Egypt in each year of forecast can be obtained by the following formula:

$$Y = 17{,}050\ (1 + 0.065)^X$$

where

Y : Forecasted value of GDP (x million US$)

X : Year of forecast (1979: "1")

Calculation result appears in Table 2-2-5 and Fig. 2-2-3.

Table 2-2-3

Requirements for faster growth

Several factors could boost the developing countries' growth above the rates projected in the High case. For example, the level of capital flows, particularly from the private sector, may be considerably higher than expected; and the industrial countries could reduce or eliminate non-tariff barriers that restrict the volume of developing-country exports. Neither development is probable, but neither are they outside the bounds of possibility.

The table shows what their effects might be. The second column illustrates the consequences of doubling the growth rate of real capital inflows (the resource gap). This would produce real transfers of capital of $83 billion in 1990, as opposed to $54 billion in the High case. Reducing protectionism is assumed to have the effect of raising export-growth rates by one percentage point a year. While this implies as easing of barriers for both manufactures and agricultural commodities, the benefits go largely to the middle-income countries. The overall effect would be to boost growth in the oil-importing developing countries by an extra half-percentage point a year.

Projected GDP growth, 1980 - 90
(average annual percentage change)

Country group	High case	Higher capital flows	Higher capital flows plus reduced protectionism
Oil importers	5.4	5.6	5.9
Low-income	4.1	4.5	4.5
Middle-income	5.6	5.9	6.2
Oil exporters	6.5	6.5	6.5
All developing countries	5.7	5.9	6.1
Memo item			
Resource gap, 1990 (1978 billion dollars)	54.3	83.1	83.1
Export growth (average annual percentage change)	7.0	7.0	8.0

by "World Development Report, 1981" (World Bank)

Table 2-2-4 GDP sensitivity to oil-price increases, 1980-90
(average annual percentage increases in real GDP)

Country group	Oil price increases[a]		
	0 percent	3 percent	5 percent
Oil importers	5.8	5.5	5.0
Low-income	4.3	4.1	4.0
Middle-income	6.1	5.7	5.2
Oil exporters	6.3	6.5	6.6
All developing countries	6.0	5.7	5.5

a. Growth rate of petroleum prices, 1980-90, in real terms.

by "World Development Report, 1981" (World Bank)

Table 2-2-5 Forecast of GDP Growth

(Million US$)

Year	1 5.6%	2 5.9%	3 6.2%	4 6.5%
1979	17,050	basic value		
1980	18,005	18,056	18,107	18,158
1	19,013	19,121	19,230	19,339
2	20,078	20,249	20,422	20,596
3	21,202	21,444	21,688	21,934
4	22,389	22,709	23,033	23,360
5	23,643	24,049	24,461	24,878
6	24,967	25,468	25,977	26,495
7	26,365	26,971	27,588	28,218
8	27,842	28,562	29,298	30,052
9	29,401	30,247	31,115	32,005
1990	31,048	32,032	33,044	34,086
1	32,786	33,922	35,093	36,301
2	34,622	35,923	37,269	38,661
3	36,561	38,042	39,579	41,174
4	38,609	40,287	42,033	43,850
5	40,771	42,664	44,639	46,700
6	43,054	45,181	47,407	49,736
7	45,465	47,847	50,346	52,968
8	48,011	50,670	53,468	56,411
9	50,699	53,659	56,783	60,078
2000	53,539	56,825	60,303	63,983
1	56,537	60,178	60,042	68,142

Note 1 : Middle-income country and High case

2 : Middle-income country and Higher capital flows

3 : Middle-income country and Higher capital flows plus reduced protectionism

4 : Oil exporters country in the developing countries

[by "World Development Report, 1981" (World Bank)]

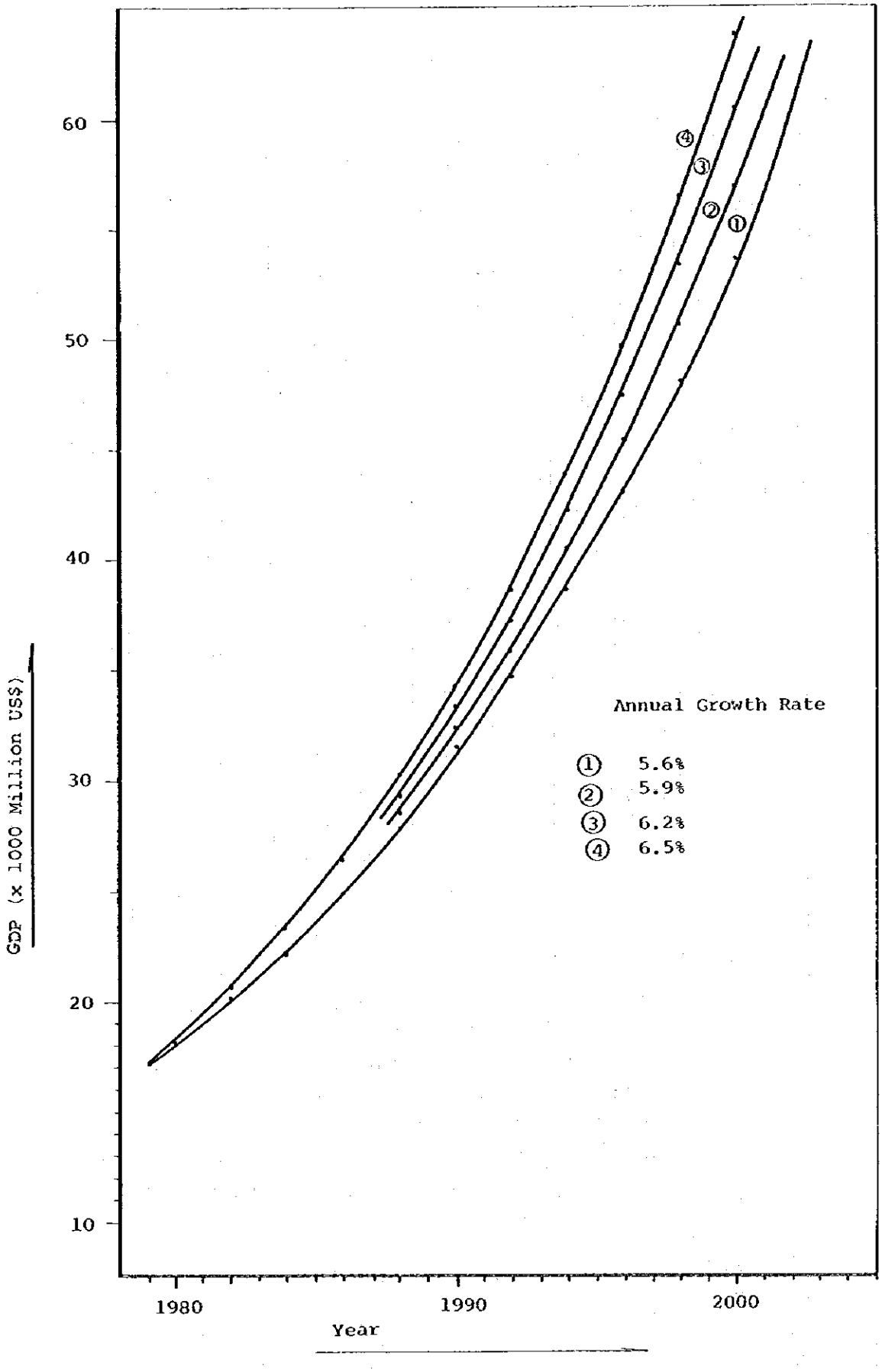


Fig. 2-2-3 Forecast of GDP Growth

2-2-4 World Correlation between Telephone Density and GDP per Capita

As the result of analysis of correlation between telephone density (main telephones per 100 persons) and GDP per capita as of 1979 in 62 main countries of the world, the following equation of correlation can be obtained:

$$Y = 0.0004254 \times 1.20545 \qquad R = 0.90$$

where

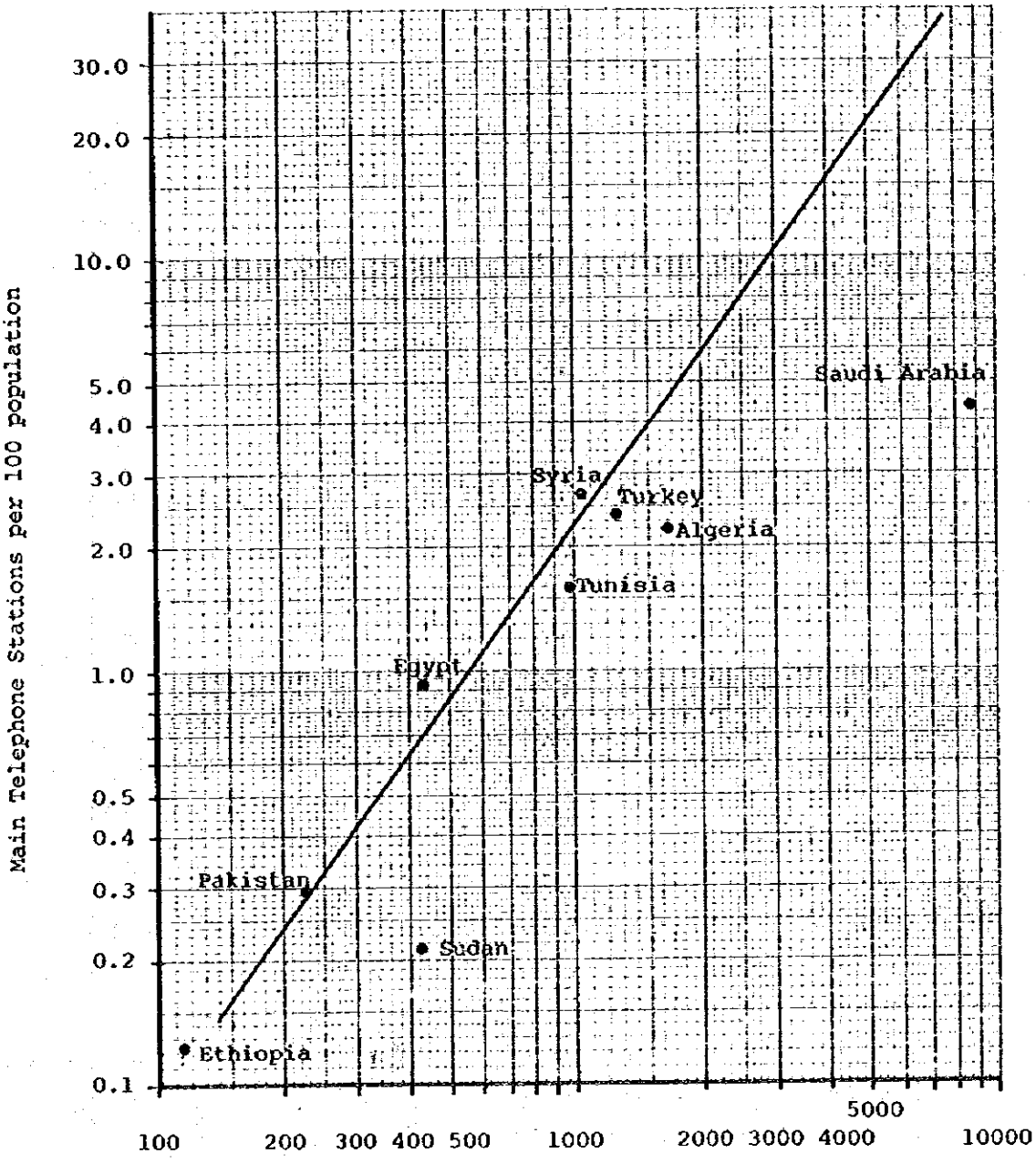
X : Real GDP per capita as of 1979 (in US$)

Y : Number of Main telephones per 100 persons as of 1979

R : Correlation coefficient of X and Y

The above equation is diagrammatically presented in Fig. 2-2-4. In this diagram, the status quo of economies of 8 nearby countries of Egypt, as well as Egypt itself, is also illustrated.

From this diagram, it can be known that the number of main telephones as referred to GDP per capita in Egypt somewhat exceeds the world standard. However, considering that Egypt is a main country of the world, the real number of telephones in the country is smaller than it ought to be. (Refer to Table 2-2-6.)



[by "World's Telephones" (ATT) and "World Development Report, 1981" (World Bank)]

Fig. 2-2-4 Relation between Main Telephones per 100 persons and GDP per capita in the world (1979)

Table 2-2-6 Number of Main Telephones in the Main Countries

Name of Country	Number of Main Telephone Stations	Density (1)
(North America)		
Canada	9,476,902	40.0
U. S. A.	91,260,000	41.2
(Africa)		
Egypt	447,096	1.1
South Africa	1,412,561	5.7
(Europe)		
France	13,870,738	25.9
Greece	2,156,046	22.7
Itary	12,166,049	21.3
Netherlands	4,747,161	33.7
Spain	6,360,840	16.8
Sweden	4,336,409	52.2
United Kingdom	17,716,747	31.7
(South America)		
Argentina	1,929,684	7.2
Bragil	4,268,745	3.4
Colombia	1,242,000	4.7
Mexico	2,382,795	3.3
(South Pacific)		
Australia	4,755,062	33.4
New Zealand	1,102,740	35.0
Singapore	444,231	18.8
(Asia)		
Hong Kong	1,172,530	23.4
Japan	40,082,274	34.4
(Middle East)		
Saudi Arabia	280,491	3.4
Kuwait	139,204	10.5
UAE	84,471	9.5

Note (1) : Main Telephone Stations per 100 population

2-2-5 Present Condition of Telephone Subscriber in Egypt

The number of telephone subscribers (main telephones) throughput Egypt as of the end of 1981 appears in Table 2-2-7.

Telephone subscribers (main telephones) throughput Egypt as of the end of 1981 number approximately 447,000. (This figure is a sum total of subscribers accommodated in automatic switching exchanges and subscribers accommodated in manual switching exchanges.) On the other hand, the estimate population throughput Egypt as of the end of 1981 totals 42,300,000. Hence, the number of main telephones per 100 persons stands at 1.05.

The number of main telephones in each area of the country is given in Table 2-2-8. Comparison in the number of main telephones between Cairo, the capital city of Egypt, and major cities of nearby countries is in Table 2-2-9 and Fig. 2-2-5.

As those tabled and illustrated data indicate, the need for more telephone installations in Egypt is distinct.

Table 2-2-7 (1/3) Existing Telephone Service Condition

	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex.
Cairo No.1	75,000	62,793	2				350	197	1				75,350	62,990	21
" No.2	26,000	15,302	3							10	3	1	26,010	15,305	15
" No.3	30,000	26,159	2										30,000	26,159	13
" No.4	36,000	33,038	2				500	293	1	80	17	2	36,580	33,348	37
" No.5	59,000	49,566	4	920	495	3				858	603	19	60,778	50,664	59
" No.6	44,000	41,685	4	240	73	1				230	140	6	44,470	41,898	38
Total	270,000	228,543	17	1,160	568	4	850	490	2	1,178	763	28	273,188	230,364	173
Alexandria 1	30,000	29,450	2	870	770	3	320	282	2				31,190	30,503	28
" 2	49,000	43,920	5	600	300	1							49,600	44,250	40
El-Alamein										520	350	6	520	350	6
Matruh	1,000	827	1	70	8	1				422	318	12	1,492	1,153	21
Damanhur	3,800	3,721	2	1,700	1,689	3	1,200	1,019	3	3,866	2,872	73	10,566	8,901	195
Total	83,800	77,918	10	3,240	2,398	8	1,520	1,301	5	4,808	3,540	91	93,368	85,157	290

Table 2-2-7 (2/3) Existing Telephone Service Condition

	Automatic			Semi Automatic			Manaul Common Battery			Manual Magnet			Total		
	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex.
Tanta	10,000	9,957	3	600	373	1				4,267	3,374	93	14,867	13,704	188
Kafr el Sheikh	4,400	2,791	2	2,330	1,780	6	400	400	1	3,300	2,260	97	10,430	7,231	173
El Mansura	10,000	8,265	2	5,220	1,745	11	3,360	2,621	10	6,149	4,281	107	24,729	16,912	319
Damietta	4,400	3,802	2	7,340	570	3				879	654	13	6,619	5,026	77
Shibin el Kom	9,800	5,539	5	3,310	1,952	11	2,320	1,400	19	2,597	1,660	116	18,027	10,551	276
Benha	2,000	1,985	1	860	265	2	710	376	4	1,028	787	42	4,098	3,413	76
Zagazig	4,250	4,227	2	2,710	1,709	6	2,414	1,858	16	6,404	5,048	186	15,778	12,842	268
Port Side	10,000	7,278	1	940	726	2	70	50	1				11,010	8,054	11
Suez	2,000	1,917	1	240	149	1	500	472	2	220	120	6	2,960	2,658	21
Ismailia	1,098	1,086	1	360	264	2	1,100	1,032	4	1,077	630	19	3,635	3,012	68
North Sinai							1,100	853	1	150	79	2	1,250	932	7
South Sinai				240	40	1				330	127	4	570	167	6
El Bahar				400	395	1				420	290	3	820	685	6
Total	57,948	46,847	20	18,050	9,968	47	11,974	9,062	58	26,821	19,310	688	114,793	85,187	1,596

Table 2-2-7 (3/3) Existing Telephone Service Condition

	Automatic			Semi Automatic			Manual Common Battery			Manual Magnet			Total		
	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex.	Capacity	Working Line	No.of Ex.
Beni Suef	1,600	1,595	1	2,120	1,875	6				1,345	981	65	5,065	4,451	149
Faiyoum	2,320	2,313	1	1,100	733	3	200	89	2	1,528	1,071	64	5,148	4,206	129
El Minya	4,000	3,922	2	1,920	1,571	5	2,210	1,705	4	2,593	1,652	91	10,723	8,850	177
Sohag	2,800	2,651	2	3,200	2,240	8	400	351	1	3,175	1,684	172	9,575	6,926	270
Asyut	8,000	4,632	1	3,660	3,082	7	462	404	9	2,864	2,336	139	14,986	10,454	206
El Wadi				1,920	1,061	2				605	476	28	2,525	1,537	44
Aswan	2,000	1,996	1	1,300	1,147	2	325	123	2	997	523	61	4,622	3,789	105
Qena	3,000	2,002	2	3,660	3,188	8				1,703	985	92	8,363	6,175	153
Total	23,720		10	18,880	14,897	41	3,597	2,672	18	14,810	9,708	712	61,007	46,388	1,333
G. Total	435,468	372,419	57	41,330	27,831	100	17,941	13,525	73	47,617	33,321	1,519	542,356	447,096	3,402

Table 2-2-8 Telephone Density for Each Areas

Area (1)	No. of Telepohnes (2)	Population (x 1000)	Density (3)
Cairo DC	230,364	15,193	1.5
Tanta DC	163,575	14,931	1.1
Ismailia DC	6,769	1,091	0.6
Asyut DC	46,388	12,443	0.4
Beni Suef	4,451	1,244.3	0.36
Faiyoum	4,206	1,368.7	0.31
El Minya	8,850	2,488.6	0.36
Asyut	10,454	1,990.9	0.53
Sohag	6,926	2,239.7	0.31
Qena	6,175	1,990.9	0.31
Aswan	3,789	746.6	0.51

Notes: (1) Detail of each area is as follows.

- Cairo area : Cairo, Giza, Nasr and Heliopolis
- Tanta area : Whole Lower Egypt without Ismailia area
- Ismailia area : Port Side, Ismailia, Suez and Sinai
- Asyut area : Whole Upper Egypt

(2) This figure is the number of main telepohone stations.

(3) Density is the number of main telephones per 100 populations.

Table 2-2-9 Telephone Density of Main City or Town in nearby Countries

Country	City or Town	Telephone Density
Bahrain	Manama	14.0
	Muharraq	10.1
Israel	Beersheba	14.9
	Haifa	27.5
	Jerusalem	22.6
	Natzareth	7.2
	Tel Aviv	32.7
Kuwait	Kuwait	10.5
Saudi Arabia	Abha	13.8
	Al Khobar	7.4
	Buraydah	5.5
	Damman	8.2
	Hail	8.4
	Jeddah	4.0
	Mecca	4.4
	Yanbu	9.5
Syria	Aleppo	4.0
	Damascus	5.8
	Dar'a	5.5
U.A.E.	Abu Dhabi	14.4
	Ajman	9.4
	Dubai	14.5
	Sharjah	11.5

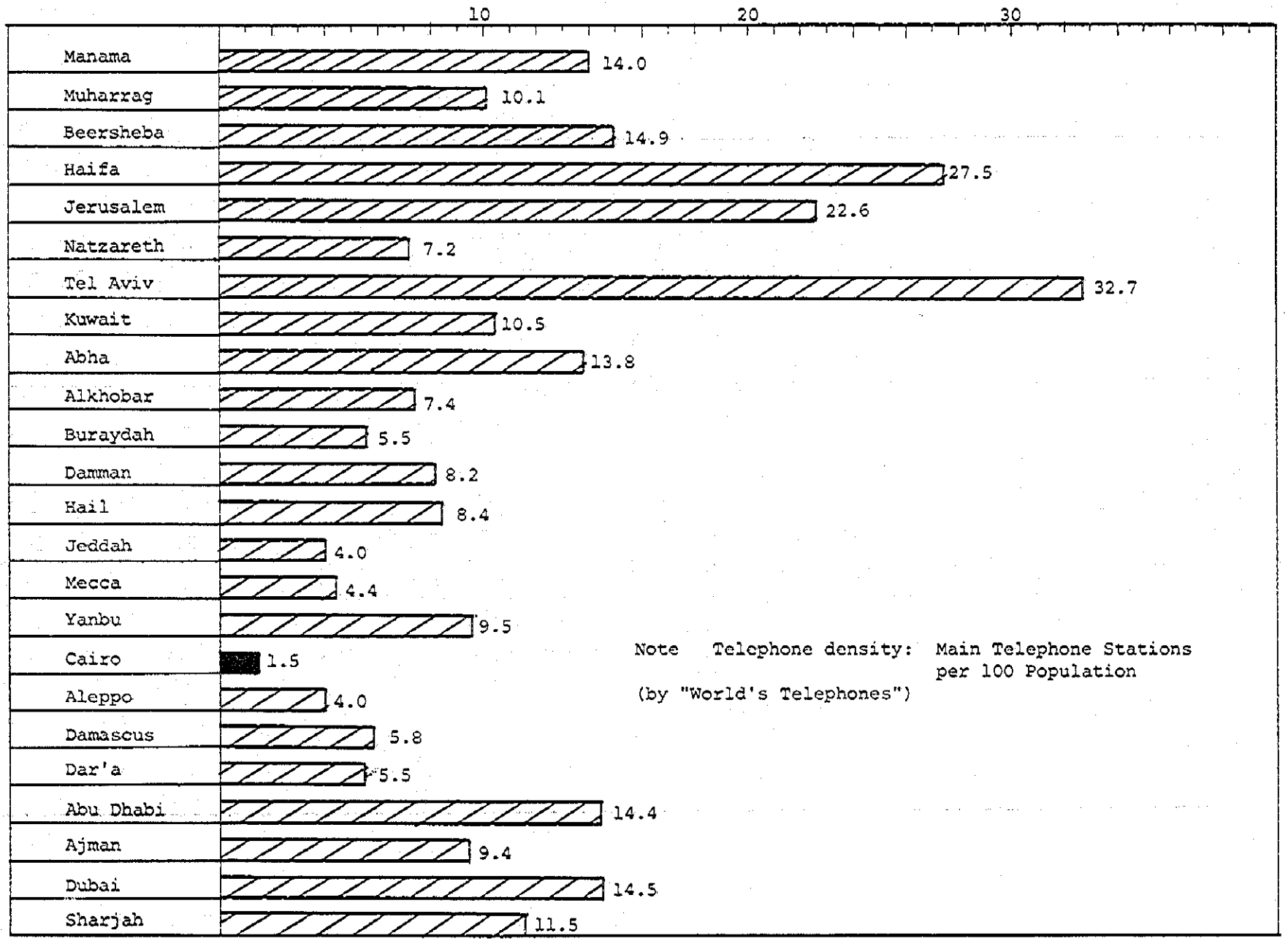


Fig. 2-2-5 Telephone Density of Main City or Town in the Nearby countries and Cairo City

2-2-6 Demand Forecast for Main Telephone Installations

Table 2-2-10 presents the number of telephone installations (main telephones) and the list of waiting subscribers, i.e.,the overall telephone demand, in Egypt up to the present.

From the historical data, the following demand forecast formula can be obtained:

$$Y = 0.0008206\ X^{1.292} \qquad R = 0.94$$

where

X : Forecasted value of GDP per capita in the year of forecast (in US$)

Y : Number of telephones per 100 persons (total of real demand and latent demand)

R : Correlation coefficient of X and Y

Forecasted demand in each year of forecast, obtained by the above formula, is in Table 2-2-11 and Figure 2-2-6.

Also shown in Figure 2-2-6 are correlations between main telephones per 100 persons and GDP per capita as of 1979 on the world basis. Correlations between the number of main telephones per 100 persons and GDP per capita, used in the forecast formula, resemble similar correlations on the world trend. For this reason, the forecast formula is considered to be acceptable.

Table 2-2-10 Existing Telephone Demands

	Direct Exchange Lines (DELs)	Telephones	Registered Waiting List	Total Demand	Telephone Density (1)	Demand Density (2)	Demand Fulfillment
1968	261,628	368,045	15,500	277,128	0.83	0.88	94.4
1969	270,254	379,466	45,500	315,754	0.84	0.98	85.6
1970	287,265	404,302	66,500	354,265	0.87	1.07	81.1
1971	305,000	439,692	95,500	400,500	0.90	1.18	76.2
1972	319,572	541,380	135,376	454,948	0.92	1.32	70.2
1973	327,251	465,064	171,200	498,541	0.93	1.41	65.6
1974	338,024	479,994	201,680	539,704	0.93	1.49	62.6
1975	345,266	497,183	231,108	576,374	0.93	1.56	59.9
1976	352,162	507,113	268,045	620,207	0.93	1.64	56.8
1977	362,403	521,869	329,978	692,381	0.93	1.78	52.3
1978	364,236	524.499	373,485	737,721	0.91	1.85	49.4
1979	382,994	551,511	411,516	794,510	0.93	1.94	48.2

Notes: (1) Telephone Density: DELs per 100 population (Statistical Yearbook 1981)

(2) Demand Density : Total Demand per 100 population (")

Table 2-2-11 Telephone Demand Forecasts

Year	GDP per Capita	Total Demand	Telephone Density
1980	429	875,382	2.07
1981	453	948,739	2.22
1982	472	1,021,597	2.34
1983	490	1,092,210	2.45
1984	513	1,183,078	2.60
1985	536	1,281,330	2.76
1986	560	1,382,532	2.92
1987	585	1,491,512	3.09
1988	611	1,603,627	3.26
1989	639	1,733,910	3.46
1990	668	1,867,881	3.66
1991	699	2,015,932	3.88
1992	731	2,173,327	4.11
1993	765	2,345,767	4.36
1994	801	2,533,721	4.63
1995	839	2,737,783	4.92
1996	879	2,952,850	5.22
1997	921	3,190,695	5.55
1998	966	3,446,308	5.90
1999	1,013	3,720,242	6.27
2000	1,062	4,019,075	6.67
2001	1,114	4,337,520	7.09

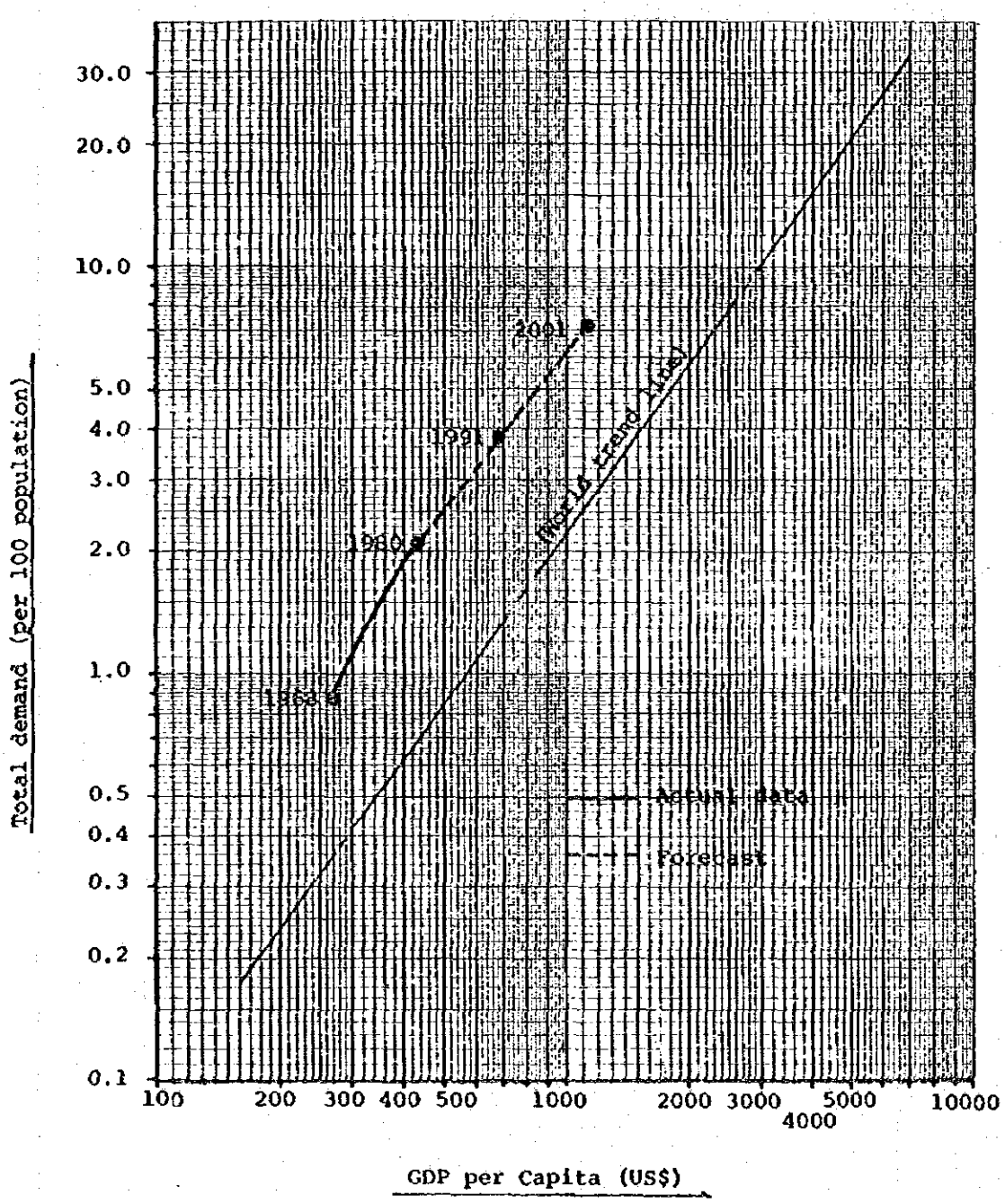


Fig. 2-2-6 Growth of Telephone Demand

2-2-7 Forecasted Demand Distribution to Each Area

The existing rate of main telephones in each area of Egypt against the total, obtained from Table 2-2-7, is as follows:

Cairo area (including Giza):	230,364 (51.5%)
Tanta area (including Alexandria):	154,836 (34.6%)
Ismailia area (including Canal and Sinai):	15,508 (3.5%)
Asyut area (Upper Egypt Area):	46,388 (10.4%)

Estimate population in each area of Egypt as of the end of 1981, based on 1976 census statistics, follows:

Cairo area:	Approx. 14,958,000 (35%)
Tanta area:	" 14,530,000 (34%)
Ismailia area:	" 1,282,000 (3%)
Asyut area:	" 11,966,000 (28%)
Total	" 42,736,000(100%)

Hence, the number of main telephones per 100 persons in each area can be estimated as follows:

Cairo area:	1.54
Cairo City:	4.54
Tanta area:	1.06
Alexandria City:	2.71
Ismailia area:	1.21
Asyut area:	0.39
national average:	1.05

The number of main telephones per 100 persons in each main city of nearby countries and the corresponding number on the national average appear below.

Algeria:	1.4
Alger:	10.3
Sudan:	0.2
Khartoum:	2.0
Bahrain:	9.8
Manama:	14.0
Saudi Arabia:	3.4
Abha:	13.8
Syria:	1.9
Damascus:	4.0
U.A.E.:	9.5
Abu Dhabi:	14.4
Dubai:	14.5

From the foregoing analysis, it can be assumed that, in Egypt also, when the forecasted demand reaches the level of 7.09 main telephones per 100 persons (i.e., in the year 2001), the demand in Cairo area will increase to 15 - 16 in Cario City and around 10 in area average. Thus, for demand distribution to each area, the existing rates of main telephones, wherein the demand in Cairo area as of the year 2001 will reach 10.58 main telephones per 100 persons, are to be applied.

Area by area distributions of forecasted demand by years are given in Table 2-2-12 and demand growth in each area in Fig. 2-2-7.

Table 2-2-12 Demand Distribution for Each Areas

Area	1991		2001	
	No. of Telephones	Density	No. of Telephones	Density
Cairo DC	1,038,205	5.81	2,233,823	10.58
Tanta DC	697,512	4.01	1,500,782	7.34
Ismailia DC	70,558	4.60	151,813	8.39
Asyut DC	209,657	1.46	451,102	2.67
(Asyut DC)				
Ben Suef	18,724	1.30	40,283	2.38
Faiyoum	18,051	1.14	38,840	2.09
El Minya	32,161	1.12	69,199	2.05
Asyut	48,976	2.14	105,377	3.90
Sohag	34,237	1.32	73,665	2.42
Qena	12,286	1.18	26,435	1.97
Luxor	16,353	1.31	35,186	2.59
Aswan	19,417	2.25	41,855	4.13
Abu Simbel	500	1.00	1,000	1.00
Others	8,952	1.24	19,262	2.13

Notes: - No. of Telephones : Main Telephone Stations
- Density : Main Telephone Stations per 100 populations.

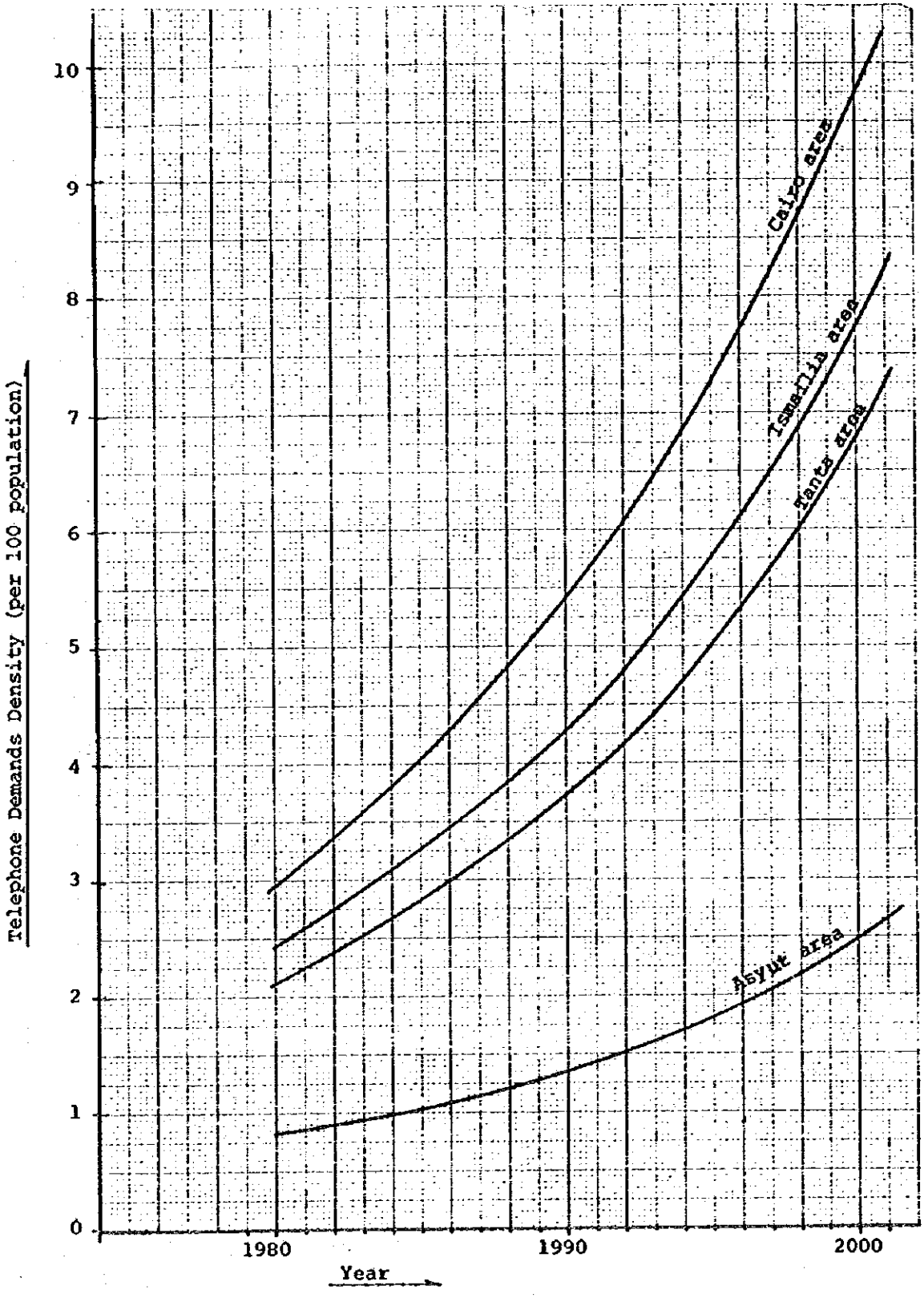


Fig. 2-2-7 Growth of Telephone Demands

2-3 Toll Traffic Forecast by Years

Presently in Egypt, the most part of long distance call service (hereinafter referred to as "LDC" service) is operator-assisted semi-automatic or manual service except in specific areas, such as Cairo and Alexandria areas.

Naturally, in the national telephone network for long distance call (hereinafter referred to as "LD" network), no definite hierarchy exists.

Now, in various places, the work is in progress to realize subscriber's trunk dialling service (hereinafter referred to as "STD" service) so that, in the not long future, full automatic toll telephone service will come true. Judging from the national numbering plan (Annex 2-2) now in effect, it can be safely assumed that with the completion of STD service system, the LD network with the fundamental hierarchy as shown in Fig. 2-3-1 will come into existence.

The LD network throughout Egypt in the future will be operated, centering upon four - Cairo, Tanta, Ismailia and Asyut - District Centers (DC), as shown in Fig. 2-3-2, whereas the operation of LD network in Upper Egypt will center upon Asyut toll Exchange as shown in Fig. 2-3-3 and 2-3-4. Outline of each area is shown in Annex 2-3.

Therefore, the calculation of toll traffic in this project is made, based on Fig. 2-3-1, 2-3-2, 2-3-3 and 2-3-4 and by means of the following processes:

1) To estimate the originating toll calling rate;
2) To calculate the originating toll calling traffic in each area by years;
3) To estimate the inter-area traffic flow by years.

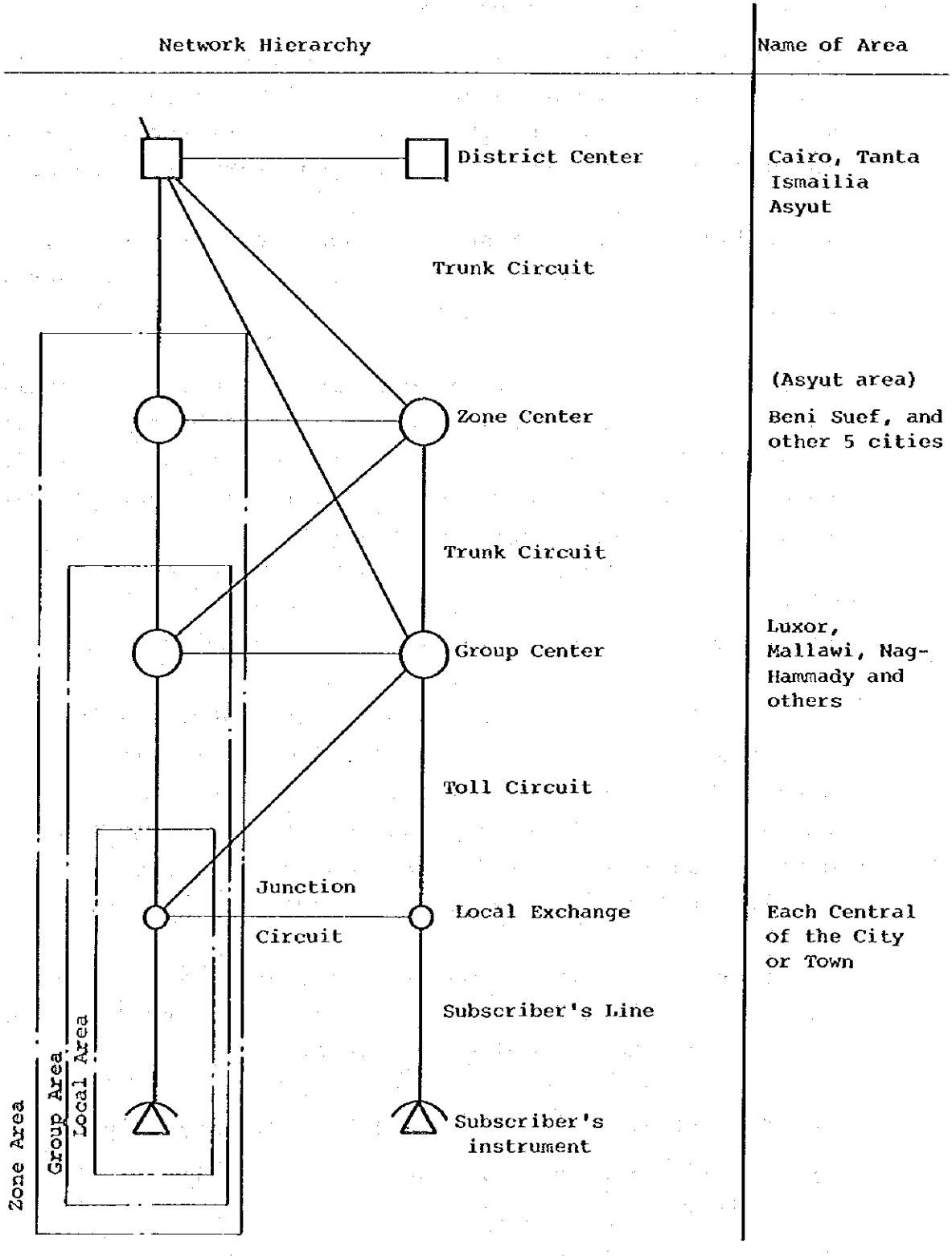


Fig. 2-3-1 Network Hierarchy

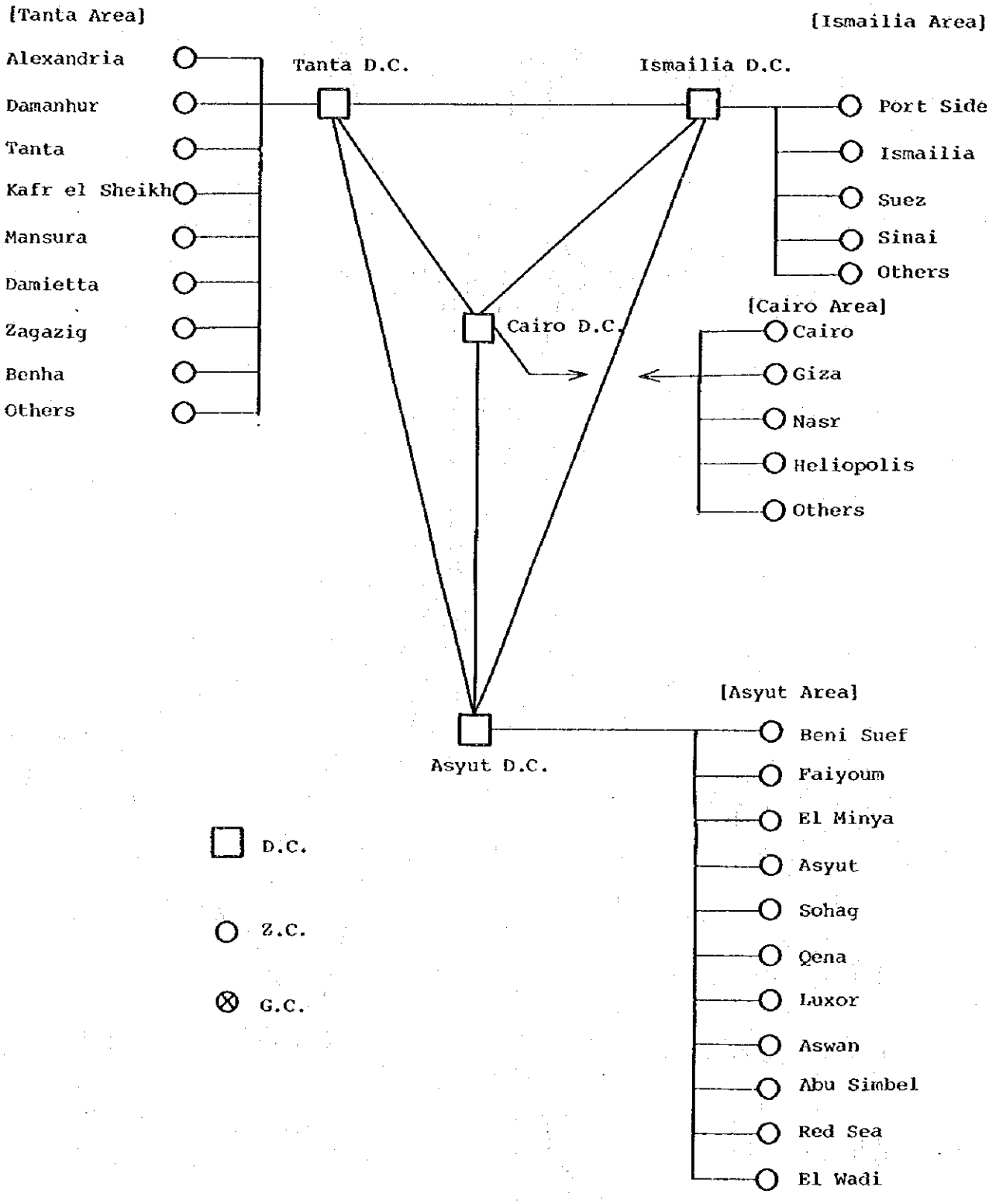


Fig. 2-3-2 LDC Service Network in Egypt

(at the End of Improvement Program for STD Service Facilities)

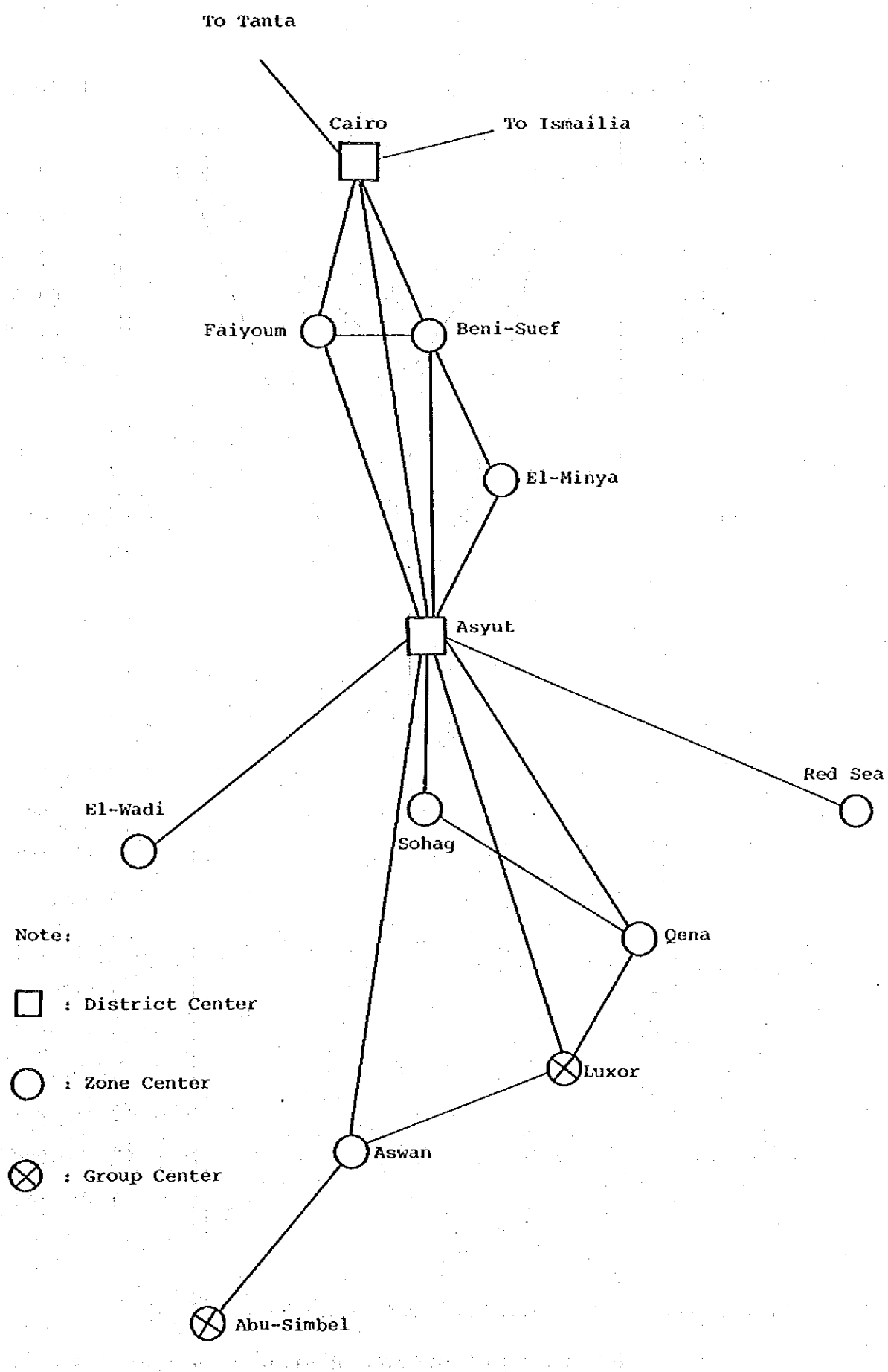


Fig. 2-3-3 LDC Service Network in Upper Egypt

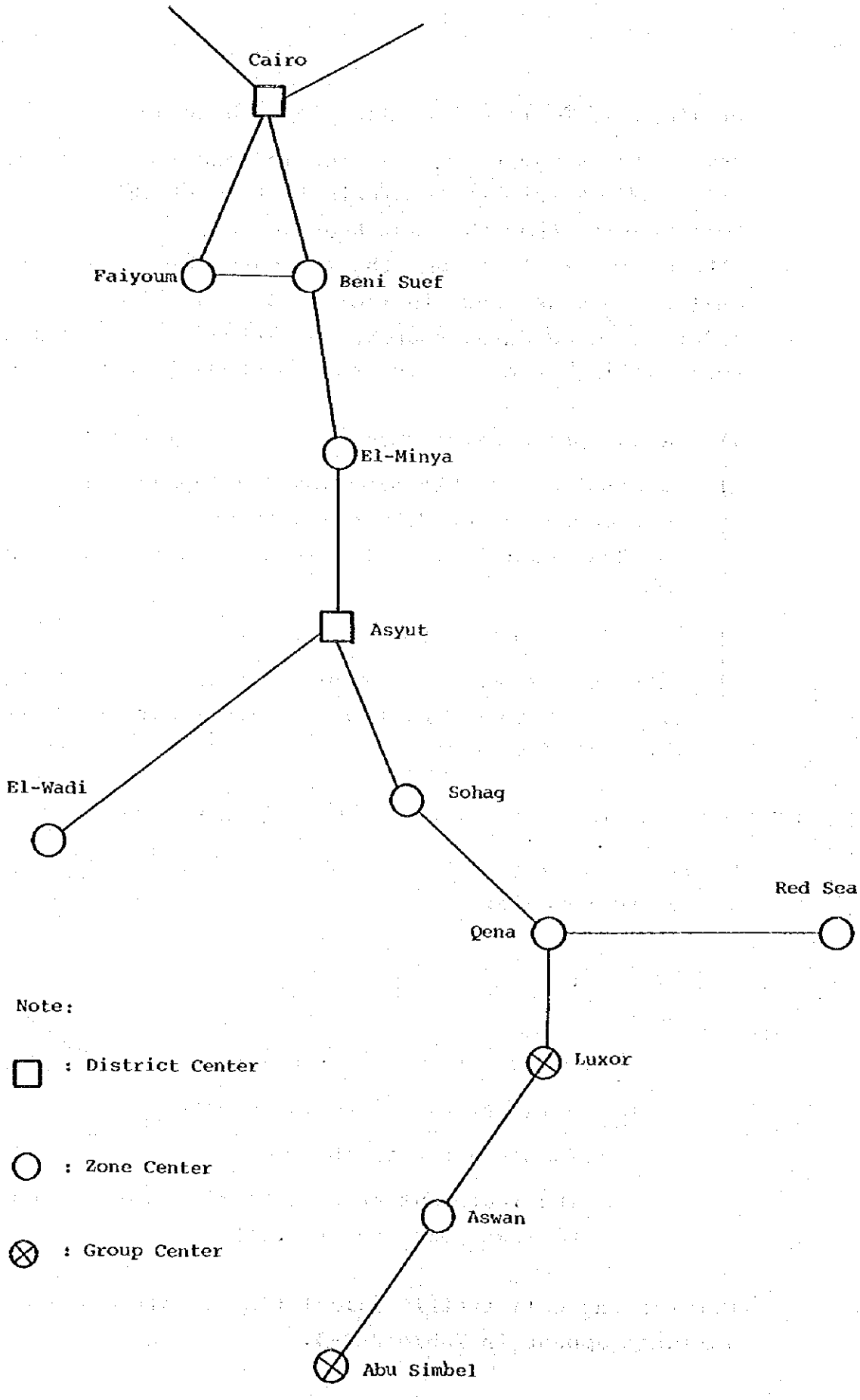


Fig. 2-3-4 LDC Service Network Routing in Upper Egypt

2-3-1 Originating Toll Calling Rate in Each Area

Presently in Egypt, STD service is seldom or never in practice, so that it is difficult to estimate the future toll traffic from the past traffic data. The alternative is to assume the standard originating toll calling rate as shown in Table 2-3-1, based on the undermentioned data, whereby to estimate the originating toll calling rate in each area as shown in Table 2-3-2.

1) "A Telephone Development Project" (by ITU)
2) "Seminar on the Planning and Development of Telecommunication Networks Outside of Large Cities and Maintenance of Telecommunication Services" (by ITU)
3) "Local Network Planning" (by ITU)
4) "The Arab Republic of Egypt Feasibility Study Report on Alexandria PCM Microwave Network Construction Project" (by JICA)

2-3-2 Originating Toll Traffic in Each Area by Years

Originating toll traffic can be calculated by the following formula:

$$A_T = CR_T \cdot S$$

where

A_T : Originating toll traffic

CR_T: Originating Toll calling rate

S : Number of subscribers

(Estimate number of subscribers distributed to each year of forecast)

Originating toll traffic calculation results by years of forecast appear in Table 2-3-3.

Table 2-3-1 Estimated Originating CR for Subscriber's Trunk Dialling Call

Subscriber Lines	STD OCR
0 - 1,000	0.008
1,001 - 2,000	0.007
2,001 - 5,000	0.006
5,001 - 8,000	0.005
8,001 - 15,000	0.004
15,001 - 30,000	0.003
30,001 - 50,000	0.002
50,001 -	0.001

(Erlangs per subscriber)

Table 2-3-2 Estimation of Originating Trunk Calling Rate

Area	Total DELs.	No. of Exchanges	Average DELs per Exchange	Trunk CR per DEL
Cairo	1,038.205	38	27,321	0.003
Tanta	697.512	57	12,237	0.004
Ismailia	70,558	8	8,820	0.004
(Asyut)				
Beni Suef	18,724	3	6,241	0.005
Faiyom	18,051	1	18,051	0.003
El Minya	32,161	3	10,720	0.004
Asyut	48,237	3	16,079	0.003
Sohag	34,237	3	11,412	0.004
Qena	12,286	2	6,143	0.005
Luxor	16,353	3	5,451	0.005
Aswan	19,417	2	9,709	0.004
Abu Simbel	500	1	500	0.008
Red Sea	2,096	1	2,096	0.007
El-Wad:	6,856	1	6,856	0.005

Note: 1. DEL: Direct Exchange Line (Main Telephone Station)
2. Total DELs: Total Demand as of 1991
3. No. of Exchange is estimated by as follows:
- No. of existing Exchanges
- Location of existing Exchanges
- Service area of each Exchanges

Table 2-3-3 Total Originating Toll Traffic

Area	1991	2001
Cairo DC	3,114	6,701
Tanta DC	2,790	6,003
Ismailia DC	282	607
(Asyut DC)		
Beni Suef	93	201
Faiyoum	54	116
El Minya	128	276
Asyut	146	316
Sohag	136	294
Qena	61	132
Luxor	81	175
Aswan	7	167
Abu Simbel	4	8
Red Sea	14	31
El Wadi	34	73

2-3-3 Inter-Area Traffic Flow by Years

Inter-area traffic flow in each year of forecast can be estimated by means of distribution of originating toll traffic in each year of forecast by the following distribution formula:

$$A_{ij} = A_i \cdot R_{ij} \cdot R_T$$

$$R_{ij} = \frac{Z_{ij}}{\sum_{j=1}^{n} \cdot Z_{ij}}$$

$$= \frac{\dfrac{A_j}{D_{ij}^{\alpha}}}{\dfrac{A_1}{D_{i1}^{\alpha}} + \dfrac{A_2}{D_{i2}^{\alpha}} + \cdots \dfrac{A_j}{D_{ij}^{\alpha}} + \cdots \dfrac{A_n}{D_{in}^{\alpha}}}$$

(CCITT - GAS 5)

where

A_{ij} : Originating traffic flow from Exchange i to Exchange j

A_i : Total originating toll traffic of Exchange i

R_{ij} : Traffic distribution ratio between Exchanges i and j

D_{ij} : Distance between Exchanges i and j

α : Constant (0.5 - 1)

R_T : Overload coefficient (This time, 1.2)

(For D_{ij} is used the highway distance by "Lehnert & Landrock Cairo" 1/750,000 map.)

Calculation result for each year of forecast appears in Table 2-3-4.

Table 2-3-4 (1/4) Traffic Distribution (DC-DC) at 1991

	Cairo DC IC/OG	Tanta DC IC/OG	Ismalia DC IC/OG	Asyut DC IC/OG
1. Beni Suef	74.33/56.42	45.89/25.00	3.29/1.96	36.62/28.22
2. Faiyoum	50.16/30.90	25.91/16.72	2.01/1.12	22.21/16.06
3. El Minya	75.94/65.28	43.77/38.84	3.68/2.70	64.86/46.78
4. Asyut	69.18/69.87	41.90/40.96	3.59/2.93	74.16/61.44
5. Sohag	57.88/59.43	32.65/37.77	3.04/2.55	53.30/63.45
6. Qena	22.72/24.27	11.85/16.45	1.22/1.04	26.36/31.44
7. Luxor	28.95/32.98	15.67/21.37	1.56/1.41	31.91/41.44
8. Aswan	24.00/31.41	11.97/20.59	1.32/1.34	25.31/39.06
9. Abu Simbel	1.19/ 1.68	0.63/ 0.71	0.06/0.08	1.5 / 2.38
10. Red Sea	4.14/ 7.23	3.18/ 6.21	0.34/0.74	1.11/ 2.62
11. El Wadi	18.12/20.55	14.15/14.53	0.98/1.06	3.21/ 4.66

Table 2-3-4 (2/4) Traffic Distribution (Upper Egypt Area) at 1991

From \ To		1. Beni Suef	2. Faiyoum	3. El Minya	4. Asyut	5. Sohag	6. Qena	7. Luxor	8. Aswan	9. Abu Simbel	10. Red Sea	11. El Wadi	Total
1.	Beni Suef	-	3.47	7.17	6.86	4.36	1.76	2.27	1.96	0.10	0.05	0.22	28.22
2.	Faiyoum	3.21	-	3.63	3.58	2.28	0.93	1.20	1.04	0.05	0.03	0.11	16.06
3.	El Minya	7.25	3.92	-	14.51	8.80	3.44	4.38	3.69	0.20	0.12	0.47	46.78
4.	Asyut	7.65	4.29	16.58	-	15.00	5.13	6.39	5.16	0.26	0.17	0.81	61.44
5.	Sohag	6.72	3.80	13.96	19.74	-	5.86	6.95	5.33	0.26	0.20	0.63	63.45
6.	Qena	2.82	1.61	5.75	7.35	6.08	-	4.53	2.79	0.14	0.14	0.23	31.44
7.	Luxor	3.89	2.22	7.89	9.88	7.73	4.83	-	4.32	0.20	0.16	0.32	41.44
8.	Aswan	3.84	2.21	7.78	9.42	6.80	3.42	4.96	-	0.24	0.11	0.28	39.06
9.	Abu Simbel	0.22	0.12	0.44	0.52	0.36	0.17	0.24	0.27	-	0.02	0.02	2.38
10.	Red Sea	0.22	0.12	0.38	0.45	0.47	0.29	0.33	0.22	0.02	-	0.12	2.62
11.	El Wadi	0.80	0.45	1.28	1.85	1.42	0.53	0.66	0.53	0.03	0.11	-	7.66
	Total	36.62	22.21	64.86	74.16	53.30	26.36	31.91	25.31	1.50	1.11	3.21	340.55

Table 2-3-4 (3/4) Traffic Distribution (DC-DC) at 2001

	Cairo DC IC/OG	Tanta DC IC/OG	Ismalia DC IC/OG	Asyut DC IC/OG
1. Beni Suef	169.74/112.90	90.26/62.94	7.12/4.23	78.85/ 61.13
2. Faiyoum	108.32/ 66.70	56.68/35.33	4.34/2.40	47.79/ 34.77
3. El Minya	163.30/140.26	93.48/84.05	7.90/5.80	139.81/101.09
4. Asyut	150.56/147.68	84.75/92.92	7.71/6.28	159.29/132.32
5. Sohag	125.56/128.62	71.36/81.07	6.59/5.50	114.77/137.61
6. Qena	49.49/ 52.78	26.75/34.80	2.66/2.26	57.03/ 68.56
7. Luxor	62.90/ 71.56	35.15/45.23	3.40/3.06	69.08/ 90.15
8. Aswan	52.04/ 68.02	35.96/44.60	2.86/2.90	54.69/ 84.88
9. Abu Simbel	2.37/ 3.36	1.01/ 1.42	0.14/0.15	2.96/ 4.73
10. Red Sea	10.53/ 19.22	5.97/10.63	0.75/0.71	2.31/ 6.64
11. El Wadi	39.11/ 50.74	20.48/23.57	2.09/1.84	6.75/11.45

Table 2-3-4 (4/4) Traffic Distribution (Upper Egypt Area) at 2001

From \ To		1. Beni Suef	2. Faiyoum	3. El Minya	4. Asyut	5. Sohag	6. Qena	7. Luxor	8. Aswan	9. Abu Simbel	10. Red Sea	11. El Wadi	Total
1.	Beni Suef	-	7.53	15.48	14.78	9.48	3.84	4.96	4.26	0.21	0.12	0.47	61.13
2.	Faiyoum	6.96	-	7.83	7.70	4.96	2.03	2.62	2.26	0.11	0.06	0.24	34.77
3.	El Minya	15.65	8.45	-	31.10	19.24	7.48	9.51	8.00	0.38	0.27	1.01	101.09
4.	Asyut	16.47	9.21	35.51	-	32.38	11.13	13.83	11.15	0.52	0.38	1.74	132.32
5.	Sohag	14.61	8.25	30.18	42.63	-	12.78	15.21	11.62	0.53	0.44	1.36	137.61
6.	Qena	6.17	3.51	12.50	15.94	13.30	-	9.95	6.11	0.27	0.30	0.51	68.56
7.	Luxor	8.48	4.83	17.10	21.38	16.89	10.61	-	9.45	0.38	0.35	0.68	90.15
8.	Aswan	8.37	4.79	16.84	20.36	14.83	7.49	10.85	-	0.50	0.26	0.59	84.88
9.	Abu Simbel	0.44	0.26	0.87	1.04	0.72	0.35	0.48	0.52	-	0.02	0.03	4.73
10.	Red Sea	0.59	0.34	1.24	1.45	1.10	0.57	0.71	0.50	0.05	-	0.12	6.64
11.	El Wadi	1.11	0.62	2.26	2.91	1.87	0.75	0.96	0.82	0.17	0.10	-	11.45
	Total	78.85	47.79	139.81	159.29	114.77	57.03	69.08	54.69	2.96	2.31	6.75	733.33

2-4 Number of Circuits Required by Years

The number of circuits required in each year of forecast consists of the number obtained by the following Erlang B loss formula plus 20% as circuits for non-voice communication services as stated in Paragraph 2-1:

$$En\ (A) = \frac{\frac{A^n}{n!}}{\sum_{i=0}^{n} \frac{A^i}{i!}}$$

where

En (A) : Allowable call loss rate
(This time, 1/1,000)

A : Traffic

n : Number of circuits

For actual calculation, the following recurrence formula is used:

$$En\ (A) = \frac{A \cdot En-1(A)}{N + A.En-1(A)}$$

The existing telephone network in Upper Egypt is to connect destinations directly as shown in Fig. 2-4-1 This is because the toll transit switching facility does not exist in Asyut Exchange to become the District Center in Upper Egypt.

Realization of STD service by this project is bound to increase toll traffic broadly. (Usually, the traffic increase after the coming into practice of automatic telephone service is to 2 - 2.4 times.) Therefore, from the viewpoint of engineering economy for toll transmission system, toll transit switching facility should preferably be installed in Asyut Exchange.

Considering the status quo of Asyut Exchange but to hasten improvement of telephone service in Upper Egypt, the time for installing toll transit switches in Asyut Exchange will be between 1991 and 1995.

The number of circuits required as of 1991 is calculated on the assumption that the connections with distant offices will be by direct trunks as in the existing network. Calculation of circuits required as of 2001 is made, assuming that all connections will be via toll transit switches of Asyut Exchange.

Calculation results appear in Fig. 2-4-2.

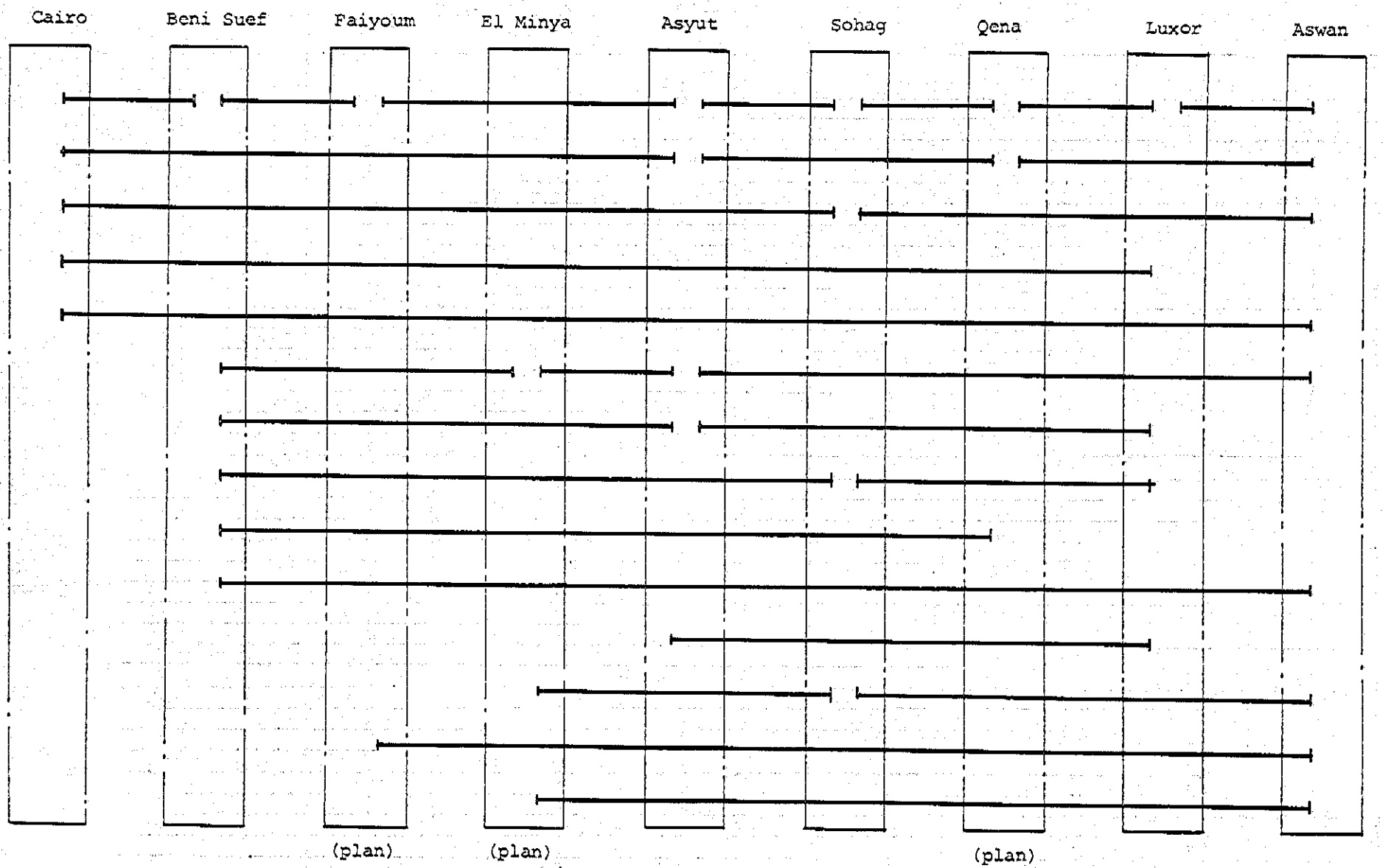


Fig. 2-4-1 Existing Condition of Trunk Circuits on Automatic Exchanges

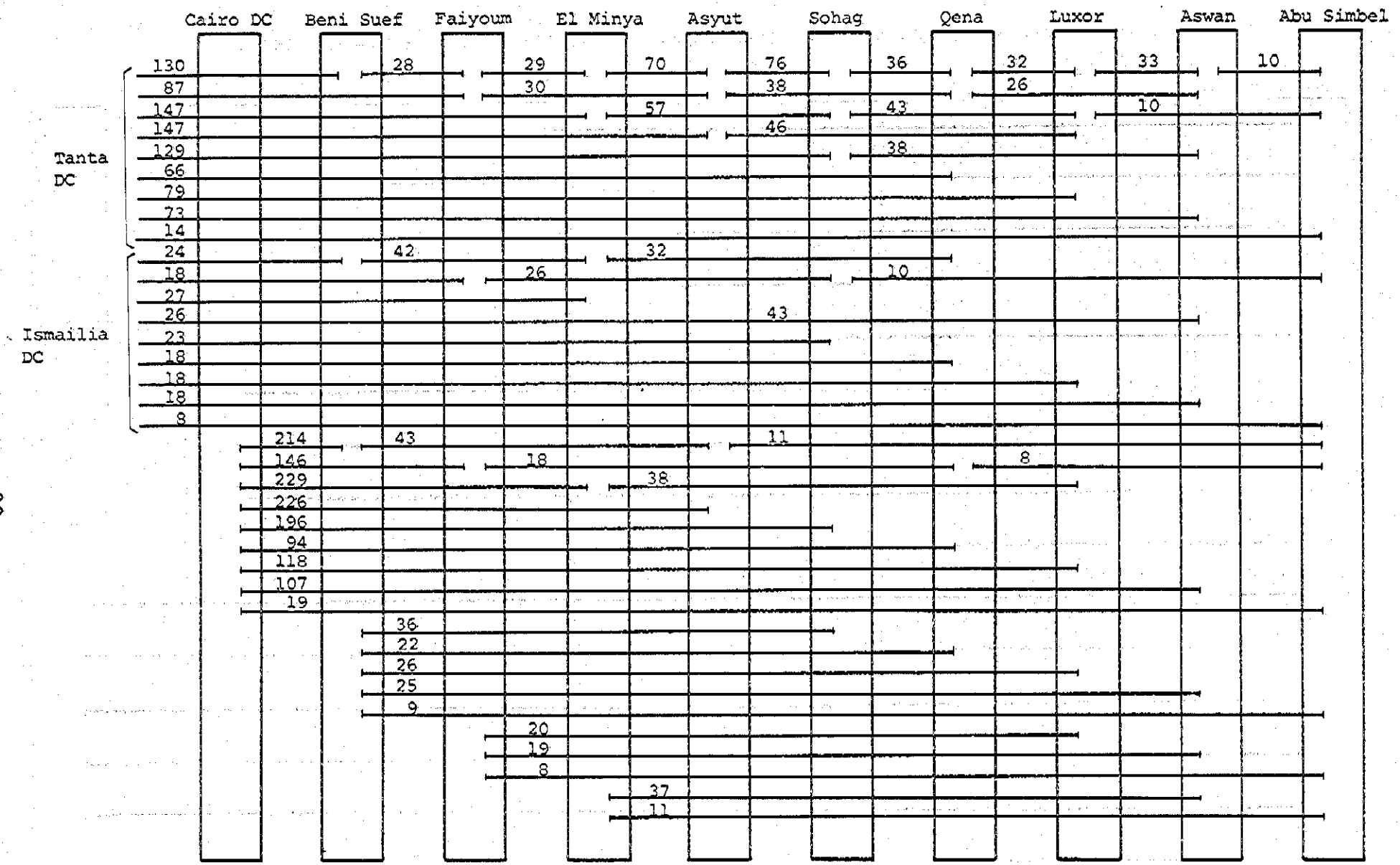


Fig. 2-4-2 (1/2) Circuits Required (at 1991) for Microwave Telecommunication Network on the Upper Egypt

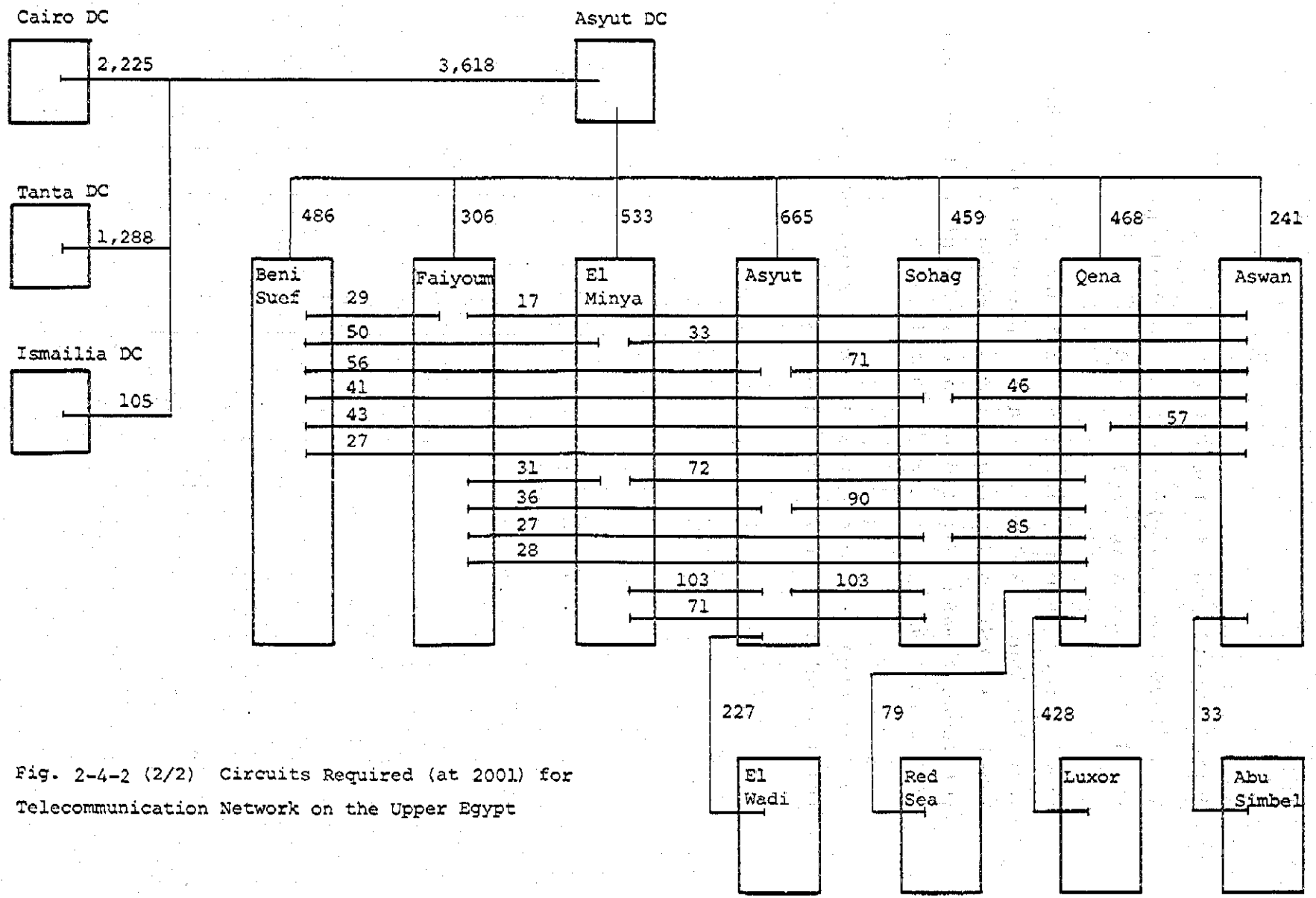


Fig. 2-4-2 (2/2) Circuits Required (at 2001) for Telecommunication Network on the Upper Egypt

2-5 Demand Fulfillment in the Future

As of 1979, the telephone demand fulfillment rate in Egypt is 48.2% as shown in Table 2-2-10.

ARENTO, for its part, is ready to increase telephone installations. ARENTO's plan is introduced in Table 2-5-1. If this plan progresses as scheduled, the telephone demand fulfillment rate in Egypt will be upwards of 90% in 1990 and attain to 100% in 1995.

In this project, however, 100% LDC service demand fulfillment in 1991 is intended.

Table 2-5-1 Expansion Plan of Telephone Facilities

ESS Expansion Plan

	1985	1990	1995	2000
ESS	1,042,200	1,178,800	1,203,800	760,050
Annual Growth	208,440	235,760	240,760	152,010

(Lines)

Expansion Plan for Upper Egypt (including ESS Plan)

Area	1985	1990	1995	2000
Beni Suef	9,300	14,500	19,600	23,800
Faiyoum	8,000	13,000	18,000	22,000
El Minya	17,000	25,200	33,800	42,000
Asyut	18,400	26,700	35,100	42,700
Sohag	8,700	14,000	18,800	23,600
Qena	10,500	16,900	23,100	29,800
Aswan	9,700	15,200	20,400	25,100
Total	81,600	125,500	168,800	209,000