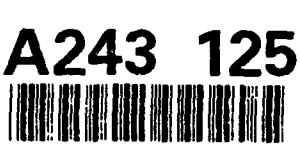

(2)

NAVAL POSTGRADUATE SCHOOL

Monterey, California

AN OVERVIEW OF THE SAUDI ARABIAN
TELECOMMUNICATIONS SYSTEM

by

Saeed Abdullah Al-Gahtani

December, 1990

Thesis Advisor: Myung W. Suh

Unclassified

Security Classification of this page

REPORT DOCUMENTATION PAGE

1a Report Security Classification UNCLASSIFIED	1b Restrictive Markings
2a Security Classification Authority	3 Distribution Availability of Report
2b Declassification/Downgrading Schedule	Approved for public release; distribution is unlimited.
4 Performing Organization Report Number(s)	5 Monitoring Organization Report Number(s)
6a Name of Performing Organization: Naval Postgraduate School; 6b Office Symbol (*If Applicable*): 32	7a Name of Monitoring Organization: Naval Postgraduate School
6c Address (*city, state, and ZIP code*): Monterey, CA 93943-5000	7b Address (*city, state, and ZIP code*): Monterey, CA 93943-5000
8a Name of Funding/Sponsoring Organization; 8b Office Symbol (*If Applicable*)	9 Procurement Instrument Identification Number
8c Address (*city, state, and ZIP code*)	10 Source of Funding Numbers: Program Element Number; Project No; Task No; Work Unit Accession No

11 Title (*Include Security Classification*) AN OVERVIEW OF THE SAUDI ARABIAN TELECOMMUNICATIONS SYSTEM

12 Personal Author(s) Al-Gahtani, Saeed Abdullah

13a Type of Report	13b Time Covered	14 Date of Report (*year, month,day*)	15 Page Count
Master's Thesis	From To	1990, December	76

16 Supplementary Notation The views expressed in this paper are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17 Cosati Codes		
Field	Group	Subgroup

18 Subject Terms (*continue on reverse if necessary and identify by block number*)
Saudi Arabia; Post, Telegraaph and Telephone; telecommunication system; telephone system; telegraph

19 Abstract (*continue on reverse if necessary and identify by block number*

This thesis presents an overview of Saudi Arabian telecommunications system. The first chapter provides the reader with necessary background about Saudi Arabia's economy and geography. The second chapter contains historical background of the world's and Saudi telecommunications and lists stages of development that the Saudi system went through. The third chapter describes Saudi Arabian current telecommunications system and its major components. The fourth chapter discusses the strategies and goals for the Saudi telecommunications sector and lists the major programs that will be implemented from 1991 to 1995. Finally, the fifth chapter provides a general summary.

20 Distribution/Availability of Abstract	21 Abstract Security Classification	
[X] unclassified/unlimited [ ] same as report [ ] DTIC users	Unclassified	
22a Name of Responsible Individual: M. W. Suh	22b Telephone (*Include Area code*): (408) 646-2637	22c Office Symbol: AS/Su

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted

All other editions are obsolete

security classification of this page Unclassified

Approved for public release; distribution is unlimited.

An Overview of the Saudi Arabian Telecommunications System

by

Saeed Abdullah Al-Gahtani
Captain, Royal Saudi Air Defence Forces
B.S., Arizona State University, 1983

Submitted in partial fulfillment of the requirements for the degree of

Master of Science in Telecommunication System Management

from the

Naval Postgraduate School
December 1990

Authors: _____
Saeed Abdullah Al-Gahtani

Approved by: _____
Myung W. Suh, Thesis Advisor

_____
Cynthia H. Dresser, Second Reader

_____
David R. Whipple, Chairman
Department of Administrative Sciences

ABSTRACT

This thesis presents an overview of Saudi Arabian telecommunications system. The first chapter provides the reader with necessary background about Saudi Arabia's economy and geography. The second chapter contains historical background of the world's and Saudi telecommunications and lists stages of development that the Saudi system went through. The third chapter describes Saudi Arabian current telecommunications system and its major components. The fourth chapter discusses the strategies and goals for the Saudi telecommunications sector and lists the major programs that will be implemented from 1991 to 1995. Finally, the fifth chapter provides a general summary.

TABLE OF CONTENTS

ACKNOWLEDGMENTS

I would like to thank my thesis advisor Prof. Myung W. Suh and my second reader Prof. Cynthia Dresser for their help and assistance. I also thank my wife for her continuous support and encouragement all through my stay at NPS.

I also thank the following for their help in collecting information and references for my thesis: Lt. Gen. Nahis F. Al-Mohammady; Col. Zuhair H. Al-Amary; Mr. Zuhair Al-Mosalem, General Manager for telephone; MOPTT Public Relations Manager; Mr. Adel Obaid and library staff in West Region Directorate in Jeddah.

I wish to acknowledge the following for their assistance and help in making life easier at NPS: Prof. D. C. Boger, my Academic Associate; the Electronics and Communications Curricular Office staff; the International Officer staff; and Ms. Hania La Born, my thesis typist.

I. INTRODUCTION

Telecommunications systems form the backbone of the national economy in every country. The Kingdom of Saudi Arabia, as a leader of the Arab and Islamic world and a major player in world affairs, considers telecommunications systems as an essential element of its national infrastructure.

Saudi Arabia now has one of the most advanced telecommunications networks in the world. That was accomplished in a very short time period compared to other industrialized countries. The objective of this thesis is to review the development of current telecommunications networks in Saudi Arabia and its telecommunications strategies for the future.

A. GEOGRAPHY OF SAUDI ARABIA

Saudi Arabia lies like a wedge between the continents of Africa and Asia, in the heart of the Arabian Peninsula. It is separated from Africa by the Red Sea. It borders on Kuwait, Iraq and Jordan to the north, and Yemen and Oman to the south. To the east it borders the Arabian Gulf, Qatar, and United Arab Emirates, and to the west, the Red Sea.

Saudi Arabia is the largest nation in the Middle East, occupying nearly nine-tenths of the Arabian Peninsula. It is a large country that sprawls over an area of 2,240,000 square kilometers (875,000 square miles), about one-quarter of the U.S.A. The major west coast port of Jeddah is 1,500 kilometers (937 miles) from the east coast port of Dammam. The northern border town

of Turaif is a 3,500 kilometers (2187 miles) drive from Jizan, the southern border.

On the Red Sea, the western coastal plan extends about 1,450 km (906 miles). Asir, the southern highlands rise from the coastal plain to heights of 3,133 m (10,279 ft.). In the north, mountains reaching 610 m. (2,000 ft.) separate the coastal plan from the rest of the country.

The central plateau rises up to 1,670 meters (6,500 ft.) in elevation and is about 485 km. (303 miles) wide. The plateau is ringed by Nafud desert to the north, Dahna desert to the east, and the Tuayq Mountains to the south.

In the east, along the Arabian Gulf coast, the coastline is about 565 km (353 miles) long. It contains a predominance of sedimentary rocks which contain the nation's petroleum reserves. In the southeastern part of the country is a desert known as Rub Alkhali or Empty Quarter.

B. CLIMATE OF SAUDI ARABIA

Saudi Arabia has remarkable variation in the climate depending on the various regions of the nation. The Continental climate is found in the north and central regions where winters are cool and summers are quite hot. Humidity is high on the coasts but the seasonal variations in temperature are moderate. In the mountainous southwest, the climate is cooler and rainfall is greater than in the rest of the country. (Table 1 shows the average mean temperature in selected cities in 1985).

The country has no permanent rivers or bodies of water due to the sparsity of rainfall. Wadis or intermittent streams flow following the rain, especially in the southwest where rainfall may amount to more than 280 mm

(11 in.) per year. Most of the other areas get about 100 mm (4 in.) of rainfall a year.

TABLE 1. AVERAGE MEAN TEMPERATURE IN SELECTED CITIES (1985)

	Average Mean Temperature (Centigrade/Fahrenheit)				
Month	**Riyadh**	**Jeddah**	**Dahran**	**Taif**	**Khamis Mushait**
January	16.9/62.4	24.5/76.1	16.9/62.4	17.2/63.0	13.3/55.9
February	15.5/59.9	22.6/72.6	15.8/59.7	15.7/78.3	13.9/57.0
March	20.9/69.6	25.6/78.1	19.7/67.5	21.2/70.2	17.4/63.3
April	26.0/78.8	27.7/81.9	25.6/78.1	19.0/66.2	17.6/63.7
May	31.8/89.2	30.4/86.7	33.5/92.3	23.2/73.8	22.4/65.8
June	34.4/93.9	30.7/87.3	33.5/92.3	28.3/83.0	22.4/72.3
July	35.4/95.7	31.5/88.7	36.3/97.3	27.9/82.2	22.8/73.0
August	36.5/97.7	31.8/89.2	34.7/94.5	29.3/84.7	23.2/73.8
September	32.7/90.9	30.6/87.1	31.9/89.4	27.7/81.9	21.8/71.2
October	27.7/81.9	28.6/83.5	27.7/81.9	23.4/74.1	18.4/65.1
November	22.8/73.0	27.1/80.8	23.5/74.3	19.0/66.2	15.9/60.6
December	15.1/59.2	25.0/77.0	17.3/63.1	15.3/59.5	13.4/56.1

Source: General Meteorological Department, Saudi Arabia.

C. REGIONS OF SAUDI ARABIA

Saudi Arabia is divided into six distinct regions. These are the Eastern Region, the Northern Region, the Western Region, the Southwestern Region, the Central Region, and the Rub al-Khali (Empty Quarter). (Figure 1 is a map of the major cities in Saudi Arabia).

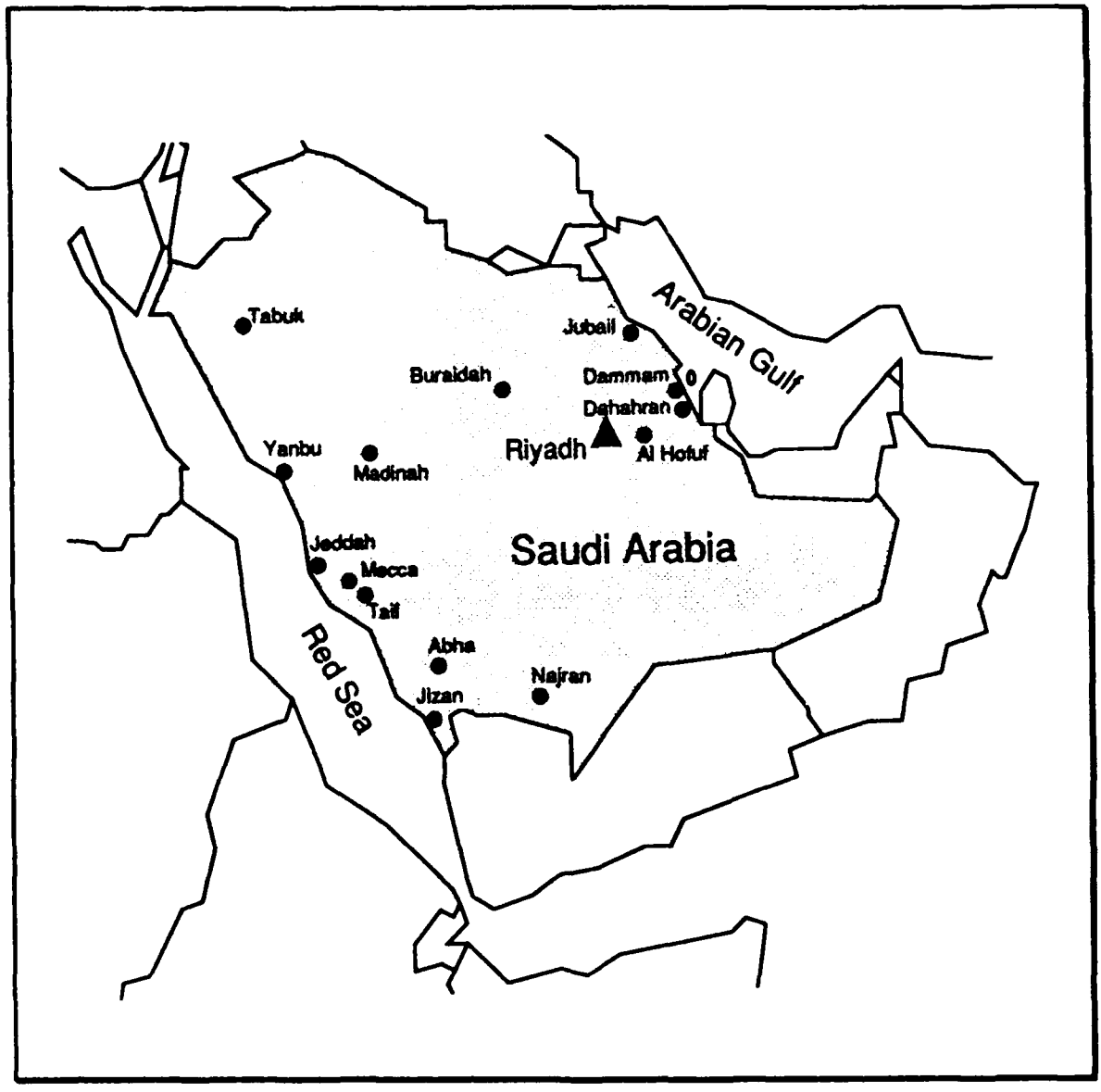

Figure 1. Major Cities in Saudi Arabia

The Eastern Region has the massive petroleum reserves—which are the main source of income for Saudi Arabian economic development. It contains the city of Dammam, which is the major eastern port, Dharan, Al-Kobar, which is a major commercial center, and Hofuf, which is a major farming and commercial center. Jubail, on the Arabian Gulf, contains an important industrial complex [Ref. 33].

In the Northern Region, there are some oases in a desert which is an extension of the Great Syrian Desert. In these oases, farming and commercial activities are exercised by the people in cities such as Tabuk, Hail, Jouf, and Hafer Albatin. [Refs. 2, 7].

Hejaz, the Western Region, contains the cities of Mecca and Madinah, which are the holiest Islamic sites. These two cities attract around two million pilgrims each year from all over the world at the time of Hajj (pilgrimage to Mecca). This region also contains the important port of Jeddah on the Red Sea. Jeddah is also an industrial center and the economic capital of the region. Other cities in the region are Taif, which is an agricultural and commercial center and is a summer resort, and Yanbu, north of Jeddah on the Red Sea, which is a center of heavy industries (the twin city to Jubail in the Eastern Region) [Ref. 2,7].

Asir, the Southwestern Region, is mountainous with mountains descending steeply to the west, forming a hot low coastal plan of Tihama. It contains tourist attractions in the cities of Abha, and Khamis-Mushait. Other cities in the region are Jizan, which is a port on the Red Sea and Najran near the Yemeni border [Refs. 2, 7]

Najed, the Central Region, contains the capital of Saudi Arabia, Riyadh. Riyadh is rapidly emerging as the nation's economic capital as well. The agricultural area of Qasim contains the cities of Buraidah and Unizah. [Refs. 2,7]

The Rub Al-Khali Region, or Empty Quarter, is the largest continuous sand body in the world and is virtually uninhabited. The region is believed to have huge oil reserves that yet have to be discovered. [Refs. 2,7]

D. THE ECONOMY OF SAUDI ARABIA

Saudi Arabia is well known for its enormous economic changes that have occurred during the past two decades. Actually, these changes happened

rapidly and were so great that this period is unique in modern economic history. [Refs. 1,2]

Most people know Saudi Arabia for its crude oil production, even though its economy consists of more than oil. Industries, agriculture, construction, services, and banking are major non-oil sectors that account for more than 55 percent of the gross domestic product (GDP). On the other hand, the petroleum sector has declined from about 60 percent to less than 23 percent, but remains the single largest contributor to government revenues. [Refs. 1, 2, 5]

Saudi Arabia is the second largest crude-oil producer in the world after the Soviet Union. Also, it owns the largest oil reserves in the world (more than 252,384 million barrels of crude oil in 1988 figures). Therefore, as a founding member of OPEC in 1960, Saudi Arabia has always played a large role and has always supported a moderate price for crude oil. Table 2 and Figure 2 list Saudi Arabian crude oil production from 1970 to 1988. [Refs. 1, 2 ,3]

As the owner of the oil reserves, the government has done a good job of developing the infrastructure and directing the economic development of the country. The government provides free education and health care with no tax paid by the people. Despite the staggering expenditures, Saudi Arabia experienced a series of large balance-of-trade surpluses, which allowed the government to provide loans and aid to numerous Third World countries. The Saudi riyal is now one of the currencies which define the Special Drawing Right of the International Monetary Fund. [Ref. 2]

> Much of the direct involvement of the government in the economy relates to the development of infrastructure. The 1970s witnessed projects of unparalleled scope: docks were expanded; a modern highway system was built; international airports were completed; a modern telecommunications network was installed; major universities, modern health care facilities and numerous public schools were built and staffed;

and the kingdom's air carrier developed into one of the world's largest. [Ref. 2:p. 181]

Conventional economic measures are at best imperfect indicators of the economic changes over the past twenty years. For example, Gross Domestic Product (GDP) (the value of all goods and services produced in the country annually) more than tripled. This translates into an annual economic growth averaging more than 6 percent. By any standards this is a creditable performance. [Ref. 1:p. 5]

In 1989, GDP recorded a growth of 6.4 percent. [Ref. 3]

TABLE 2. CRUDE OIL PRODUCTION IN SAUDI ARABIA 1970-1988

YEAR	PRODUCTION (millions of barrels)	INDEX NUMBER (1970 = 100)
1970	1286.7	100.0
1971	1740.6	125.5
1972	2202.1	158.8
1973	2773.0	199.9
1974	3095.1	223.2
1975	2582.5	186.2
1976	3139.3	226.3
1977	3357.9	242.1
1978	3029.9	218.5
1979	3473.5	250.5
1980	3622.6	261.2
1981	3581.5	258.2
1982	2364.8	170.2
1983	1656.9	119.5
1984	1492.9	107.6
1985	1158.9	83.6
1986	1746.2	125.9
1987	1505.3	108.6
1988	1890.1	136.3

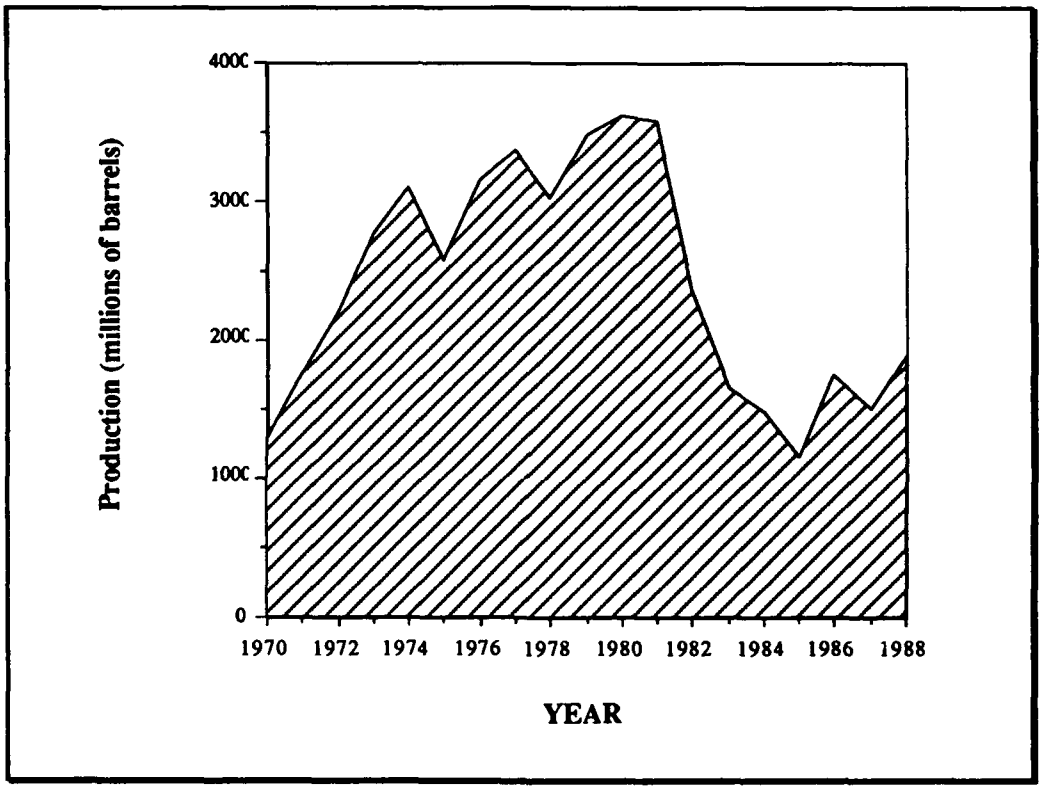

Figure 2. Oil Production, 1970-1988

II. BACKGROUND

A. INTRODUCTION

Although new inventions and developments in telecommunications systems happen at a lower rate compared to developments in some other fields such as computer hardware and software, they are of greater importance. The reason is that communication is the backbone of the economy and welfare of the people. People can use telecommunications systems to talk long distance for business, education, or socializing. Now it is possible to use telecommunications networks to send documents, pictures, video, or computer data. All of these capabilities did not happen overnight, but rather went through stages of development over a long period of time.

Telecommunication refers to long distance communication. It consists of the sender, the recipient, the message, and the communication method. The communication method has continued to improve over time with the help of technological advancements in other fields such as electricity and computers. This is triggered by the change in requirements by the sender and the recipient and the change in contents, type, and urgency of the message.

B. TELECOMMUNICATIONS HISTORY

In earlier times, communications depended on various basic methods such as human screams, smoke signals, drums, and light beacons. Then people used messengers to deliver their verbal or written messages. As the need increased for such services, postal services were introduced, such as the Pony Express in the United States.

1. Telegraph

In the early years of the nineteenth century, and after the understanding of electric and magnetic phenomena, scientists recognized that using an electric current to communicate between two separate stations was possible and the age of the telegraph arrived. The transmission of a message by telegraph was simple: with the use of a switch, an operator provided short pulses of electric current from a battery. The problem of how to detect current pulses at the remote receiving station was solved in 1819, when Hans C. Oersted discovered that a wire carrying an electric current deflected a magnetic needle. In 1837, William F. Cooke and Charles Wheatstone successfully installed the first railway telegraph in England.

In the U.S., Samuel F. B. Morse devised a telegraph receiver with an electromagnet energized by the pulse of current from the wire. He also invented a code of dot and dash symbols still called the Morse code after his name. The two Morse code symbols corresponded to pulses of short and long duration and was implemented in the telegraph receiver to be printed. In 1844, Morse successfully demonstrated a telegraph line he built between Baltimore and Washington. Duplexing, triplexing, and quadruplexing methods were invented later to permit transmission of more than one message in each direction. In 1874, a multiplex system was introduced by Emile Bandot to increase the traffic capacity of a line using time division. Since the first successful telegraph communication took place, the use for the telegraph spread over the United States, Europe, and the rest of the world for military and commercial purposes.

2. Telephone

The telephone is a device for reproducing sound at a distance from its source by converting sound waves into electrical oscillations which could be sent longer distances than sound waves. The telephone was developed by Alexander Graham Bell, who received probably the single most valuable patent in the history of any industry [Ref. 9:p. 210]. Bell, a Scottish-born teacher of the deaf, was developing a harmonic telegraph in 1876, when he invented the telephone. In 1877, Bell and Associates constructed the first telephone line from Boston to the suburb of Somerville, Massachusetts.

When Bell and Associates first began to sell telephones in 1877, they offered them in sets of two with wire between them. Then calls began to be connected through common switches until a central exchange that served 21 subscribers was opened in 1878 as the first switching facility. The first automated switch was patented in 1891 by Almon Strowger [Ref. 10:p. 49-50]. And in 1895, Guglielmo Marconi invented the radio where telegraph and telephone wireless transmissions were possible. In January 1927, a public transatlantic telephone service was opened using powerful radio-transmission. In 1956, the first submarine telephone cable was laid between the United States and Great Britain. Then in July 1962, during its first days of orbiting the Earth, Telstar established telephone communications between European and American towns.

So, at first, telephones were hooked up in pairs where each link connected two parties only. Then later, manual switching was made possible at a central switching office where operators sat at manual switchboards. But today, switching is done automatically through a system called Direct Distance

Dialing where the electrical signals of the telephone are transmitted over long distances using cable, radio, microwave, optical fiber, and communication satellites. Besides voice, telephone networks are capable of carrying radio and television programming, facsimile, and computer data.

C. HISTORY OF TELECOMMUNICATIONS IN SAUDI ARABIA

1. Introduction

In 1926, the Directorate of Posts, Telegraph and Telephones (PTT) was established and became part of the Ministry of Communications in 1953. However, in 1975, the Director of PTT became a separate ministry as an indication of its importance and essential role in the development of the country. [Refs. 11, 12]

The development of modern communication started in 1930 when long-wave and medium-wave transmitters were imported from Marconi Company. Two six-kilowatt transmitters were installed in Mecca and Riyadh, being the first telegraph stations in Saudi Arabia. Later, six 500 watt stations were installed in six other cities and towns. [Ref. 11, 12]

In 1954, using the modern technology offered at that time, RT-1 (receiver transmitter radio) network scheme was installed to provide communication inside the country, and from a node in Jeddah to the rest of the world. This network was upgraded in 1964 to an RT-3 allowing more channels and capacity to be used. The equipments of RT-1 and RT-3 networks were supplied and installed by Siemens of Germany. Saudi Arabia then had more powerful links to all centers of business and trade in the world.

The first teleprinters to come into operation were Loren 2133 and the Siemens T37h with Arabic alphabets, operating with a speed of 50 bauds on

HF links. In 1975, the first automatic telex dialing service started and was installed. [Ref. 11].

2. Stages of Development

In 1924, there was only one manual switchboard with limited capacity to serve government agencies in Mecca and Madinah. Two wire links were used to link Mecca to both Jeddah and Taif for telegraph and telephone usage. Also, there were some lower power radio stations in Jeddah, Madinah, Yanbu, and some border towns. At the same time, there was a cable link across the Red Sea between Jeddah and Port Sudan for communications with the outside world. Since then, telecommunications has gone through stages of development starting with putting the infrastructure in place.

a. Telephone Developments

Saudi Arabia established a direct radio link from Jeddah to New York with a relay in Morocco in 1949. Direct radio links had also been established to some Arabian countries. PTT then built a telephone HF transmission station in Jeddah with the use of the new technology (at that time) of Single Side Band (SSB). The station was put to work in 1954 with 800 watts power for communications within the country, 2.5 kilowatts for communications with countries within the Middle East, and 10-20 kilowatts to reach Europe and America. In 1968, PTT established an automatic telephone network using (the new technology at that time) Cross Bar System (CBS) to serve 76,600 lines.

Starting in 1970, Saudi Arabia adopted a series of Five-Year Planning methods for comprehensive developments including

telecommunications. During the First Five-Year Plan (1970-75), the Ministry of PTT (MOPTT) built a network of 137,000 telephone lines using cable and microwave links, and replaced the manual switchboards with automatic ones. In 1978, and during the Second Five-Year Plan (1975-80), a contract was signed with Ericsson Telephone Company of Sweden, Phillips of Netherlands, and Bell Canada at a cost of $3 billion to increase the number of lines to 650,000. The system was to be run by Saudis within a period of five years. The local exchanges were upgraded to Stored Program Control (SPC) status. The system was among the first in the world to have integrated digital switching and transmitting (IST) in high traffic metropolitan networks, using Pulse Code Modulation (PCM) transmission and solid state tandem switches. In addition, many new projects introduced services which were not previously available such as Mobile Telephone Service, Coastal Radio System, Data Transmission and the Computer Data Center. [Refs. 8, 13]

The general objectives for telecommunications in the Third Five-Year Plan (1980-85) were to add more telephones to the system and continue to improve the quality of service provided to customers. Telephone lines reached more than 1.2 million lines in 400 towns and cities at the end of the plan period. (See Table 3 for the number of telephone lines from 1978-89.)

In the Fourth Five-Year Plan, MOPTT plans included implementation of the latest technology in telecommunications systems, improvement of the financial and administrative management of the network, and provided more services to the growing number of customers in a timely and economical fashion. By 1989, the number of telephone lines increased to more than 1.4 million lines with direct call dialing to 183 countries. [Refs. 14, 15]

TABLE 3. NUMBER OF AVAILABLE TELEPHONE LINES IN SAUDI ARABIA FROM 1978-1989
[Ref. 12:p. 18; Ref. 14:p. 37; Ref. 15:p. 1]

Year	Available Telephone Lines
1978	196,800
1979	278,000
1980	406,000
1981	692,000
1982	826,000
1983	1,060,000
1984	1,190,000
1985	1,202,462
1986	1,295,136
1987	1,376,076
1988	1,412,348
1989	1,488,378

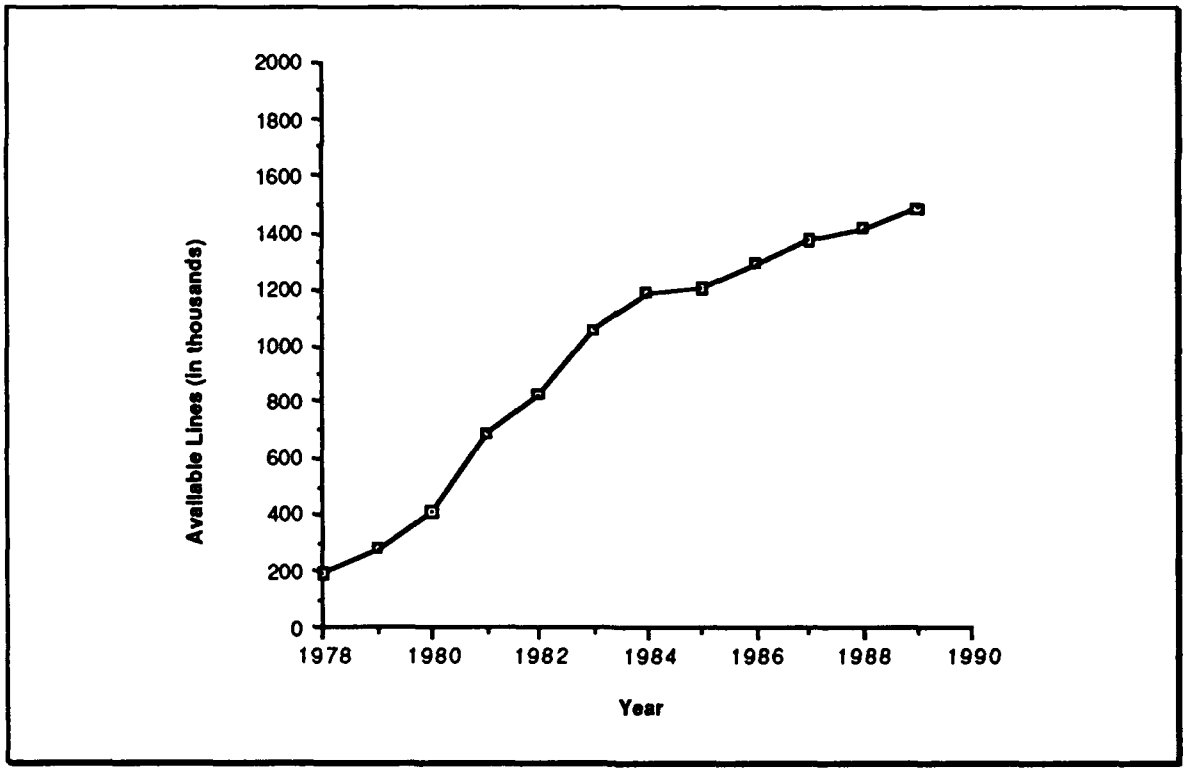

Figure 3. Graph Displaying the Increase in Number of Available Telephone Lines from 1978-1989.

Mobile telephones went through the same planning period and received due attention for their importance to the welfare of the people. Mobile telephone services started with HARS system in 1977 with 480 subscribers in Riyadh, 180 in Jeddah, and 120 in Taif. Thereafter, the Phillips and L. M. Ericsson joint venture was contracted at the beginning of the Third Five-Year Plan to install the Automatic Mobile Telephone System (AMTS). AMTS went through two stages, with stage one in 1981 to expand the number of subscribers to 1155 in 8 main cities. The second stage started in 1982 with 18,000 subscribers covering most cities. The contract included installation of exchanges for mobile telephones in Riyadh, Jeddah, and Dammam, as well as installation of 65 radio stations for mobile radio systems all over the country. AMTS implements the cellular radio service with two bands using Ericsson AXE-10 Digital switching system. [Refs. 14,16]

b. Telegraph Developments

The telegraph service is still one of the most important telecommunications services in the world, due to its cost effectiveness, urgent communication means, and the fact that it does not require high investment costs. In addition, it provides communications with countries which do not possess an advanced telecommunications network. Therefore, MOPTT took great care in order to provide telegraph offices along with other telecommunications means in the holy cities and sites where pilgrims from all over the world visit every year.

There are 280 telegraph offices in Saudi Arabia supervised by 14 telegraph regions. These telegraph offices communicate with 18 international stations. In 1988, the total number of telegrams exchanged inside the country

decreased by 42% from 1985 and the total number of telegrams exchanged with foreign countries decreased by about 50%. This reduction in the use of telegraph is due to an increase in the use of other telecommunications means such as telex and facsimile. (See Figure 4 for number of telegrams exchanged.) [Refs. 14, 18]

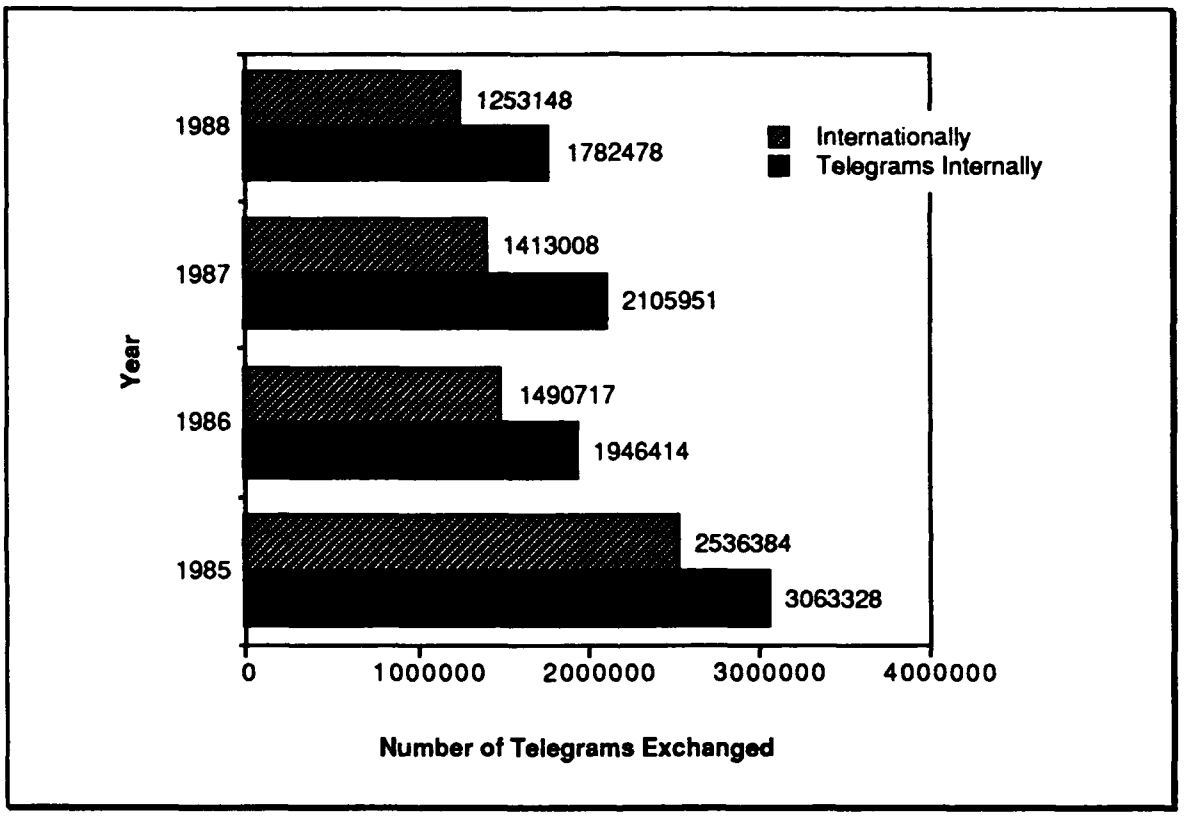

Figure 4. Telegrams Exchanged, 1985-1988

c. Telex Development

Telex has grown very fast as a principal means of business communications. In order to meet the increasing demands of industry and commerce and the growing volume of international traffic within Saudi

Arabia, telex facilities were expanded as an important component of the overall telecommunications development program.

The beginning of telex in Saudi Arabia was in 1972, using a manual network. In 1974, a new automatic network was installed with 200 subscribers. The network was then expanded several times to satisfy the increasing need for telex lines. In 1978, MOPTT introduced computerized telex exchanges to parallel and complement an electronic telephone system which was adopted at the same time. Transmission facilities were enhanced by coaxial cables and 60 megaHertz microwave links. Furthermore, three gateway exchanges were completed in Riyadh, Jeddah, and Dammam in 1979 for a total capacity of 15,000 telex lines. (Table 4 shows the number of telex subscribers from 1974-1988). [Refs. 19, 14]

TABLE 4. NUMBER OF TELEX SUBSCRIBERS FROM 1974 TO 1988

Year	Number of Telex Lines	Percent Increase
1974	200	—
1975	495	147.5
1976	575	1878.5
1977	927	363
1978	3494	1647
1979	5973	2886.5
1980	8465	4132.5
1981	11,040	5420
1982	13,251	6525
1983	16,044	7122
1984	16,771	8281.5
1985	16,607	8203.5
1986	16,023	7911.5
1987	15,367	7580
1988	14274	7037

Serving over 300 cities and villages inside the country, there was a capacity exceeding 30,000 telex lines available in 1989. The telex subscribers are able to communicate with most of the world's countries. The number of telex subscribers (as shown in Table 4) and the number of outgoing calls (Figure 5) have been decreasing lately due to the increasing use of facsimile facilities.

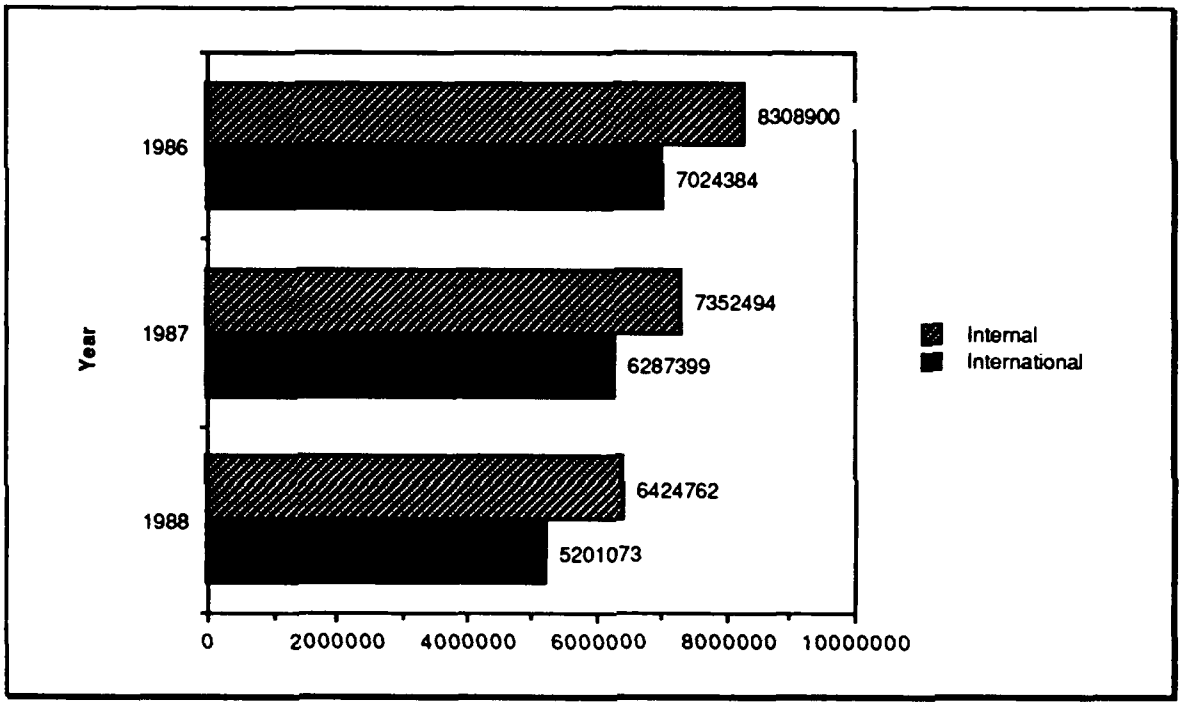

Figure 5. Number of Internal and International Outgoing Telex Calls (1986-1988)

The MOPTT in Saudi Arabia has taken the risk in development of a new teleprinter and introducing the first bilingual telex service in the Arab world. The Saudi-West German joint venture developed new teleprinters (Siemens Model T 1000s) which went into operation in June, 1983. Then, in 1987, the new bilingual screen-based teleprinter (model T 1200) was produced with storage capacity of 256,000 characters and many advanced

editing features. Later, three packet-switching exchanges manufactured by Siemens were installed serving more than 6000 lines with transmission speeds up to 64,000 bytes per second using X.25 interface to provide access for all kinds of computer terminals. [Refs. 11, 19]

d. Long Distance Telecommunications

(1) Coast Radio Development. Saudi Arabia established a modern Coast Radio System in 1980 to provide telephone and telex services all along the eastern and western coasts for ships requiring services in either territorial or international waters up to 12,000 km (7,500 miles). Services provided to ships include weather forecasting, distress and safety communication, navigational warnings, and medical advice. These services are provided to ships daily on VHF for up to 80 km (50 miles), on MF for up to 700 km (437 miles), and on HF for up to 12,000 km (7,500 miles). [Refs. 16,19]

(2) Coax Cable Developments. In 1970, long distance communications in Saudi Arabia depended on HF radio equipment. But in 1972, MOPTT started the installation of a coax cable network stretching for 1460 km (912 miles) from Taif to Dammam passing through Riyadh. The 12 MHz backbone project provided 7200 telephone channels besides two TV channels on a bandwidth of 60 MHz. In 1979, a coax cable link joined Jubail City with all cities in the country through Dammam. An expansion project for the coax cable network ended in 1986 providing telephone and TV services to new cities and villages. Besides meeting the increase in telephone traffic, the new expanded coax network provided alternative routes for traffic, raised service efficiency, and provided more security for telephone communications. The expanded network connected Riyadh, Taif, Mecca, Jeddah, Yanbu, Madinah, Tabuk, and all towns and villages in between, with a total length of 2473 km (1546 miles). Kuwait, a neighboring country, was

linked with a coax cable in 1977 to establish telephone communications. [Refs. 14,20]

(3) SEA-ME-WE Submarine Cable Project. The project which started its operation in 1986, provides Saudi Arabia with alternate routes for communications with 28 countries in Europe, Asia, Africa, America, and Australia. The cable runs from Singapore to Marseille in France through Indonesia, Sri Lanka, Djibouti, Jeddah in Saudi Arabia, Suez in Egypt, and Palermo in Italy. The 13,200 km (8250 miles) marine cable cost about 390 million U.S. dollars of which Saudi Arabia contributed 66 million. As shown in Table 5, Saudi Arabia uses 1818 circuits of the total circuits provided by the cable for all sorts of telecommunications. [Refs. 12, 14]

TABLE 5. CIRCUITS PROVIDED BY SEA-ME-WE MARINE CABLE BETWEEN SAUDI ARABIA AND 28 COUNTRIES

Country	Saudi Dedicated Circuits	Country	Saudi Dedicated Circuits
Indonesia	26	USA	87
South Korea	24	Australia	8
Malaysia	5	Japan	12
Singapore	39	Philippines	20
Thailand	9	Taiwan	8
Djibouti	12	Sri Lanka	25
Egypt	480	Kenya	6
Italy	198	Greece	36
West Germany	120	Austria	15
Belgium	12	Spain	24
Holland	20	Portugal	8
England	240	Switzerland	60
Scandinavia	12	France	240
Tunisia	60	Canada	12
Total: 1818 circuits			

(4) Fiber Optic Cables. Fiber optic cables have been used in Saudi Arabia since the early 1980's to link main exchanges in the cities. The multimode fiber optic cable uses the first window of the light band of 800 nanometers. This same type of fiber optic cable was used to connect Taif with Mecca was installed in 1985. Then, once the new technology of single mode fiber optics and was developed, the fiber optic cable has been used between exchanges in all major cities operating at the 13 nanometer window that allows long distances between repeaters and increased rate of 140 Mbits per second. In 1989, as the first of its kind in the Middle East, a fiber optic system was installed across King Fahd Bridge to neighboring Bahrain. The system data rate is 545 megabits per second and a capacity of 7680 channels. [Ref. 21]

(5) Microwave Networks. The main microwave network establishment started in 1977 with a distance exceeding 10,000 km (6,250 miles). The network was ready in 1979 providing telephone, telegraph and telex, TV, and data transmission channel services. The network included more than 60 main routes and more than 300 microwave stations serving more than 80 cities and villages with 35,000 channels. In addition, there were three TV channels, one of which is a standby. The network provided 265 road emergency telephones controlled and monitored from two centers in Riyadh and Jeddah. [Refs. 11, 14, 20]

In 1986, the microwave network was expanded for an additional capacity of 40,000 telephone channels. An additional 123 microwave stations were installed to provide 125 new microwave subroutes with a length of 4000 km (2,500 miles). The expanded network connected additional cities and villages. In addition, MOPTT established branch sub-

microwave links to join other cities and villages to the network. As a means of telecommunications, microwave links have been used to connect Saudi Arabia to neighboring countries such as Jordan, Kuwait, Bahrain, UAE, Qatar, Sudan, and Yemen. The 370 km (230 mile) microwave link between western Saudi Arabia and Sudan is the longest link across water (the Red Sea) without the use of repeater stations. [Refs. 11,14,20]

(6) Satellite Earth Stations. Saudi Arabia started using satellite communications in 1974 with two small stations providing only 29 international circuits. But in 1975, two standard A earth stations started working, the first one in Riyadh (Riyadh-1) to communicate with 25 countries using the Indian Ocean Primary Path Satellite, and the second was installed in Taif with 72 circuits to communicate with countries in the Atlantic Ocean region using the Atlantic Ocean primary path satellite. Both stations provided telephone, telex, radio, and television communications. These two satellite earth stations went through a number of expanding projects to increase the number of circuits to fulfill the increasing demand for international telecommunications. The latest expansion project in 1984 increased the capacity of each of the satellite earth stations to 720 circuits.

In 1979, MOPTT started a third satellite earth station in Riyadh (Riyadh-4) to communicate with the Atlantic Ocean Major Path-2 Satellite, with a capacity of 432 channels covering 11 countries. The capacity then increased to 624 channels in 1980 in order to increase communications with Western Europe and the United States. Expansion projects continued until a capacity of 2500 circuits was reached.

Since the INTELSAT organization started to limit the number of channels to be used by each country on different satellites, MOPTT decided to establish other routes to provide more channels. So, in 1985, MOPTT built two new satellite earth stations, Jeddah-4 and Jeddah-5, in King Fahd Satellite Telecommunications City in Jeddah. The Jeddah-4 station provided means of communicating with countries in the Atlantic Ocean region with a capacity of 1400 telephone circuits using the Atlantic Major Path-1 Satellite. The Jeddah-5 station provided 1300 telephone circuits for communication with countries in the Indian Ocean region using the Indian Ocean Major Path-1 Satellite. Both stations have television transmission and reception facilities. [Refs. 14, 24, 25]

In regional satellite telecommunications, Saudi Arabia signed an agreement with other Arab countries to establish an Arab Satellite System (ARABSAT) for general services in telecommunications for all member countries. In February 1985, the first Arab satellite was launched, followed by the second Arab satellite in September 1985. The ARABSAT system orbits equatorially over the African Congo with two orbital satellites (main and spare) and one reserve satellite held for emergency launch. ARABSAT provides a capacity of 8000 telephone channels and seven television channels. Table 6 lists the number of ARABSAT circuits utilized by Saudi Arabia. ARABSAT Earth Station (Jeddah-8) was built in King Fahd Satellite Telecommunications City in Jeddah in 1985 with 852 circuits. In the same telecommunications city, there is an INMARSAT Earth Station established in 1986 offering INMARSAT Mobile Satellite Services to the maritime community. Saudi Arabia is a member of the assembly and the

council of INMARSAT and is actively participating in its activities. [Refs. 14,24, 25]

TABLE 6. NUMBER OF ARABSAT CIRCUITS UTILIZED BY SAUDI ARABIA

Country	Saudi Dedicated Circuits	Country	Saudi Dedicated Circuits
Algeria	11	Syria	30
Bahrain	27	Tunisia	18
Jordan	84	UAE	36
Kuwait	36	North Yemen	70
Morocco	34	Iraq	12
Oman	24	South Yemen	5
Qatar	19	Djibouti	3
Sudan	41	Mauritania	4
Total: 453 circuits			

III. THE CURRENT TELECOMMUNICATIONS SYSTEM IN SAUDI ARABIA

A. INTERNATIONAL COOPERATION

The Saudi Arabian government considers international cooperation very important in all fields including telecommunication. Therefore, MOPTT (Ministry of Post, Telegraph, and Telephone) is actively participating in international telecommunications organizations and working with many of the world's most experienced telecommunications companies. (Appendix A lists major companies that were contracted to carry out telecommunications projects in Saudi Arabia.)

MOPTT has participated in all International Telecommunications Union (ITU) activities and serves on its administrative council. MOPTT also participates in the meetings of the Consultative Committee on International Radio (CCIR) and the Consultative Committee on International Telegraphy and Telephony (CCITT). MOPTT applies ITU standards and recommendations and supports its special programs for improving international telecommunications in developing countries. The Ministry is also an active participant in the International Telecommunications Satellite Consortium (INTELSAT) and the International Maritime Satellite Organization (INMARSAT). In addition it has a role in regional organizations such as the Arab Telecommunications Union (ATU) and ARABSAT.

In addition, Saudi Arabia serves as an international transit center in telecommunications due to its central geographical location and time zone. International traffic between East and West moves during the night and off-peak hours within the kingdom which coincide with peak periods in Europe, the Orient, and the Americas.

B. MANAGEMENT STRUCTURE

The telecommunications system in Saudi Arabia is government-owned and operated. It is managed by the Ministry of Post, Telegraph, and Telephone (MOPTT). MOPTT's role is summarized as follows:

- Operate, maintain, and improve telecommunications services
- Provide telegraph, post, telephone, and telex services to government offices, the private sector, and the public. These services include those within the country as well as connections with the outside world
- Establish and supervise satellite communication stations.

The Minister of Post, Telegraph and Telephone is at the top of the management pyramid of MOPTT. The minister is assisted by the General Manager of Post, as well as four deputies for Operation and Maintenance Affairs, Telegraph Affairs, Telephone Affairs, and Financial and Administrative Affairs. In addition, four directorates report directly to the minister

- General Directorate for Planning, Organizing and Budgeting
- Directorate of Legal Affairs
- Directorate of Auditing and Inspecting
- Directorate of Conferences and International Relations

MOPTT divides the country into four regions, which are the West Region, the South Region, the Central Region, and the East Region. These regions are managed by three separate general directories which report directly to the Assistant Deputy for Operation and Maintenance. Other

directorates that report to the Assistant Deputy for Operations and Maintenance include the Directorate of Engineering Affairs and Network Operations Directorate. Other administrative and monetary parts of the ministry organization will not be mentioned due to irrelevance to the thesis topic. Figure 6 shows the hierarchy of MOPTT. [Ref. 26:p. 22]

Each of the four regions are broken up into districts according to major cities and residential areas in that region. These districts are:

West Region

- Mecca District
- Madinah District
- Jeddah District
- Taif District
- Tabuk District
- Al Baha District
- Yanbu District

South Region

- Assir District
- Jizan District
- Najran District

Central Region

- Riyadh City District
- Riyadh Region District
- Qasim District
- Hail District

East Region

- Dammam District
- Alhasa District
- Aljouf District
- Arar District
- Jubail District

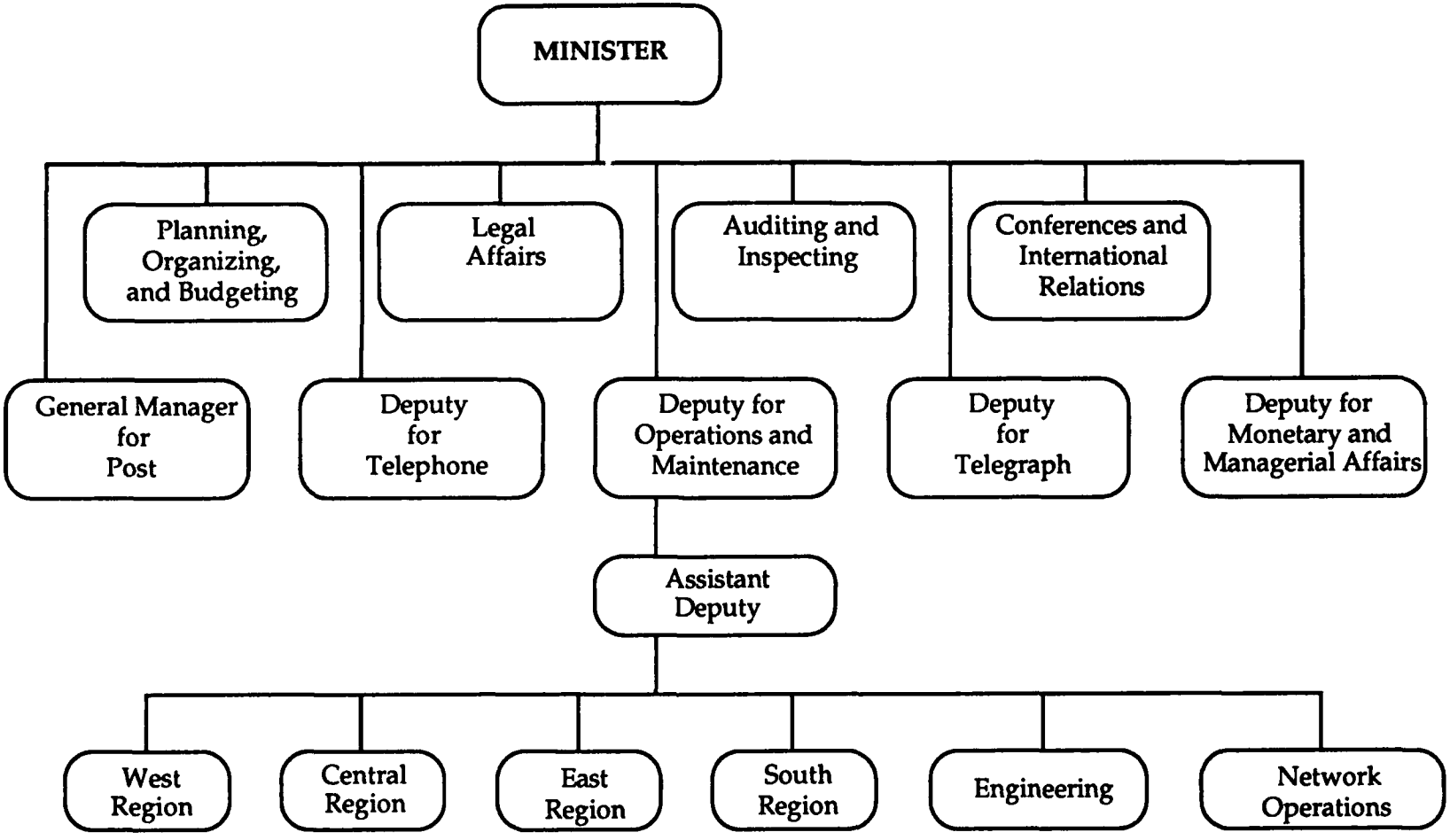

Figure 6. Summarized Organization Hierarchy for MOPTT

Each district is operated, maintained and managed separately to ensure good service and maximum productivity. At the same time, districts plan for expanding to provide telecommunications services to customers in remote areas within the district. The general directorate for a region is responsible for its district's operations and evaluation.

C. THE OPERATION AND MANAGEMENT OF THE SYSTEM

In order to manage, operate and maintain such an integrated telecommunications network, a special organization called SAUDI TELECOM has been established and assigned all responsibilities pertaining to the day-to-day operations of the network. SAUDI TELECOM headquarters are located in Riyadh. In addition, there are 16 branches spread throughout the country. This organization has been equipped with support facilities needed to successfully carry out its activities. These facilities include the following:

- A modern computer data center
- National Network Control Center (NNCC)
- Telephony Inquiry Center
- Customer payment system
- Three training centers
- 17 work centers
- 126 subscription offices (in 1988)
- 117 payment offices (in 1988)

D. TRAINING AND MANPOWER DEVELOPMENT

One of the primary objectives of MOPTT is the training of Saudi nationals in the managerial and technical principles necessary to become a world leader in telecommunications. MOPTT acquired advanced telecommunication systems with the latest technology necessary to allow Saudi Arabia to assume

complete management of operations. The goal of SAUDI TELECOM is to increase the proportion of Saudi management and technical personnel in its organization. Therefore, MOPTT works to prepare the most qualified Saudis through many parallel and integrated channels to specialize in various fields of telecommunications. These channels include:

- Two specialized telecommunications institutes in Riyadh and Jeddah to train technicians in the many aspects of the network.
- Three field training centers in Riyadh, Jeddah, and Dammam.
- Companies involved with construction of the network have developed training courses inside and outside Saudi Arabia.
- Graduates of seven local universities in Saudi Arabia are encouraged to join SAUDI TELECOM.
- Selected employees are granted scholarships to get their bachelors, masters, or doctorates in science and management.

MOPTT has developed more than 220 courses in various exchange services including operation and maintenance of analog and digital switching systems, network engineering, equipment installation, and customer services. Training courses are geared toward high performance with an extensive hands-on training approach. Therefore, the training centers and institutes are equipped with transmission connections and complete exchanges in addition to integrated laboratories. Using the management by objectives method, management training courses are highly personalized with courses designed to develop specific skills. In 1989, 4208 employees went through training courses in the training centers and in the same year more than 900 students were midway through training in the telecommunications institutes. Table 7 lists specialization and number of graduates from both telecommunications institutes until 1988. [Ref. 14:p. 34]

TABLE 7. SPECIALIZATION AND TOTAL NUMBER OF GRADUATES FROM THE TELECOMMUNICATIONS INSTITUTES FROM 1973 TO 1988

SPECIALIZATION	TOTAL GRADUATES
Satellite Assistant Engineer	99
Microwave Assistant Engineer	52
TV Transmission Assistant Engineer	4
Broadcasting Assistant Engineer	27
Transmission Assistant Engineer	58
Switching Assistant Engineer	130
TV and Broadcasting Technician	423
Transmission Technician	374
Microwave Technician	284
Switching Technician	447
Power and A.C. Technician	265
Outside Plants Technician	320
Satellite Technician	42
Teleprinter and Telex Technician	278
Frequency Technician	74
Broadcasting and TV Studio Technician	120
Networks Assistant Technician	177
Teleprinter and Telex Operator	400
Radio Communication	93
Teleprinter Operator	32
Computer Assistant Programmer	23
Teleprinter Maintenance Assistant Engineer	16
Computer Operator	17
Teleprinter and Operations and Maintenance Supervisor	29
Mobile Telephone	39
Frequency Management and Supervision	17
Electrical Power	14
Telex Exchange Assistant Technician	14
Telephone Exchange Assistant Engineer	46
Telex Exchange Assistant Engineer	11
TOTAL	**3925**

E. MAINTENANCE AND TECHNICAL SUPPORT

Telecommunications equipment and links installed between cities and towns within Saudi Arabia face additional challenges presented by the severe climate. To withstand these conditions, the equipment was designed to operate at higher temperatures and humidity. Microwave repeater stations extend through uninhabited land between cities and towns. Therefore, the microwave network was designed to be completely controlled and its operation monitored from two control centers, in Riyadh and Jeddah. These two control centers monitor all microwave routes and stations and continuously control the operation of all the stations. Performance reports are generated automatically for technicians regarding place and type of outage in the equipment. Also, there are ten maintenance centers connected to the control centers and distributed all over the country.

In addition, there is the National Network Control Center (NNCC) in Riyadh which is at the core of the automatic monitoring and controlling structure. With the aid of comprehensive computer control, NNCC provides access to traffic and operational status information on every exchange and trunk. NNCC supervises all telecommunications services such as microwave, coaxial cables, fiber optics, and satellites. NNCC goals include the following:

- Guarantee continuous smooth telecommunications flow over the National Network and ensure the best performance of the Network and its components.
- Minimize any degradation of telecommunications services due to overloading or sudden failure of routes.

- Provide continual 24-hour surveillance and supervision of all network components and ensure that maintenance is performed in a timely manner.
- Provide weekly and monthly performance reports on operation and maintenance of the National Telecommunications Network.

As a result of the high standard operation and maintenance procedures, the Network has excellent performance statistics. In March 1990, the average number of subscriber fault reports per 100 working lines was 1.88, and the outside plant fault reports per 100 working lines averaged about 0.27. Of these reports, 90.42% of the faults were cleared in eight hours, 99.19% of them were cleared within three days, and 99.9% were cleared within seven days. Table 8 shows some operational results of the National Network. [Ref. 14, 32, 33]

F. NETWORK DESCRIPTION

The government of Saudi Arabia has spent more than 58 billion Saudi riyals (more than $17 billion) during the four Five-Year Development Plans (1970-1990) on telecommunications which have now attained high international standards. Figure 7 shows the Saudi Arabian Telecommunications Network.

In 1987, the Minister of PTT, Dr. Alawi D. Kayyal, said:

> Today, Saudi Arabia's telecommunications network is one of the most advanced in the world. Telephone network exchange capacity now exceeds 1,300,000 lines, and both analog and digital exchanges are computer controlled. The transmission network connecting these exchanges is comprised of coaxial cables operating at 4, 12, 18, and 60 mHz, PCM and optical fibre cables, and microwave radio systems. Capacity of the transmission system exceed 180,000 voice circuits and includes two color television channels. [Ref. 28:p. 2]

TABLE 8. NETWORK OPERATIONAL RESULTS FOR MARCH 1990
[Ref. 32]

District	Transmission Equipment Maintenance Index (National)	% Successful Call Attempts	% Dial Tone in less than Three Seconds
Riyadh City	99.1	99.5	99.2
Riyadh area	99.1	99.9	99.9
Qassim	99.0	99.5	100.0
Hail	100.0	99.9	100.0
Central Region	99.1	99.7	99.5
Mecca	99.9	99.9	99.9
Madinah	99.6	99.7	99.7
Jeddah	99.1	99.8	99.6
Taif	100.0	99.9	99.9
Tabuk	49.7	99.9	99.9
Yanbu	100.0	99.7	100.0
Albaha	97.1	100.0	99.8
West Region	99.2	99.8	99.8
Dammam	99.4	99.9	99.9
Alhasa	100.0	99.6	99.8
Al Jouf	100.0	99.9	100.0
Arar	100.0	100.0	100.0
Jubail	93.5	99.9	99.9
East Region	99.3	99.9	99.9
Asir	99.9	99.8	99.8
Jizan	100.0	99.5	99.3
Najran	100.0	99.8	99.8
South Region	99.9	99.7	99.7
Kingdom	99.2	99.6	99.7

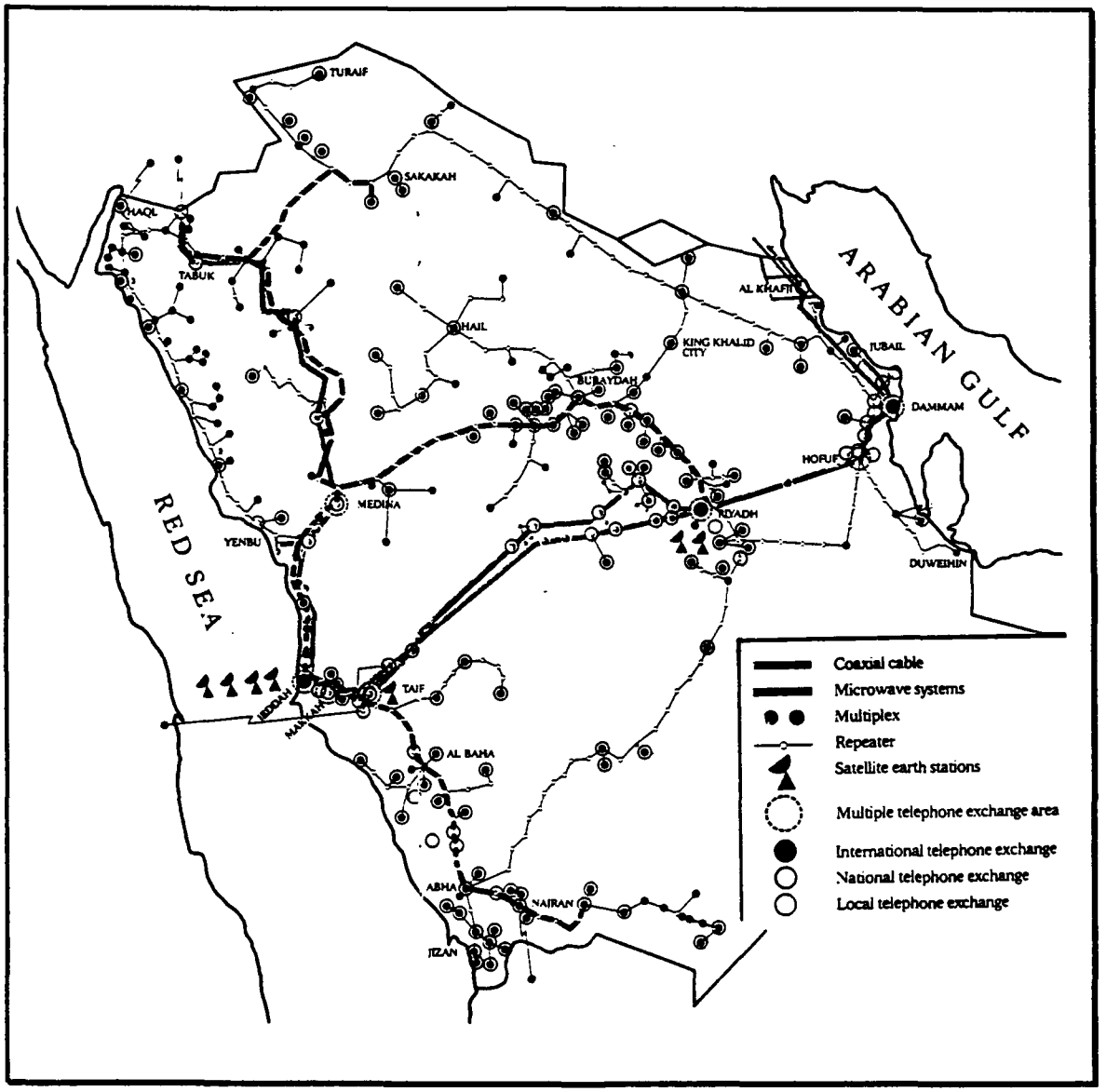

Figure 7. Saudi Arabia Telecommunications Network

He added that:

> The Kingdom has seven international exchanges, for telephone and three for telex communications. In the near future, three more international gateways will be added for the national Packet-Switched Public Data Network to support telex and other data applications. The Kingdom has direct links with neighboring countries via coaxial cables, optical fiber cables and microwave radio systems. Communications with other countries utilize satellites or submarine cable. Finally, the Kingdom has access to ships, airplanes and off-shore installations via INMARSAT satellites. [Ref. 28:p. 2]

1. The National Network

There are more than 243 local Stored Program Controlled (SPC) exchanges that enhance the capability for the management and control of the telecommunications network as a whole. These exchanges provide the country with more than 1.5 million lines in about 400 cities, towns and villages. More than 137,000 trunk lines are hooked to 22 trunk exchanges. In addition, there are 10 international exchanges, four for telephone with a capacity of 8300 trunks, three for telex, and three for the National Packet Switched Data Network to support data applications.

National and international telephone service is also available through the Automatic Mobile Telephone System (AMTS) and 7000 public coin telephones. AMTS provides 20,000 mobile telephone lines served by 65 radio stations. In addition, Emergency Roadside Telephones (ERT) provide vital links from the many highways in the Kingdom to local emergency centers. These ERTs are powered by solar energy in conjunction with batteries.

To facilitate national long distance communications, microwave, coax cables, and fiber optic cables are used. More than 5000 km (3125 miles) of

12, 18, and 60 mHz coaxial cables and more than 15,000 km (9375 miles) of microwave system link the Kingdom cities and towns. Fiber optic cables are used to link main exchanges in the cities and between some cities and towns.

2. The Regional Network

Saudi Arabia is connected to its Arab neighbors by many terrestrial telecommunications networks as well as satellite communications. The terrestrial telecommunications include:

- 960 circuit coaxial cable link to Kuwait
- microwave link to Bahrain with 300 telephone circuits
- microwave link to the United Arab Emirates with a capacity of 960 telephone circuits and one color TV channel
- microwave link to Qatar with a capacity of 960 telephone circuits and one color TV channel
- microwave link to Yemen with a capacity of 960 telephone circuits
- microwave link to Sudan across the Red Sea with a capacity of 960 circuits
- microwave link to Kuwait with a capacity of 960 circuits
- fiber optic cable to Bahrain with 1920 circuits
- coaxial cable to Jordan and Syria with 60 circuits
- microwave link to Jordan and Syria with 960 circuits
- UHF radio link to Jordan with 12 channels.

In addition to the region terrestrial network, there are a submarine cable network providing 480 circuits with Egypt, 60 circuits with Tunisia and 12 circuits with Djibouti.

In regional satellite telecommunications, Saudi Arabia utilizes 469 ARABSAT circuits to communicate with all Arab countries. The ARABSAT earth station is located in Jeddah and provides a capacity of 850 circuits in addition to television reception and transmission facilities.

3. The International Networks

Saudi Arabia's international telecommunications network provides subscriber direct dialing access to 183 countries. International telephone service is provided using four digital telephone exchanges located in Riyadh, Jeddah, and Dammam. In addition, there are three international exchanges for telex and three packet switching exchanges equipped for international service. Appendix B lists the international working circuits in March 1990. Major components of the international network include:

- Five standard A earth stations for telecommunications in conjunction with the INTELSAT satellite system. Two stations are located in Riyadh, two in Jeddah, and one in Taif. The total capacity of these five stations is more than 5000 telephone circuits in addition to television transmission and reception facilities. Figure 8 shows all INTELSAT earth stations in Saudi Arabia.
- One INMARSAT earth station is linked to the INMARSAT satellite over the Indian Ocean. It has an initial capacity of 12 telephone and 22 telex circuits which may be expanded. This station provides communications for vessels and aircraft via the public telecommunications network.
- The SEA-ME-WE submarine cable that runs from Singapore to France via the Middle East provides Saudi Arabia with over 1800 international circuits. This marine cable is 13200 km (8250 miles) long and runs through Jeddah on the Red Sea.
- A coastal radio system covering the Red Sea and the Arabian Gulf providing commercial communications to ships at sea.
- An electronic telex network with a capacity exceeding 30,000 telex lines. And, a new bilingual teleprinter that serves more than 300 cities, towns, and villages with Arabic or Latin telexes and links them to most countries in the world.

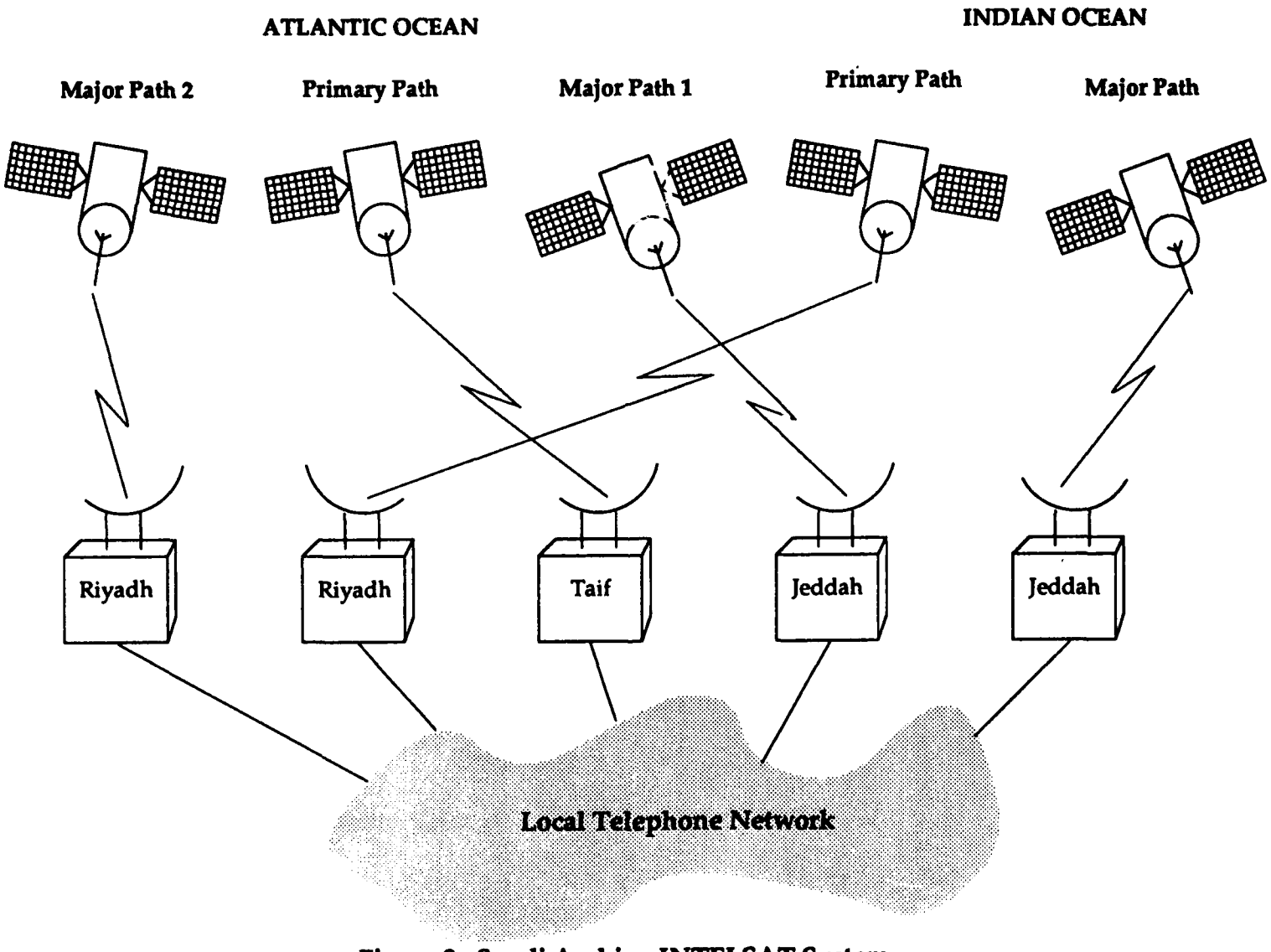

Figure 8. Saudi Arabian INTELSAT System

G. SERVICES PROVIDED BY THE NETWORK.

The quality of service offered by MOPTT through Saudi Telephone is improving constantly, along with excellent quality transmission for local, national, and international calls; universal International Subscriber Dialing (ISD) is also available. Furthermore, a uniform seven-digit telephone numbering and three-digit emergency codes facilitate calls to police, fire, ambulance, telephone repair, and other emergency services. Call cabins service is available by grouping coin telephones and operator-assisted telephone service in one location which makes it easy for customers to pay as they call without the trouble of carrying too many coins. In addition, the telecommunications network offers these services:

- 800 service (free call service) available to government offices and businesses.
- Leased circuits with either two-wire 1200 bits/second or four-wire 2400 bits/second that could be used for data transmission.
- Hotline service with the use of dedicated lines between two parties.
- Private data circuits available to the public with data rates up to 9600 bits per second.
- A paging system is available for the public in Riyadh, Jeddah, and Dammam.
- Wake-up service where subscribers program their telephone to ring at a preset time.
- Modern computer-assisted telephone inquiry service is available to all customers.
- Electronic mail and video teleconferencing transmission services are available over the telecommunications network.
- Alwasset network, which is the name of the public packet switched data network, provides fast and accurate transmission and reception of digital data. This network allows the user to access national and international networks and information centers.

Telecommunications services such as telegraph, telex, and telephone are available to about two million pilgrims that attend Hajj in the holy city of Mecca and visit the holy places in Medinah. More than one half of the pilgrims come from other countries. Therefore, MOPTT provides international telecommunications services around the clock at telegraph and telex offices. In addition, about 1500 coin telephones are distributed in the holy places to enable pilgrims to directly dial their own local or international calls about 183 countries.

IV. STRATEGY AND FUTURE PLANS

The Saudi Arabian telecommunications system went through a tremendous growth process in the past two decades. Now, the infrastructure for the national telecommunications network is in place and capable of providing top quality services for government, business, and the public. For the 90s, the telecommunications network calls for plans and strategies to enhance new technologies and to meet the growing demand for lines and services. The network will contribute to different applications needed by the military, economic structure, education, health, and national security of the nation.

A. STRATEGIES

The kingdom's national development programs have progressed under a series of five-year plans with telecommunications receiving its fair share of attention. The Fifth Five-Year Development Plan covers the period from 1990 to 1995. Its objectives and basic strategic principles are listed in Appendix C. This five-year plan emphasizes these areas of commitment by the Saudi Arabian government: responsibilities towards the welfare of the people and maintaining a leading role in the Islamic world and the international community. Saudi Arabia has always, and will continue to, have great responsibilities to provide facilities and services for millions of pilgrims visiting the holy cities of Mecca and Medinah every year. In addition, the kingdom is pledged to continue its leading role in pursuit of international peace and stability.

1. Broad Strategies

The objectives of the Fifth Development Plan in Saudi Arabia include the following:

- Form a productive national workforce by encouraging citizens to avail themselves of the benefits from the infrastructure and institutes provided by the state, ensuring their livelihood and rewarding them on the basis of their work.
- Develop human resources, thus ensuring a constant supply of manpower, upgrading its quality and improving its efficiency to meet the requirements of the national economy.
- Raise cultural and information standards to keep pace with the kingdom's development.
- Continue with real structural changes in the kingdom's economy so as to establish a diversified economic base with due emphasis on industry and agriculture
- Concentrate on qualitative development of already established utilities and facilities by improving their level of performance
- Complete the infrastructural projects necessary to achieve overall development
- Achieve balanced growth through all regions of the kingdom [Ref. 38]

The Saudi Arabian strategy supports a protective defense and security system to ensure the defense of the nation. Therefore, in the presence of peace and security, the country shall concentrate on improving the economic and productive standards of the services, utilities, and products which the government provides for its citizens. Economic performance may be improved by means of:

- Reducing production costs of public services and utilities and ensuring that services are appropriate and not excessive
- Utilizing advanced technology in all public service sectors through mechanization and the use of advanced methods, and concentrate on technologies that are relevant to the needs of the national economy such as automation

- Assessing the economic feasibility of projects of all types by including capital costs, operational costs, maintenance costs, and management costs
- Encouraging and providing incentives for the public to invest in feasible and worthwhile industries that depend on local raw material, and relying on production methods which require minimum labor and minimum quantities of critical natural resources such as water
- Making full provision for all foreseeable future maintenance and operational requirements for any project and reducing maintenance requirements as far as possible
- Standardizing the technical specifications of projects to facilitate reduced maintenance costs, and encouraging the private sector to invest in maintenance projects. [Ref. 38]

In addition, the government strategy includes giving the private sector the opportunity to undertake many of the economic tasks and functions of the government. This policy gives the private sector the opportunity to operate, manage, and maintain many of the utilities currently operated by the government. The public, however, is allowed to subscribe for shares of basic industries owned by the government, which provides an opportunity to share in the ownership and management of these industries.

One of the basic strategy principles deals with rationalizing the system of direct and indirect subsidies on many goods and services provided by the state. By making economic efficiency fundamental, the cost of production of services would be reduced.

The Saudi Arabian government will continue the development of Saudi manpower through the evaluation of education and training in conformity with Islamic Sharia (Islamic Law) and teachings. This strategy principle will be achieved through quality training programs which concentrate on the use of advanced technology at all educational levels.

The Fifth Development Plan includes a basic strategy that reads:

> Give attention to the development of Saudi society; to the provision of social welfare and health care for all; and encourage society participation in implementing the programs of the plans as well as reaping the benefits of development. [Ref. 38:p. 31]

2. Telecommunications Strategy

As the number of sectors that depend on collection, processing, and distribution of information increases, telecommunication's role in performance and development of the economy increases. More and more sectors depend on telecommunications services to raise productivity, control costs, and manage decentralized units. Therefore, high quality telecommunications services are a necessary condition for the development of other sectors. The following are the long-term objectives to be established to ensure highest quality of the telecommunications system:

- Provide telegraph, telephone, telex, and data services covering the whole country.
- Provide a digital telephone network and advanced services such as electronic mail, teletex, telemetry/teleaction services, and data transmission for all standard speeds and interfaces, via a digital long-distance transmission network.
- Provide cellular phone service and public information services on a country-wide basis.
- Provide video teleconferencing service between major cities within the kingdom and internationally to other countries, in addition to Integrated Services Digital Network (IDSN) services.
- Provide hybrid satellite facilities for domestic and international telecommunications traffic, and broadcast television channels directly to the homes. [Ref. 38]

Telecommunications strategy calls for more private sector participation and financing. Therefore, MOPTT will undertake an intensive investigation to define and establish an institutional structure that will allow

greater involvement by the private sector. The private companies are encouraged to compete in the fields of services and terminals. However, the network will continue to be under the operation of MOPTT organizations due to the government responsibilities toward national security and equitable distribution of service, in addition to the economies of large-scale production. In addition, telecommunications sector should be financially self-sufficient in terms of both capital and expenditures in order to relieve the government of the burden of providing funds for future investments.

B. POLICIES AND MAIN PLANS

1. Policies

In order to achieve the goals and objectives of the Fifth Development Plan, MOPTT will follow the following policies:

- Expand the coverage of services to reach all villages and settlements
- Apply new telecommunication technologies such as digital electronics, ISDN, optical fibres, and advanced satellite technology
- Introduce new telecommunications services and provide the necessary prerequisites for the swift introduction of new services
- Improve operational efficiency by directing telecommunications organizations to be more business-oriented and by promoting the development of human resources
- Reorganize the telecommunications sector and establish policies to guide the development of the telecommunications system. In addition, take immediate short-term measures towards financing the necessary investments and restructuring the sector

2. Main Plans

The telecommunications network in Saudi Arabia will go through many projects and expansion programs in order to reach the goals of the Fifth Development Plan. The main plans will be discussed below.

a. Expansion Programs

There is an immediate need for telephone service to reach villages all over the country. Therefore, an expansion plan has been approved for an extra 500,000 telephone lines to be distributed all over the country. This project will increase the coverage of telecommunications services to about 450 cities, towns, and villages. This project will cost an estimated two billion U.S. dollars.

b. Modernization Programs

A digital long-distance network will be installed, linking the main population centers, to provide transmission paths for the planned digital telephone network and digital data transmission services. In addition, facilities will provide digitalization up to the subscribers terminal to connect ISDN service. The Integrated Services Digital Network will integrate the digital telephone network with the existing telex and data traffic to offer an open communication structure with networks for enormous economic advantages. About 375 million U.S. dollars will be spent on this program.

c. New Services

Two new services will be offered to customers starting at the end of 1990. The first one is the paging system available for the public in 19 cities. The second service is the card telephone service providing a customer with a prepaid card, eliminating the necessity of coins. The card telephone is convenient for both the customer, for not having to look for the right change, and for Saudi Telecom, for not having to collect the coins. By the end of this program, 2750 public telephones will be operated by cards.

d. Telecommunications Reorganization

A reorganization plan will be formulated for the future policies and structures for the telecommunications system with emphasis on financing investment, privatization, and competition. In addition, private companies will be allowed to franchise in telecommunications terminal equipment and to provide telecommunications services under the regulation of the MOPTT.

By the end of the Fifth Plan, the telephone network will have grown by 700,000 lines. In addition, the number of public telephones will be increased by 5,000. This expansion will reduce operational costs through economics of scale. In addition, the productivity level will increase and the economic performance will improve.

V. SUMMARY

The Kingdom of Saudi Arabia has amazed the entire world in recent years with its development projects. Utilizing the huge income of oil sales in the late 70s and early 80s, Saudi Arabia moved from the row of less developed countries to a fully developed country. Saudi Arabia has accomplished in a relatively short time what took the industrial countries decades. For example, over the past 20 years, the Gross Domestic Product (GDP) increased more than threefold, which translates into an annual economic growth averaging more than six percent. Over time, the dependence on oil income has decreased and the country's economy is expanding and moving towards more private non-petroleum industries.

The people of Saudi Arabia are provided with free education all the way to the university and receive free health care. Other than Zakah (2.5 percent Islamic based tax given to the poor by the rich), the people of Saudi Arabia enjoy first-class services and facilities provided by the state without paying income tax, property tax, or sales tax.

In order to cope with growth in all aspects of life in Saudi Arabia, dependable and rapid communications are given due attention. For a large country such as Saudi Arabia with cities, towns, and villages scattered throughout its vast 2.24 million square km. (875,000 square mile) area, telecommunications is vital to the prosperity and growth of the nation and to the complete fulfillment of well-being of the citizens. Therefore, Saudi Arabia is benefiting from the advent of the information age and has been able to install the latest technology in electronics and transmission equipment

resulting in the acquisition of one of the most modern telecommunication systems in the world today.

Saudi Arabian telecommunications system has gone through a series of development plans, and thereafter, made massive advancement in installing telephones, telex, television, radio, telegram, and data transmission facilities. These facilities were linked together with a modern system of coaxial cables, microwave links, fiber optical cables, and satellites.

Since 1977, the telephone lines have increased from 126,000 to 1.5 million lines in 1990, up 1090%. For the same period, international trunks increased from zero to over 8300. Similarly, the number of pay telephones has increased from zero to over 7000 nationwide. In addition, more services such as telex and data communications became available for users. In 1977, there was little or no direct dialing available in the kingdom, but today every phone is linked by the modern seven digit system with direct dialing within the country and internationally to about 183 countries.

In 1986, when Riyadh and Taif satellite earth stations began operating, with less than 300 combined available circuits, they were virtually the kingdom's only means of communicating with other countries. Now, the number of satellite earth stations has increased to seven, providing more than 6,000 satellite circuits. In addition, Saudi Arabia is utilizing terrestrial telecommunication links to neighboring countries, and the internationally important SEA-ME-WE submarine cable that extends from Singapore to France.

Telecommunications is one of the fastest growing industries in Saudi Arabia today. It has very substantial capital assets and revenues. Therefore,

the telecommunications system is under ongoing expansion in order to keep pace with the growing demands of industry, commerce, the government organizations, and the public. The expansion includes the telephone lines, switches, public phones, addition trunk lines, telex, and training programs.

In the 70s, the kingdom's goals were to put in the infrastructure for the telecommunication network, to provide telecommunications services for the people at an affordable and reasonably low rate, to install the latest technology and equipment, and to provide all that in a short period of time. These goals are in conflict with private sector goals that look for profits as their primary goal. Therefore, the government of Saudi Arabia found itself forced to take over this enormous burden to fulfill its goals. Now, however, since the infrastructure is in place and main development programs are complete, MOPTT is reorganizing the telecommunications sector to adapt market-based management of the system.

The strategies and plans for the telecommunications system in Saudi Arabia emphasize mainly diversification and more private sector involvement, expanding the coverage of the services, implementing new technologies, such as ISDN, as they become available, introduce new telecommunications services, and improve efficiency of the telecommunications system and organizations.

APPENDIX A. SUMMARY LIST OF MAJOR COMPANIES THAT WERE CONTRACTED TO CARRY OUT TELECOMMUNICATIONS PROJECTS IN SAUDI ARABIA

- **Phillips & L. M. Ericsson Joint Venture (Phillips, Holland & Ericsson, Sweden)**
  Project: Expansion of the telephone network, construction of some transmission links, and installation of the Automatic Mobile Telephone System.
- **AT&T International (USA)**
  Projects: Construction of the microwave network as well as King Fahd Satellite Telecommunications City.
- **Siemens (West Germany)**
  Projects: Establishment of the telex network and supply of teleprinters and new packet switched public data network.
- **Satelco, in joint venture with SIRTI (Italy)**
  Project: Construction of the coaxial cable network.
- **Mitsubishi (Japan)**
  Projects: Construction of three satellite earth stations in Riyadh and Taif.
- **E. B. Nera**
  Project: Installation of an INMARSAT earth station for marine telecommunications via satellite.
- **Telettra (Italy)**
  Projects: Construction of many short distance microwave links as well as the microwave link between the Kingdom and Sudan across the Red Sea.
- **Bell Canada International (Canada)**
  Projects: Expertise in the transferring of technology for the administration, operation and maintenance of the telecommunications network.
- **Detecon Al Saudia**
  Projects: Operation and maintenance of the telex network and microwave network.

- **Gentec**
  Projects: Operation and maintenance of the telex network and the coastal radio stations.
- **Saudi Cap**
  Projects: Operation and maintenance of the computer systems.
- **Al Bilad BCI**
  Projects: Operation and maintenance of the microwave network.
- **Saudi Company for Electronic Circuits**
  Projects: Operation and maintenance of earth satellite stations.
- **Norconsult (Norway)**
  Projects: Consultant services for development of the telephone network.
- **Italcable**
  Projects: Consultant services for expansion of the coaxial cable network, microwave network and satellite systems.
- **Arthur D. Little (USA)**
  Projects: Consultant services for enhancements to the telecommunications network.
- **Western Electric (USA)**
  Installation of microwave system.
- **Telecom Australia**
  Operation and maintenance of the telecommunications network.

APPENDIX B. INTERNATIONAL WORKING CIRCUITS IN MARCH 1990

	MODE				
COUNTRY	COAX CABLE	MICROWAVE	SUBMARINE CABLE	SATELLITE	TOTAL
Algeria	-	-	-	11	11
Australia	-	-	-	8	8
Austria	-	-	8	6	14
Bahrain	156	156	-	27	339
Bangladesh	-	-	-	17	17
Belgium	-	-	12	7	19
Brazil	-	-	-	6	6
Canada	-	-	12	16	28
Cyprus	-	-	-	12	12
Djibouti	-	-	8	2	10
Egypt	-	-	339	61	400
Ethiopia	-	-	-	12	12
France	-	-	85	29	114
Germany	-	-	60	59	119
Greece	-	-	31	4	35
Holland	-	-	12	-	12
Hong Kong	-	-	-	14	14
India	-	-	-	84	84
Indonesia	-	-	17	-	17
INMARSAT	-	-	-	13	13
Iran	-	-	-	5	5
Iraq	45	-	-	13	58
Ireland	-	-	-	12	12
Italy	-	-	80	36	116
Japan	-	-	8	32	40
Jordan	25	-	-	84	109
Kenya	-	-	6	5	11
Portugal	-	-	-	3	3
South Korea	-	-	-	39	39
Kuwait	162	-	-	36	198

	MODE				
COUNTRY	COAX CABLE	MICROWAVE	SUBMARINE CABLE	SATELLITE	TOTAL
Lebanon	-	-	-	11	11
Libya	-	-	-	6	6
Malaysia	-	-	2	6	8
Mauritania	-	-	-	4	4
Morocco	-	-	-	34	34
Niger	-	-	-	2	2
Oman	-	-	-	24	24
Pakistan	-	-	-	196	196
Philippines	-	-	1	54	55
Qatar	-	65	-	19	84
Scandinavia	-	-	12	13	25
Senegal	-	-	-	5	5
Singapore	-	-	16	2	18
Somalia	-	-	-	7	7
Spain	-	-	-	36	36
Sri Lanka	-	-	20	-	20
Sudan	-	26	-	41	67
Switzerland	-	-	34	8	42
Syria	36	-	-	30	66
Taiwan	-	-	8	7	15
Thailand	-	-	9	10	19
Tunisia	-	-	7	19	26
Turkey	36	-	-	60	96
U.A.E.	-	126	-	36	162
U.K.	-	-	145	123	268
U.S.A.	-	-	-	347	347
Yemen	-	169	-	91	260
TOTAL	**304**	**542**	**935**	**1850**	**3631**

APPENDIX C. SAUDI ARABIAN FIFTH DEVELOPMENT PLAN STRATEGY

1410-1415 AH

1990-1994 A.D.

A. THE OBJECTIVES OF THE FIFTH DEVELOPMENT PLAN FOR THE KINGDOM OF SAUDI ARABIA (1410-1415 AH)

1. To safeguard Islamic values by duly observing, disseminating and confirming Allah's Sharia (God's Divine Law);
2. To defend the Faith and the Nation; and to uphold the security and social stability of the Kingdom;
3. To form a productive national work force by encouraging citizens to avail themselves of the benefits from the infrastructure and institutions provided for them by the State — ensuring their livelihood and rewarding them on the basis of their work;
4. To develop human resources, thus ensuring a constant supply of manpower, upgrading its quality and improving its efficiency to meet the requirements of the national economy;
5. To raise cultural and information standards to keep pace with the Kingdom's development;
6. To reduce dependence on the production and export of crude oil as the main source of national income;
7. To continue with real structural changes in the Kingdom's economy so as to establish a diversified economic base — with due emphasis on industry and agriculture;
8. To develop mineral resources and to encourage discovery and utilization thereof;
9. To concentrate on qualitative development of already-established utilities and facilities by improving their level of performance;
10. To complete the infrastructural projects necessary to achieve overall development;
11. To further encourage growth throughout all regions of the Kingdom;
12. To achieve balanced growth throughout all regions of the Kingdom;

13. To achieve economic and social integration among the Gulf Cooperation Council (GCC) countries.

B. THE STRATEGIC BASES WHEREBY THE AFOREMENTIONED OBJECTIVES MAY BE ACHIEVED

The First Basic Strategic Principle:

Continue to support the presence of a protective defence and security system, further the continuous development of the Kingdom's intrinsic defence potential, and to forge ahead in inculcating an ever-deepening sense of loyalty and belonging on the part of the individual citizen. The defence and security authorities shall plan their strategy in order to ensure the defence of the nation, and shall submit that strategy to the National Security Council prior to presenting it for consideration by the Council of Ministers.

The Second Basic Strategic Principle:

Concentrate on improving the economic and productive standards of the services, utilities and products which the government provides for citizens — both directly (such as education and security services) and indirectly (such as electricity, transportation and basic commodities).

Economic performance may be improved by means of:

1. Reducing production costs of public services and utilities;
2. Ensuring that services are appropriate and not excessive: for example, by limiting specifications for construction or operations of projects to what is actually required;
3. Utilizing advanced technology in all public service sectors through mechanization and the use of advanced methods;
4. Concentrating on those technologies that are relevant for the needs of the national economy such as automation, use of saline water in agriculture, and other methods.

5. Assessing the economic feasibility of projects of all types by including not only capital costs, but operational and maintenance, as well as management costs;
6. Encouraging and providing incentives for the public to invest in feasible and worthwhile industries dependent on local raw materials, and relying on production methods which require minimum labor and minimum quantities of critical natural resources such as water;
7. Emphasizing diversification of the productive base in agriculture, by encouraging the establishment of joint stock companies in large-scale feasible agricultural projects, employing modern irrigation equipment and machinery, and continuing to encourage individual investment therein;
8. Supporting the trend to invest in projects applying new technologies for which the Kingdom has economic advantages or which are badly needed, such as solar energy projects, modern irrigation methods and the use of greenhouses;
9. Supporting centers and programs for applied research;
10. Making full provision, with regard to any project, for all foreseeable future maintenance and operational requirements; in project design, consideration should be given to reducing maintenance requirements as far as possible;
11. Including safety programs in maintenance schedules based on the lifespan of the unit and/or its rate of operation (capacity utilization);
12. Standardizing the technical specifications of projects to facilitate reduced maintenance costs;
13. Developing training programs for machine operation, thereby reducing operational errors;
14. Including general principles of maintenance as part of the educational curricula for the post-elementary stages, to enable individuals to carry out simple maintenance tasks and understand general safety principles;
15. Encouraging the private sector to invest in maintenance projects;
16. Laying emphasis on the employment of trained Saudi manpower in important permanent utilities;
17. Developing appropriate administrative and financial organizations to serve the new needs of the community.

The Third Basic Strategic Principle:

Adopt a policy giving the private sector the opportunity to undertake many of the economic tasks of the Government, while ensuring that the Government does not engage in any economic activity undertaken by the private sector.

This policy may be implemented through:

1. Giving the private sector the opportunity to operate, manage, maintain and renovate many of the utilities currently operated by the Government, on condition that this would result in lower costs, better performance and employment opportunities for Saudi citizens;
2. Developing appropriate methods to encourage the private sector to provide employment opportunities for Saudi citizens;
3. Offering for public subscription the shares of SABIC and PETROMIN companies — thus giving the private sector the opportunity to share in the ownership and management of basic industries set up by the Government.
4. Reconsidering some of the prevailing methods, policies and regulations so as to enable the private sector to operate with greater freedom and flexibility, and to assist it in becoming more creative and developed. These considerations include: (i) the equitable adjustment of price control on private hospitals and clinics, thus ensuring fairness to citizens and investors alike, and (ii) the development of procedures for commercial courts and notary public offices, etc.;
5. Encouraging co-operatives, as well as private benevolent and commercial societies and institutions to undertake social and economic projects, such as the management of private sanitaria, hospitals and clinics, tourist areas and recreation centers;
6. Urging commercial banks to extend their credit facilities to production projects instead of concentrating on the import trade;
7. Encouraging the incorporation of more joint stock companies to undertake large projects with economies of scale, so that the greatest number of citizens may benefit from investment transactions;
8. Creating a regulated financial market, under Government supervision, for trading of company shares in order to encourage investment and avoid the pitfalls of financial speculation;

9. Encouraging the private sector to participate in the formulation and implementation of training programs;
10. Making information more widely available to citizens by increasing the quality and frequency of special programs which identify investment opportunities in the productive sectors;
11. Carrying out a greater number of studies of investment and marketing opportunities and of the feasibility of projects in the productive sectors;
12. Acquainting investors regularly with results of official studies relating to mining; encouraging investors to undertake the utilization and development of available minerals; allowing companies to invest in minerals that have been discovered; and encouraging investment in mining through such means as the provision of basic infrastructure;
13. Continuing to give priority to qualified and classified Saudi contractors in the implementation of various projects; when a foreign company is awarded a contract it must subcontract a proportion of the work to Saudi contractors;
14. Ensuring that projects, whenever possible technically or economically, are divided into multiple contracts or sub-projects, thus enabling the participation of Saudi companies in their execution.
15. Promoting the incorporation of national financial institutions for the investment of (private) funds within the Kingdom.
16. Enhancing and supporting research and development activities in private sector industrial and productive institutions;
17. Facilitating and encouraging the participation of the private sector in providing opportunities for scientists and researchers to conduct scientific and technological research, with the cooperation of the King Abdulaziz City for Science and Technology (KACST) and of the universities, and with particular emphasis on applied research.

The Fourth Basic Strategic Principle:

Rationalize the system of direct and indirect subsidies on many goods and services provided by the State through:

1. Reducing subsidy rates in ways that will rationalize consumption without significantly affecting low income consumers;
2. Ensuring that all Government departments which administer public services make economic efficiency fundamental to the function of these services by adopting two basic principles:

First: the cost of producing such services to the Saudi community should be reduced;

Second: the prices of such services should not be less than production costs, except in rare cases — and with the provision that they should be periodically reviewed.

The Fifth Basic Strategic Principle:

The consideration of economies should predominate in the Government's investment and expenditure decisions.

In practice this means:

1. Considering water as as basic factor and an important determinant of efficiency in Government project, as is the case with expatriate labor or inflation;
2. Developing economically promising natural resources such as the exploration of mineral and sea resources, the mapping of their location, their further development and utilization, and the processing of available natural gas to the maximum extent possible;
3. Expanding — both horizontally and vertically — the petrochemical industries as well as the production of gas and petroleum derivatives, through the private sector or joint-venture companies, whenever economic feasibility is proven;
4. Maximizing the capacity for manufacturing refined petroleum products within the bounds of economic feasibility.

The Sixth Basic Strategic Principle:

Continue the development of (Saudi) manpower, through the evaluation of education and training programs and curricula, as well as by their further development or modification in conformity with the Islamic Sharia, the changing needs of society, and the requirements of the development process. This continuing development of Saudi manpower can be achieved by:

1. Making primary education mandatory for all boys and girls;
2. Identifying, at each educational stage beyond the intermediate level, the proportion of students qualified to receive higher education, so that the remainder can be guided towards specialized technical institutes;

3. Guiding admissions policy in the universities in conformity with the requirements of the development process in the long-run, and developing educational systems, curricula and programs accordingly;
4. Ensuring integration between all levels of education and flexibility of access between all academic and technical institutes of learning;
5. Increasing the participation of women in the labor force in conformity with the Islamic Sharia;
6. Limiting university bursaries to proficient students and to those fields of specialization (including technical education and vocational training) identified as needing incentives;
7. Paying attention to the quality of training by concentrating on the use of advanced technology at the intermediate and advanced levels;
8. Developing training programs which, in terms of quality, reflect actual economic needs, and which are oriented towards the level of proficiency required;
9. Increasing concentration on encouraging on-the-job training;
10. Paying attention to industrial safety and occupational health in both public and private sectors;
11. Placing great emphasis on libraries in order to encourage and accustom students to make use of such facilities.

The Seventh Basic Strategic Principle:

Give attention to the development of Saudi society; to the provision of social welfare and health care for all; and encourage society's participation in implementing the programs of the Plan, as well as in reaping the benefits of development.

It is therefore necessary to:

1. Create in Saudi citizens an awareness of the objectives and requirements of development and of the handling of the tools of development.

   This calls for:

   - the provision of information through the public media, stressing the religious and social value of work as an important and respectable activity, in order to change attitudes towards certain occupations which are present are not acceptable to some;

- the dissemination of culture by encouraging literary authorship, the spread of public libraries, the establishment of museums and the preservation of historical and archaeological sites;
- the establishment of a National Library with a collection of books and manuscripts which includes every Saudi author.

2. Provide enhanced care for children in all fields and at all levels, such as:
   - giving attention to health care for mothers, including health education, and the elimination of illiteracy among mothers;
   - further developing care programs for delinquent juveniles;
   - identifying diseases to which children are susceptible at an early age;
   - providing space in the public libraries for children;
3. Increase attention for the handicapped and introduce national programs for their rehabilitation and welfare;
4. Introduce compulsory military service;
5. Introduce some basic military principles into the secondary school curriculum;
6. Expand the development of anti-illiteracy and adult education programs;
7. Give more attention to local community programs based on the effective participation of citizens in the planning and implementation of local projects;
8. Give attention to preventive medicine and health education; increase the effectiveness of preventive and curative institutions in protecting the citizens; and widen the scope of health programs;
9. Improve the capabilities of individuals to increase their income, thereby promoting greater social balance;
10. Pay greater attention to social welfare programs in all fields and induce private sector participation by encouraging the establishment of yet more private benevolent societies;
11. Continue the development of environmental programs;
12. Give attention to conservation and development of wildlife;
13. Encourage the contribution of citizens to urban improvement, landscaping, and the establishment of parks;

14. Pay greater attention to youth welfare programs, to developing the capabilities of young people, and to enabling them to gain mental and physical skills in the fields of culture, science and sports.

The Eighth Basic Strategic Principle:

Achieve balanced development in all regions of the Kingdom by:

1. Establishing the development centers as the bases for regional development. These centers should be identified in accordance with selected criteria.
2. Ensuring efficient use of existing facilities and services in all regions of the Kingdom.

The Ninth Basic Strategic Principle:

Adopt a fiscal policy which keeps the level of expenditure in line with the Government's revenues throughout the Fifth Development Plan period, with emphasis on:

1. Studying the best ways and means to increase the Government's revenues.
2. Maintaining a definite level of government expenditure which will safeguard the national economy from external fluctuations and will ensure the growth of a stable economy;
3. Authorizing projects for implementation only if they comply with the development objectives and the strategic principles set out above;
4. Authorizing projects for implementation only on the basis of their combined operating and maintenance costs (including management and replacement costs) over the lifespan of the project.

LIST OF REFERENCES

1. The National Center for Financial Economic Information, *Two Decades of Progress*, Ministry of Finance and National Economy, Riyadh, Saudi Arabia, 1988.

2. Johany, A. D., Berne, M., and Mixon, J. W., *The Saudi Arabian Economy*, The Johns Hopkins Press, Baltimore, MD, 1986.

3. Research and Statistics Department, *Statistical Summary*, Saudi Arabian Monetary Agency, Riyadh, Saudi Arabia, 1989.

4. Central Department of Statistics, *The Statistical Indicator*, Ministry of Finance and National Economy, Riyadh, Saudi Arabia, 1986.

5. Cleron, J. P., *Saudi Arabia 2000*, St. Martin's Press, Inc., New York, 1978.

6. Alzahri, S. M., *Communication Satellites for Saudi Arabia*, Master's Thesis, Naval Postgraduate School, Monterey, CA, March 1978.

7. *Academic American Encyclopedia*, Grolia Incorporated, Connecticut, 1983.

8. Al-Moybel, M. H., *Modern Telecommunication Technology and its Future Impacts*, Master's Thesis, Naval Postgraduate School, Monterey, CA, June 1979.

9. Pusateri, C. J., *A History of American Business*, 2nd Ed., Harlan Davidson, Inc., IL, 1988.

10. Victor, R. H. K., and Dyu, D., *Telecommunications in Transition*, Harvard Business School, MA, 1986.

11. *World of Communication in the Kingdom of Saudi Arabia*, Ministry of Posts, Telegraph, and Telephones, Riyadh, Saudi Arabia.

12. Saleem, M. H., "Wire and Wireless Communication in Saudi Arabia," *The Caravan Magazine*, Aramco, Dahran, v. 33, no. 5, pp. 8-23, January, 1985.

13. Zedan, S. A., *The Effect of Telecommunication Developments in Commerce in Saudi Arabia*, King Abdulaziz University, Jeddah, Saudi Arabia, 1980.

14. Statistical Department, *Statistical Year Book, 11th Issue,* Ministry of PTT, Riyadh, Saudi Arabia, 1989.

15. Public Relations Department, *Summary of Public Telephone Service in Saudi Arabia,* Ministry of PTT, Riyadh, Saudi Arabia, 1989.

16. *Automatic Mobile Telephone System,* Ministry of PTT, Riyadh, Saudi Arabia.

17. Callmer, C., "Around the World on a Tour of Cellular Communications," *Telephony,* v. 205, no. 6, pp. 30-31, August, 1983.

18. Public Relations Department, *Summary of Telegraph Network in Saudi Arabia,* Ministry of PTT, Riyadh, 1989.

19. *Telex and Coast Radio, Two Pillars of the Telecommunications Network in Saudi Arabia,* Ministry of PTT, Riyadh, Saudi Arabia.

20. *Telecommunications in Saudi Arabia, a Story of a Unique Experience,* Ministry of PTT, Riyadh, Saudi Arabia, 1983.

21. Aktamany, A. E., *Fiber Optics in Saudi Arabia,* Ministry of PTT, Riyadh, Saudi Arabia, 1990.

22. Public Relations Department, *The Desert is Talking,* Ministry of PTT, Riyadh, Saudi Arabia, 1985.

23. Wedert, M. M., *Integrated Services Digital Network (ISDN),* Master's Thesis, Naval Postgraduate School, Monterey, CA, 1985.

24. *King Fahd Satellite Telecommunications City,* Ministry of PTT, Riyadh, Saudi Arabia, 1987.

25. *Report on Telecommunications and Peaceful Uses of Outer Space,* Ministry of PTT, Riyadh, Saudi Arabia, 1989.

26. Alsynedy, A. R., *Staged of Improving and Organizing of Government Management in Saudi Arabia, First Edition,* Farazday Commercial Printers, Riyadh, 1989.

27. *Saudi Communication System,* Saudi Telecom, Riyadh, Saudi Arabia.

28. *Gateway to the World,* Ministry of P.T.T., Riyadh, Saudi Arabia.

29. *Telecommunications in the Kingdom of Saudi Arabia, A Story of a Unique Experience,* Ministry of P.T.T., Riyadh, Saudi Arabia.

30. *The Saudi Arabian Experience in Telecommunications,* Ministry of P.T.T., Riyadh, Saudi Arabia.

31. "ST 58 Bil Spent on Telecommunications Sector," *Arab News,* p. 2, January 13, 1988.

32. *Operational Results,* Ministry of P.T.T., Riyadh, Saudi Arabia, March 1990.

33. Public Relations Department, *National Network Control Center,* Ministry of P.T.T., Riyadh, Saudi Arabia.

34. *Telecommunications Institutes,* Ministry of P.T.T., Riyadh, Saudi Arabia.

35. Alahmady, M., *Huge International Telecommunications Network in the Holy Places,* Almajalla Magazine, v. 541, p. 18-70, 26 June, 1990.

36. Saudi Telecom, *West Region Annual Report,* Ministry of P.T.T., Riyadh, Saudi Arabia, 1985.

37. Stalling, W., *Data and Computer Communication,* Second Edition, Macmillan Publishing Company, 1988.

38. *Fifth Development Plan Strategy,* Ministry of Planning, Riyadh, Saudi Arabia, 1989.

39. Alahmady, M., *Paging System and Card Telephone Services Enter Saudi Telecomm,* Almajalla Magazine, v. 543, p. 38-39, 10 July 1990.

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center 2
   Cameron Station
   Alexandria, VA 22304-6145

2. Library, Code 52 2
   Naval Postgraduate School
   Monterey, CA 93943-5000

3. Professor Myong W. Suh, Code AS/Su 1
   Naval Postgraduate School
   Monterey, CA 93943-5000

4. Professor Cynthia H. Dresser, Code AS/Dr 1
   Naval Postgraduate School
   Monterey, CA 93943-5000

5. Professor Dan C. Boger, Code AS/Bo 1
   Naval Postgraduate School
   Monterey, CA 93943-5000

6. Minister of Post, Telegraph and Telephone 1
   Dr. Alawi Darweesh Kayal
   Ministry of Post, Telegraph and Telephone
   Riyadh, Saudi Arabia

7. Abdullah Al-Hodaithy, Lt. Col., ... 1
   Royal Embassy of Saudi Arabia
   Armed Forces Office
   2109 E Street N.W.
   Washington, DC 22307

8. Saeed A. Al-Gahtani, Capt., ... 3
   Ministry of Defense and Aviation
   Royal Saudi Air Defense Forces (RSADF)
   Air Defense Forces Command
   Projects Directorate
   Riyadh, Saudi Arabia