ALPHA LYRACOM
SPACE COMMUNICATIONS

ALPHA LYRACOM SPACE COMMUNICATIONS, INC./ PAN AMERICAN SATELLITE

Overview: May 17, 1991

PAN AMERICAN SATELLITE • ONE PICKWICK PLAZA • GREENWICH, CONNECTICUT 06830 • TELEPHONE 203/622/6664 • FAX 203/622/9163

I. OVERVIEW OF ALPHA LYRACOM

Business Scope

Alpha Lyracom Space Communications, Inc. / Pan American Satellite ("Alpha Lyracom") operates the world's first private international satellite system. Using its PAS-1 satellite, which provides coverage of Western Europe, North America, Latin America and the Caribbean, Alpha Lyracom provides video, data and voice telecommunications services to over 130 clients in more than 60 countries.

Alpha Lyracom emerged in response to President Reagan's determination in 1984 to introduce competition in the satellite communications industry. In 1985, the Federal Communications Commission passed a decision allowing private separate systems to operate in an open market for international satellite communications. PAS-1 was launched in June 1988 and became operational in September 1988.

Alpha Lyracom's telecommunications offerings consist of three primary services: (1) the sale of spot beam transponders, (2) broadcast services, and (3) data services. Under a sale of a spot beam transponder, a customer obtains satellite facilities by acquiring the right to use a transponder for any purpose throughout the life of the transponder. Customers for transponder sales are public and private telecommunication carriers and broadcasters with full time requirements. Broadcast services involve the use of satellite capacity to distribute video or audio programming on a full time and part time basis. Data services involves the transmission of digital information (data, voice or video) over a satellite network. In addition, Alpha Lyracom provides full, end-to-end telecommunications services to many of its customers in collaboration with overseas partners.

Alpha Lyracom is a vertically integrated company, which provides services on a contractual rather than a tariff basis. As a result, Alpha Lyracom can control both the space and ground segments of its satellite system and can offer its customers customized networks and a higher degree of quality, flexibility and reliability than services which rely on satellite capacity from Intelsat. Alpha Lyracom provides its customers with "one-stop shopping" and quick, responsive, innovative and low cost solutions to their telecommunication needs in an extremely complex regulatory environment. Alpha Lyracom also provides customers with network control, small inexpensive on-site earth stations and, in most areas, higher power availability. Alpha Lyracom's satellite operations offer customers superior service and technical performance.

Based on its operating experience, reputation and expertise, Alpha Lyracom believes that it is well positioned to capture a material portion of the expected growth in the global satellite communications industry. Accordingly, Alpha Lyracom intends to construct and launch three additional satellite communications satellites by 1995. The first additional satellite, PAS-2, will cover the same regions presently served by PAS-1 -- Europe, North America, Latin America and the Caribbean. The second satellite, PAS-3, will cover the Pacific Ocean, including the western United States, Japan, Southeast Asia and Oceania. The third satellite, PAS-4, will provide coverage of the Indian Ocean region, including the Middle East, the Soviet Union, China, East Africa, Europe and Asia. PAS-2, PAS-3 and PAS-4 will be followed by additional satellites as the market for satellite services expands and operational requirements dictate.

PAS-1, PAS-2, PAS-3, PAS-4 and future satellites will be owned and operated by a strategic partnership to be formed by Alpha Lyracom. Alpha Lyracom will manage the business of the Partnership, as general partner, and will contribute PAS-1 and Alpha Lyracom's business operations to the Partnership. Strategic Partners will make cash capital contributions to the Partnership.

Through its ownership of PAS-1, PAS-2, PAS-3 and PAS-4, the Partnership will operate the world's only privately owned global satellite communications system.

Location of Headquarters and Contact Points.

The executive offices of Alpha Lyracom Space Communications are located at:

Rene Anselmo - Chairman
Frederick Landman - President

One Pickwick Plaza
Greenwich, CT 06830 USA
(203) 622-6664 telephone
(203) 622-9163 facsimile

Technical personnel are located at the Homestead International Teleport:

143 North Flagler Avenue
Homestead, Florida 33031
(305) 247-7055 telephone
(305) 245-3720 facsimile

II. FCC & LICENSING

Alpha Lyracom has filed applications with the FCC for several new satellites, including one additional satellite in the Atlantic Ocean Region, two satellites in the Pacific Ocean region, and two satellites in the Indian Ocean Region. The FCC accepted the two Pacific satellite applications for filing on November 16, 1990, and no party has filed in opposition of these applications.

One potential competitor asked that the FCC condition its grant of one of the Pacific applications and the two Indian Ocean applications on the completion of technical coordination; Alpha Lyracom has stated its willingness to engage in good-faith coordination efforts to minimize instances of objectionable interference. Alpha Lyracom believes that, in light of the public interest benefits demonstrated in its applications and the absence of opposition thereto, it is virtually certain to obtain the requested licenses from the FCC.

III. INTELSAT & 14 (d) CONSULTATIONS

The PAS-1 satellite, currently in orbit, has been consulted for use by a large number of countries under Intelsat Article XIV (d). A current list of these consultations is appended to this document.

Alpha Lyracom has no reason to believe that it will not be able to achieve similar success with respect to consultation of the PAS/Pacific and the PAS/Indian satellites. Indeed, in the period since most of the PAS-1 consultations were concluded, Intelsat has liberalized certain aspects of the process for Article XIV (d) consultations of international separate system satellites. In addition, Alpha Lyracom has already received preliminary indications that it will receive landing rights in Australia, New Zealand and Hong Kong. The progress made in these areas should enhance Alpha Lyracom's position in Japan and in other countries in the Pacific Ocean region. Accordingly, Alpha Lyracom is confident that it will be able to consult successfully with Intelsat with respect to the proposed Pacific satellites.

IV. INTERNATIONAL FREQUENCY REVIEW BOARD (IFRB)

The IFRB has approved the 45 degree orbital slot of PAS-1. Applications for the orbital slots for PAS-2, PAS-3 and PAS-4 have been submitted for IFRB approval. Publication of the IFRB ruling on PAS-3 can be expected during June 1991 at the earliest, and September 1991 at the latest.

V. SPECIFICATIONS OF PAS-1 THROUGH PAS-4 SATELLITES

1. PAS-1:

1. Useful Life

13.3 years.

2. Weight

Launch weight = 2690 lbs. Orbit weight = 1560 lbs.

3. Launching Schedule

June 1988. Operational September 1, 1988.

4. Geostational Orbit Position Plan

45 degrees West Longitude.

5. Number of Transponders

18 C-band transponders (12 narrowband 36MHz and 6 wideband 72MHz) and 6 Ku-band transponders (wideband 72MHz). All utilizing 16 watt travelling wave tube amplifiers.

6. Coverage

Four C-band beams totaling 18 C-band transponders cover Latin America. Three Ku-band transponders downlink in Continental United States. Three Ku-band transponders downlink in Europe. Please see Exhibit 2 for coverage areas.

7. Contractor

General Electric Astro Series 3000 satellite. Launched by Arianespace.

2. **PAS-2:**

1. Useful Life

12 years.

2. Weight

3000 lbs in dry state.

3. Launching Schedule

July 1993. Operational September 1993.

4. Geostational Orbit Position Plan

39.5 degrees West Longitude.

5. Number of Transponders

24 C-band transponders (36MHz narrow bandwidth) providing service to the Western Hemisphere and northwest Africa and 18 Ku-band transponders (72 MHz wide bandwidth) providing transAtlantic and European service.

6. Coverage

Approximately the same coverage area as PAS-1. Please see Exhibit 3.

3. **PAS-3:**

1. Useful Life
12 years.

2. Weight
3000 lbs in dry state.

4. Launching Schedule
First half of 1994.

5. Geostational Orbit Position Plan
192 degrees West Longitude.

6. Number of Transponders
24 C-band 36MHz transponders. Sixteen 54MHz Ku-band transponders.

7. Coverage
International service between the west coast of the United States and all major points in the Pacific Basin and as far west as Thailand and Singapore. Please see Exhibit 4.

4. **PAS-4:**

1. Useful Life
12 years.

2. Weight
3000 lbs in dry state.

3. Launching Schedule
Second half of 1994.

4. Geostational Orbit Position Plan
68 degrees East Longitude.

5. Number of Transponders
24 36MHz C-band transponders and 16 54MHz Ku-band transponders.

6. Coverage
From Japan in the east to England in the West. Please see Exhibit 5.

Exhibit 6 provides an outline of the global coverage.

5. PAS-1 THROUGH PAS-4

An contractor for satellites PAS-2 through 4 has not been selected. Proposals have been submitted by five satellite constructors, including a proposal for the construction of four light satellites. The proposal to launch four light satellites is referred to as "lightsats".

Launch

a. Large versions of satellites would be launched by Long March 2E with PKM or Ariane 4 shared payload. Smaller satellites would be dual launch on Long March 2E with PKM or Ariane 4 shared payload. Smaller satellites would be dual launch on Lang March 2E, small payload on Ariane, Delta or if light enough, one of the new US launchers.
All satellites will be three-axis stabilized using momentum wheels, reaction control systems and other attitude control systems.

b. Launch Schedule: PAS-1 was launched during June 1988 and became operational on September 1, 1988. PAS-2 would be launched during the fourth quarter of 1993, with additional launches every three to six months.

c. Geostationary Orbit Positions: Alpha Lyracom has submitted applications for a total of seven orbital slots, as follows:

PAS-1 - 45 degrees WL - registered at IFRB.
PAS-2 - 43 degrees WL - registered at IFRB.
PAS-3 - 39.5 degrees EL - registration process at FCC.
PAS-4 - 168 degrees EL - registration process at FCC.
PAS-5 - 166 degrees EL - registered at IFRB.
PAS-6 - 68 degrees EL - registration process at FCC.
PAS-7 - 72 degrees EL - registration process at FCC.

d. POWER:

PAS-1 Beam Center EIRP Latin Beam = 37 dBW
PAS-1 Beam Center EIRP Spot Beams = 40 dBW
PAS-1 Beam Center EIRP US Beam = 46.5 dBW
PAS-1 Beam Center EIRP Europe Beam = 47.5 dBW

PAS-2 Beam Center EIRP Latin Beam = 38 dBW
PAS-2 Beam Center EIRP Spot Beams = 41 dBW
PAS-2 Beam Center EIRP US Beam = 48 dBW
PAS-2 Beam Center EIRP Europe Beam = 49 dBW

PAS-4 Beam Center EIRP Asia Beam = 37 dBW
PAS-4 Beam Center EIRP US Beam = 46.5 dBW
PAS-4 Beam Center EIRP Australia Beam = 47.5 dBW

PAS-6 Beam Center EIRP Asia Beam = 37 dBW
PAS-6 Beam Center EIRP Africa Beams = 40 dBW
PAS-6 Beam Center EIRP Middle East Beam = 46.5 dBW
PAS-6 Beam Center EIRP Europe Beam = 47.5 dBW
PAS-6 Beam Center EIRP India Beam = 47.5 dBW

These values are subject to change for when an actual contractor is selected and the final vehicle specifications are agreed upon. The values assume a directivity which has been calculated and 20 watt SSPA's are C-band and 40-50 watts at TWTA's at Ku-band. Values provided here are consistent with FCC and IFRB filings.

e. Spot Beam Coverage:

Please see the attached spot beam coverage maps for detailed coverage.

f. Contractor:

Presently in negotiations with GE Astro, Hughes, TRW, SS/Loral and Fairchild.

g. Other Characteristics

Satellites will use state-of-the-art technology and the largest power amplifiers consistent with available solar energy. Some consideration will be given to inter-satellite links in these designs by agreement with NASA Lewis.

ALPHA LYRACOM
SPACE COMMUNICATIONS

The following countries have coordinated with Intelsat under Article XIV of the Intelsat Agreement for the Pan American Satellite System:

North America
Mexico
United States
Canada*

Central America
Belize
Costa Rica
Guatemala
Honduras
Panama

Caribbean
Anguilla
Antigua & Barbuda
Aruba
Bahamas
Barbados
Barbuda
Bermuda
British Virgin Islands
Cayman Islands
Dominica
Dominican Republic
Grenada
Haiti
Montserrat
Netherlands Antilles
St. Kitts & Nevis
St. Lucia
St. Vincent & Grenadines
Trinidad and Tobago
Turks and Caicos Islands

South America
Argentina
Bolivia
Brazil
Chile
Colombia
Ecuador
Guyana
Paraguay
Peru
Suriname
Uruguay
Venezuela

Western Europe
Austria
Belgium
Denmark
France
Germany
Greece
Ireland
Italy
Luxembourg
Monaco
Netherlands
Portugal
Spain
Sweden
Switzerland
United Kingdom

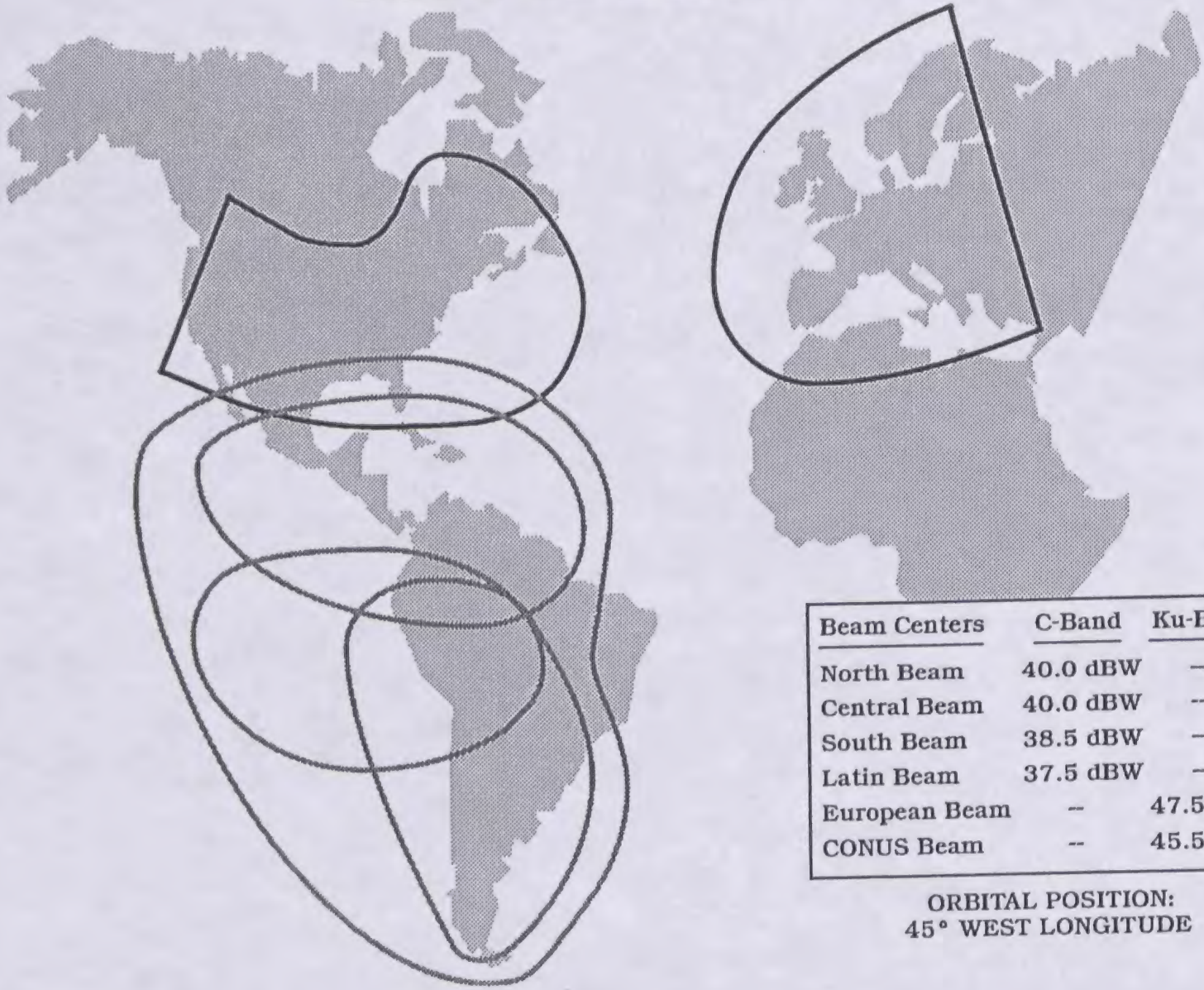
Eastern Europe
Albania
Bulgaria
Czechoslovakia
Hungary
Poland
Romania
Soviet Union
Yugoslavia

Exhibit One

April 1991

*Pending June Board of Governors meeting.

PAS-1 COVERAGE

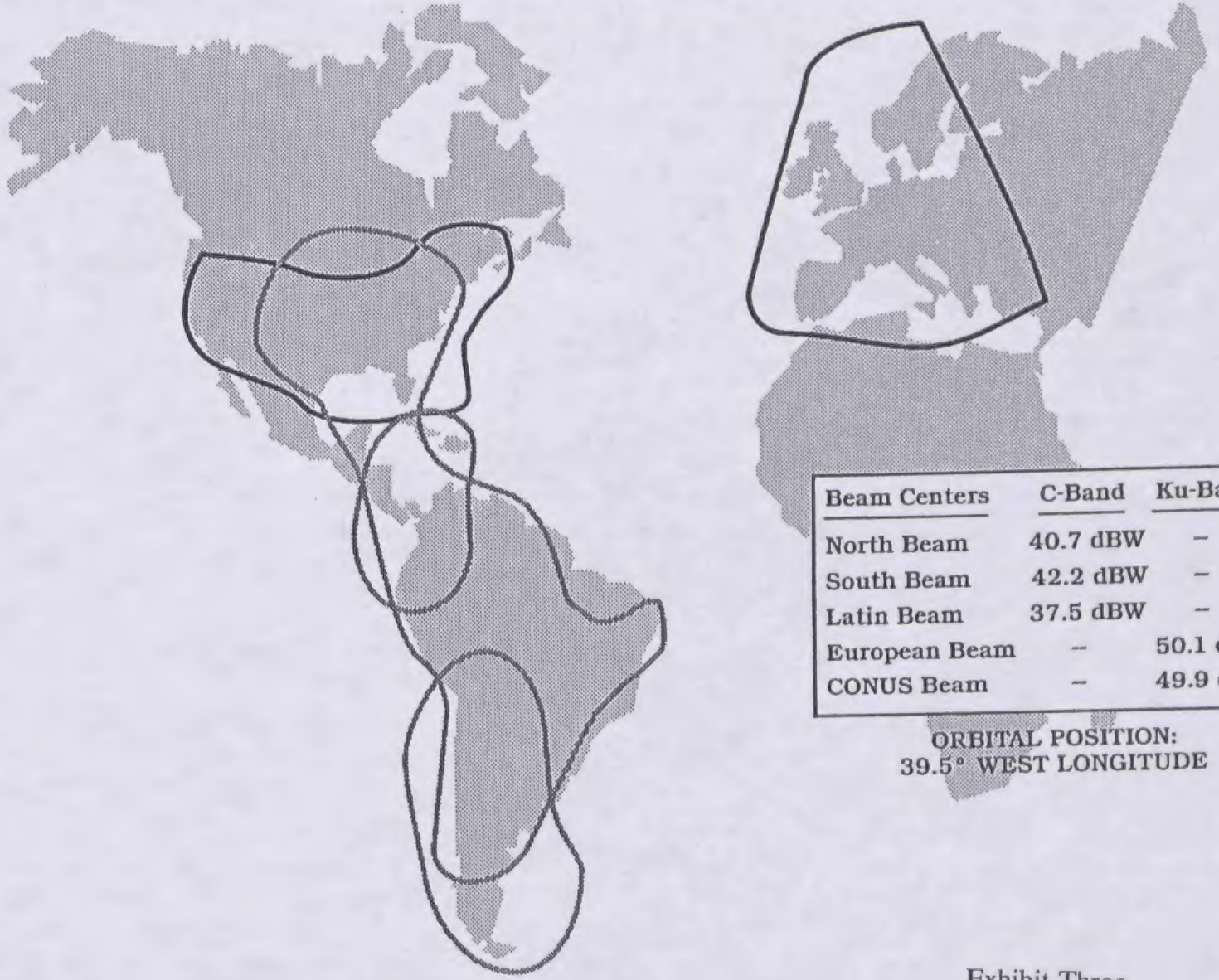


Beam Centers	C-Band	Ku-Band
North Beam	40.0 dBW	–
Central Beam	40.0 dBW	–
South Beam	38.5 dBW	–
Latin Beam	37.5 dBW	–
European Beam	–	47.5 dBW
CONUS Beam	–	45.5 dBW

ORBITAL POSITION:
45° WEST LONGITUDE

Exhibit Two

PAS-2 COVERAGE

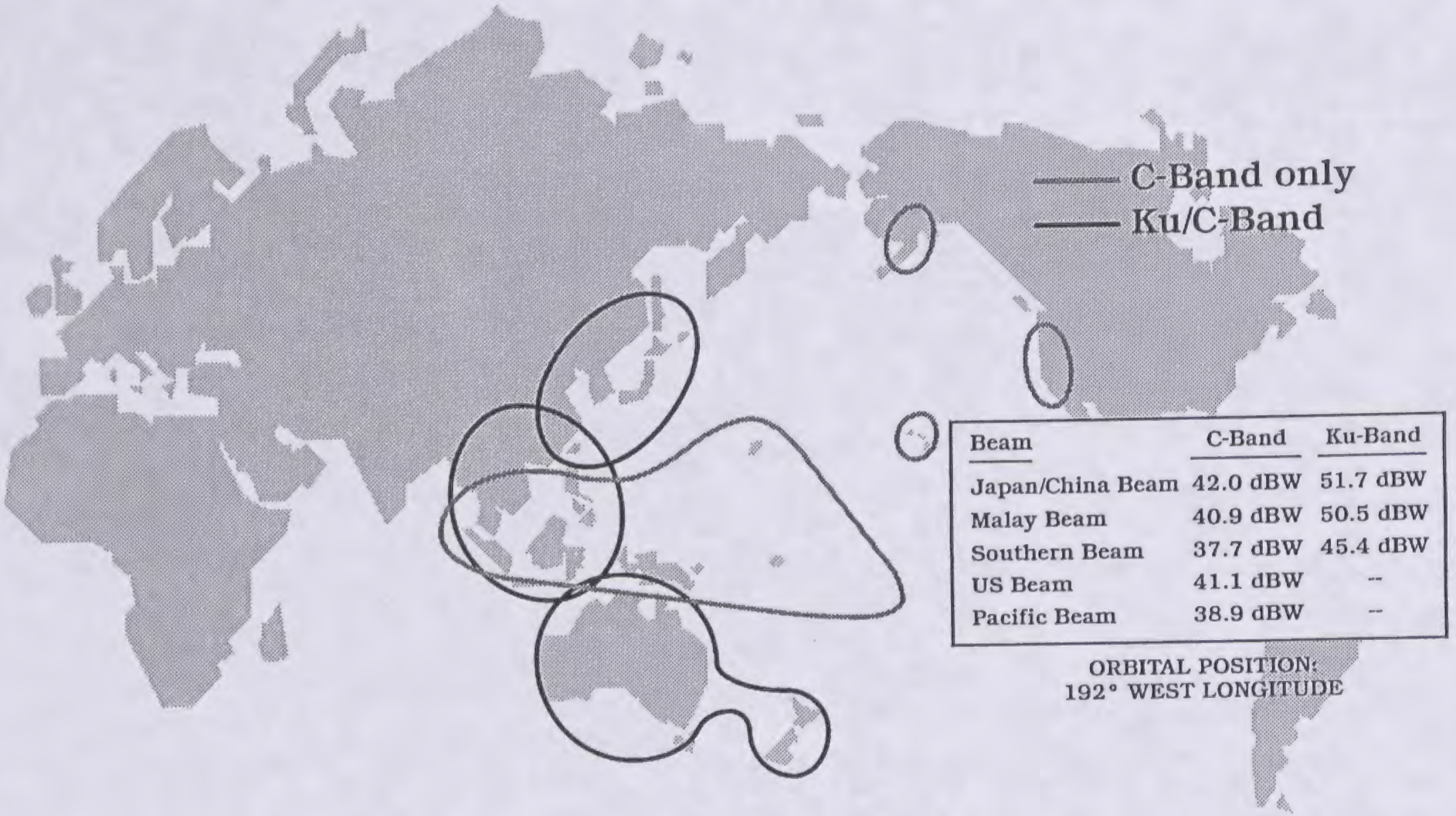


Beam Centers	C-Band	Ku-Band
North Beam	40.7 dBW	–
South Beam	42.2 dBW	–
Latin Beam	37.5 dBW	–
European Beam	–	50.1 dBW
CONUS Beam	–	49.9 dBW

ORBITAL POSITION:
39.5° WEST LONGITUDE

Exhibit Three

PAS-3 COVERAGE



Beam	C-Band	Ku-Band
Japan/China Beam	42.0 dBW	51.7 dBW
Malay Beam	40.9 dBW	50.5 dBW
Southern Beam	37.7 dBW	45.4 dBW
US Beam	41.1 dBW	--
Pacific Beam	38.9 dBW	--

ORBITAL POSITION:
192° WEST LONGITUDE

Exhibit Four

PAS-4 COVERAGE

EIRP Beam
Ku Band: 48 dBW
C-Band: 39 dBW

Ku ◄——► C

Transponders Switchable Among Beams

ORBITAL POSITION:
68° EAST LONGITUDE

Exhibit Five

ALPHA LYRACOM GLOBAL COVERAGE

Exhibit Six

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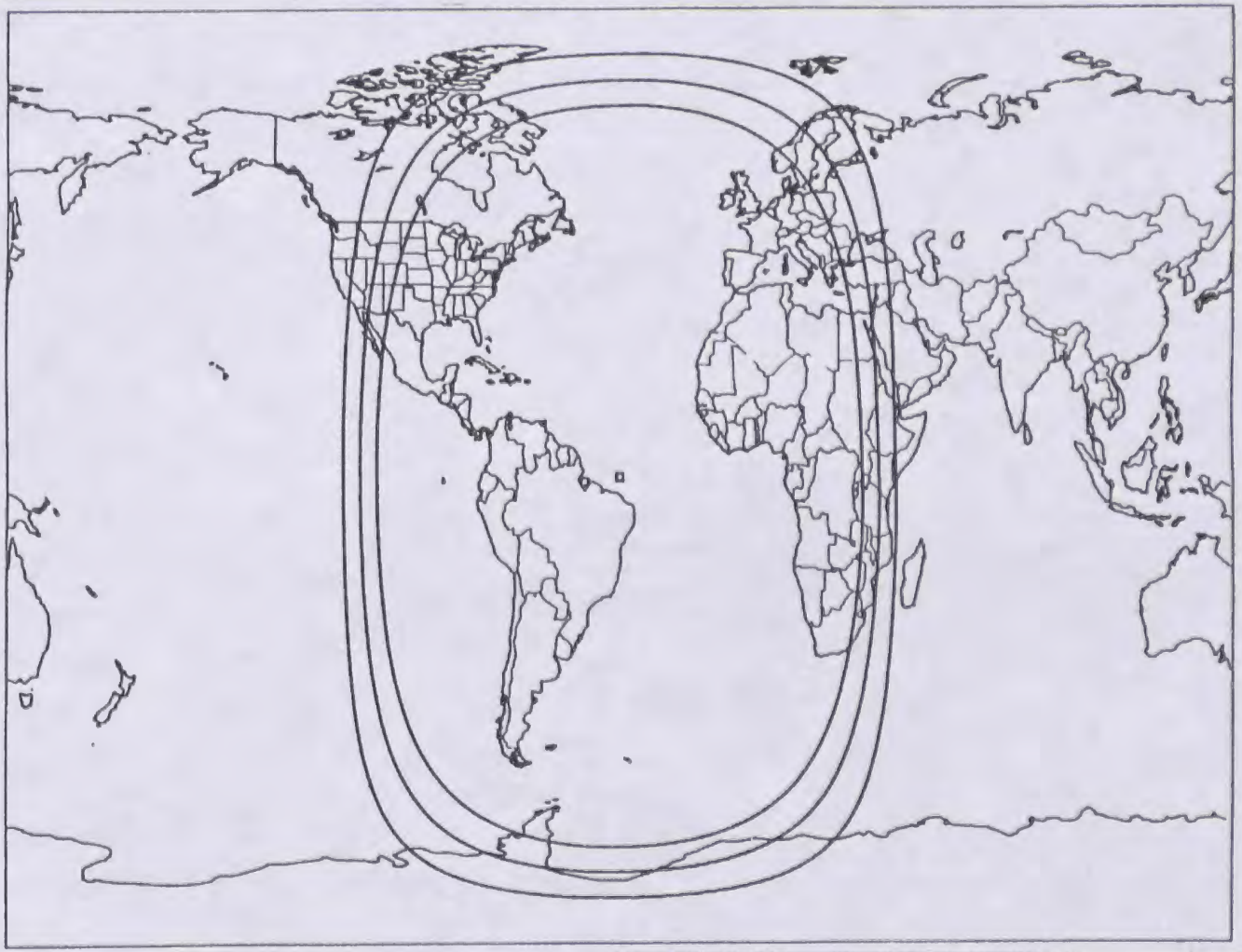

Figure 1 - Areas of Coverage

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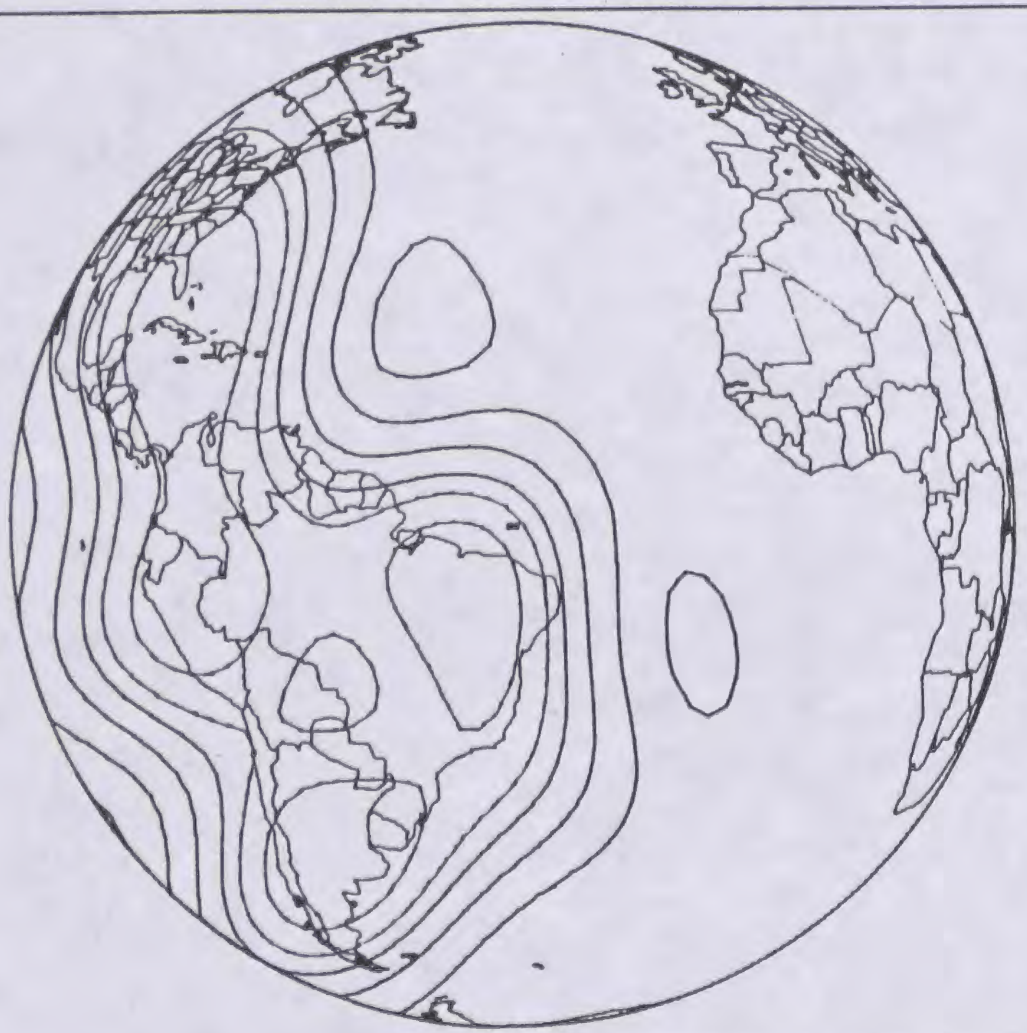

Contours shown are -2, -4, -6 -10 and -20dBi.

Figure 2 - Latin Beam Downlink

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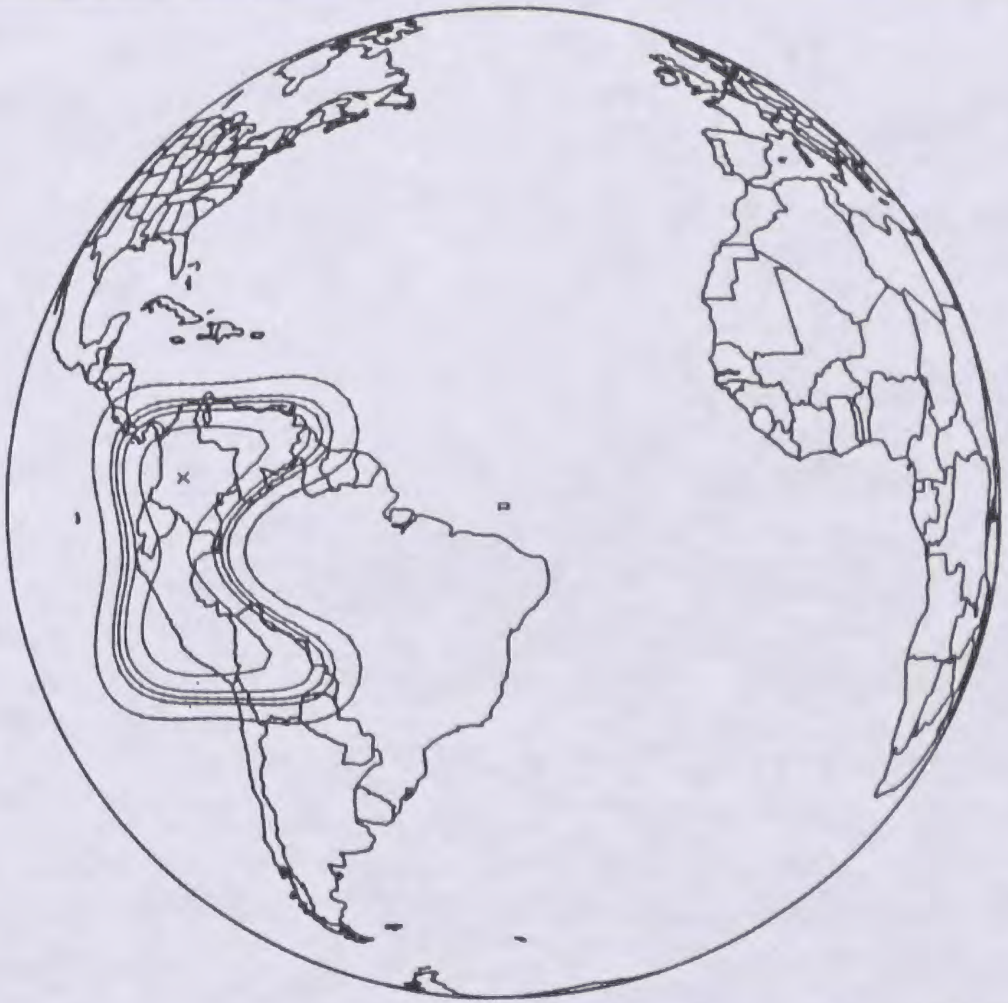

Contours shown are -2, -4, -6 -10 and -20dBi.

Figure 3 - North Spot Beam

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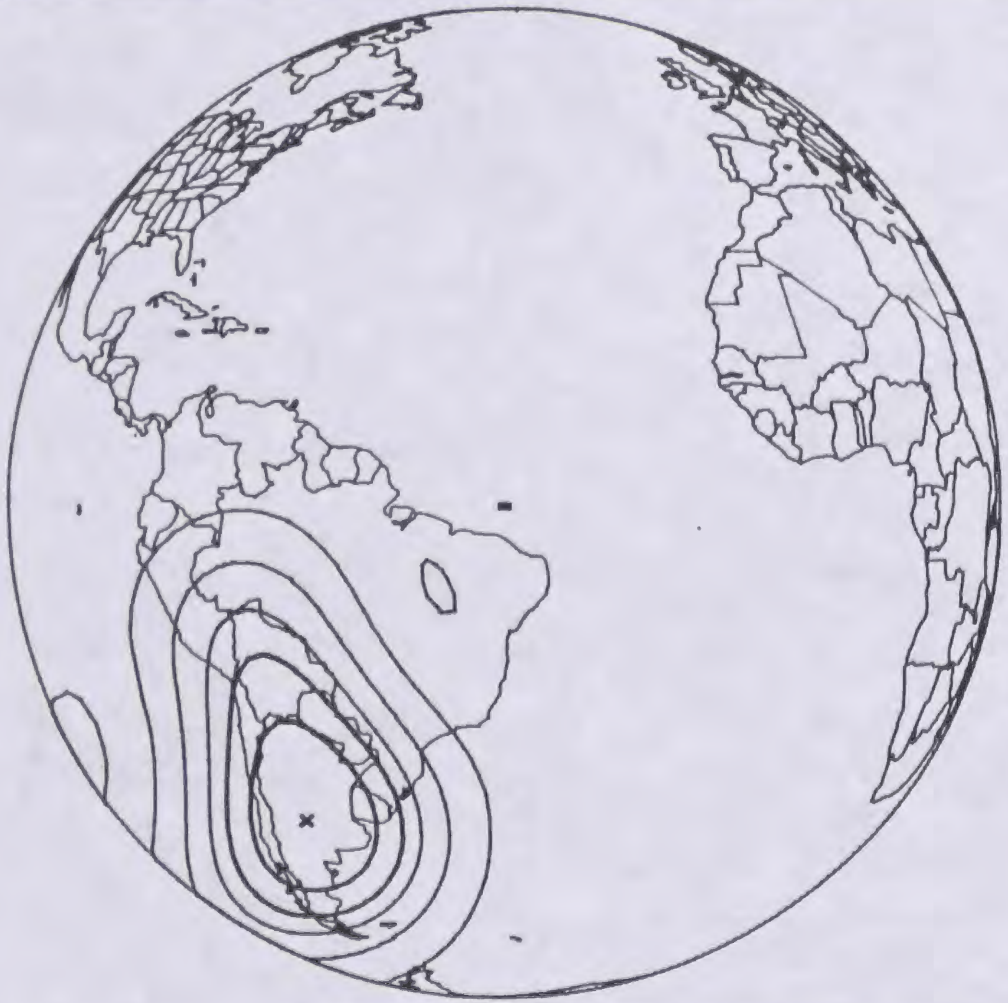

Contours shown are -2, -4, -6 -10 and -20dBi.

Figure 4 - South Spot Beam

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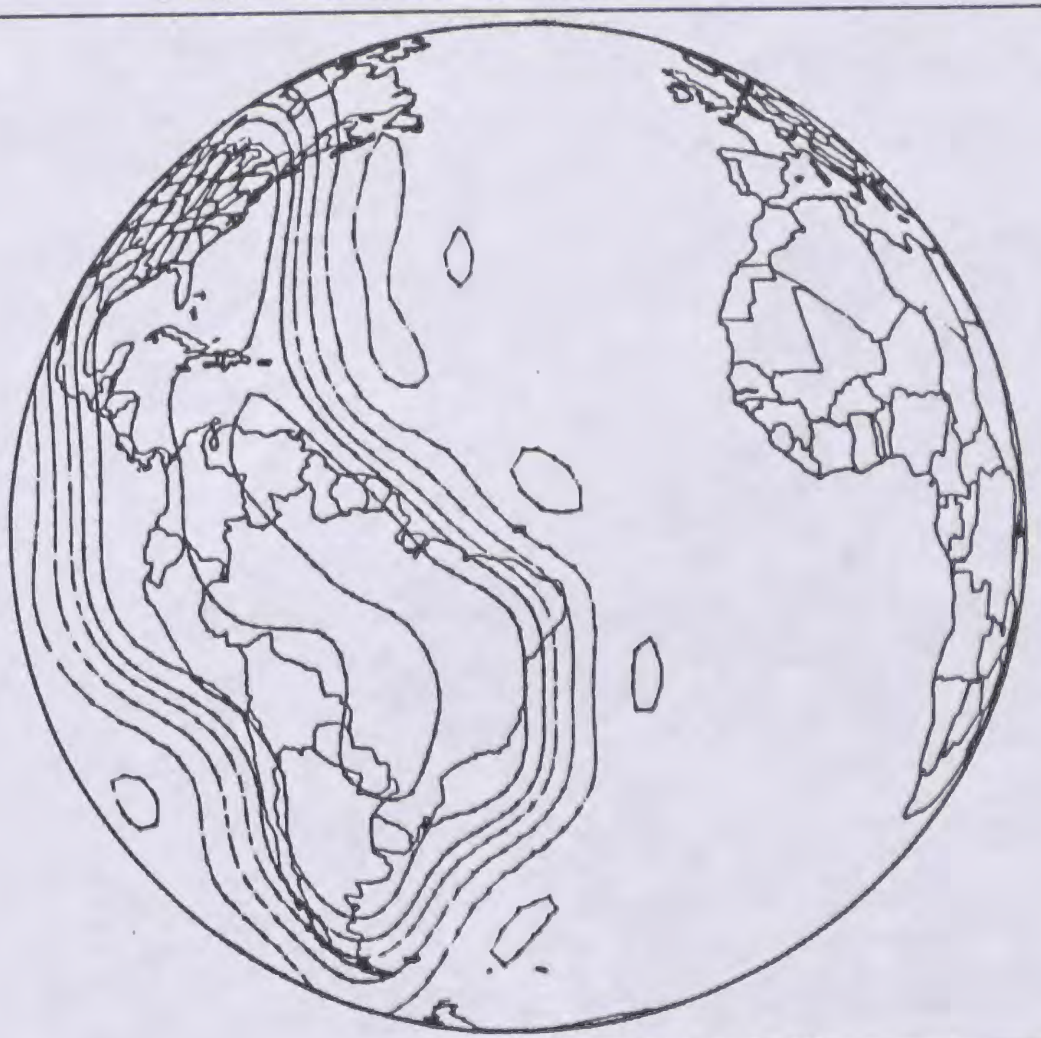

Contours shown are -2, -4, -6 -10 and -20dBi.

Figure 5 - Latin Uplink Beam

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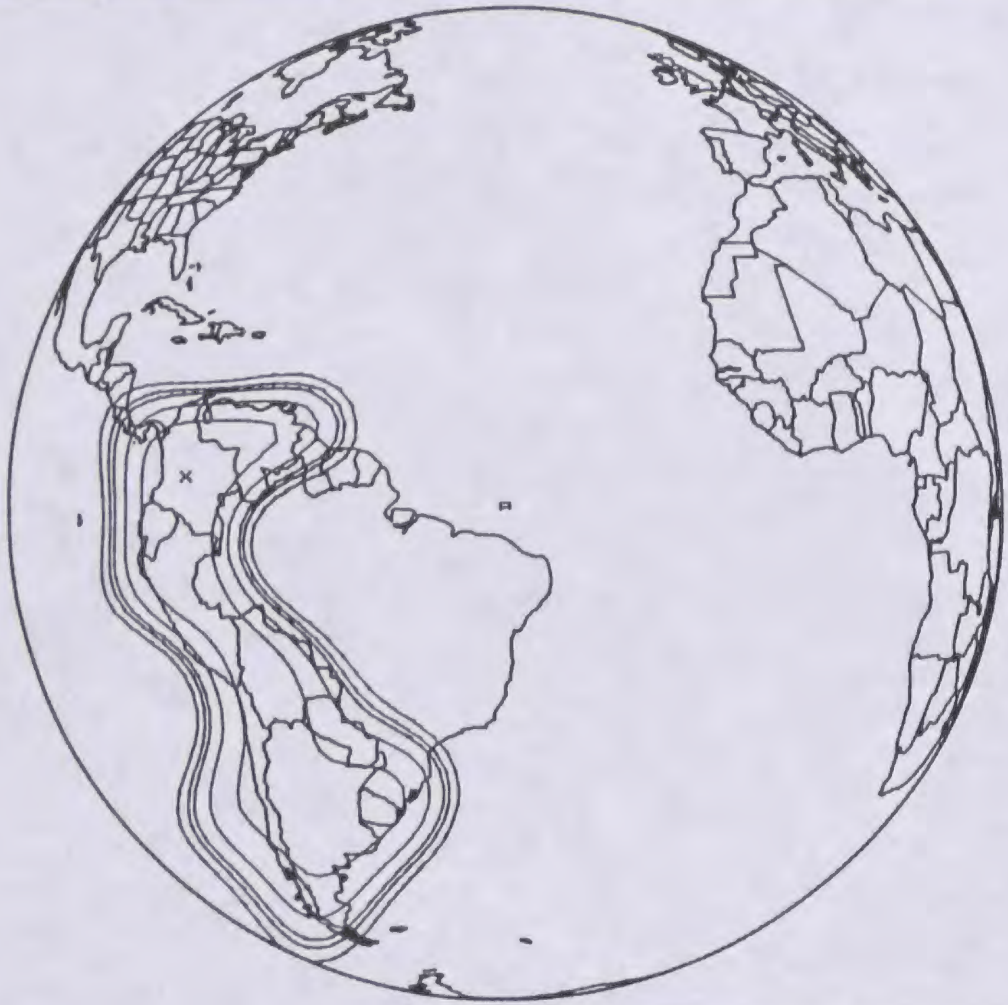

Contours shown are -2, -4, -6 -10 and -20dBi.

Figure 6 - Spot Uplink Beam

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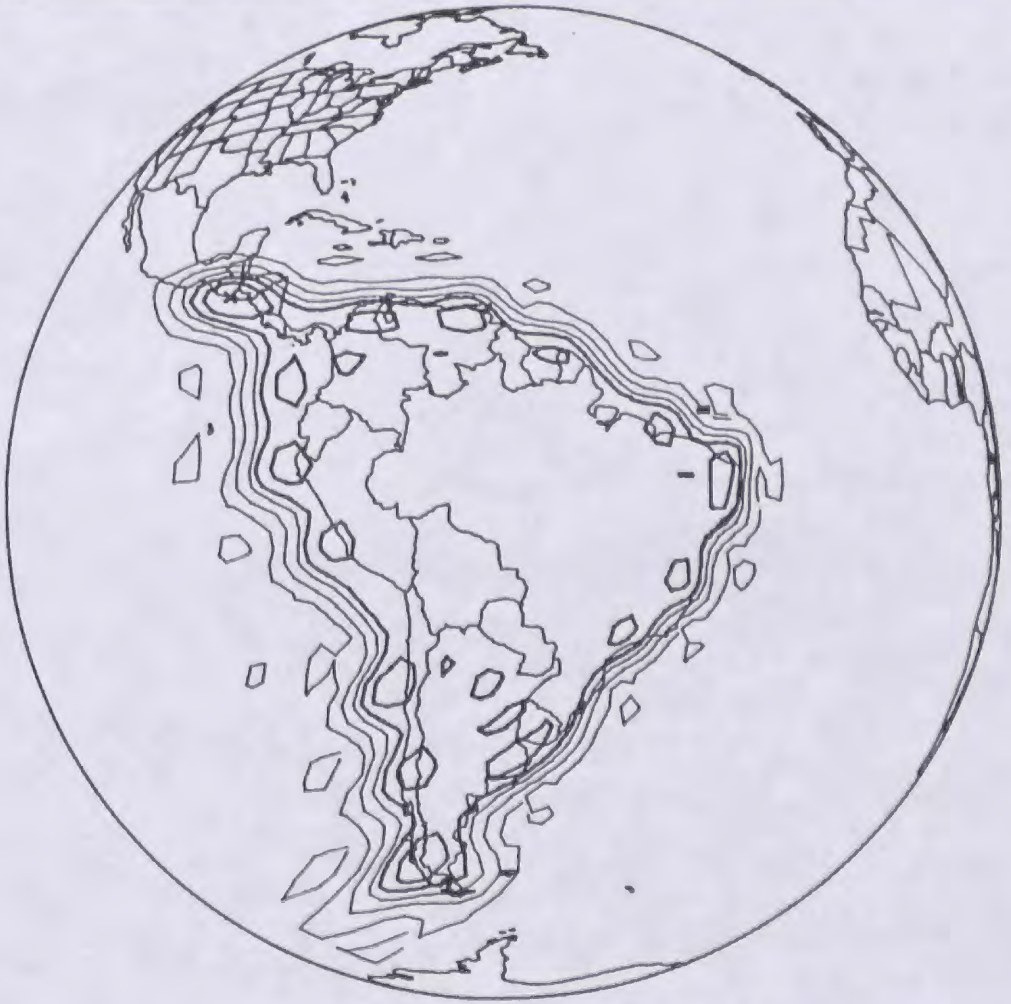

Contours shown are -2, -4, -6 -10 and -20dBi.

Figure 7 - Latin Ku Uplink Beam

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Contours shown are -2, -4, -6 -10 and -20dBi.

Figure 8 - Conus Beam

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Contours shown are -2, -4, -6, -10 and -20dBi.

Figure 11 - Conus Uplink Beam

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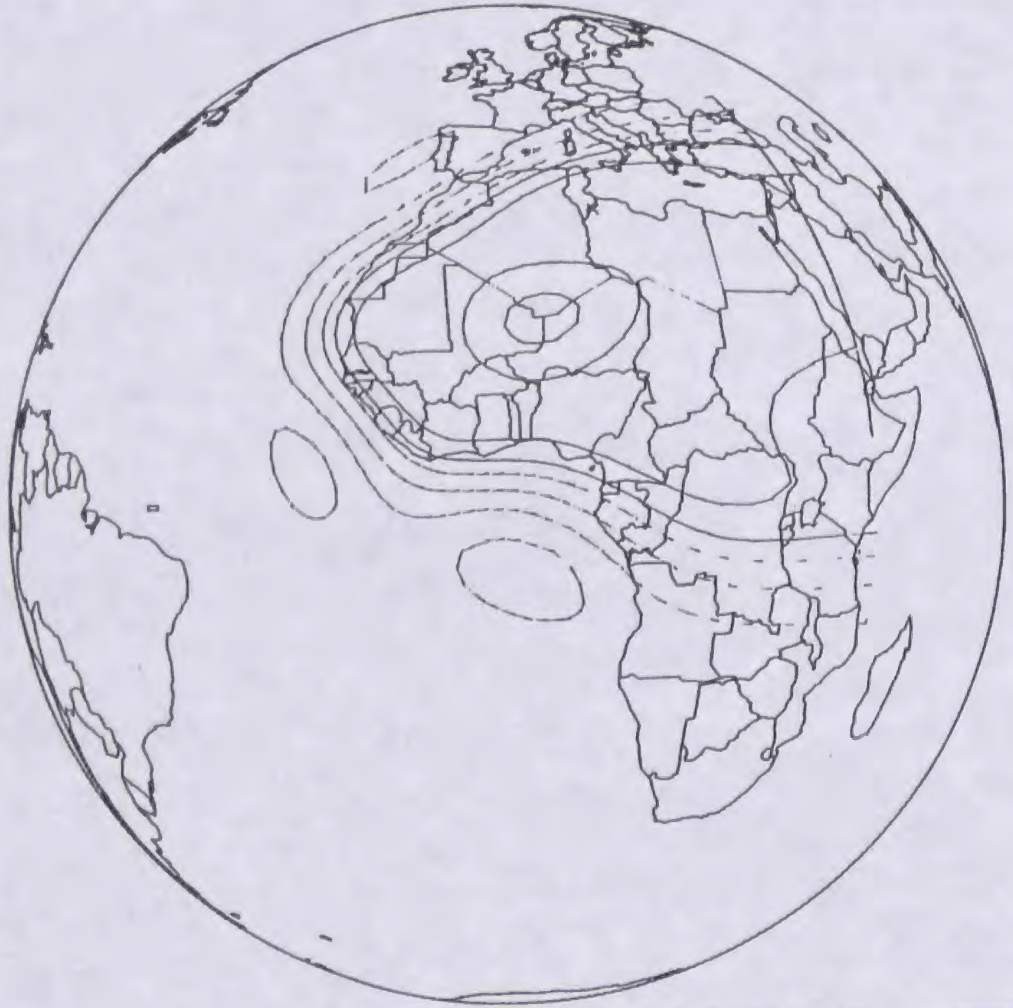

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure 13 - Africa Uplink Beam

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Contours shown are -2, -4, -6, -10 and -20dBi.

Figure 14 - Africa Downlink Spot Beam

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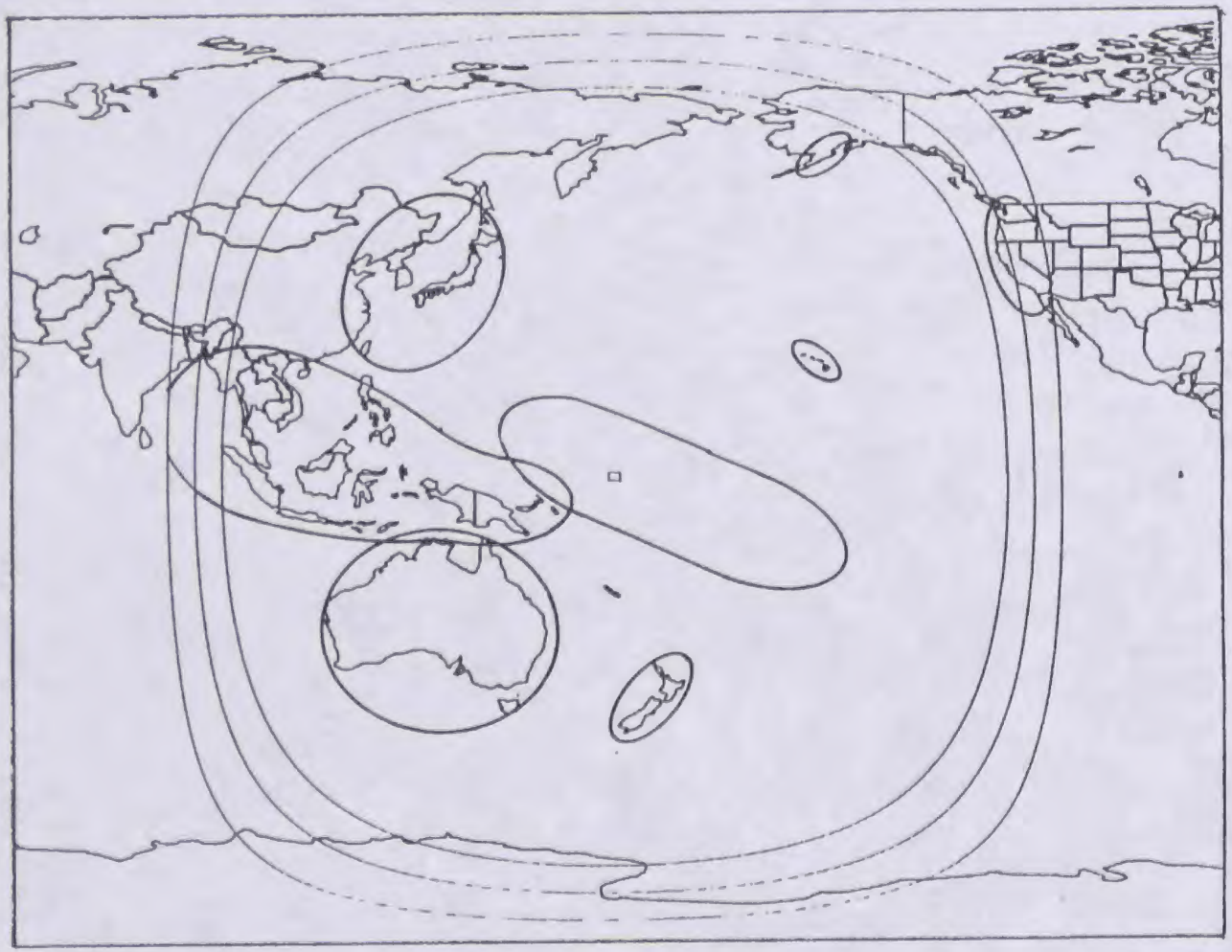

Figure A1 - PAS Asia/Pacific Coverages

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Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A2 - Japan/China C-Band Spot Beam

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Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A3 - Malay C-Band Spot Beam

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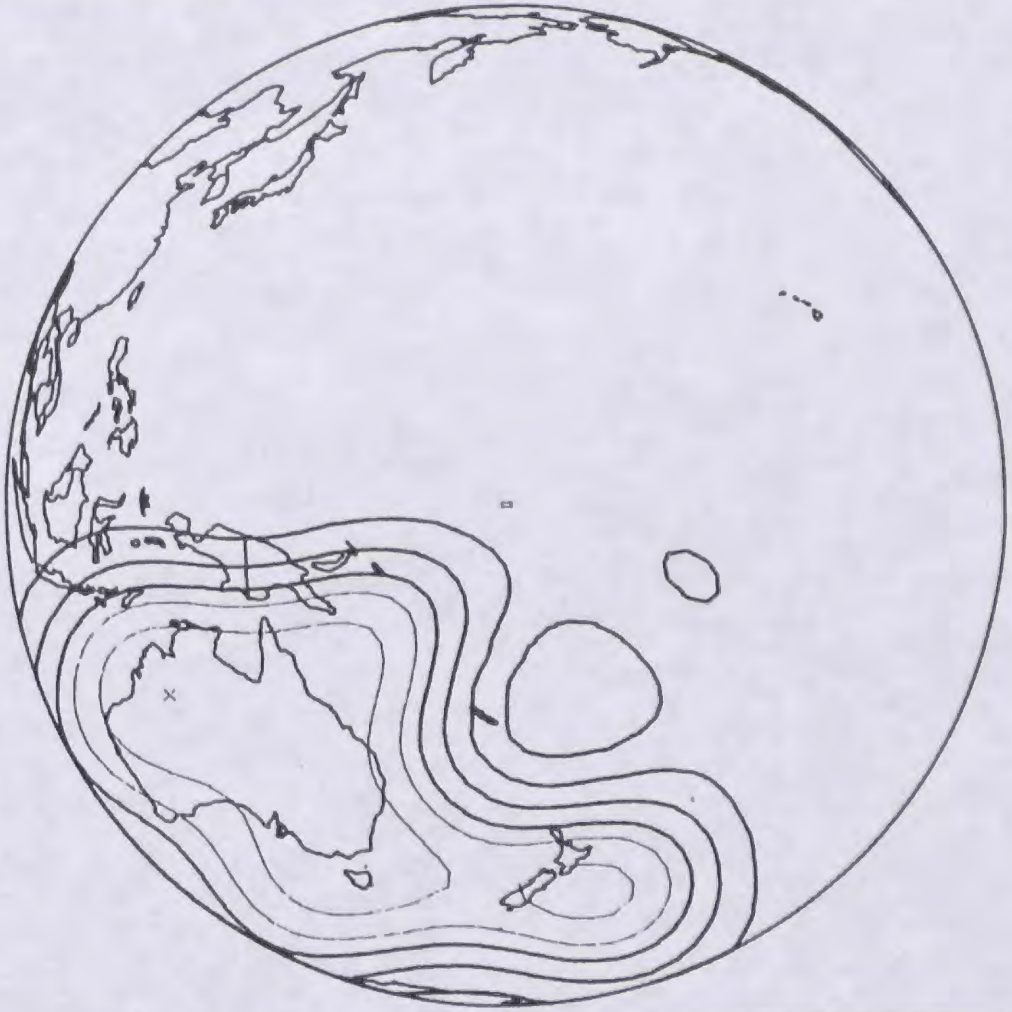

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A4 - Southern C-Band Beam

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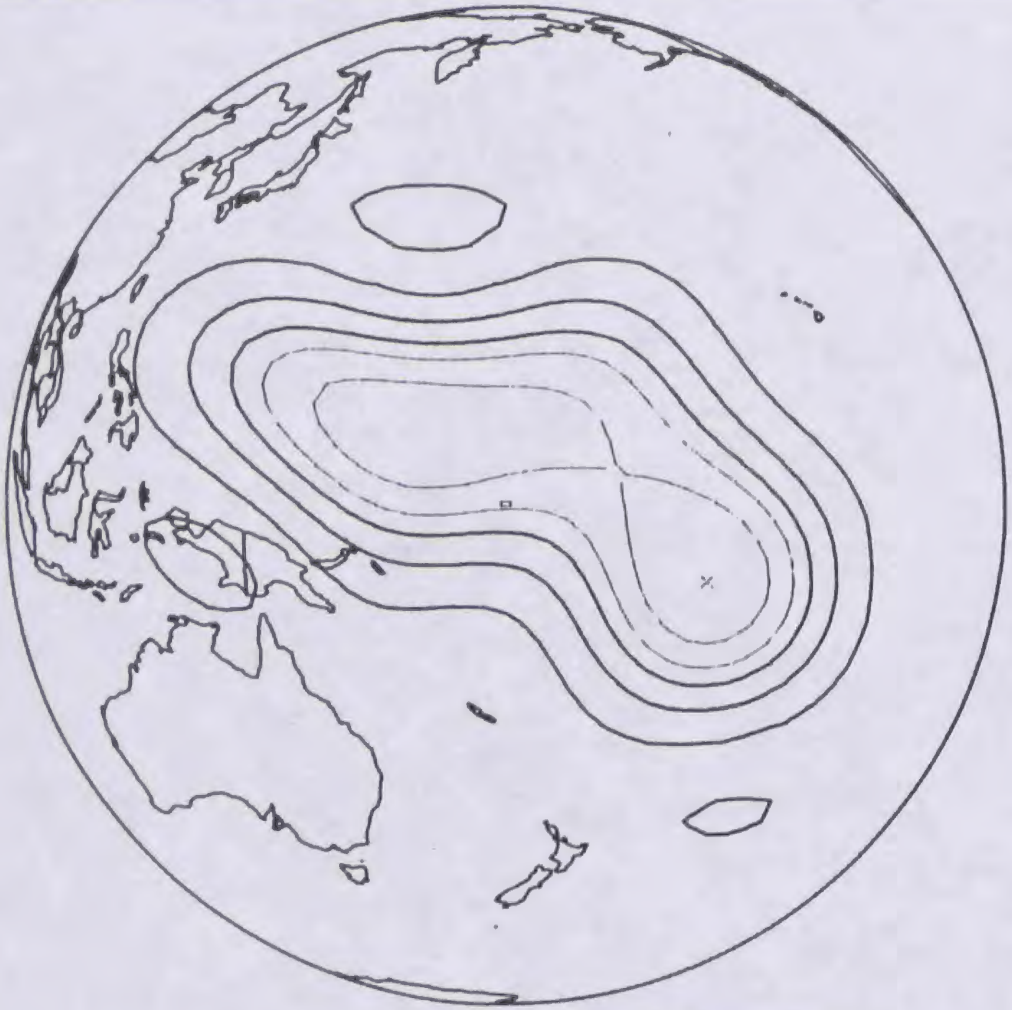

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A5 - Pacific C-Band Beam

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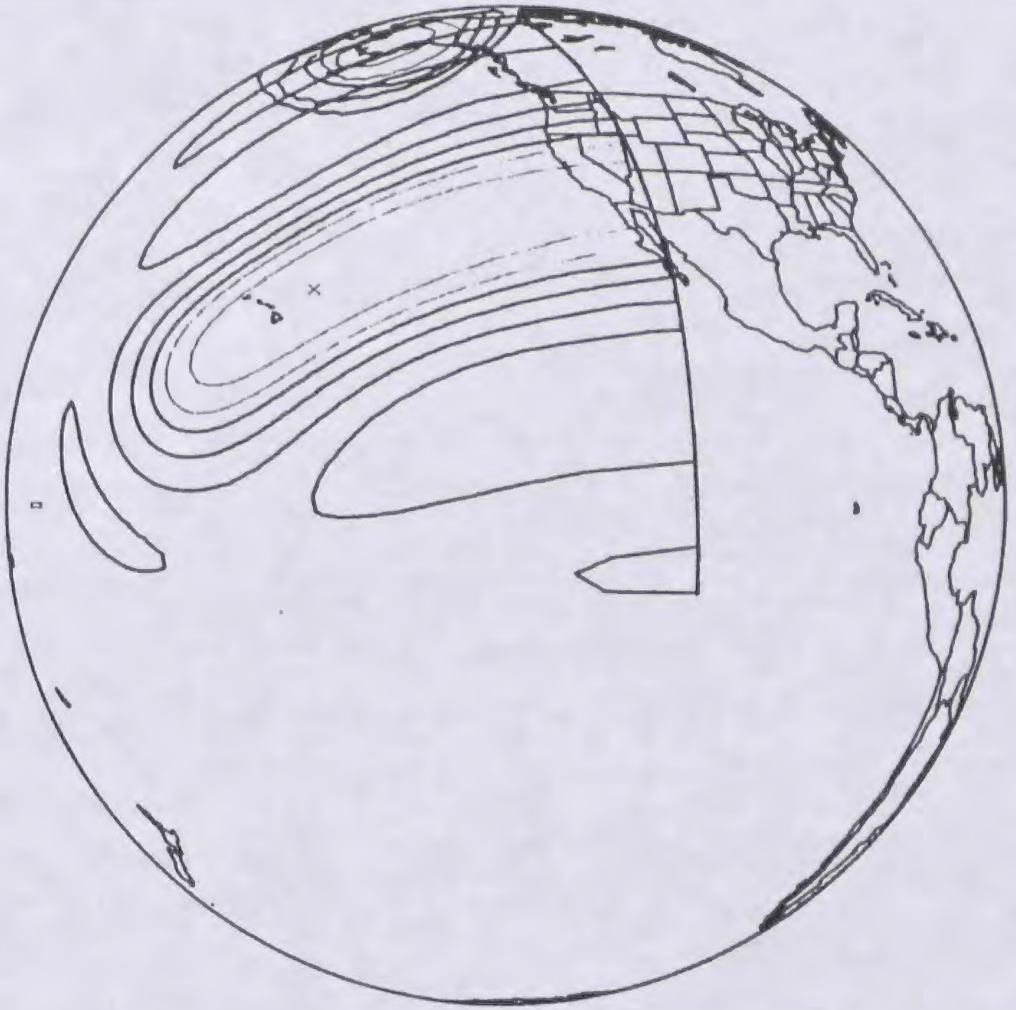

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A6 - US C-Band Beam

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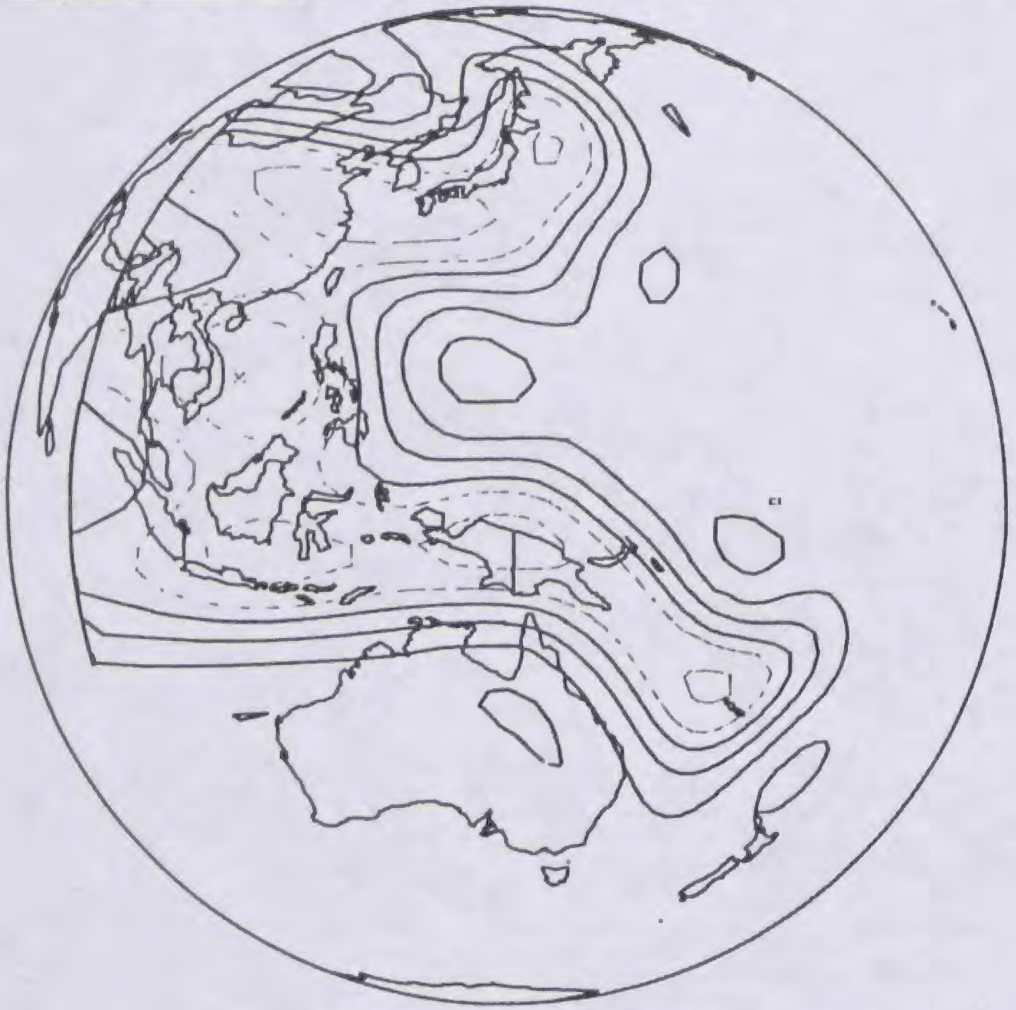

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A7 - Asia C-Band Uplink Beam

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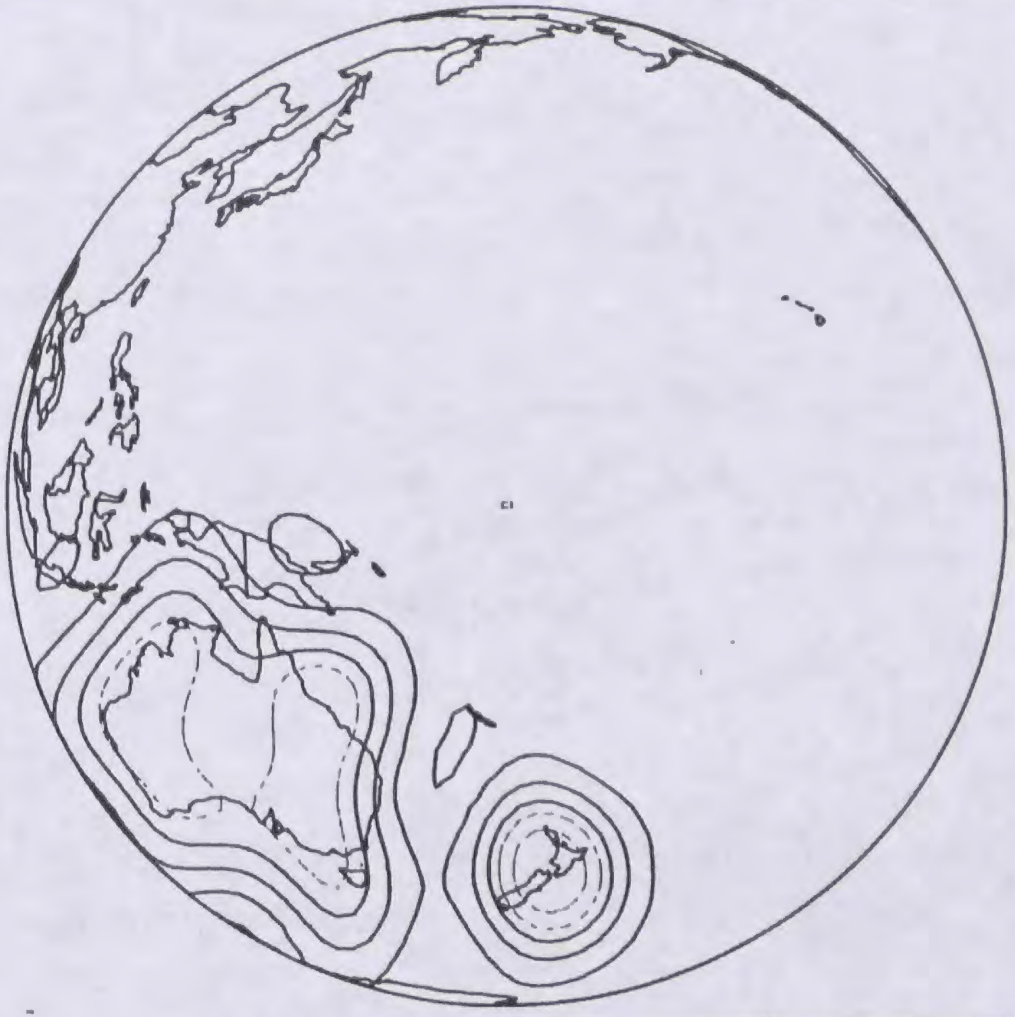

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A8 - Southern C-Band Uplink Beam

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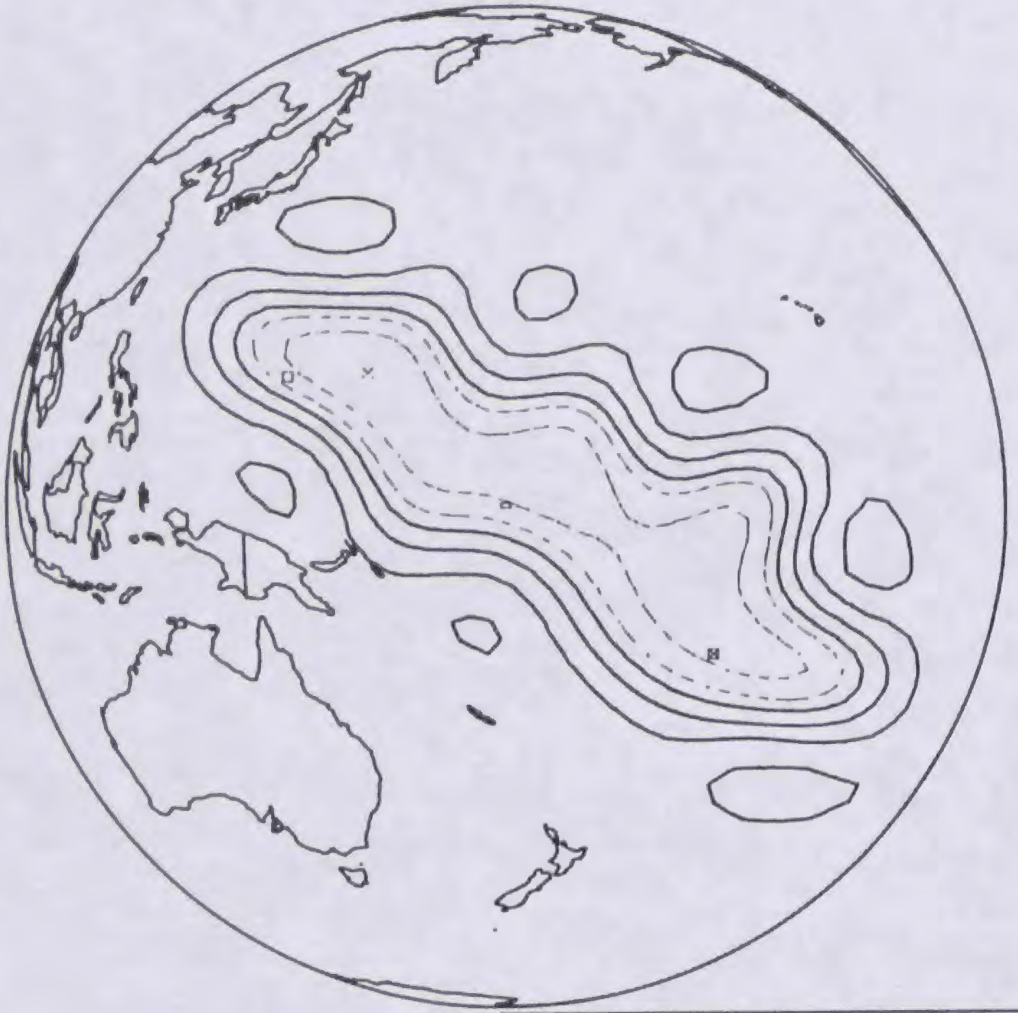
PAN AMERICAN SATELLITE



Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A9 - Pacific C-Band Uplink Beam

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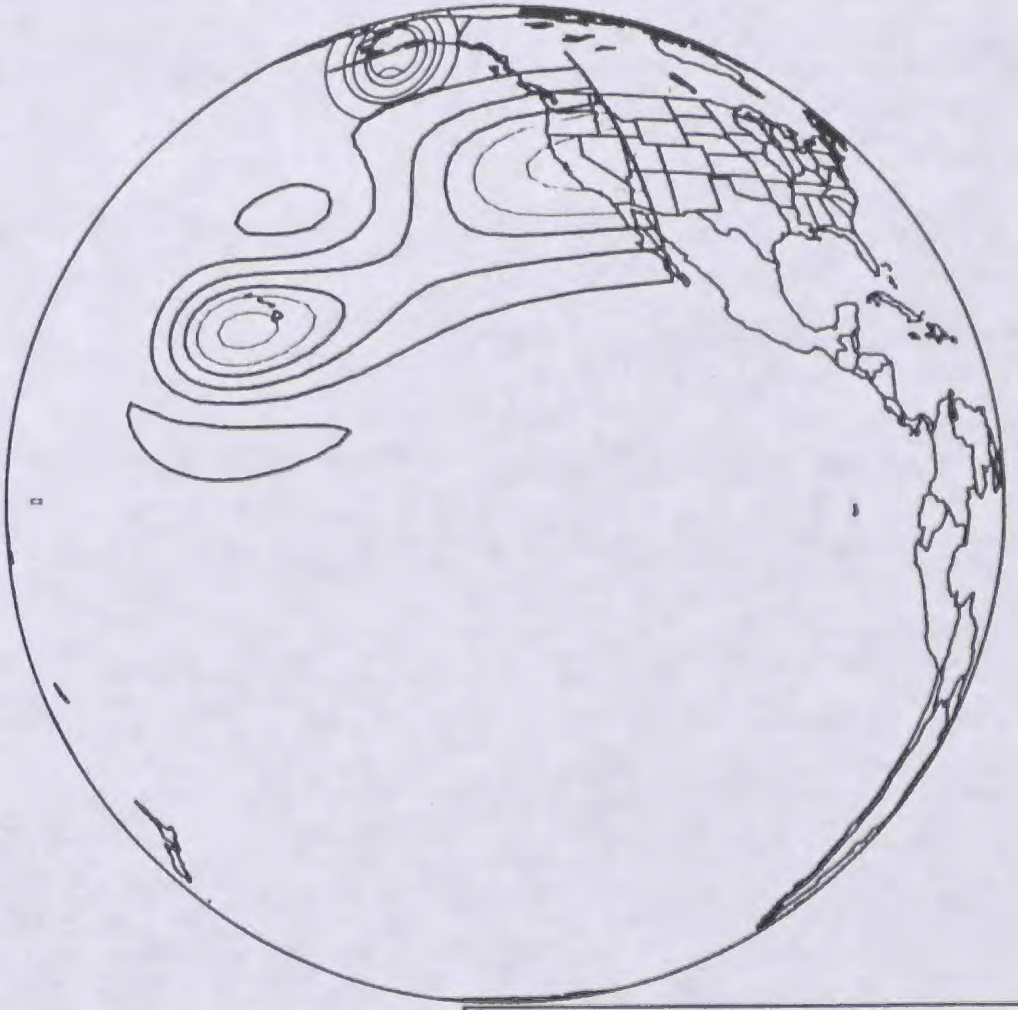
PAN AMERICAN SATELLITE



Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A10 - US C-Band Uplink Beam

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Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A11 - Japan/China Ku-Band Spot Beam

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Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A12 - Malay Ku-Band Spot Beam

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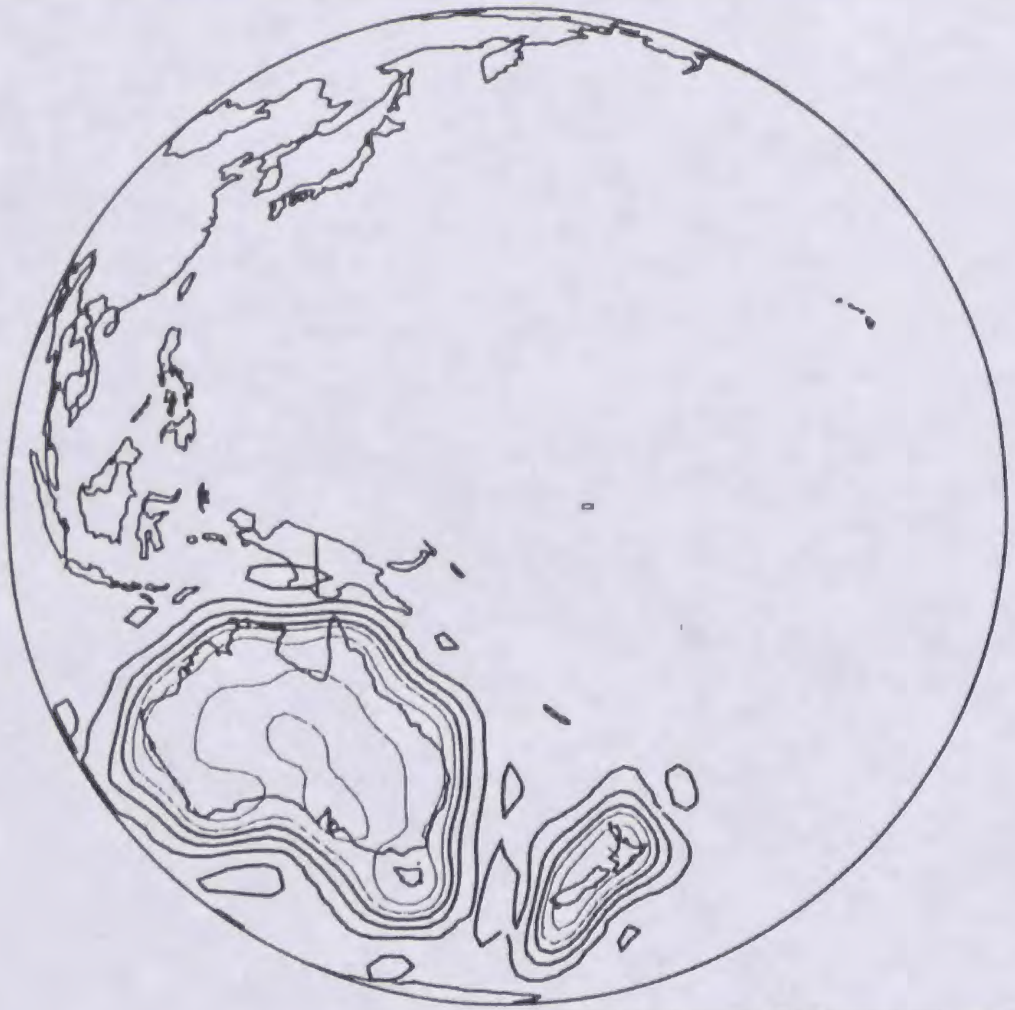

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A13 - Southern Ku-Band Beam

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Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A14 - US Ku-Band Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A15 - Japan/China Ku-Band Uplink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

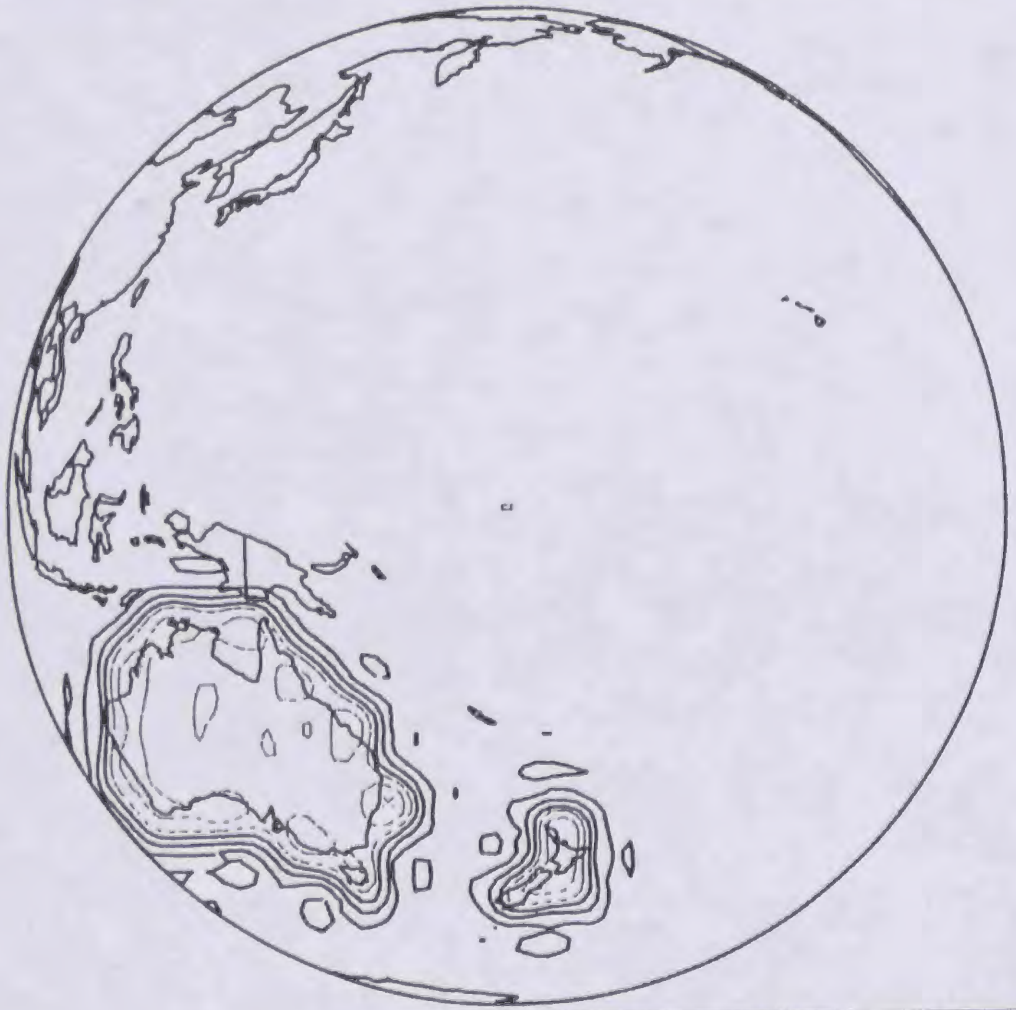
PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A16 - Malay Ku-Band Uplink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE



Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A17 - Southern Ku-Band Uplink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

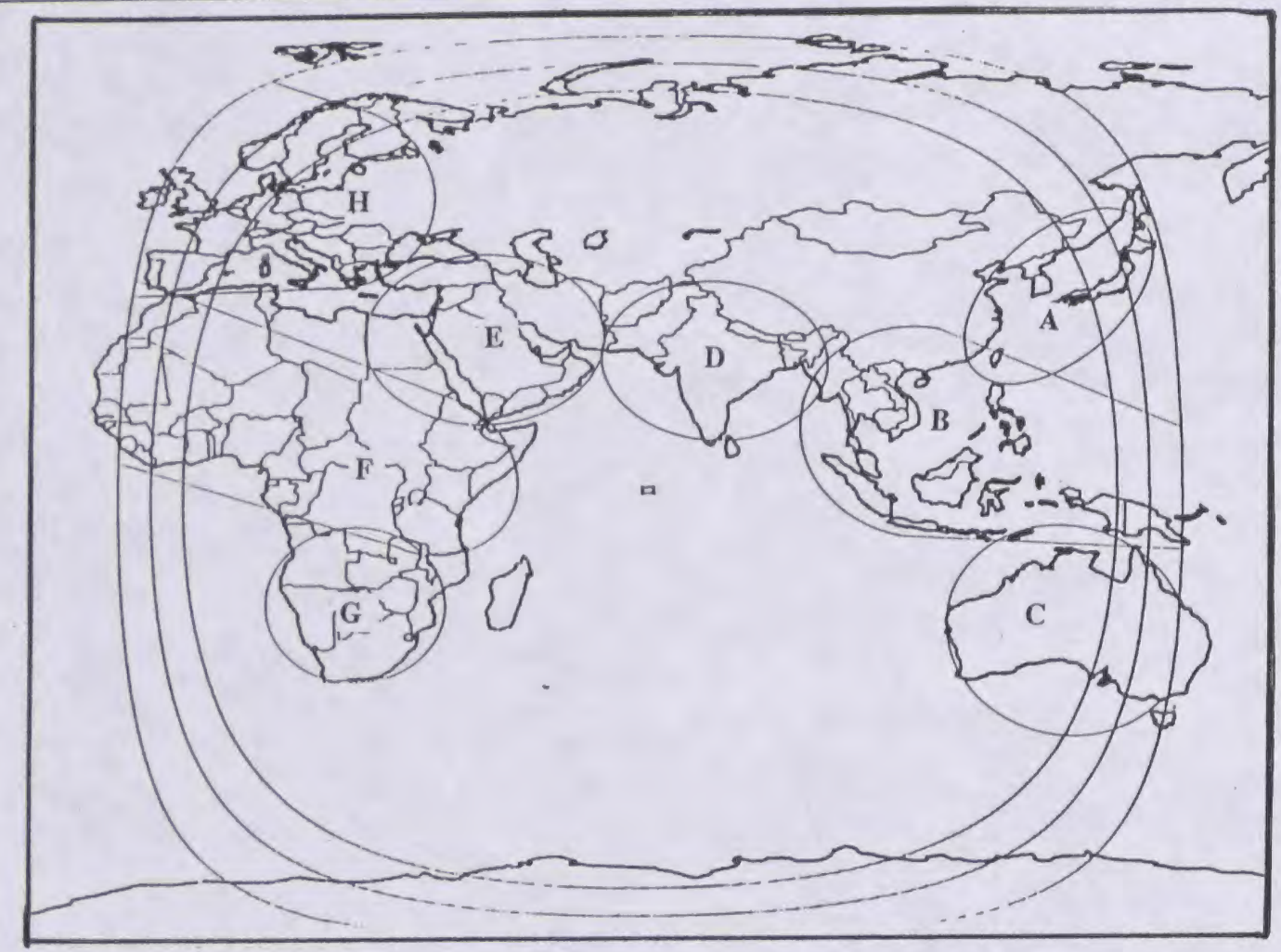
PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A18 - US Ku-Band Uplink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

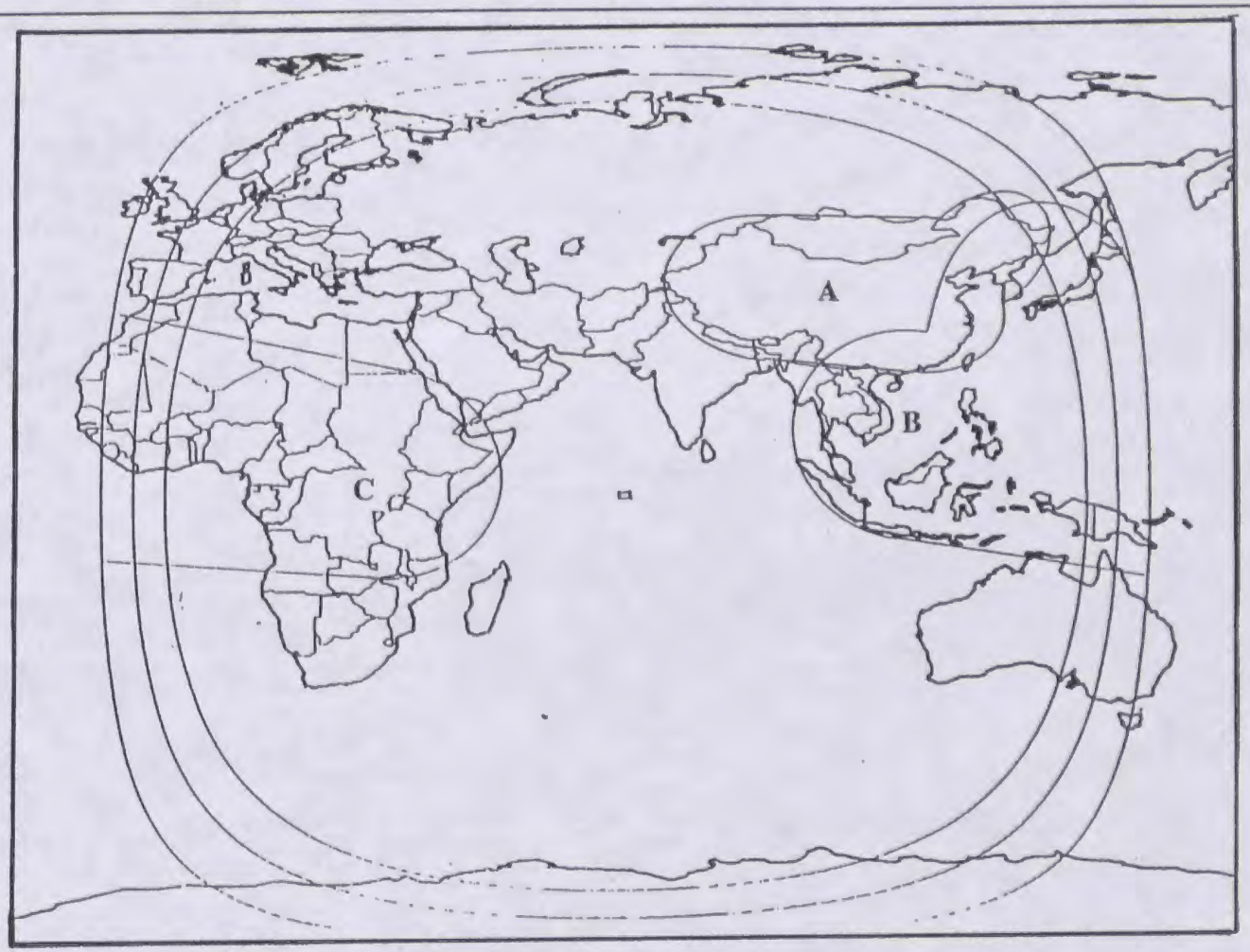
ALPHA LYRACOM INDIAN OCEAN Ku-BAND



Indian Ocean Ku-band Coverage
Beam Center

A = 52.6 dbw
B = 46.6 dbw
C = 52.1 dbw
D = 48.7 dbw
E = 48.4 dbw
F = 47.2 dbw
G = 58.0 dbw
H = 49.8 dbw

ALPHA LYRACOM INDIAN OCEAN C-BAND



Indian Ocean C-band Coverage
Beam Center
A = 42.8 dbw
B = 43.1 dbw
C = 42.8 dbw

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A2 - Europe/USSR Downlink Spot Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

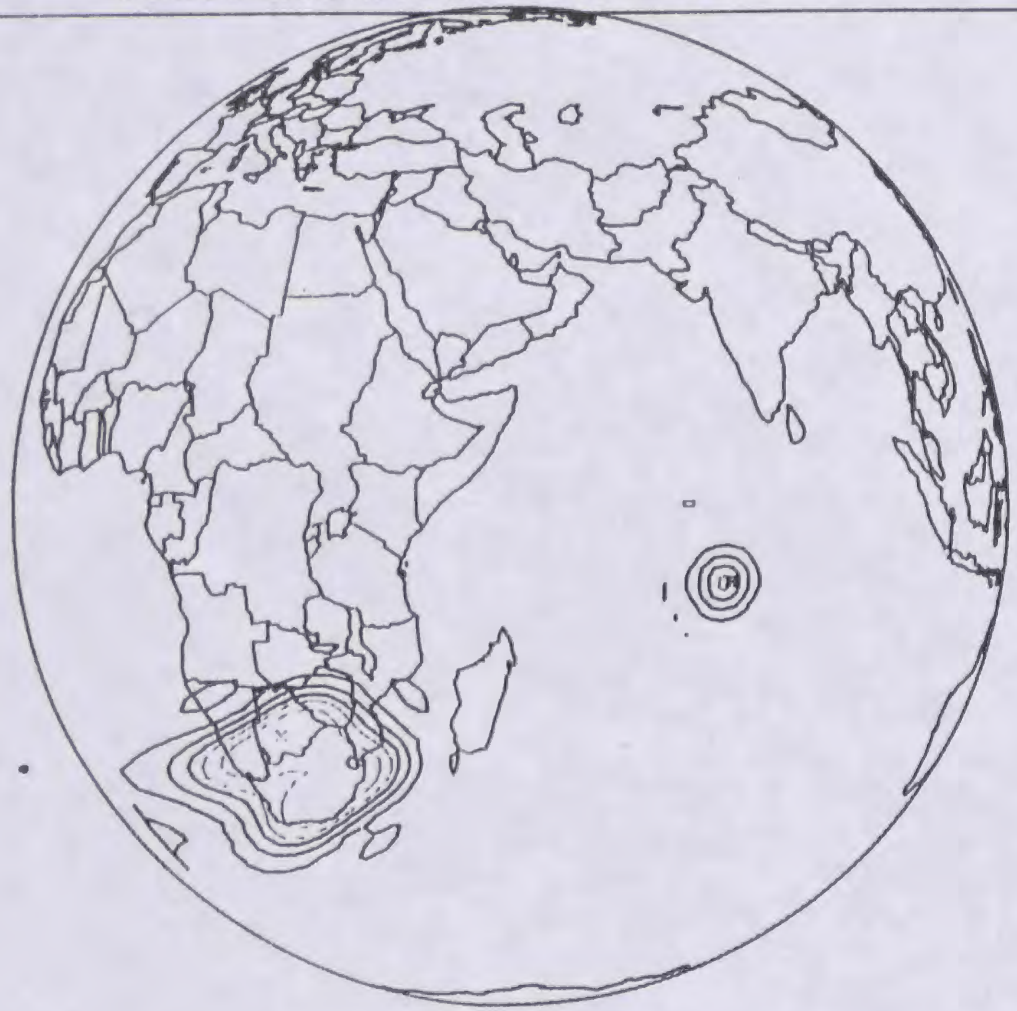
PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A3 - Central African Downlink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE



Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A4 - South African Downlink Spot Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A5 - Middle Eastern Downlink Spot Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A6 - Central Asia Downlink Spot Beam

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Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A7 - Japan/China/Korea Downlink Spot Beam

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Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A8 - Malay Downlink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A9 - Australian Downlink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A10 - Europe/USSR Uplink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A11 - Africa Uplink Beam

Rubin, Bednarek and Associates
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Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A12 - Central Asian Uplink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

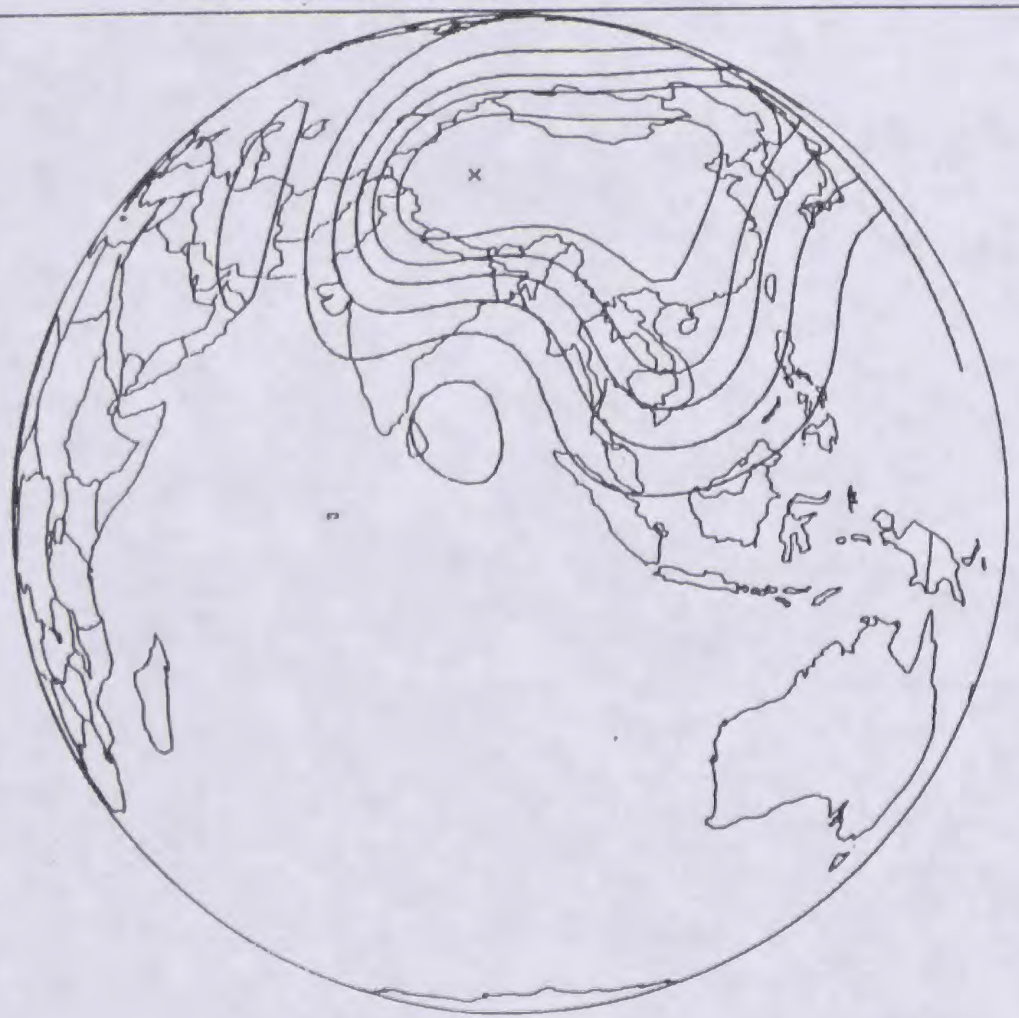
PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A13 - Far Eastern Uplink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE

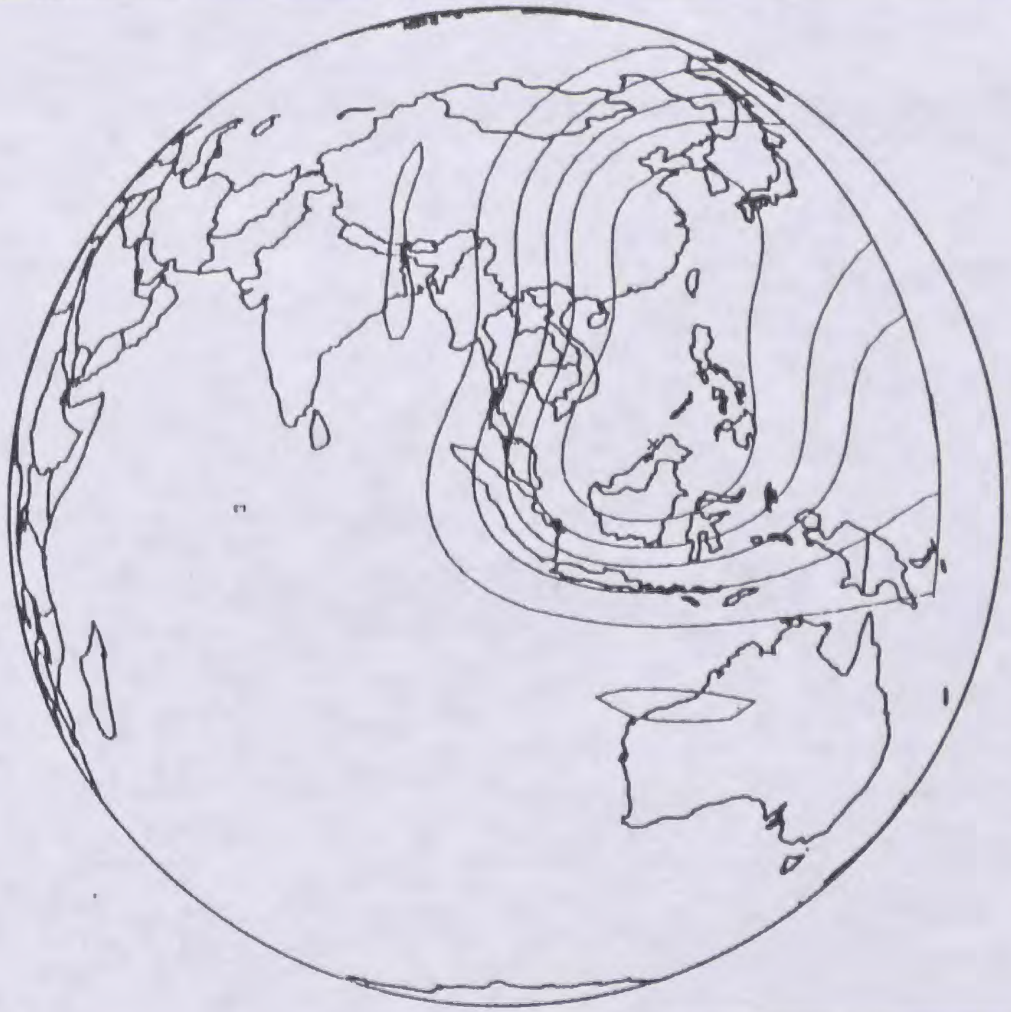


Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A14 - China C-Band Downlink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE



Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A15 - East Asia C-Band Downlink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A16 - Central Africa C-Band Downlink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

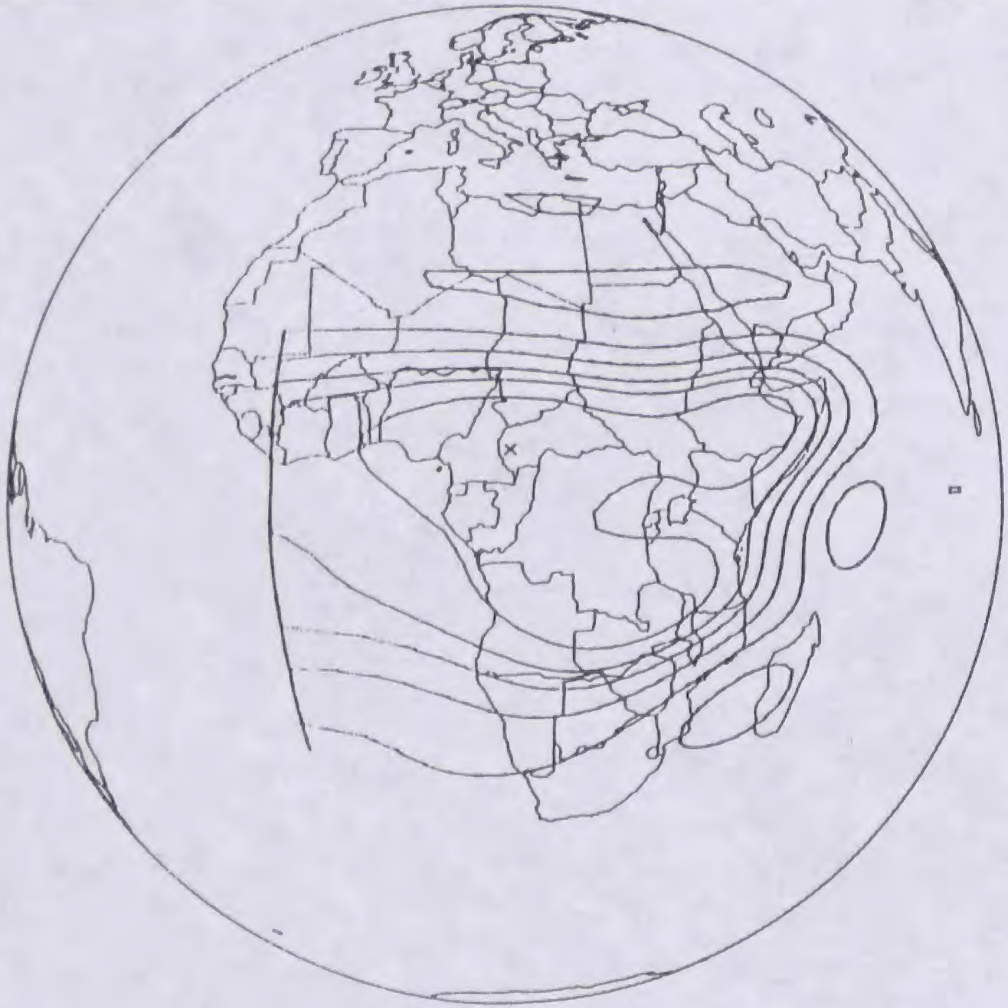
PAN AMERICAN SATELLITE

Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A17 - China C-Band Uplink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE

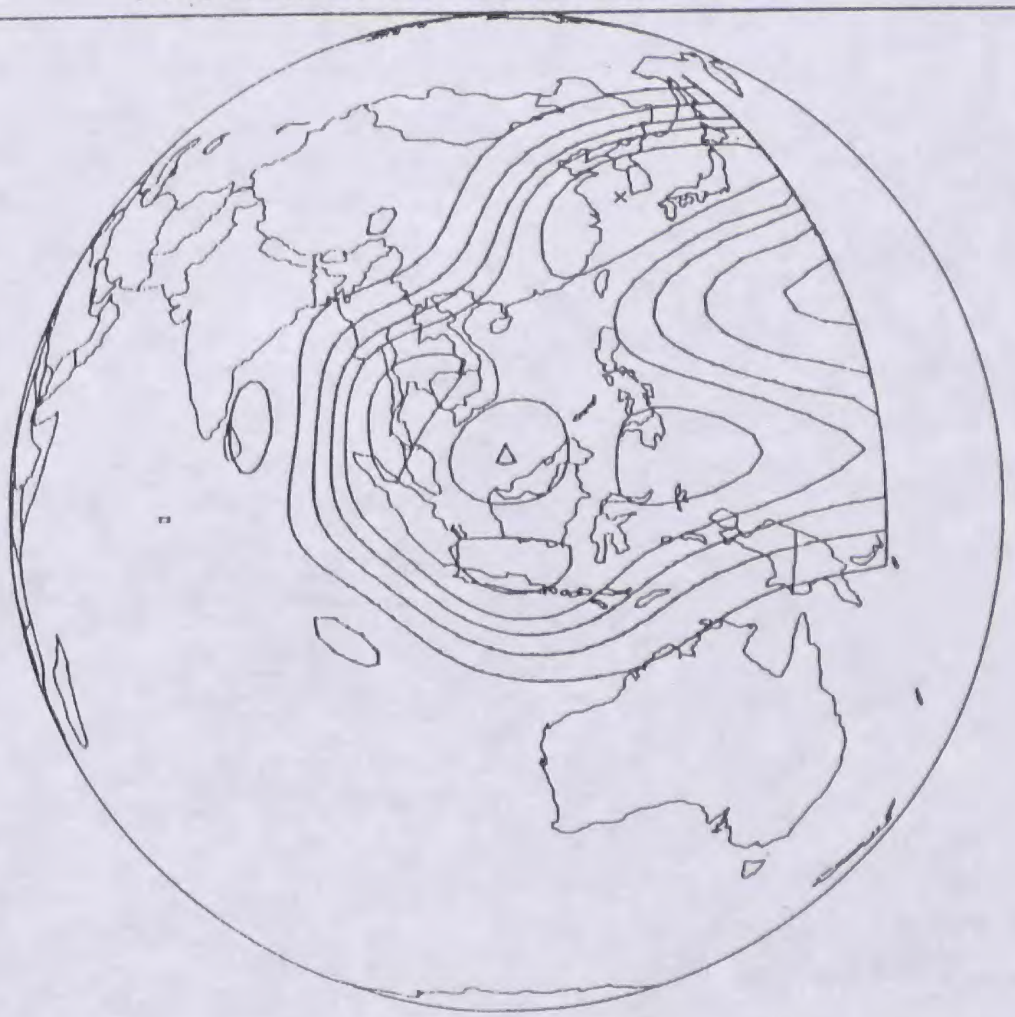


Contours shown are -2, -4, -6, -10 and -20dBi.

Figure A19 - Central Africa C-Band Uplink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

PAN AMERICAN SATELLITE



Contours shown are -2, -4, -6, -10 and -20dBi.

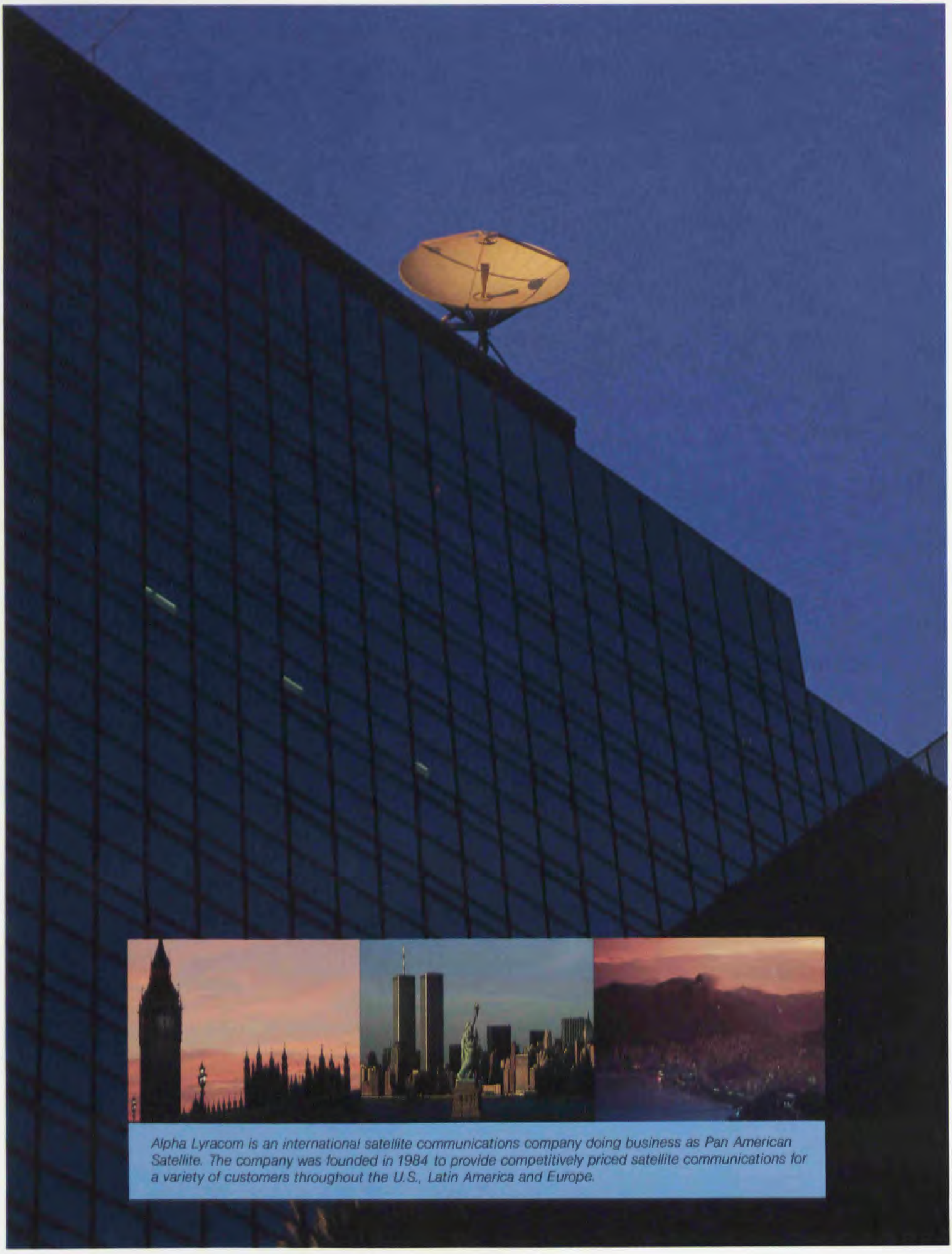
Figure A18 - East Asia C-Band Uplink Beam

Rubin, Bednarek and Associates
Consulting Telecommunications Engineers
Washington, D.C.

ALPHA LYRACOM

PAN AMERICAN SATELLITE

Launching A New Age In Satellite Communications.



Alpha Lyracom is an international satellite communications company doing business as Pan American Satellite. The company was founded in 1984 to provide competitively priced satellite communications for a variety of customers throughout the U.S., Latin America and Europe.

The World's First Private International Satellite System.

The 1988 launch of PAS I—the first of two planned satellites—marks Alpha Lyracom's entry as the first private company in history to own and operate an international communications satellite outside of the Intelsat consortium.

By providing flexible, low-cost business communications and broadcast links between the U.S., Latin America and Europe, it also marks the beginning of a bold new age in international satellite service.

With PAS I, you can custom-design your own international networks or have us create them for you. Either way, you'll enjoy all the benefits of a privately owned satellite facility—including direct access, use of inexpensive on-premise earth stations and unparalleled design flexibility to meet a broad range of needs.

In addition to providing satellite capacity, Alpha Lyracom can also provide a wide variety of turnkey communications services. From planning and designing complex international networks, to managing their operation and future growth.

If you ever considered international satellite communications before and found it either too expensive or too limited, now is the time to re-examine your alternatives. Because Alpha Lyracom's PAS I finally brings the ease, flexibility and low cost of domestic satellite service to the realm of international communications.

PAS I's Advanced Satellite Technology

The Alpha Lyracom PAS I is an RCA Astro Series 3000 Hybrid Communications Satellite, with 24 transponders operating in both the C- and Ku-band. It can accommodate many different types of international, regional and domestic communications needs.

To make the system more accessible and substantially reduce user costs, PAS I's transponders have been specially designed for access via small, inexpensive antennas. These antennas are small enough to be located directly on a customer's premises.

Gateways to PAS I satellite are provided through Alpha Lyracom's South Florida International Gateway. Among other things, this gateway provides the necessary "double-hop" for customers whose international communications needs combine European and Latin American coverage.

Alpha Lyracom's South Florida International Gateway provides the link between Europe and Latin America.

PAS I maintains a geostationary orbital position of 45° West Longitude. The satellite's monitoring and control services (tracking, telemetry and command functions) utilize our South Florida International Gateway control center and Contel ASC's state-of-the-art facility in Atlanta.

Contel ASC's Atlanta facility helps perform control and monitoring for the PAS I.

PAS I Covers All Your Satellite Communication Needs

PAS I Coverage Areas

PAS I provides international, regional and domestic coverage to five major geographic areas: Latin America, the Caribbean, Europe, the continental United States and Canada.

International Coverage

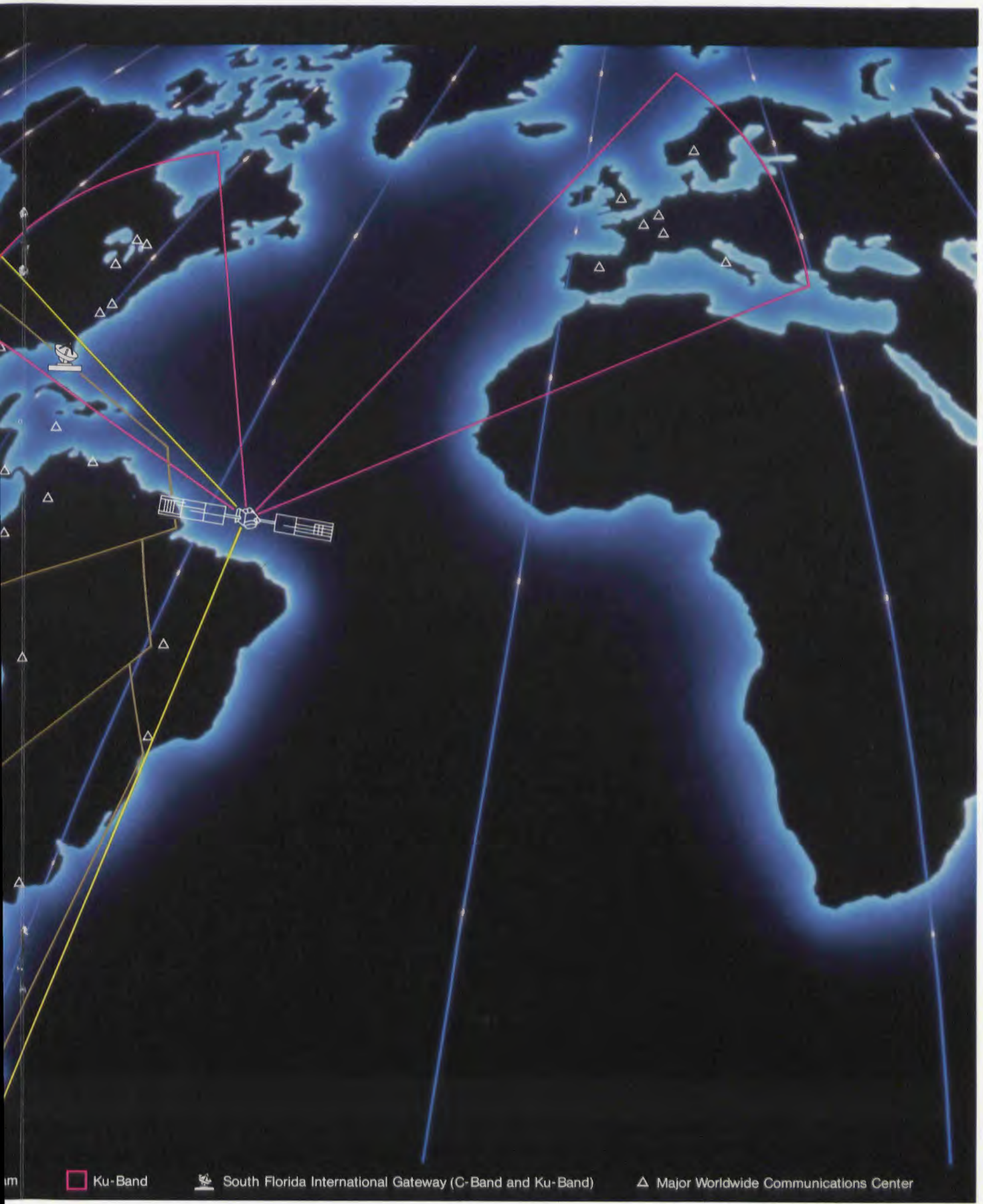
U.S./Latin America

PAS I's regional service to Latin America provides C-band coverage to an area that includes Southeastern and Gulf Coast States, the Caribbean, Central America and South America. This beam operates at power levels equal to those of a U.S. domestic satellite and far in excess of any other system serving all of Latin America.

Our Latin America service makes possible for the first time the development of television, data and voice communications between all the countries of the Western Hemisphere.

U.S./Europe

PAS I also provides high-quality transatlantic communications service between the U.S. and Europe, using a total of six Ku-band transponders (three for the U.S. and three for Europe). The area covered by this service includes the sections of Europe west of Vienna and those parts of the U.S. and Canada east of the Sierra Mountains.


Ku-Band
South Florida International Gateway (C-Band and Ku-Band)
Major Worldwide Communications Center

Since Alpha Lyracom offers a common uplink for the U.S. and European transponders, all six transponders may be accessed from either location to provide maximum flexibility in routing your communications.

Due to the high power and advanced design of our transponders, customers may use small aperture earth stations to establish transatlantic video, private voice and data communications networks at a very low cost.

U.S./Latin America/Europe

Using a combination of C- and Ku-band transponders, PAS I easily addresses the needs of those whose communications span Latin America, the U.S. and Europe.

Under this service, a signal originating in Latin America would be carried via C-band to our South Florida International Gateway, then transmitted to Europe via Ku-band. Signals originating in Europe would work in a similar fashion, operating on the Ku-band to the U.S., then simultaneously relayed in the C-band to Latin America.

Taken together, the international coverages offered by PAS I give you unprecedented flexibility and scope for creating advanced satellite networks throughout Europe and the Western Hemisphere.

PAS I can carry live or taped programming and bring high-quality video to a broad geographic area.

Domestic Coverage

Latin America-Domestic

In addition to its long-distance intercontinental transmission capabilities, Alpha Lyracom's PAS I also offers three highly-focused spot beams to bring power to specific countries in Northern, Central and Southern Latin America.

These spot beams are specially contoured to provide maximum power within the national boundaries of each country. This makes them ideally suited to the inexpensive development and expansion of domestic and sub-regional telephone, data and television networks.

The North Beam covers Central America, Colombia, Venezuela and the Caribbean. The Central Beam's coverage includes Ecuador, Peru and Bolivia. And the South Beam extends over Argentina, Chile, Paraguay and Uruguay.

One Satellite... A Wide Spectrum of Uses.

Broadcast and Video

The Alpha Lyracom PAS I is ideally suited to the national and international transmission of broadcast and video signals for television and cable networks, news-gathering and special events coverage, educational networks, and teleconferencing purposes.

The satellite enables users to distribute high-quality video signals in the same manner as a domestic satellite system. Due to its high power, earth stations as small as 2.8 meters may be used for transmission and reception, allowing inexpensive access and providing coverage to geographically remote areas.

PAS I will carry programming from any point within our satellite's coverage area to any others for a single charge—there is no additional cost for multi-point distribution.

Private Networks

Businesses that wish to set up private networks can use PAS I's services to interconnect numerous, geographically distant offices.

In addition to carrying voice and data signals, the satellite can accommodate telex, facsimile, video, teletext, and a host of other communications.

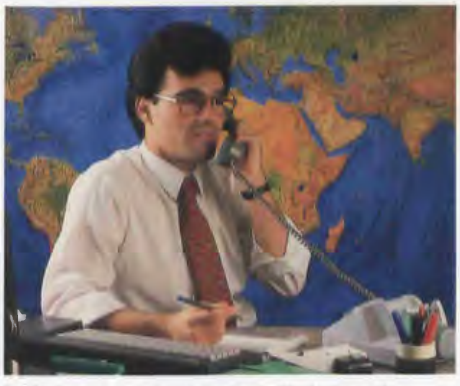
There are many industries and applications for which PAS I offers a perfect solution. A few of these include:

News Agencies and Financial Information Services—Expand networks internationally, using on-premises terminals at customer locations.

Banks and Financial Services Companies—Design interactive data networks for electronic funds transfers or credit card processing and verification.

Manufacturers and Retailers— Control inventory over multiple locations and set up point-of-sale transaction systems.

Petroleum and Mining Industries—Collect data gathered at remote or inaccessible sites and relay it to central offices for processing and analysis.



PAS I private networks can include voice, data, video, telex, facsimile and many other communications.

Alpha Lyracom's PAS I offers reliable, high-capacity data transmission capabilities, with transmission rates ranging from 64 kbps to T1s and higher.

Again, because PAS I's power lets it be accessed by on-premise antennas less than 2 meters in size, businesses can establish satellite links almost anywhere there's an

The PAS I brings national satellite network capabilities within reach of any country.

office. From the most isolated outpost to the most densely populated urban area. By eliminating the need for large earth stations, PAS I makes it practical to establish wide-ranging networks that can improve the flow of information and sharpen your business's competitive edge.

National Satellite Networks

With PAS I, Latin American and Caribbean countries can finally enjoy all the advantages of a dedicated national communications satellite without concern for the financial commitment or excess capacity in owning one for themselves.

Through PAS I satellite service, governments and private industries can economically establish or expand the reach of telephone, television, education and information services throughout their nation's borders.

Our satellite's powerful spot beams operating with small earth stations mean no area is too remote to be reached. As a result, truly comprehensive national coverage becomes an immediate and affordable reality.

In telephony, PAS I can be used to expand existing trunk groups or provide telephone service to rural areas that previously could not be economically served. In broadcasting, the satellite can carry radio or television programming to every populated area in your country—no matter how small or remote. Through PAS I, information from the capital can at last be brought to *all* of the nation's people.

PAS I represents an important opportunity for Latin American countries to unlock the power and potential of an advanced national communications system. By providing the means to expand and improve national communications, this cost-effective tool can vitally enhance your country's social and economic progress.

Accessing the PAS I.

International and Domestic transponders on PAS I are available for sale or long-term lease on a condominium basis to television networks, foreign governments, communications companies and businesses in need of state-of-the-art telecommunications capabilities.

Alpha Lyracom is responsible for all required U.S. licenses necessary for the operation of the system, and will provide an experienced management team to help our customers obtain any foreign approvals that may be needed.

PAS I Technical Overview

Manufacturer:	*RCA Astro Electronics*
Launch Vehicle:	*Ariane 401*
Orbital Location:	*45° West Longitude*
Service Date:	*June 28, 1988*
Satellite Launch Weight:	*2690 lbs.*
Satellite Weight in Orbit:	*1560 lbs.*
Stabilization:	*3-axis*
Stationkeeping:	*±0.1°*
Peak Power Required:	*1235 W.*
Eclipse Capability:	*100%*
Life Expectancy:	*13.25 years at launch*
Reliability:	*99.99%*
Frequency Bands:	*C-Band (4/6 GHz)* *Ku-Band (11/14 GHz)*
Transponder Configuration:	
C-Band:	*12 narrowband (36 MHz) transponders using 8.5 Watt, solid-state power amplifiers* *6 wideband (72 MHz) transponders using 16 Watt traveling wavetube amplifiers*
Ku-Band:	*6 wideband (72 MHz) transponders using 16 Watt traveling wavetube amplifiers*
Redundancy Communication System:	
C-band (36 MHz):	*7 for 6 (SSPA)*
C-band (72 MHz):	*4 for 3 (TWTA)*
Ku-band (72 MHz):	*7 for 6 (TWTA)*
Ku-Band Receivers:	*2 for 1*
C-Band Receivers:	*4 for 2*

Alpha Lyracom is proud to initiate the age of private satellite communications to serve a variety of government and industry needs.

Combining advanced technology, inexpensive earth station requirements, direct customer access and a comprehensive range of services, we are an attractive alternative to any form of information transmission available today.

If you or your company would like to find out more about Alpha Lyracom's PAS I and its services, please contact:

Alpha Lyracom Space Communications, Inc.
One Pickwick Plaza, Suite 270
Greenwich, CT 06830
(203) 622-6664
FAX: (203) 622-9163

ALPHA LYRACOM®
PAN AMERICAN SATELLITE

Alpha Lyracom Space Communications, Inc. is the exclusive marketing and managing agent for Alpha Lyracom/Pan American Satellite.

ALPHA LYRACOM

PAN AMERICAN SATELLITE

Broadcast Services

Alpha Lyracom Broadcast Services

With Alpha Lyracom's video and audio services, broadcasters can finally have it all: the power of a domestic satellite, the reach of an international system and the flexibility to create, design and maintain control over your own networks. Plus, end-to-end cost savings that result from independent ownership and technology designed to meet today's broadcasting needs.

As the world's first private international satellite system, Alpha Lyracom brings new freedom to the realm of international broadcasting. With direct satellite access, you can construct and contract for the networks and services you need.

In addition, the power of our PAS I satellite permits the use of small, inexpensive earth stations for both transmission and reception. These small, low cost earth stations deliver high-quality signals and also make it possible to locate distribution facilities practically anywhere: from a rooftop in the city to a remote rural area.

Using a combination of regional and spot beams on PAS I, Alpha Lyracom offers broadband coverage throughout Latin America, the Caribbean, the U.S. and Europe. As a result, our service is ideal for broadcasters, businesses, governments and others who require a cost-effective means for transmitting and receiving quality television signals domestically or internationally.

Pan American Satellite delivers broadcast quality signals to stations in North America, Latin America and Western Europe.

The PAS I user is not subject to any unnecessary restrictions on the type of earth station used or on the operation of the transponder.

Dedicated Capacity

Alpha Lyracom provides customers with dedicated capacity on a flexible, full- or part-time lease basis. Since ours is a private satellite—unencumbered by restrictive international tariffs and usage limits—you can tailor the access plan to meet your precise needs.

Long-term, Full-time Use.
Alpha Lyracom offers full-time use contracts covering periods of 5, 7, 10 years or longer. This gives customers guaranteed satellite access 24 hours a day, 365 days a year.

Long-term, Part-time Use.
Alpha Lyracom also offers part-time use contracts for periods of a year or longer. This gives you guaranteed satellite access one or more hours per day, one or more days per week. Alternatively, we can arrange to provide you with a requirements agreement with a specified number of access hours per year, which may be used at your discretion.

Applications

Alpha Lyracom's Broadcast Service opens up a wide range of opportunities to help you create and expand programming coverage. Our service makes it possible to link major urban centers—on the national or international level—and to expand the reach of your network to remote population centers within a country. Our dedicated capacity particularly suits the needs of:

Broadcasters • Pay TV Services
Cable Networks • Program Syndicators
News Services • Business Television
Special Interest Programming
Radio Networks

Using our service, customers can:

- Distribute live sports or special events programming to networks and affiliates located anywhere within PAS I's coverage area;

Broadcasters can configure any network that meets their nee

- Initiate satellite newsgathering for transmitting up-to-the-minute news reports directly to regional news distribution centers;

Cover special events using Pan American Satellite's flexible service arrangements.

- Establish national, regional or international video-conferencing networks;
- Create or expand educational networks throughout a nation's borders;
- Provide direct-to-home reception via small, low-cost earth stations;
- Access new markets in special interest programming for SMATV, hotels and cable systems;
- Reach new listeners for national and international radio networks.

PAS I Coverage

PAS I uses a combination of C- and Ku-band transponders to provide national, regional and international distribution of broadcast signals. Two major types of service are available on PAS I: Intercontinental and Domestic/Regional.

Intercontinental Service

PAS I Intercontinental Service is for customers who wish to distribute

heir needs.

high-quality signals throughout the Caribbean, Latin America, the U.S. and Europe.

By leasing an international transponder from Alpha Lyracom, customers can receive the same quality and reliability for their international service that they've come to expect from domestic satellites.

PAS I Intercontinental Service allows for the design of the most cost-effective and flexible networks available today. By simply placing a small earth station where you want, you can have direct satellite access to any location in our coverage area.

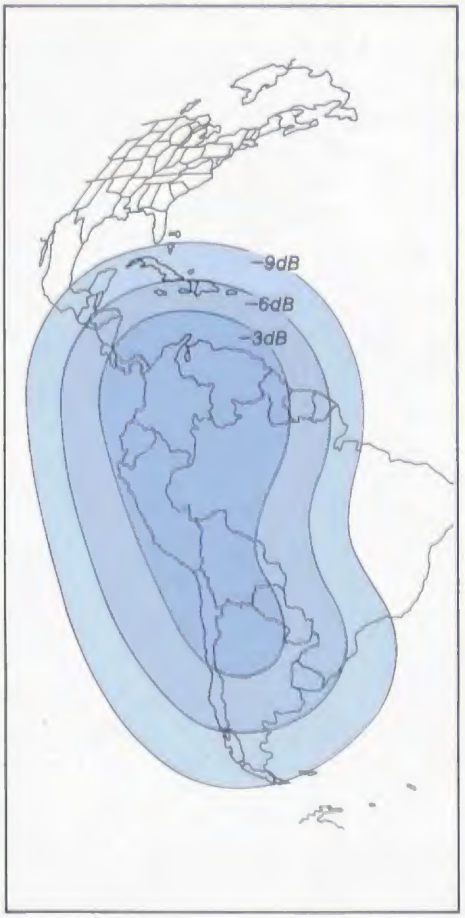
Domestic/Regional Service

PAS I Domestic Spot Beam and Regional Service provides the equivalent of a dedicated communications satellite for individual countries or groups of countries within the PAS I coverage area, at a fraction of a dedicated satellite's cost.

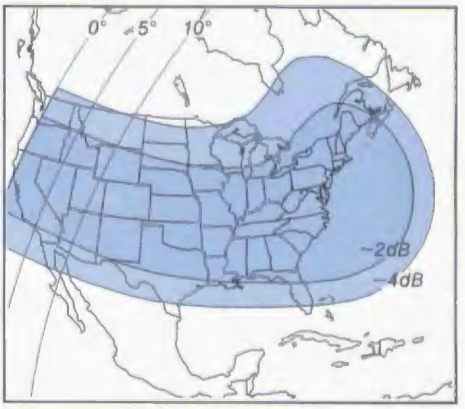
The service can provide full national or regional coverage of even the most remote population centers; facilities for extensive educational networks; capabilities for establishing business, military and government video-conferencing networks; direct-to-home television reception; and the ability to utilize multiple uplinks for regional broadcast and news distribution.

Dedicated capacity for domestic use on PAS I is available for purchase from Alpha Lyracom.

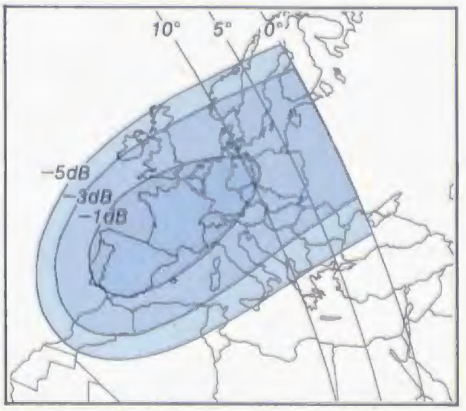
PAS I International coverage EIRP values (±1dB)



Latin American beam has a 37dBW beam center.



U.S. coverage provides a 45dBW beam center.



Pan American Satellite covers Europe with a 47dBW beam center.

Typical Antenna Sizes

	UPLINK		DOWNLINK		
	Ku-Band				
	Fixed	Mobile	Home	Cable SMATV	Broadcast
Europe	7 Mtr	2.4 Mtr	1.8 Mtr	2.4 Mtr	3.7 Mtr
U.S.	5.6 Mtr	2.4 Mtr	2.4 Mtr	3 Mtr	4.5 Mtr
	C-Band				
Latin America			(in the 3dB contour)		
	7 Mtr	5.5 Mtr	2.4 Mtr	2.4 Mtr	4.5 Mtr
			(in the 6dB contour)		
	7 Mtr	5.5 Mtr	3 Mtr	3.1 Mtr	4.5 Mtr
Spot Beams	7 Mtr	5.5 Mtr	2 Mtr	3 Mtr	3.5 Mtr

Advanced satellite technology allows small, inexpensive antennas to be used throughout the coverage area.

Alpha Lyracom Assistance

Alpha Lyracom is available to assist you in setting up and managing your satellite network. Working with your own specialists, we can help to determine the equipment and capabilities that will deliver full value on your investment.

Alpha Lyracom also provides international customers with the services of our Miami International Gateway for uplinking and downlinking. The Gateway gives you simultaneous access to North America, the Caribbean, Central America, South America and Western Europe.

Contact Alpha Lyracom for further information and for a program to handle all your regional and international broadcast requirements.

Alpha Lyracom Space Communications, Inc.
One Pickwick Plaza, Suite 270
Greenwich, CT 06830
(203) 622-6664
FAX: (203) 622-9163

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ALPHA LYRACOM

PAN AMERICAN SATELLITE

Data Services

PAS 1 private satellite business networks include voice and data.

International Satellite Networks

Alpha Lyracom's data services allow multinational businesses to extend the reliability, flexibility and efficiency of their national data networks to overseas facilities and offices in North America, Latin America and Europe. With Alpha Lyracom's PAS 1 satellite customers can combine voice, data, facsimile, video, electronic mail and a host of other vital communications services in a single all-digital network. And, PAS 1's power promotes the use of low-cost VSAT terminals located directly on customer premises.

As the world's first private international satellite system, Alpha Lyracom offers businesses and institutions increased freedom in meeting their international communications needs. From 56 kbps to T1s and higher, Alpha Lyracom can provide the data, voice or video circuits businesses demand. It's the ideal communications technology for:

- Multinational corporations building private networks to link all their offices for voice, data and video communications.
- Companies with remotely-located mining and offshore drilling facilities that cannot be reached by terrestrial lines.
- Financial institutions needing instant access to international business centers for electronic funds transfers and credit card processing.
- Newspapers and magazines developing or extending remote publishing services.
- International news wire, weather and financial reporting services.
- National governments and institutions that need satellite services to link facilities and offices.

PAS 1 meets publishers' needs for multiple printing locations.

End-to-End Service

North America

Alpha Lyracom uplinks both C-band and Ku-band intercontinental traffic through its International Gateway in South Florida. Customers can deliver their communications to the Gateway using a long-distance carrier, or Alpha Lyracom will provide channels from users' North American offices to the Gateway. Customers with communications to Europe can also directly access PAS 1 using their own earth stations or earth stations provided by third parties anywhere within the coverage areas.

Europe and Latin America

In Western Europe and throughout Latin America, Alpha Lyracom will assist satellite users in establishing end-to-end circuits. Through a network of affiliated data communications companies throughout Latin America, Alpha Lyracom can provide full, end-to-end services to international customers. In both Latin America and Europe, users can access the satellite through shared antennas, with terrestrial links, or dedicated antennas, located directly on customer premises.

Alpha Lyracom customers will have complete flexibility in designing and reconfiguring their networks, subject, of course, to any existing national regulations.

Flexible Network Design

Alpha Lyracom's PAS 1 satellite can accommodate a variety of network architectures, including:

Data Broadcasting Networks, where a single source delivers traffic to multiple facilities. Spread spectrum technology allows multiple 19.2 kbps data streams to be delivered to many small (60 cm), inexpensive earth stations. For point-to-multipoint applications, this technology is extremely cost effective.

Hub-Based VSAT Networks, in which a central hub facility communicates with several very small aperture terminals (VSATs), offer the most economical means of establishing large corporate data networks. These VSAT antennas can be as small as 1.2 meters, resulting in significant ground segment savings. Individual and shared hub systems can readily utilize PAS 1's high powered beams. And, most importantly, these services can be established for the first time between North America and Europe using PAS 1's Ku-band common uplink

beam. This beam permits a user to simultaneously access both the U.S. and Europe with the same earth station without having to reconfigure the satellite or incur additional operating costs.

Point-to-Point Networks,
in which every facility has unlimited access to every other facility. These can employ a *mesh* architecture with direct satellite links between all points, a *star* design in which all points communicate through a central point, or a combination of the two.

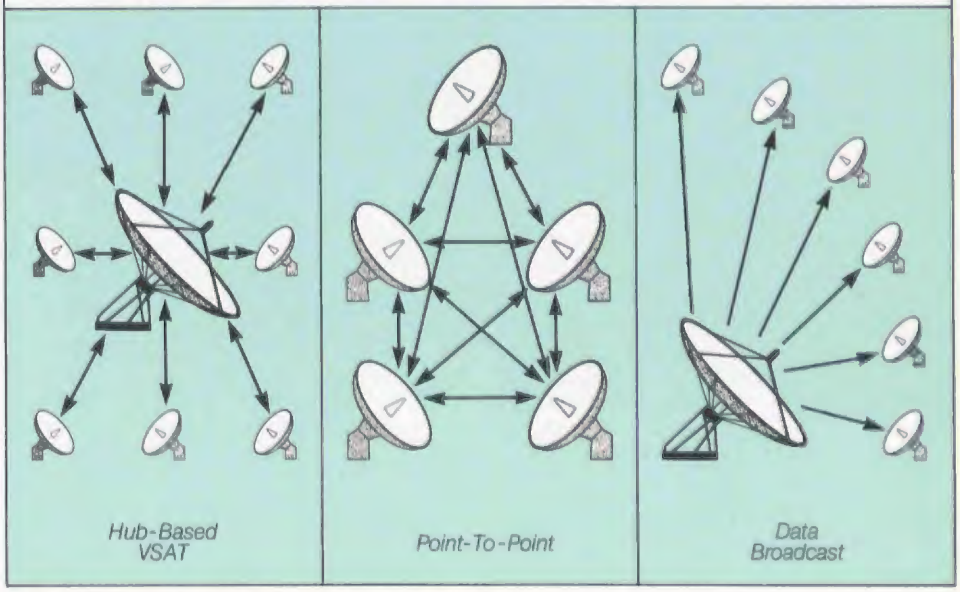
Low-Cost Earth Stations

Small, low-cost antennas can be used throughout PAS 1's coverage area because of the satellite's signal strength. SCPC earth stations as small as 2.4 meters in diameter can be used for transmitting and receiving data streams up to a T1, and data receive antennas can be as small as 60 cm. Two-way VSAT antennas can be as small as 1.2 meters in diameter. While antenna sizes may vary slightly according to the satellite power at each location, Alpha Lyracom will assist in specifying the precise terminal equipment required for each customer site.

Note that due to the satellite's high power, there is no compromise between using small antennas and achieving excellent Bit Error Rates and system margins. Alpha Lyracom's data services are more than competitive with existing international satellite data services, and far superior to international digital services previously available in Latin America.

With PAS 1, customers can use data receive antennas as small as 60 cm.

SATELLITE NETWORK ARCHITECTURES



PAS 1's power allows for flexible network design.

PAS 1 Coverage

The PAS 1 satellite uses a combination of regional and spot beams to provide national, regional and intercontinental distribution of voice and data signals.

Intercontinental Services

Ku-band links North America with Western Europe, and C-band connects the U.S. with Latin America. Alpha Lyracom can distribute traffic to any of these destinations from the U.S., either via direct customer access to the satellite or through our South Florida International Gateway.

High-speed data capability serves the communications needs of large EDP centers.

Regional Services

For regional businesses in South America and Europe, users can access the satellite directly. European customers are able to establish regional communications networks, using PAS 1 as a European satellite. In the same way, customers in Central and South America and the Caribbean can build regional networks using PAS 1 as a Latin American satellite.

National Services

PAS 1 covers Latin America with three C-band spot beams, designed for national data services, government administrative networks or for telephone services within a specific country. National data services can be arranged by working with the Alpha Lyracom affiliate in each country.

PAS 1's European Beam can similarly be used for national services, particularly for data distribution services and digital video conferencing.

By using combinations of these various types of coverage, Alpha Lyracom customers can design a network to fit their most demanding communications needs, and minimize their costs in the process.

Alpha Lyracom Assistance

Alpha Lyracom engineers and data communications specialists are available to assist in defining the services you need. Together with a network of experienced affiliates, ALSC can help customers build and maintain state-of-the-art satellite-based data networks.

Our professional staff can specify the terminals required for each location and assist in acquiring and installing terminal equipment. Alpha Lyracom will also arrange with national and regional carriers for local terrestrial links that may be required to build an end-to-end network. And we provide the full service of our South Florida International Gateway for network management.

Contact Alpha Lyracom with your international communications needs and plans. We'll respond with a proposal that delivers a new level of communications performance, and significant savings in your communications costs.

Alpha Lyracom Space Communications, Inc.
One Pickwick Plaza, Suite 270
Greenwich, CT 06830
(203) 622-6664
FAX: (203) 622-9163

ALPHA LYRACOM℠
PAN AMERICAN SATELLITE

Alpha Lyracom Space Communications, Inc. is the exclusive marketing and managing agent for Alpha Lyracom/Pan American Satellite.

台灣電訊網路服務股份有限公司

TAIWAN TELECOMMUNICATION NETWORK SERVICES CO., LTD.

台灣電訊的精神

- Able
一能接受挑戰，以尖端技術，突破任何困難。
- Anticipative
二能眼光遠大，以前瞻性的遠見，規劃未來。
- Aggressive
三能積極主動，以進取的態度服務社會。
- Ambitious
四能雄心萬丈，以宏大的抱負，推展業務。
- Achievement
五能自我創造，以個人成就服務國家，造福人群。

THE SPIRIT BEHIND TAIWAN TELECOMMUNICATION NETWORK SERVICES CO. LTD.(TTN)

. Able
TTN can surmount all existent obstacles by utilizing the latest technology.

. Anticipative
TTN has the vision and foresight to predict need and demands in a vibrant market.

. Aggressive
TTN attacks problems with optimism and confidence

. Ambitious
TTN maintains a desire for perfection, continually striving to improve services and products.

. Achievement
TTN functions as a team, looking at results and practice not just theories.

公司創立

八十年代爲世界電信政策轉變的關鍵年代，美、日、英、歐陸諸國均變法邁向電信自由化。我國歷經三年之研究，亦自民國七十八年七月起開始開放電信加值網路業務。本公司於民國七十七年成立籌備處，決心配合國際趨勢，突破萬難，於國內興辦大型新型之電信事業。經羅政國內極珍貴之各式電信人才，進行研究分析，確定事業計劃四大領域——數據通信、呼叫器服務、行動無線電話及有線電視。而於民國七十八年十一月一日組成公司，十二月七日獲得交通部加值網路業務執照，以數據通信服務爲起點，正式展開營運。

公司選擇數據通信服務爲起點，因其爲邁向資訊化社會的基礎，也是整合資訊標準的重要工具（如中文電腦應用）。數據通信服務是集電腦、電子、工業工程、管理等高科技之服務，也是其它服務業、製造業提昇延伸服務的動力工具。我國數據通信市場亟待進一步開發，以加速整體經濟發展之脚步。本公司將與電信總局密切合作，相輔相成，互補互助，提高延伸資訊服務業之技術品質，以將高科技的果實帶入國人生活。

CORPORATE FOUNDING

The 1980's was a crucial era for changes in worldwide telecommunications policy as the U.S., Japan, and most countries in Europe modified laws liberalizing telecommunication. In July of 1989 Taiwan opened it's Value-Added Network service market and thus became a player in the arena of advanced international telecommunications, Foreseeing the explosive growth potential of such services in Taiwan, Taiwan Telecommunication Network Services established a preparatory office in 1988 and began conducting research in the areas of data communication, paging services, mobile phone services and cable television. In December 1989, Taiwan Telecommunication Network Services received it's Value-Added Network (VAN) License and began formally providing data telecommunications service.

公司使命

十九世紀末電話之發明，使人類得享快速便利之通信，本世紀中電腦及電子科技之萌發，賦予人類處理分析大量資料之能力。到八十年代，電信及電腦兩項科技更進一步結合，使世界邁入資訊化社會。各種新科技所組合之電信網路，配合各式新開發之終端設備，不但可傳輸聲音與電報，尚可大量、快速、有效地傳輸文字、數據及影像等各式資訊。因此，社會上訊息之流通乃至交易行爲，均朝向電子化，更爲便利、頻繁，也爲新時代開啓了新服務之契機。

資訊工業的進步，帶來了便利。另方面也導致資訊量的暴增，使人有茫然之感，也會使人群感覺無從學習，有被遺棄之感，這是因爲整合性的資訊服務業並不普遍也未能深入生活。今天，必須要有有力的、普及的、科技性的服務業，來整合資訊與電信的品質能力，爲社會提供生活化的服務。

現代之經濟發展，受電腦及電信科技之影響極爲深遠。過去，加值型網路僅是一句口號，如今則已成爲工商界不可或缺之有力工具。在先進國家，主幹網路固然重要，但其在最新通訊科技中已成爲漸小部份，商業性之加值網路益見重要。我國在先進通訊技術與硬軟體設備上仍落後先進國家。惟有政府與民間之電信及資訊事業群策群力，共同努力，或有與先進國家一較長短之可能。今天，國際間資訊傳輸已是最重要之一環。爭取時間，縮短空間，尖端通訊科技，實爲命脈所繫。

CORPORATE PHILOSOPHY

The invention of the telephone at the end of the last century allowed mankind to enjoy quick and convenient communication. The development of the computer and electronic technology in the middle of this century gave us the ability to organize and analyze large volumes of data. In the early eighties, telecommunications and computer technology merged, ushering in the information era. Today, telecommunication networks benefit from all types of new technology, transmitting sound and text as well as digital and graphic data. This has brought the diversification and quantity of datum transactions to epic proportions.

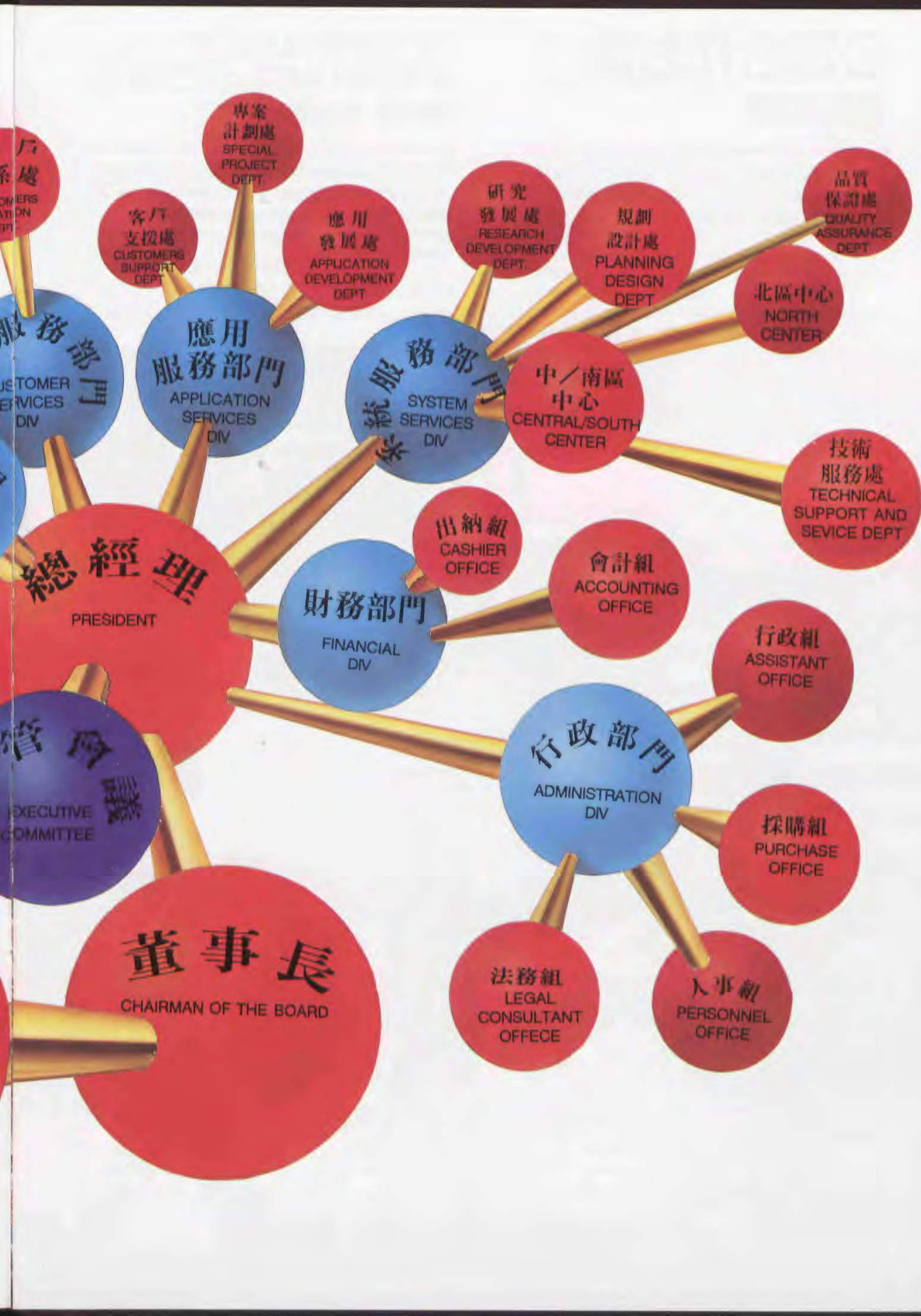
To some extent this has created feelings of alienation towards high technology since electronic access to information remains foreign to second wavers. Many feel they have already been left behind. Why? The answer is simply that the linking of information services is not widespread and thus not a significant part of daily life. Powerful, readily available and user-friendly network services are required to link vast amounts of information for practical purposes.

Commercial Value-Added Networks are now recognized as one of the factors required to achieve this goal. Taiwan Telecommunication Network Services in conjunction with the Directorate General of Telecommunications will play a major role in bringing third wave technology to consumers via Value-Added Networks and enhanced netowrk services. These efforts will streamline business, boost productivity, increase information exchanges and over time, grow to become the lifeblood of our economy.

公司組織


CompuServe


客戶關係處
CUSTOMER RELATION DEPT
行銷作業處
MARKETING DEPT
推廣作業處
PROMOTION DEPT
客戶服
CUSTO
SERV
綜合企劃處
CORPORATE PLANNING DEPT
企劃部門
PLANNING DIV
顧問室
ADVISORY GROUP
董事會
BOARD OF DIRECTORS


董事長
CHAIRMAN OF THE BOARD
總經理
PRESIDENT
EXECUTIVE COMMITTEE
應用服務部門
APPLICATION SERVICES DIV
系統服務部門
SYSTEM SERVICES DIV
財務部門
FINANCIAL DIV
行政部門
ADMINISTRATION DIV
專案計劃處
SPECIAL PROJECT DEPT.
客戶支援處
CUSTOMERS SUPPORT DEPT
應用發展處
APPLICATION DEVELOPMENT DEPT
研究發展處
RESEARCH DEVELOPMENT DEPT.
規劃設計處
PLANNING DESIGN DEPT
品質保證處
QUALITY ASSURANCE DEPT
北區中心
NORTH CENTER
中／南區中心
CENTRAL/SOUTH CENTER
技術服務處
TECHNICAL SUPPORT AND SEVICE DEPT
出納組
CASHIER OFFICE
會計組
ACCOUNTING OFFICE
行政組
ASSISTANT OFFICE
採購組
PURCHASE OFFICE
法務組
LEGAL CONSULTANT OFFECE
人事組
PERSONNEL OFFICE

公司合作對象
網路連線

公司與美、日、歐洲最負盛名之數據網路連線，服務可延伸至全球。世界主要地區之訊息及資料，均可透過本公司之服務傳送、儲存。

THE IMPORTANCE OF INTER-RELIANCE
Network Interconnection

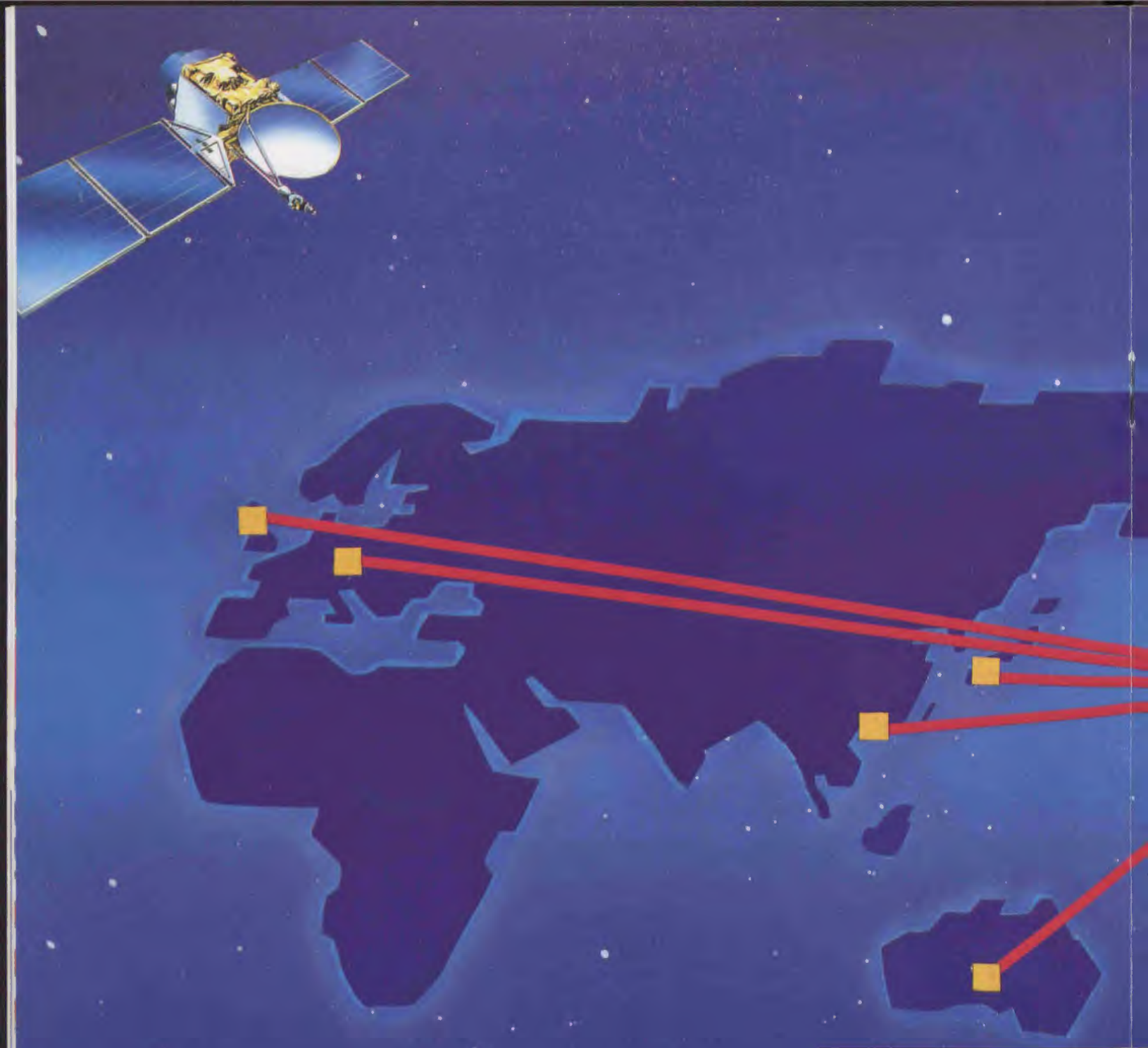
Taiwan Telecommunication Network Services can presently interconnect with networks in the U.S., Japan and Europe, enabling international telecommunication services and access to over 800 databases worldwide.

技術合作

公司主要服務項目，硬、軟體設備，均係與世界最著名之廠商技術合作或購置，如美國最大之個人電腦網路廠商。CompuServe、U.S. SPRINT日本之 NIFTY-Serve、等。本公司尚投入大量人力與資金自行開發中文版龍門網(TTN-Serve)網路服務，於1990年9月1日推出，俾適應國人之需求並進而推廣於全世界。

Technical Cooperation

Taiwan Telecommunication Network Services principal service technology is either developed or supplied through technical cooperation with the world's most famous telecommunication service companies, such as America's largest personal computer network company CompuServe, and U.S. Sprint Japan's NIFTY-Serve among others. Furthermore, Taiwan Telecommunication Network Services enjoys close working relationships and open channels of communication with the research and development depatments of these high tech leaders. This provides us with invaluable insight which directly translates into service and systems uniquely compatible with Chinese language and the Taiwan market.



龍門網服務項目

- 龍門網
  - 服務指引
  - 電子郵遞
  - 論壇
    - 龍門網論壇
    - 休閒／嗜好論壇
    - 藝術／文化論壇
    - 家庭／教育論壇
    - 飲食／消費論壇
    - 財務／投資論壇
    - 健康／醫療論壇
    - 時事／科技論壇
    - 電腦／技術論壇
    - 感性論壇
    - 影歌迷俱樂部
    - 一般討論區
  - 佈告欄
  - 線上交談
  - 新聞／氣象
    - 國內新聞
    - 國外新聞
    - 氣象預報
    - 氣象天文常識


ITT
教育／文化
工商快報
商業／金融
電腦／技術
政府公告／法律
生活／休閒
貿易
財務
金融
保險
證券
期貨
微信
食
衣
住
行
娛樂

公司業務

加值網路及數據通信服務

向電信局機構租用高速T1電路，加裝電腦，控制設備及端點機件提高品質，組成公司之幹線網路，向客戶提供廣泛，可靠且經濟之特殊電信／資訊服務（如商用電腦及事務機器之連線，固定商業格式資料交換、電子郵件、資料存轉、個人電腦連線、速度、費率之選擇，自動偵誤等），本公司國內網路將與美國、日本、香港等國外連線，使各項加值網路有堅實之基礎，能爲客戶提供高品質之電信，資訊服務，公司提供加值網路服務可分爲標準網路與專屬網路二種。

VALUE-ADDED NETWORK (VAN) AND DATA COMMUNICATION SERVICE

Taiwan Telecommunication Network Services will lease high-speed circuits from DGT and install computer and network management systems to create a Value-Added Network which will provide customers with broad, reliable and cost-effective telecommunication/data service such as business computers and office equipment interconnections, electronic data interchange,(EDI)electronic mail, data storage and transfer, personal computer interconnection, choice of speed and cost, error correction and much more. These TTN supplied Value-Added Network services can be divided into two categories: standard and specialized network services.

A 標準網路服務

設置於高速數據網路上之一般公衆服務，係針對個人、家庭及一般企業之用。

1. 台訊個人電腦網路服務 (TTN-Serve)
2. 台訊電子文件存送服務 (TTN-EDS)
3. 台訊語音存送服務 (TTN-Message)
4. 台訊商業通訊服務 (TTN-RFS)
5. 台訊電子交易服務 (TTN-ET)
6. 台訊電子數據交換服務 (TTN-EDI)

B 專屬網路服務

按照顧客個別需要爲其設置專屬網路系統。服務原則爲通信系統與電腦系統結合、並重，係針對特大型企業機構或業務系統服務之用。服務項目包括：

通信系統
- 網路規劃、設計
- 網路設備選擇
- 網路安裝
- 網路操作、維修
- 網路管理、監控

電腦系統
- 軟體系統規劃
- 軟體設計
- 軟體製作
- 軟體測試
- 軟體操作

Standard Network Service

A general mass-user service based on TTN own and operated Value-Added Networks target individual, family and general business use:

1. PC Communication Network (TTN-Serve)
2. Electronic Data Store and Forward (TTN-EDS)
3. Voice Message Service (TTN-Message)
4. Remote File Service (TTN-RFS)
5. Electronic Transaction (TTN-ET)
6. Electronic Data Interchange (TTN-EDI)

Specialized Network Service

Private network services are tailored to meet specific needs of clients via interconneted telecommunication systems and customized software systems. Private network services are especially relevant to large-scale business enterprises and marketing system services. Services include:

Telecommunication Services
1. Network design
2. Network equipment selection
3. Network installation
4. Operation/Maintenance
5. Management/Control

Systems Integration
1. Analysis
2. Design
3. Production
4. Testing
5. Operation

資訊服務
資料庫服務

與國內外最著名之資料庫合作，透過本公司之網路或電信機構之網路，向國內企業及個人客戶提供金融及商情等服務。

軟體開發服務

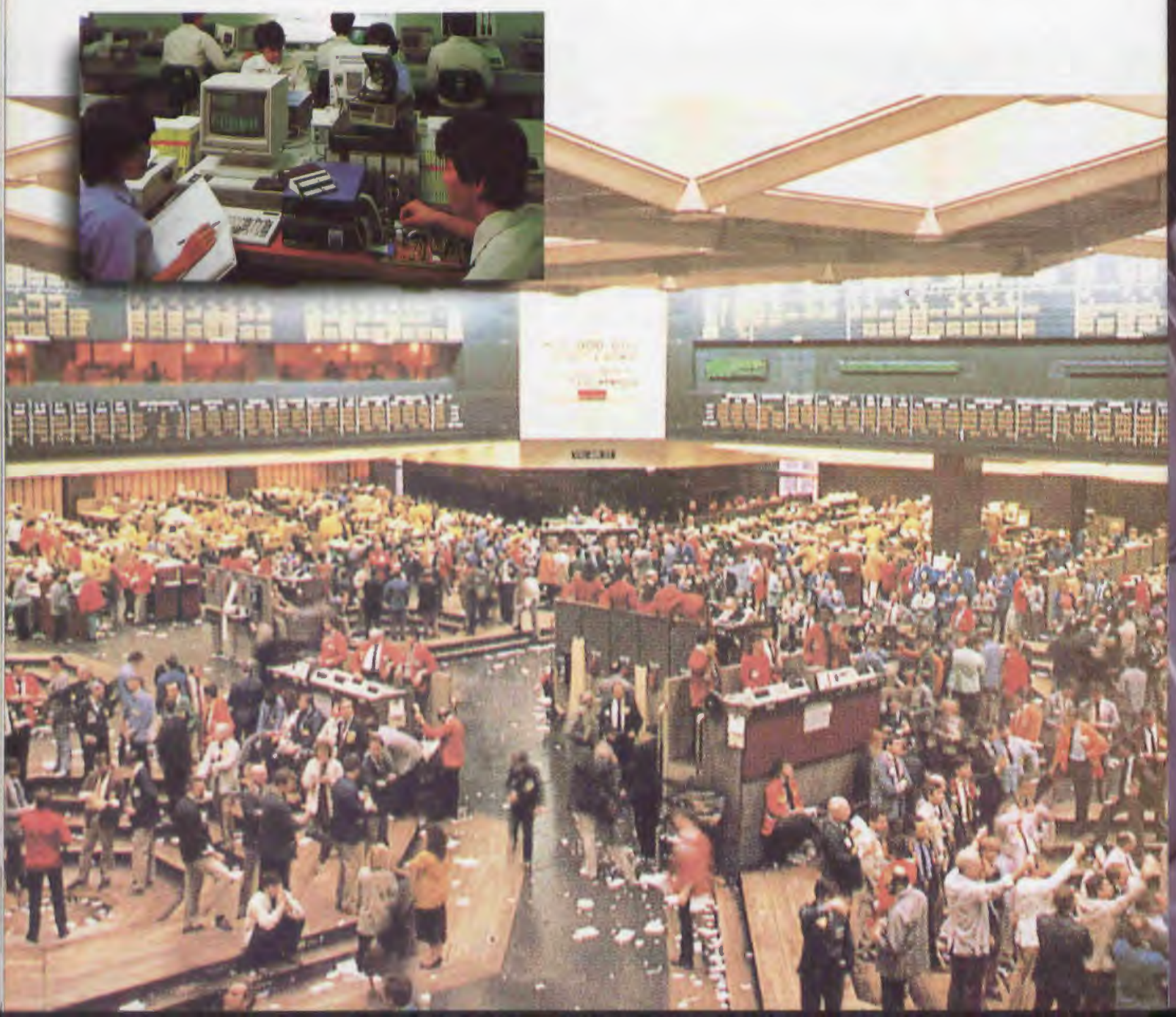
爲國內大企業客戶規劃、設計整體通信及資訊之網路架構，並爲其製做相關之軟體，引導其使用本公司網路，甚至開發出新的業務。

INFORMATION SERVICES
Database Service

Both local and over 800 international data-bases will be accessible either through TTN networks, providing local business clients with information regarding banking, business, finance, news, travel, etc...

Software Development

Taiwan Telecommunication Network Services remains uniquely capable of providing a total solution, with superior software program designs not only customized to specific needs of a client but also integrated into TTN's information network.



新型電信服務

行動無線電話及呼叫服務，引進行動通訊之最新科技，整合語音與數據，提供個人或商業更方便、更自由之新型電信服務。

MOBILE PHONE AND PAGING SERVICE

TTN introduces the latest technology in mobile communications and integrated voice and data, providing a wide range of new freedom and convenience in the field of telecommunications.

傳播服務

利用公司對於線纜及無線電網路方面之能力，建設長途超級幹線網路，向國內各個地區性之有線電視台經營業者提供多頻道之節目，並且自營部份地區之電台，以向全省居民提供多頻道、多種選擇且能切合地方及特定群體需要之有線電視服務。

BROADCAST SERVICES

TTN will set up a nationwide super station making multi-channel programming possible throughout Taiwan. TTN also plans to own and operate cable television stations which will provide subscribers with multi-channel, multi-selection cable television programs.

研究發展

由於電子科技發展之迅速，導致通訊技術之進步亦有一日千里之勢。本公司秉持以尖端科技爲導向，對研究與發展之推行亦不遺餘力，除引進國外之新技術，自身也設置研究發展部門，羅致國內、外精英人才從事與通訊有關之研究工作，期能有所突破與先進國家並駕齊驅。

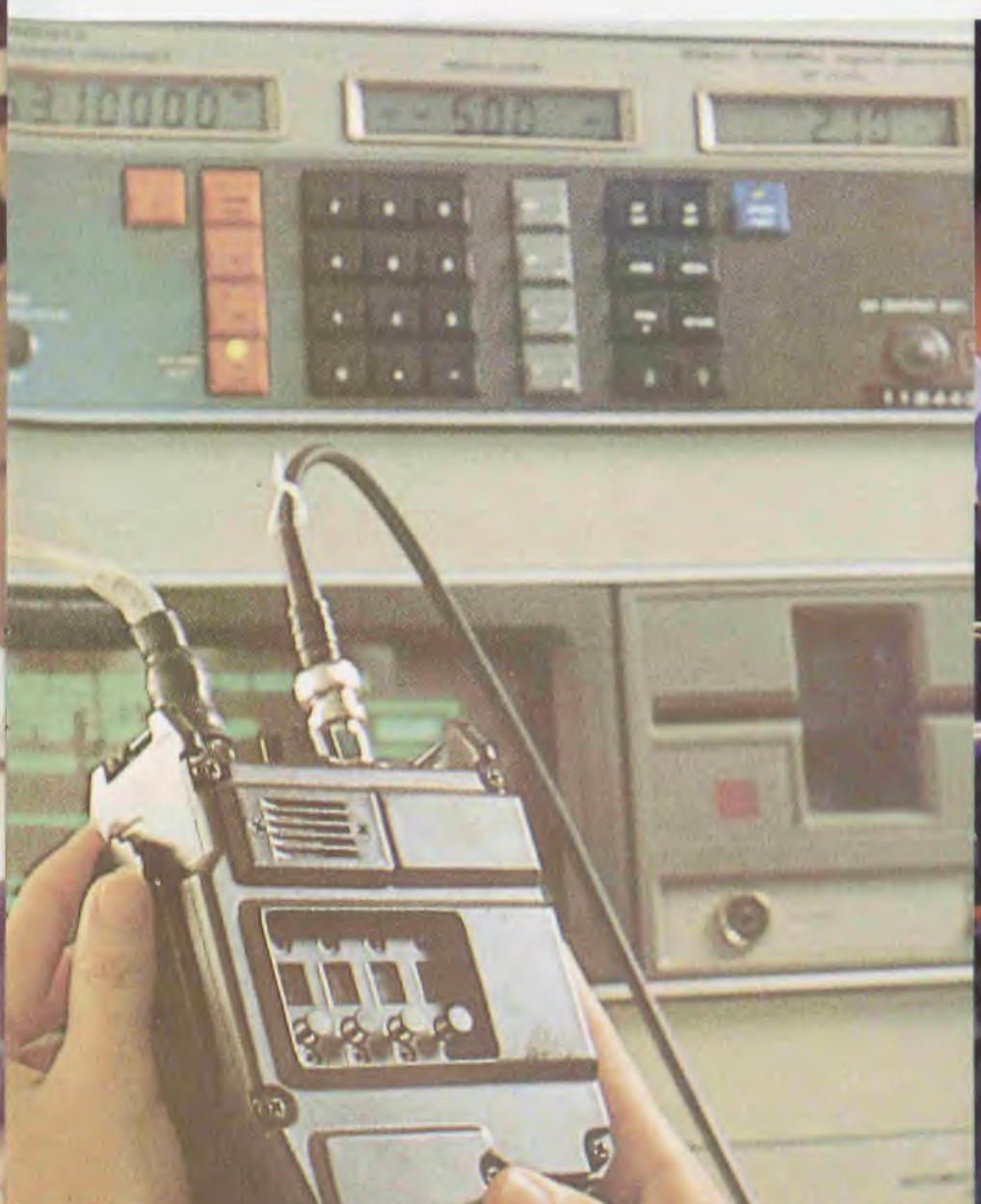
- 有線電視網路之推展
- 多功能通訊網路之推展
- 行動通訊之研究推廣
- 光纖網路與介面之研究
- 衛星通訊之研究
- 其他有關通訊技術之研究

RESEARCH AND DEVELOPMENT

Realizing that the promotion of research and development is the cornerstone of any high technology-related venture, TTN will spare no efforts or expense to continue to import the newest technology and staff it's own Research and Development Department with the best personnel available.

The following areas have been targeted for intensive research and analysis:

1. Development of cable television networks
2. Development of enhanced telecommunication services
3. Mobile and personal communications
4. Fiber optic networks and interfacing
5. Satellite communications and applications
6. Alternative communication technologies



公司展望

在後期工業社會的激烈競爭之下，電腦與通訊的結合，已成必然，通訊亦經由電腦之功能，而達到前所不能之境地。加值型網路及加值型服務由此而誕生，使電腦服務之範疇，深達高科技之應用，廣至一般家庭之休閒娛樂，幾乎無所不在。

本公司以前瞻性，整體規劃，爲國家社會佈建各式電訊網路與服務，提昇國內之技術能力與效率，將高品質的資訊帶入社會，高科技的成果帶入生活。有賴國民與客戶之信任支持，配合資訊化社會之需要而成長，將公司建設成爲國際一流水準之電訊服務公司，以優良的服務回饋社會。

THE NEW AGE

The future promises intense global competition at a crucial transitional period in our respective societies. The inevitable merging of computers and communications will reach levels never thought possible, revolutionizing the ways in which human beings interact with information and each other. Words such as accountability, efficiency and impossibility willl be redefined forever as computerized services will rapidly find their way into all aspects of existence, from ultratech science to computer simulated dreamscapes.

Taiwan Telecommunication Network Services will be there to meet the challenge, constantly striving to update all available technology and bring the power of information and communication to generations to come.

Telecommunications will play a major role in the future,because the goal of advanced telecommunications is consistent with certain principles inherent in the human race; desire for fraternity, unity, freedom and security.

Telecommunications is making these dreams possible, and TTN has the technology and the vision, the inspiration we gain from you. TTN bringing minds and magic online so tomorrow can be a day earlier.

台灣電訊網路服務股份有限公司
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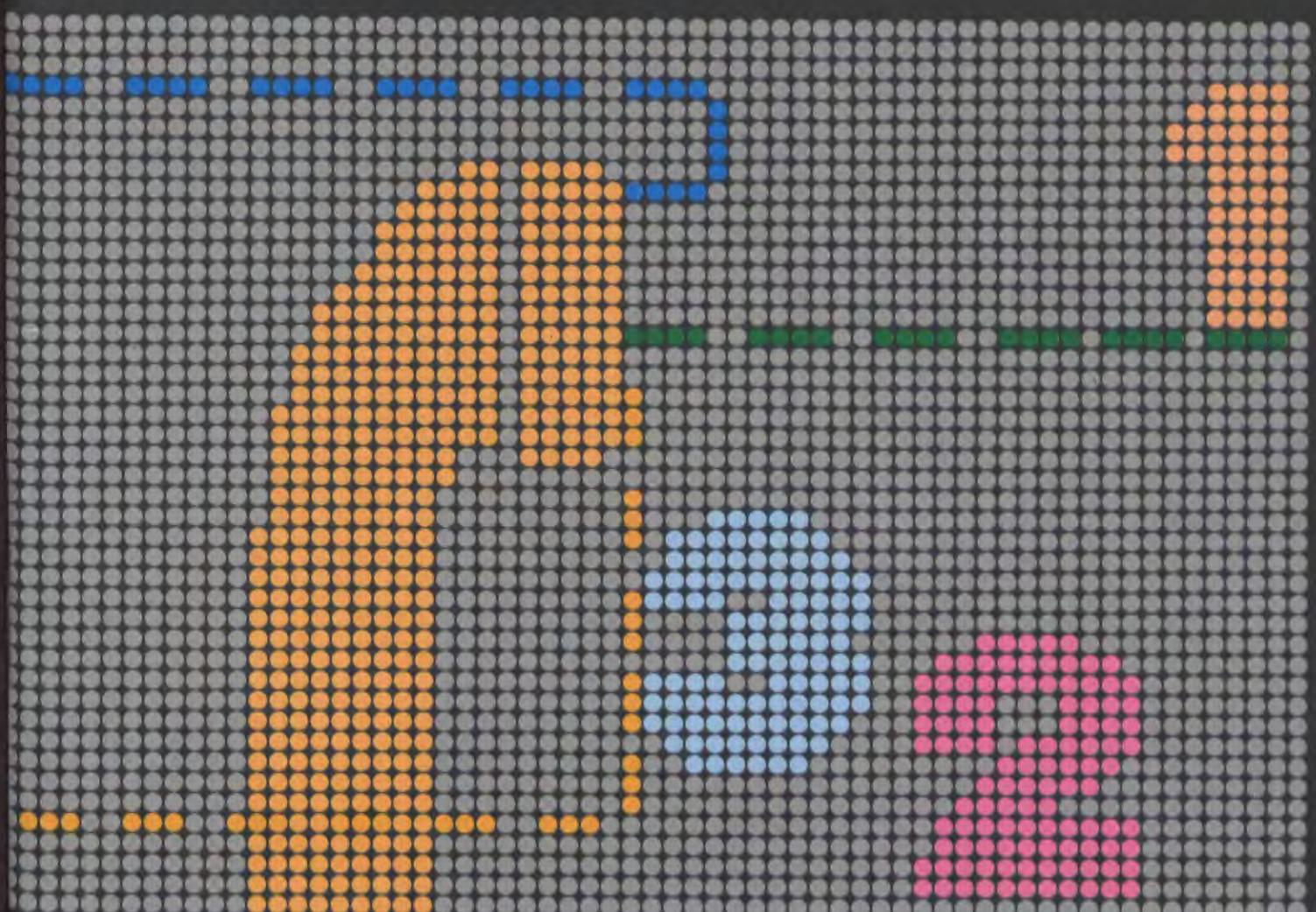
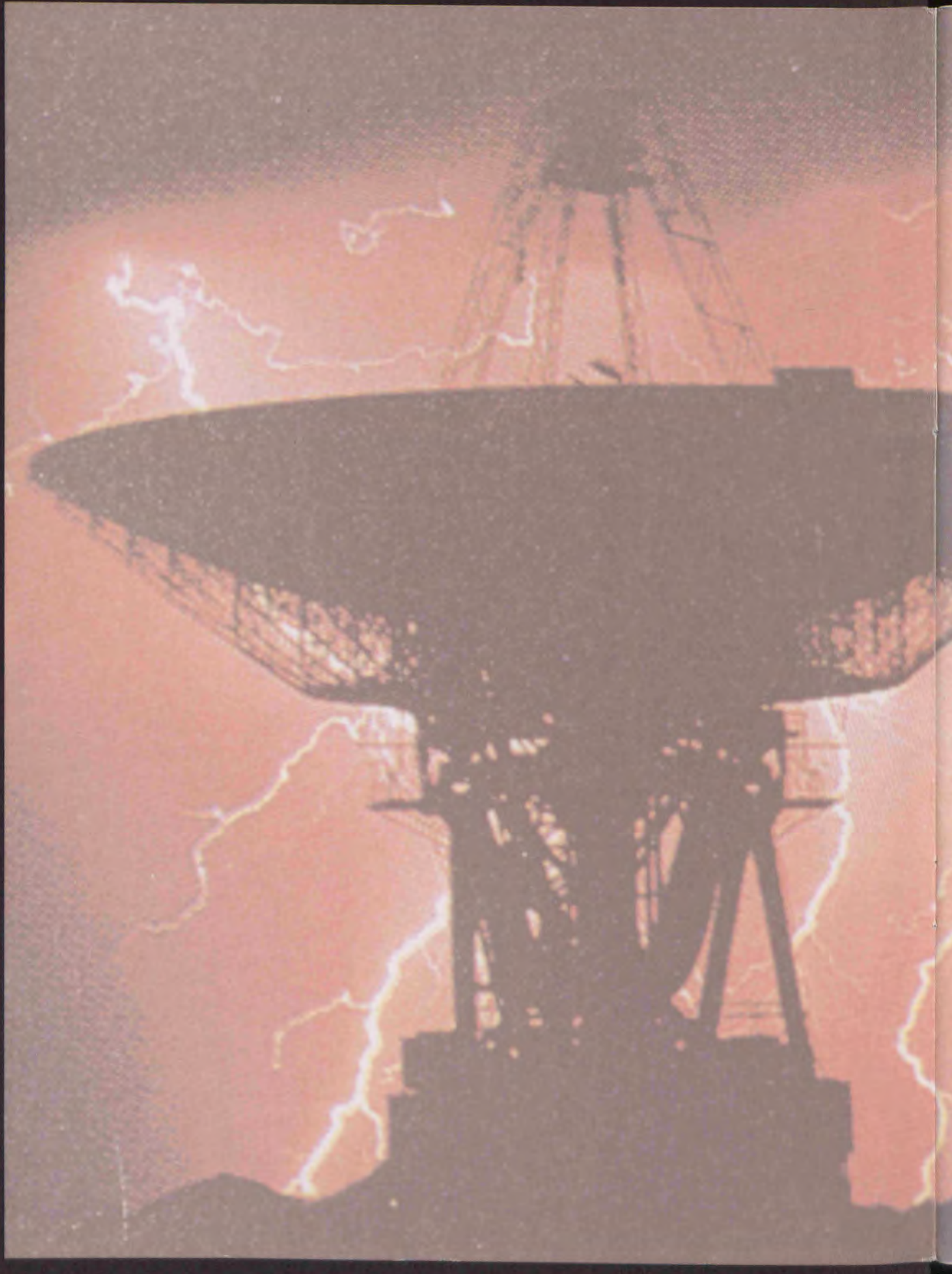
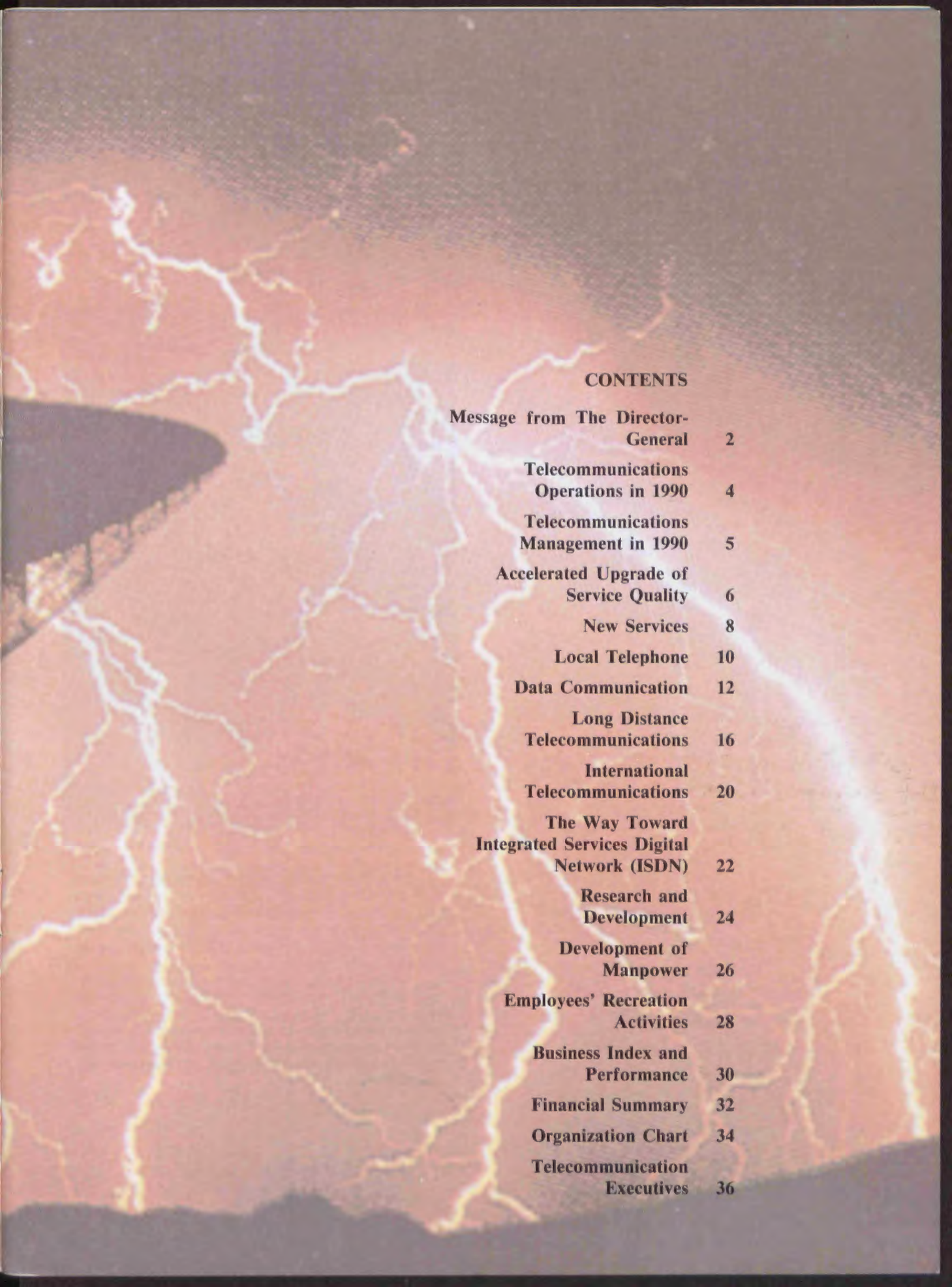
TELECOMMUNICATIONS IN THE REPUBLIC OF CHINA

Annual Report 1990







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Message from The Director-General

In May, 1990, the total number of our telephone subscribers reached 6 million, ranking the 15th in the world. This achievement attributes to the undaunted and tireless effort of our 35,000 telecommunications employees. It marked an important milestone in the history of telecommunications development in the Republic of China.

Now we're heading for offering services of diversification, sophistication and internationalization as our long term development strategy. In addition, we devote ourselves to popularize our services and upgrade the service quality in order to promote our telecommunications in a new era--an information-oriented society converging the technologies of computers and communications.

Looking around the great circumstances we are in, it is easy for us to find that we are in an age full of good opportunities for development, for instance, the burning demand for democracy on the Mainland China; gradual opening policy of our government toward Mainland China; rapid reunion of East and West Germanies; the collapse of Soviet and the East European Bloc; and the political and economic union among 12 European countries in 1992. This information has been rushing to our country. The industrialists and businessmen in Taiwan spare no effort in grasping this opportunity and hasten their pace to get ready to plunge into the international competition and thrust. Being working in the telecommunications, we also have to perceive the duty and get ourselves fully prepared to provide them with the essential services of telecommunications and information, and help them penetrate the world market. Our mere mission is to develop the telecommunications network for supporting the international economic and trade activities. Hence, every telecommunications employee should be very proud of himself in contributing his professional knowledge and techniques.

The growth of telecommunications industry depends largely on the continuous expansion of various service networks. However, before we invest huge capital on digital and intelligent switching and transmission networks, we have to think carefully how to make the capital investment effectively, how to offer fastest services to benefit our customers, how to market effectively for attracting more customers. We keep in mind that only enormous capital investment could not bring us reputation nor profits, but only can we provide services of international standards and then obtain deserved return from them that makes our enterprise grow. This is our noble mission vested by the government and the people. To face the challenges of providing quality services at reasonable tariff rates, our duty becomes harder and harder. That is the severe trial we have to face before the telecommunications administration could be privatized.

While recalling on the effort and achievements in the past year, we have to review carefully what our defects and shortcomings, then we can improve our business in the following year. The prospect of telecommunications technology and services is very bright. I hope that every colleague has the same expectation. Let us exert concerted effort and go straight ahead bravely.

P. Y. Lee

P. Y. Lee
Director-General

Telecommunications Operations in 1990

C. B. Shiue

C. B. Shiue
Deputy Director-General

Telecommunications operations relies to some extent on the rapid change of business environment, the needs of the customers and the overall national development. The major achievements in the telecommunications operations in fiscal 1990 are summarized as follows:

1. Expansion of Basic Service Capability

- Increase new telephone subscribers by 522,564 with annual growth of 9.4%, and the accumulated total number of subscribers, 6,089,398
- International telephone linking 221 countries or territories, among them ISD can reach 175
- Subscribers who can dial ISD reached 96%
- International telephone (outgoing minutes) increased by 30.72%
- Display-type radio paging system II, 550,000 lines, the accumulated total reached 1,015,000 lines including System I and single-tone pagers.

2. Extension of Service Spectrum

- International PACNET reached 30 countries or areas
- IODC calls could reach six countries including Japan and the U.S.
- International video conferencing opened to three countries, i.e. the U.S., Japan and Singapore.
- OTD toll telephone service opened to the off-shore islands of Quemoy and Matsu
- STD toll telephone, telex and collect call telephone opened to connect the Chinese mainland via a third country.

3. Introduction of New Services

- Introduced cellular mobile telephone service with initial capacity of 40,000 lines and service areas covering three metropolis of Taipei, Taichung and Kaohsiung, and the cities along the Freeway
- Opened TVM service to Taipiei, Taichung and Kaohsiung metropolitan areas
- Opened customs declaration information network service, upgrading the service quality of customs service

4. Elevation of Service Quality

- Promoted to achieve the goal of "instant handling upon application" for radio pager, cellular mobile telephone, installation or removal of local telephone, and data circuit
- Installed extensively PASS measurement systems to shorten the time of detection and recovery defective public telephones
- Accelerated lineplant modernization
- Upgraded the quality of telephone directory and trouble reporting services

5. Modernization of Business Operations System

- Telecommunications tariff ratification--Tariff rates should reflect the service costs and be established in accordance with traffic, connecting time, communication speed, and the interval of call, so as to meet the emergence of Information Age. We plan to:
  - * Continue to lower local telephone installation charge
  - * Implement three-class STD call charges
  - * Decrease ISD call charge
  - * Decrease usage charge of international video conferencing
  - * Merge local telephone basic rate service areas from 280 to 16
  - * Implement local telephone 5-minute call billing system
  - * Liberalize value-added network service to competition

6. Telecommunications Development Program

- Telecommunications Modernization Plan is 97.77% completed to be fully completed by the end of 1990 as scheduled
- Accelerating Elevation of Telecommunications Quality Program, is 18 project items completed and to be fully completed by the end of 1990
- Network Digitalization--Toll Transmission 91.8%
  Toll Switching 76.2%
  Local Switching 24.5%
  It is anticipated that the above ratios will be 100% by the year 2000 when the ISDN is established in Taiwan.

The following major development projects will be launched by us in order to focus our effort in the establishment of intelligent network (IN) to provide diversified services required by the customers in the Information Society:

- To add 10 million lines of DSS for local switching and 430,000 lines for toll switching
- To construct optical fiber cable subscriber loops 23,000 core/km and the Freeway optical communication system 48 cores, 420 km
- To lay Taiwan-Matsu optical fiber submarine cable 12 cores, 300 km
- To introduce CT2/3 telepoint service
- To develop IN pilot network system
- To establish pre-ISDN commercial network 2,200 lines.

Telecommunications Management in 1990

Steven Y. Chen
Deputy Director-General

In the accelerated progress of telecommunications liberalization and privatization, the telecommunications industry in the ROC has been exposed to double pressure from both abroad and home. To cope with the keener competition from outside, we cannot but gear up our effectiveness of performance and improve our service quality. To alleviate the impact from inside organization development, we must strengthen our two-way communication and promote humanitarian management. In the past year of transition, we have achieved remarkable accomplishments in the financial management, the development of human resources and the utilization of manpower.

1. Financial Management

A slight slump has appeared in the telephone revenues due to the continued decrease of tariff rates and the merger of basic rate service areas. However, the total revenues continued to grow in the past year owing to the dedication and devotion of our fellow telecommunications employees. following table shows the soundness of our financial situation and the effectiveness of our financial management:

Ratio of Cash Flow 336.96%
Ratio of Operating Revenues/
Operating Expenses 73.22%
Net Profit 31.94%
Rate of Return on Equity 11.14%
Ratio of Liabilities/Assets 12.43%

2. Development of Human Resources

Human resource is the most fundamental resources and the prime mover indispensable in converting all other resources into those useful and enjoyable to mankind. To develop effectively the human resources and to upgrade the quality of manpower, our subordinate Telecommunications Training Institute sponsored a variety of professional training courses and symposia in compliance with the manpower requirements in the fiscal 1990. In order to absorb new technology and management skills, we selected and sent many outstanding employees to receive both technical and managerial trainings in the academic and professional institutions both abroad and at home.

3. Utilization of Manpower

In a series of talents selection, cultivation and application, our manpower has been very effectively utilized. In recent years, thanks to the elevation of manpower quality, the promotion of job computerization and the trenchment of manpower deployment, the total number of our employees amounted to 35,192 as of June 30, 1990, a saving of 2,405 persons from the budget.

Lack of labor force tends to be the trend of future society. To meet with this tendency, to effectively motivate our employees and to elevate our management performance, we shall educate our employees to have the sense of expertise. In other words, every employee should work in the mood of a manager instead of a "hired hand", to united together his personal objective and the corporate goal of DGT.

Accelerated Upgrade of Service Quality

The subscriber's demand for telecommunications services has been from quantity to the upgrade of quality as a result of the high growth of national economy and the fast vicissitude of the social environment. To satisfy our subscribers, we have in the past few years exerted our effort in promoting the quality of service such as:

1. Merger of Local Telephone Basic Rate Areas

To lessen the subscriber's burden, we started in January, 1984 and completed in June, 1990, our merger program of local telephone basic rate areas by merging original 280 areas into the existing 16 areas. Each basic rate area was then enlarged to 2,250 km² from original 128 km². Beginning July, 1990, the total subscribers can save around NT$3.2 billions of Telephone charge.

2. Liberalization of Telecommunications Service

To cope with the social needs and to comply with the government policy, we have opened the following service items to private sector for open competition:

(1) Deregulated such customer premises equipment as the main station and extension of push button telephones, facsimile, telex terminal equipment, and data modem.

(2) Deregulated since July 1, 1989 the value-added network (VAN) services and receive applications for license to operate VAN services.

3. Free Installation of Touch-tone Telephones

We started since October, 1988, free replacement of the existing dial telephone by touch-tone telephone in order to promote new telephone services. As of June 30, 1990, the total number of touch-tone telephones amounted to 5,824,872 stations, marking 90.19% of the total.

4. Rationalization of Tariffs

To lessen the burden of our subscriber and to establish the philosophy of payment-by-the-user, we have put into effect the following adjustments of telecommunications tariffs:

(1) Beginning July 1, 1989, long distance telephone rates were changed from original six classes to 3 and number of seconds decreased by 17%.

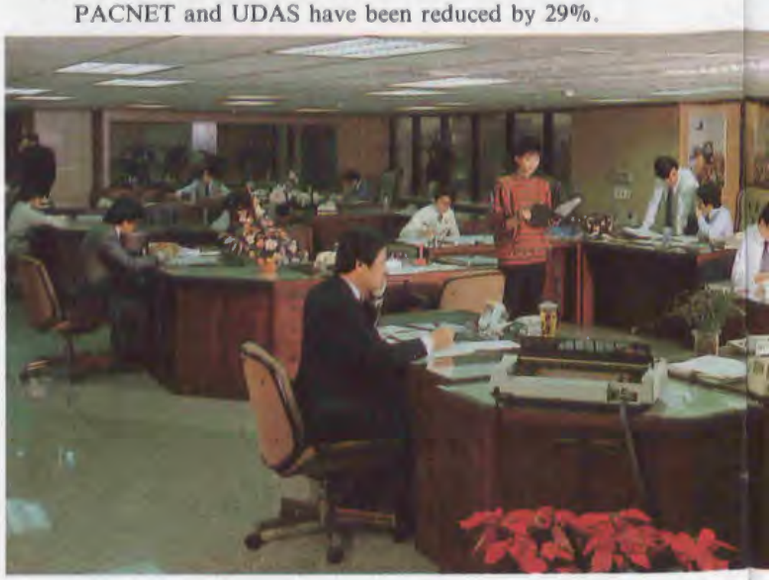
(2) Beginning July 1, 1989, the outside boundary material cost within 3 km was waived and that beyond 3 km only NT$200 for each 100 m is charged.

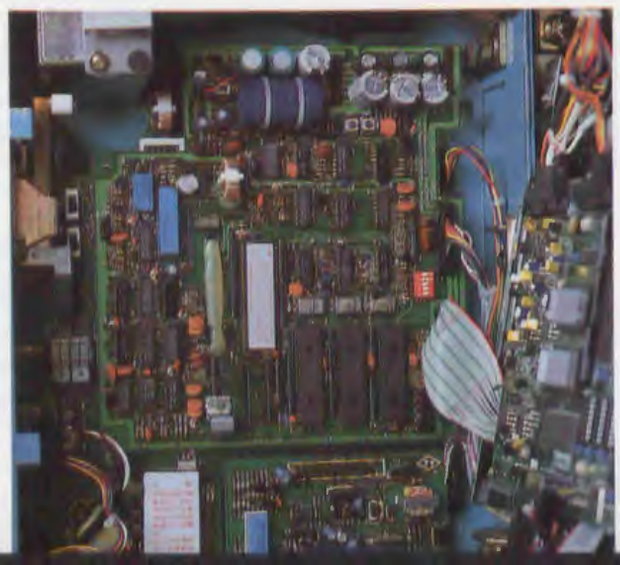
(3) Beginning July 1, 1989, the domestic operator toll dialing calls are charged on three-minutes one-minute basis instead of three-minutes three-minutes basis.

(4) Beginning July 1, 1989, calls to the directory information service of 104 and 105 are charged.

(5) Beginning August 1, 1989, monthly basic rentals of PACNET data communication has been reduced by 16.7 to 27.8%.

(6) Beginning April 1, 1990, partial rentals of PACNET and UDAS have been reduced by 29%.





5. Improve the Quality of Business Representatives and their Service Attitude

In order to elevate service quality, we have continued in conducting various training courses and sponsoring unperiodically service contests. In addition, we collaborated with China Productivity Center in unleashing a Total Quality Promotion Movement from August to November, 1989. By sampling survey, the satisfaction degree of the customers has been boosted to 81.5% in average.

6. Improving the Quality of Telephone Calls

A strict service quality standard of not exceeding 1.5% when the customer picks up the receiver and dial tone does not ring longer than 3 seconds. For those central offices fails to reach such standard, a common control facility will be installed to shoot latent troubles, or to replace switching equipment. At present, only five central offices in Taipei and two in Kaohsiung are under the standard.

7. Improving the Service Quality of Directory

Since August 1, 1989, tele-voice message (TVM) systems have been generally installed to lessen the workload of the operators and to reinforce the service quality. Meanwhile, change number inquiry systems are established to provide information service of new telephone numbers.

8. Introducing Payphone Automatic Supervision System (PASS)

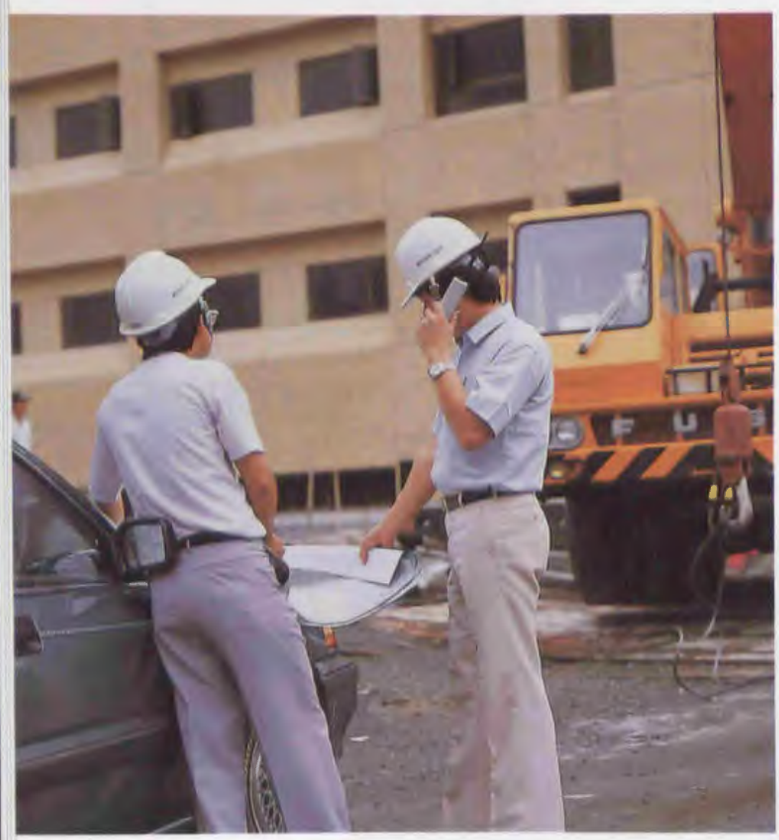
In the past, troubles on public telephones could only be discovered by the enthusiastic people or our patrol employees and then repaired with considerable delay. The PASS system can detect the default payphones instantly and hence shorten the time of repairment, thereby upgrading the service quality. The system has been widely adopted to the public telephones overall Taiwan since December, 1989.

New Services

1. Display Type Radio Pager

We started on February 1, 1988 to provide display type radio paging service to meet the social needs, to strengthen our servcie to the people, to upgrade the quality of radio paging service, and to keep pace with the world trend. The display type radio pager can not only receive the sound of calls, it can also display and store the simple message the calling party pushes on the push-button MF pager and the message will be displayed on the screen of the receiving party's receiver when he hears "bee..." sound. Thus the value of using the pager is greatly increased by saving the time to call by telephone.

The service has been very welcome to the customers. To coordinate with telecommunications liberalization program, DGT opened on February 1, 1990 the provision of the pagers by the subscribers themselves. Up to the end of June, 1990, the total number of display type radio pagers amounted to 670,743.

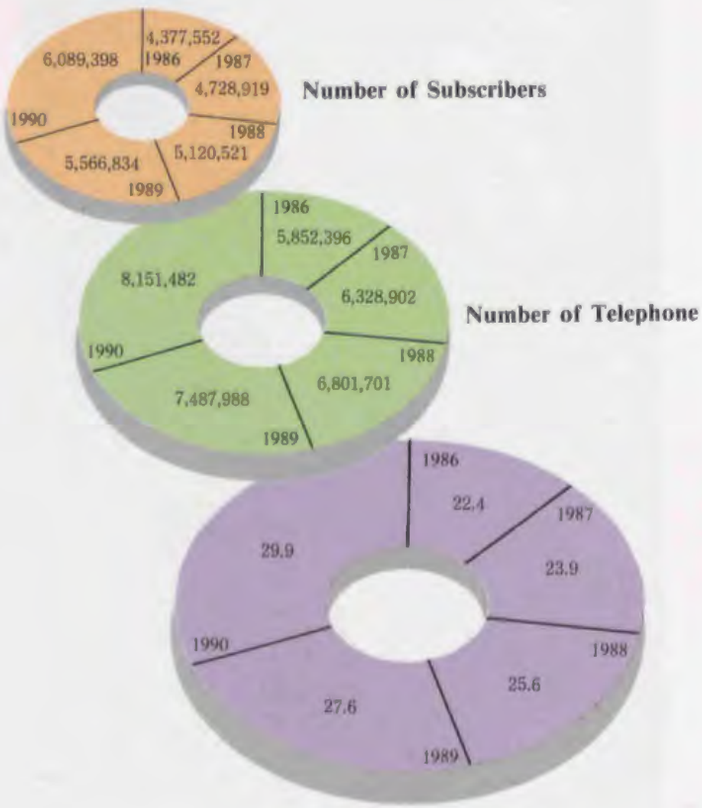


2. Cellular Mobile Telephone

DGT cut the cellular mobile telephone service to the three metropolitan areas of Taipei, Taichung and Kaohsiung on July 1, 1989 and extended the service coverage to the whole area along the Chungshan Freeway. The service has been much enjoyed by the general public since its inception, particularly by the car drivers. As of June 30, 1990, there were 38,500 subscribers in the country.

Local Telephone

Social demand for telephone service in Taiwan was still imminent due to the incentive in reducing twice the installation charge and the raise of the people's living standard although the national economy appeared a little sluggish. Hence the number of telephone subscribers grew by 523,000, at a rate of 9.4% in 1990, or accumulated total of 6,089,000 as of June 30, 1990. Of the total number, 73% were residential telephone subscribers, marking 29.9 subscriber lines per 100 population. The following is a comparison of local telephone service in 1990 with those of the last four years.



Rural Telephone

To coordinate with the "instant handling upon application" program launched on July 1, 1990, we spare no effort in installing telephones to new subscribers in the shortest possible period and in clearing the waiting list. Thus made possible the increase of as many telephones as 265,000 in the six months from January to June, 1990, showing an increase of 13% more than that in 1989 and almost equal to 268,000 installed in the whole year in 1986.

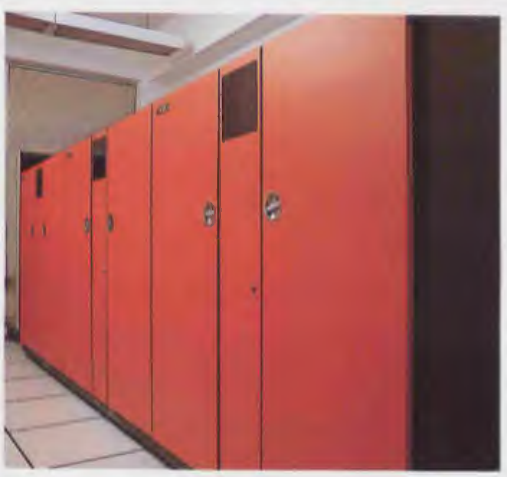
For quite a few years, the growth rate of our local telephones has been ranked in the top of the whole world, but mostly in the metropolitan areas while that in the rural villages was rather slow. To promote the overall development of the country, we have exerted our efforts in the rural telephone popularization program and completed the goal of the "telephone in every Hsiang" first and then that of the "telephone in every village". Up to the end of 1990, we have finished installing C. O. offices in 155 rural areas including those mountainous, remote and off shore locations.

New Services by Digital PABX

In recent years, the rapid progress in electronics and VLSI technology has brought about tremendous advancement in telecommunication transmission and switching, resulting in the convergence of computer and communication (C&C) technologies. This has enabled fast storage or transmission of voice, character, signal, image, etc., through digital switching network, thus having brought great welfare to mankind.

Digital PABX can integrate voice or data to provide various services and has become the mainstream of communication in the Information Society and the nerve of office automation. It is also the foundation of the integrated services digital network (ISDN) in the future.


IC卡式公用電話機



Data Communication

Data communication service plays an important role in telecommunications today. Internally, it is responsible for the computerization in all units in DGT. It has successfully developed 10-odd management information systems to elevate service quality and save manpower. Externally, it is responsible for providing public data communication service to the government agencies, private industry and the general public for the promotion of business operations, management and decision-making. Following are some typical services provided by DGT:

1. MOTOR VEHICLE MANAGEMENT INFORMATION SYSTEM

The total number of automobiles and drivers (including those of automobiles and motorcycles) in Taiwan exceeds ten million and their statistics are quite concerned to the public. This information system provides the following services:

(1) Information Storage and Retrieval

i. The subscriber can check the basic information of the car according the the number of car plate or the engine number of the car.

ii. The subscriber can check the statistics and analysis through combining the information of car maker, year of production, output of gas, area, etc.

iii. The subscriber can build up relevant information in network center databank for retrieval by the other people.

(2) Facsimile Interchange

Designated car manufacturer can process the information about the car when input the relevant information according to the format of system exchange. It can electronize the standard business document such as, invoice, surmons, bill, order sheet, etc., and make the facsimile exchanges.

(3) Consigned Service

To provide specific information by receiving the consignment of an enterprise or individual, such as, the information about new car plate, etc.

2. Multi-access Reservation Network

This is a multi-channel storage and retrieval network system. The subscriber can acquire various services by means of a terminal or a personal computer with any airline on line with the system.

The MARNET system was opened to service on April 28, 1989 and up to the end of June, 1990, there were 224 subscribers. The service items currently provided are:

(1) Airline flight schedule inquiry

(2) Seat reservation inquiry

(3) Seat reservation

(4) Input and inquiry of passenger information

(5) Notice of flight schedule change and seat confirmation

(6) Provision of travel information by airlines

(7) Information inquiry of going abroad by travel agents

(8) Issuance of airticket according to reservation

(9) Book clearance by banks

(10) Cabin seat reservation and inquiry of air cargo

3. Videotex

An emerging data communication service results from the convergence of computer and communication technologies. It has grown very rapidly since its cutover on August 1, 1987, Up to the end of June, 1990, the total number of subscribers amounted to 13,712 and the number of frames created 290,209.

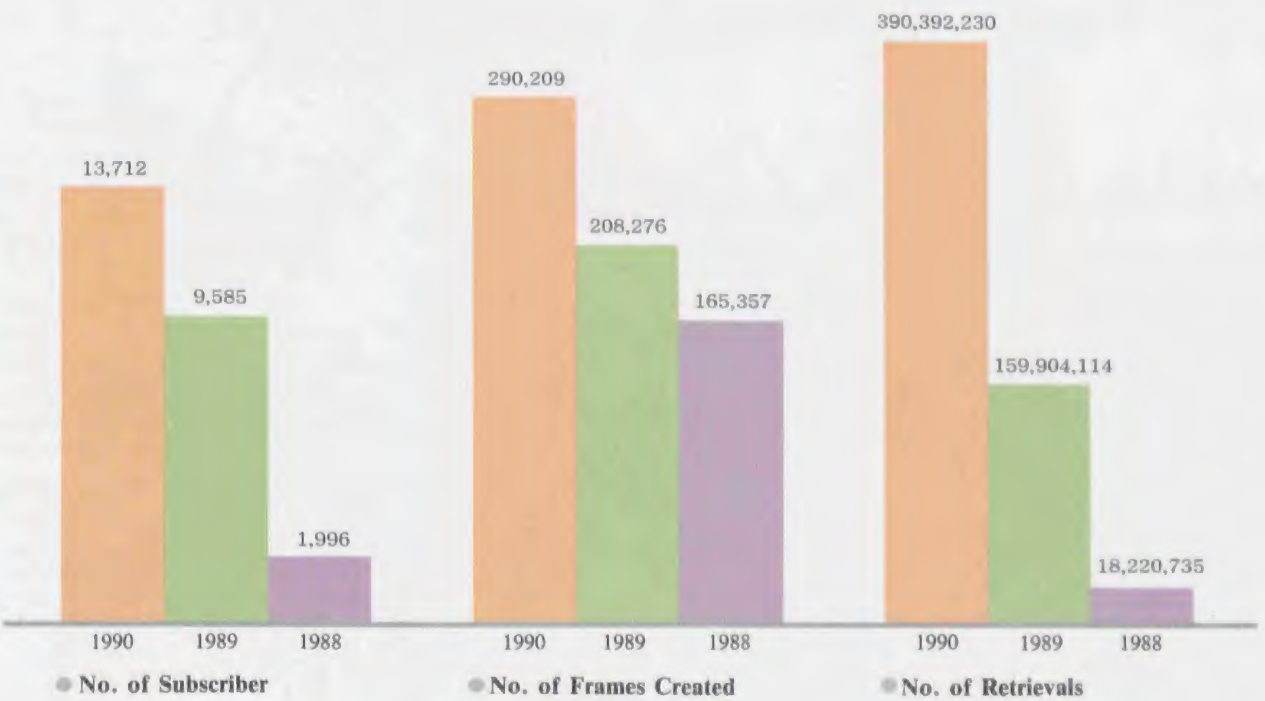
At present, the system has two usages, namely, ordinary joint use and specifically for stock exchange. The former can provide information retrieval, group communication, message exchange, telemail exchange, telemail software, and connecting the outside database while the latter the simultaneous information of stock exchange.

We are now positively developing toward distributed videotex architecture and opening the receiver of videotex to facilitate access to various databases and promote the development of domestic database industry.

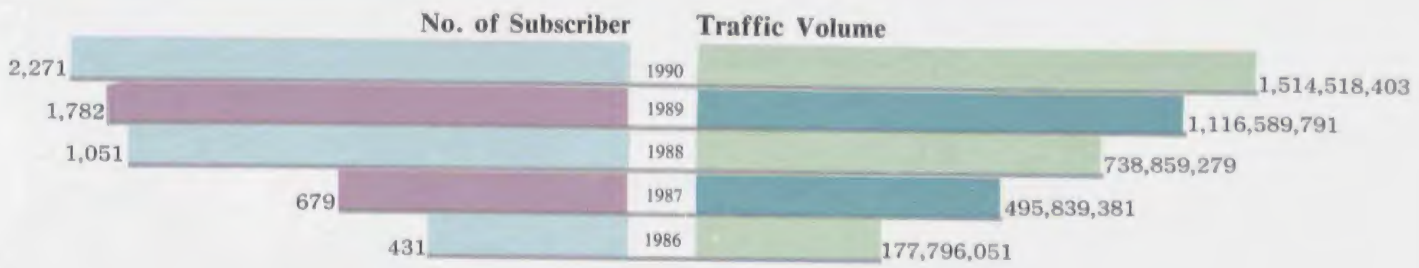
4. Packet Switched Network

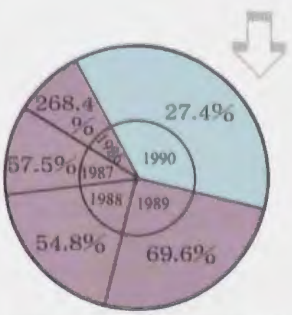
This is the backbone of modern data communication networks. By virtue of its speed, economy, high reliability, and strong function in network management, PACNET service has been much welcome to the customers since its inception in October, 1984. One thousand ports each were added in 1989 and 1990 and as of June 30, 1990 there were 2,271 subscribers, connecting more than 34 countries.

Growth of Videotex Service

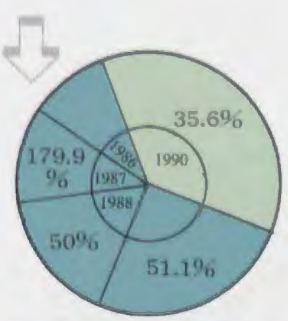


Growth of PACNET Service





Subscribers Growth (%)



Segments Growth (%)

Long Distance Telecommunications

Long distance telephone, domestic telegraph, data communication, cellular mobile telephone, and maritime communication make up the long distance telecommunications in the ROC. Except the domestic telegraph service which continued shrinking, the other four services have been steadily growing.

1. Toll Telephone Switching Systems

To accelerate the construction of an integrated services digital network (ISDN) in Taiwan, we geared up the installation of digital toll switching systems in fiscal 1990. A total capacity of 124,200 lines was added in the year, making the digitization of toll switching systems 76.23% up to the end of June, 1990

2. Cable Transmission Systems

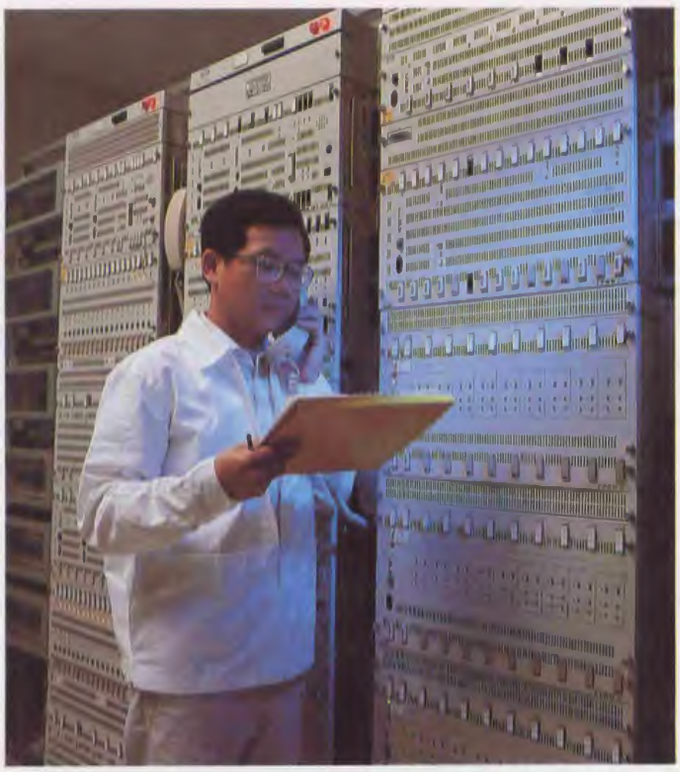
Since 1983, we have exerted our effort in laying optical fiber cable, which has the advantages of minimum transmission loss and huge transmission capacity, in order to reinforce the digitization and sophistication of telecommunications network. We have completed the construction of Taiwan-Penghu optical submarine cable system, east-coast and west-coast backbone optical cable systems, and their branch systems. These plus the existing coaxial cable systems and digital microwave radio systems enable the double link transmission in Taiwan. The construction of the optical cable systems along the Sun Yatsen Freeway and the southern Taiwan railway trackline is now in progress. Upon their completion, an around-the-island transmission link of optical transmission will be realized.

3. Radio Transmission Systems

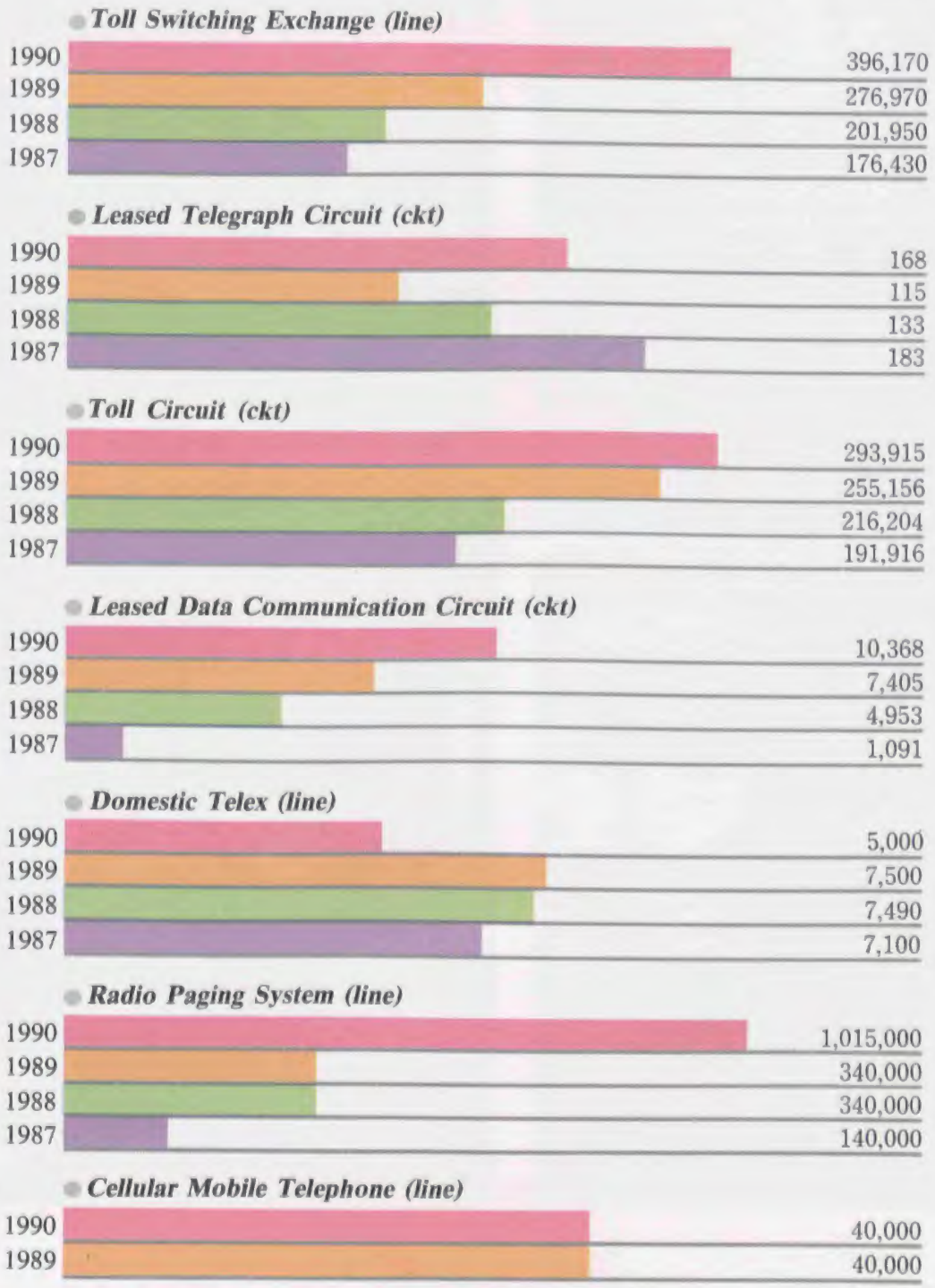
In recent years, we have consecutively completed the construction of east-coast and west-coast backbone digital microwave radio systems and a number of branch systems. This has much upgraded the transmission systems and, moreover, enabled the around-the-island and double route transmission links coupled with the cable transmission systems. We are planning to construct the second west-coast backbone digital microwave radio system and to develop metropolitan area microwave radio transmission routes in the near future to meet the growing demand for and elevate the stability of transmission circuits.

4. Domestic Satellite Communication

To provide service to such remote areas as mountains and off-shore islands by a more economical and effective information network, we are engaged in the development of domestic satellite communication network. We purchased in February, 1989, the No. 63 transponder of INTELSAT 5 to use as the receiving and transmitting trunk of telecommunications network. We put into service in August, 1989, the Taiwan-Quemoy and Taiwan-Matsu trunk networks and some light-capacity network and small-size ground station network. In the second stage, we will stress investments and applications in satellite and accelerate taking root in satellite technology by training the planning and engineering manpower. Last in the third stage, we will own a satellite by ourselves in order to usher the ROC into the era of high-tech communication.



Construction Statistics of Toll Telecommunications in FY 1987-1990



International Telecommunications

In coordination with the development of international trade and the rapid increase of the people going abroad, as well as the growing interflow in international economics and culture, we have been engaged in the diversification, digitization and sophistication of our communication satellite systems, optical fiber submarine cable systems, and international telephone and telex systems in recent years to greatly upgrade the quality of the international telecommunications.

1. International Satellite Communication

Satellite communication has the advantages of broad-band transmission, wider coverage, high service quality, and easy to set up direct communication routes. We have completed consecutively three satellite communication earth station antennas of same type and planned to construct a satellite communication earth station antenna at Fangshan, Pingtung, in early November, 1990. As satellite communication is developing to digitization, we not only continue to use our existing FM communication facilities, but gradually adopt most advanced TDMA, IDR, and IBS communication facilities.To cope with the development of international maritime satellite communication we are planning to set up two coastal stations so that we can provide services to the vessels of our nationality and those of the neighboring countries in the Pacific and Indian Oceans with the terminal equipment on land.

2. International Optical Submarine Cable Systems

We started to lay submarine cables in 1979. We have also invested in the construction of four international submarine coaxial cables through joint venture with the neighboring international telecommunications authorities, namely, OKI-TAI, TAI-LU, TAI-GU, and SIN-HON-TAI Submarine Cable Systems.

In view of the muturity of digital optical fiber cable technology with larger capacity and higher transmission speed, we have been aggressively participating in the construction of international optical fiber submarine cable systems through joint venture in Asian and Pacific region in the later years. These include the TPC-3/Hawaii-4, Hongkong-Japan-Korea, TPC-4/Hawaii-5, PACRIM-EAST and PACRIM-WEST, and ASEAN optical submarine cable systems. At the same time, we are engaged in the procurement of Indefeasible Right of User (IRU) to use the circuits of the optical submarine cable systems in the Atlantic Ocean. In addition, we are collaborating with our friendly countries in laying three more international optical submarine cables, namely, GPT, HONTAI-2 and APC optical submarine cable systems.

3. International Telephone

The revenue of international telephone service in fiscal 1990 accounted 44.47% of total international services, even excluding the U.S. Dollar portion. The increase is likely to continue. The traffic of international telephone grew in the year by 30.72%, marking 212,210 million minutes, higher than the annual growth of major economics index. In the year, a total of 3,093 direct telephone circuits was able to connect with 40 countries or territories, almost accessible to all the major cities in the world. The international subscriber dialing promoted by us in recent years serves more than 95% of our 6,080,000 subscribers. In June, 1989 and March, 1990, we opened ISD service to the Chinese Mainland and USSR Via third countries. In June, 1990. the ISD calls reached 97.36% of all outgoing calls, connected to 175 countries and territories. We also opened Service 800 and IODC service recently.

To insure the communication security of international telephone, we are engaged in installing AT&T No. 5 ESS digital switching system in both Kaohsiung and Taipei gateway exchanges. The installation work is expected to complete on June 30, 1990 and July 30, 1990 respectively, with the function of CCS #7 paving the way to the era of ISDN.

4. International Video Conference

International video conference is achieved by linking vedio conference rooms at different locations abroad where people are holding meeting by international telecommunications network. Thus the participants can not only listen to the other he can also see the live image of his counterpart in the CRT. He can further transmit chart, document, data and other information to his counterpart and vice versa, like face to face meeting.

The service was opened to the public in May, 1989, first linking to Japan, next to the United States, Hawaii and Singapore via International Business Service Satellite circuits.

The Way Toward Integrated Services Digital Network (ISDN)

To meet the social demand for diverse needs, the telecommunications network development in the ROC has been toward the direction of digitization in order to transmit such services as data, image, etc., in addition to voice. To reach the target of establishing an ISDN by the year 2000. we exert our effort in carrying out the Telecommunications Modernization Plan, including accelerating digitization of telecommunications facilities, improving the quality of local telephone lineplants, and introducing digital communication systems, etc. We are pleased to scan the progress of each program as follows:

1. Acceleration of Telecommunications Facility Digitization

As of June 30, 1990, digitization status of each category is as follows:

Local Telephone Exchanges	**24.5%**
Toll Switching Equipment	**76.23%**
Toll Transmission Circuits	**91.84%**

2. Improvement of Local Telephone Lineplants

High quality two layer PVC insulated cables are adopted to replace the existing paper insulated cables in coordination with the lineplant expansion project. Up to June 30,1990, the local telephone lineplant of non-multiple distribution areas rated 45.91% of the total while the underground distribution areas 53.38% of the total.

3. Introduction of Various Digital Communication Systems

Besides installing digital switching systems, we have also introduced digital microwave radio systems, digital optical cable (land and submarine) systems, digital subscriber carrier systems, etc.

To promote the ISDN program smoothly, we have delegated the Northern, Central and Southern Taiwan Telecommunications Administrations to plan a trial project each as follows:

• Northern Taiwan Telecommunications Administration (NTTA)

To link part of local telephone exchanges, Hsinyi metropolis area, business & banking area in Taipei with Hsinchu Science-based Industrial Park by means of local and toll telephone digital network in order to provide new advanced services in trial basis and make the performance evaluation.

• Central Taiwan Telecommunications Administration (CTTA)

To construct digital network in the exchange area of Liming in Taichung and link Tunghai University and Feng Chia University to provide new advanced servcies in trial basis and make the performance evaluation.

• Southern Taiwan Telecommunications Administration (STTA)

To construct digital telecommunications network in Chungshan and other three exchange areas and select some business and banking areas plus National Sun Yat-sen University, China Steel Corportion in order to provide new advance services on trial basis and make performance evaluation.

Research and Development

With the major mission to support DGT and its subordinates for the modernization, expansion and improvement of the facilities and operating systems so that high quality telecommunications services can be provided to the public, the Telecommunication Laboratories (TL) is today engaged in the research and development of telecommunications technology summarized as follows:

1. Intelligent Network Technology

With a hope to reach the target of establishing an integrated services digital network (ISDN) in Taiwan, ROC, the TL was devoted to the technology development of ISDN and common channel signalling (CCS) in the past three years. It has successfully completed the following tasks:

- Planned and established the Fiber Metropolitan Area Network (FMAN) in Hsinchu Science-based Industrial Park to provide advanced telecommunications services;
- Drafted the specification of ISDN User-Network Interface;
- Developed the ISDN UNI protocol tester for testing ISDN customer premise equipment;
- Developed a CCS signal transfer point (STP) model system;
- Developed a service emulation system for the emulation and demonstration of 080 service.

Based on these experiences, the development of an intelligent network (IN) test bed is underway, on which new services are surveyed and some of them are emulated according to the four-year development project.

2. Digital Network Planning Model

In accordance with the network development policy of DGT, the Digital network Planning Group of TL has been devoted to the digitalization of communication network and the development of digital network planning models and tools. In the past few years, they have completed:

- Local switch construction plan information system,
- Rural network digitalization planning,
- Toll switch digitalization planning,
- General trunk network optimization program,
- Local traffic database and application system.

They now focus their research and development on:

- New network planning models;
- Network planning tools; and
- Network operation and administration system.

3. Digital Transmission Technology

To improve the service quality and enhance the capacity and function of the existing telecommunications network, we have developed the evaluation technology of subscriber line digitalization capability, studied the architecture of synchronous optical network (SONET) to meet the needs of broadband ISDN in the future and completed the three-phase domestic satellite communication development program. We have purchased a satellite transponder of INTELSAT V and placed to commercial operation since September, 1990. In addition, we have developed a prototype of IC card paystation and manufactured 20 sets for trial use.

4. Switching System Technology

To greet the early emergence of the era of ISDN and catch up the forward looking switching technology and, at the same time, upgrade the functions of the existing switching systems in operation, the Switching Group of TL is now engaged in three R&D projects, namely, Switching System Technology, Broadband Switch Technology and ISDN PABX Development. In the past few years, they have successfully developed a tele-voice message system (TVM) which was put to service on August 1,1989, an auto-reply telephone inquiry system (ARTIS), and Crossbar exchange trunk automatic measurement equipment (TAME). All these tools developed by TL are very useful in upgrading the service quality and saving maintenance manpower.

5. Information Technology

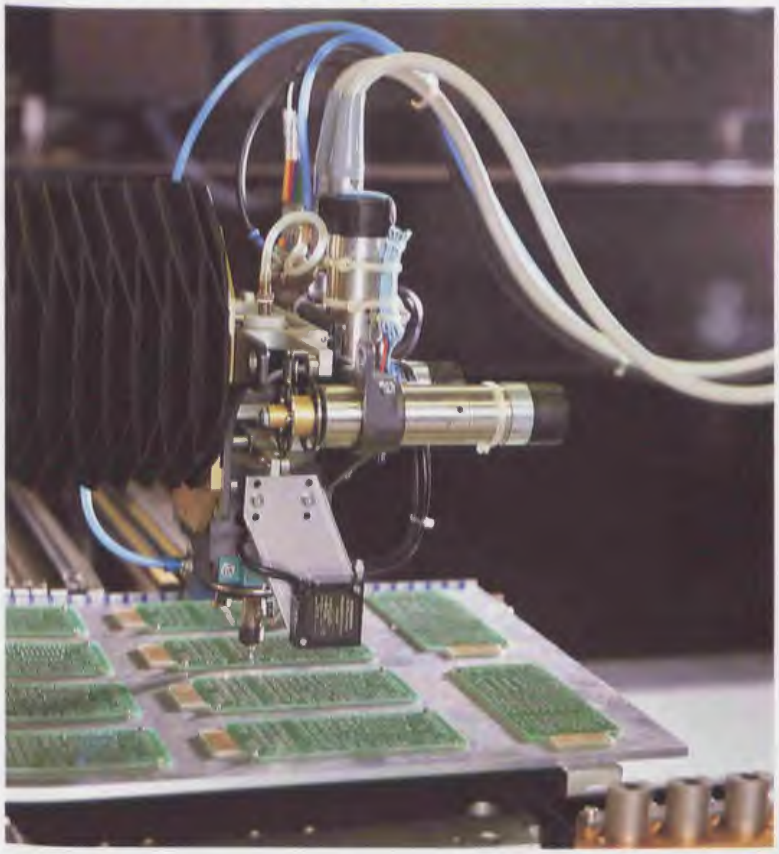
In order to accelerate computerization of telecommunications business operations, TL has developed a number of information systems for DGT, such as Service Order Processing System (SOPS), Information Software Procurement processing Guide, etc. In addition, to keep pace with the development of the forward-looking computer and data communication technology, TL has also developed such software technology, expert system, etc., to cope with the needs of technology development and business operations in the Information Age.

6. Outside Plant Technology

As the telecommunications network runs everywhere, from the cities to the villages, the quality of the line plant bears the key to the service quality of telecommunications. Our research in this area stresses on optical fiber technology, fiber cable installation, optic fiber subscriber application and telecommunication civil engineering. We have successfully developed optical fiber subscriber loop technology, evaluation technology of subscriber line and its improvement, and the vibration-proof manhole cover.

7. Applied Research in Telecommunications

In order to establish a sound foundation of edge-leading telecommunication technology, we have selected a few major R&D topics in basic and applied research. In the area of optoelectronics, we have developed coupling technique between light source and optical fiber, fabrication technology of integrated modulator and switch devices, etc. In the area of digital signal processing, our achievements include On-line Recognition System of Hand-written Chinese characters, Fast Automatic Chinese Multi-style Characters Zooming and Generating System, Speaker Identification System of Text Independence, etc. Besides having obtained patents at home and abroad, we have transferred technology to the local information industry for application.




TL-PM45

Development of Manpower

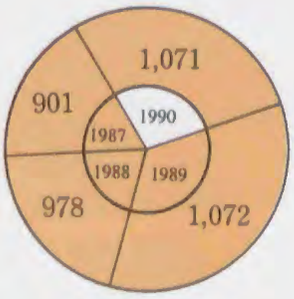
Human resources are elemental to the progress of an industry and high quality manpower is a key to its ultimate success. Telecommunications science and technology advances in rapid tempo and the new telecommunications services emerge incessantly. Telecommunications employees have to enrich their professional knowlege and services. Telecommunication Training Institutes (TTI) has been the cradle of developing telecommunications manpower. In coordination with the diversification of telecommunications services, TTI has spent no effort in offering systematical professional training for the telecommunications employees in the ROC by means of its training facilities to aggressively develop their potential and specialty. It also provides such trainings as computer programming, English language, managerial communication, etc., so as to cultivate them with the second career capability and thereby improve the manpower structure of DGT.

To cope with the change of social environment and the surge of labor consciousness, TTI not only opens courses for the executives of the labor union, sponsors seminars on the relationship between the workers and the management in order to promote their harmony but also gives classes on laws and regulations to improve their working knowledge. In addition, to improve the interflow of academic and telecommunications technology, TTI gives such seminars as International Telecommunications Symposium, Telecommunications Engineering Symposium on the engineering and Telecommunications Business Concepts, Management Development Seminars for low, medium and high levels to enrich them with the concepts of modern operations and management.

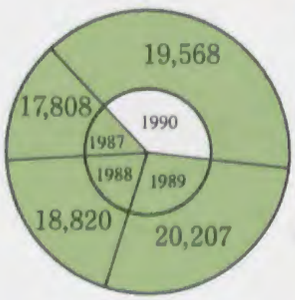
In recent years, TTI has devoted to upgrading its training quality besides has tranined about 19,000 persons/time. Please refer to the chart hereto attached. To better insure the quality of training, TTI established in June, 1988, a quantitative methodology of evaluation to understand the trainees' degree of satisfaction. Since the implementation of the evaluation method, the averaged satisfaction degree has been elevated from 3.6 in June, 1988 to 4.49 today as the full mark is set at 5 for the teaching. Owing to the limited budgets, the satisfaction degree on the study environment appears to be comparatively low. Such training evaluation system has much promoted the performance of training in TTI.

To upgrade the training quality, TTI has spared no effort in the faculty training and the introduction of new teaching facilities. In fiscal 1990, a total of 26 man/times or 1,035 man/days was sent to the U.S., Japan and Europe for study and observation. Such simulated development systems for GTD-5 EAX, CCS#7, and ISDN, personal information serve processing equipment, subscriber loop digitalization measurement set, portable digital microwave system, etc., were introduced in the same year.

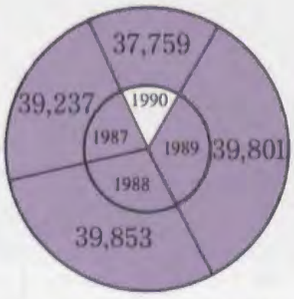
Growth of Training Volumes in FY1987-1990



No. of Class



No. of Trainee



No. of Man/Week

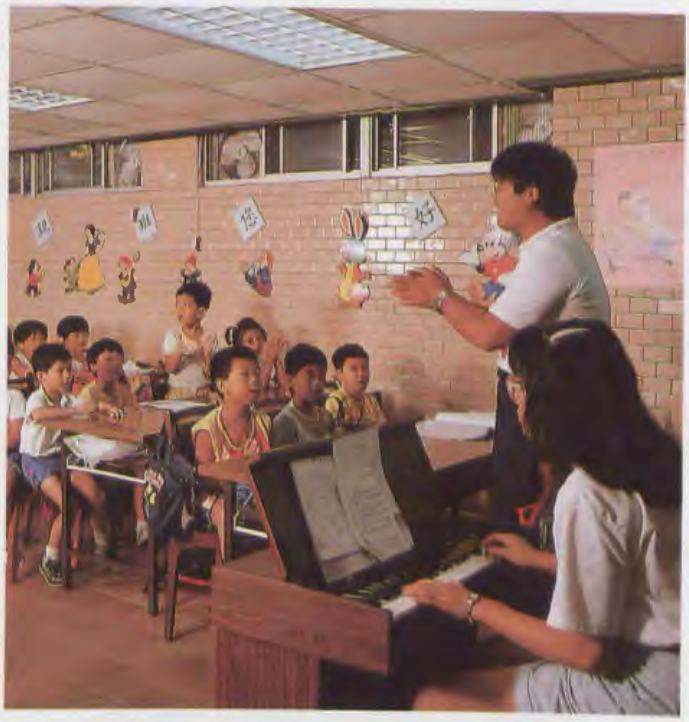

ISDN

Employees' Recreation Activities

A modern business management places emphasis not only on the high efficiency productivity of employees but also on their loyalty to the corporation. We pay much attention to their daily life by providing welfare measures and recreation activities so that each employee would enjoy his time in the company as if he does at home or school.

To strengthen their bodies, to cultivate their good hobbies and activities and to increase their friendship and the harmony of the group of people, the employees have established various societies such as, chess, bridge, flower arrangement, caligraphy, Chinese painting, kungfu, karate, wrestle, yoga, mountain climbing, pingpong, tennis, badmington, folk dance, etc. once there is anniversary, we sponsors athletic meeting to encourage each employee to join so that lèsprit de corps is developed.

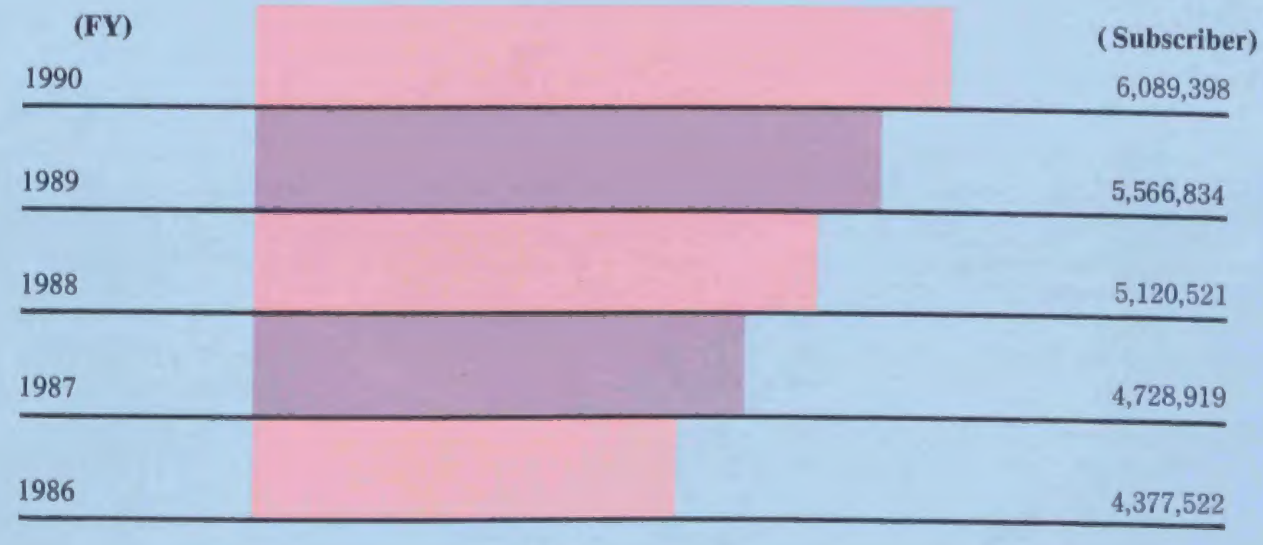
In fiscal 1990, our employees won many prizes in the contests among the agencies under the Ministry of Communications. In such contests as, basketball, volley ball, tennis, pingpong, and badmington, etc. we all won the top three prizes. In chess and bridge contests, we won the championship.



Business Index Performance

Index	Unit	FY1986	FY1987	FY1988	FY1989	FY1990
Telephone Density	Sets/100 Population	30.1	32.3	34.3	37.3	40.2
Subscriber Density	Subscriber/ 100 Population	22.56	24.13	25.84	27.78	30.04
Public Telephone Stations	Set	88,343	92,973	97,952	102,873	106,625
Public Telephone Density	Set/1000 Population	4.5	4.7	4.9	5.1	5.3
Telex Subscribers	Subscriber	19,088	20,476	19,702	17,853	14,540
UDAS Subscribers	Subscriber	53	54	88	101	147
Data Leased Circuits	Circuit	5,117	6,888	9,437	14,931	22,967
PACNET Subscribers	Subscriber	431	679	1,051	1,621	2,066
Dial-up Data Service Subscribers	Subscriber	966	1,858	4,600	11,129	15,437
Local Telephone Exchanges	Line	6,161,960	6,247,360	6,573,356	7,032,606	7,874,406
Local Telephone Switching Digitalization	%	1.7	3.4	8.3	14.2	24.5
Toll Trunk Circuits	Circuit	170,101	191,916	216,204	255,156	291,804
Toll Trunk Circuits Digitalization	%	79.4	83.2	85.1	87.4	91.8
Number of Employees	Person	32,079	31,983	32,017	32,911	35,180

Local Telephone Subscribers



Local Telephone Sets

Financial Summary

Balance Sheet

Unit: NT$Million

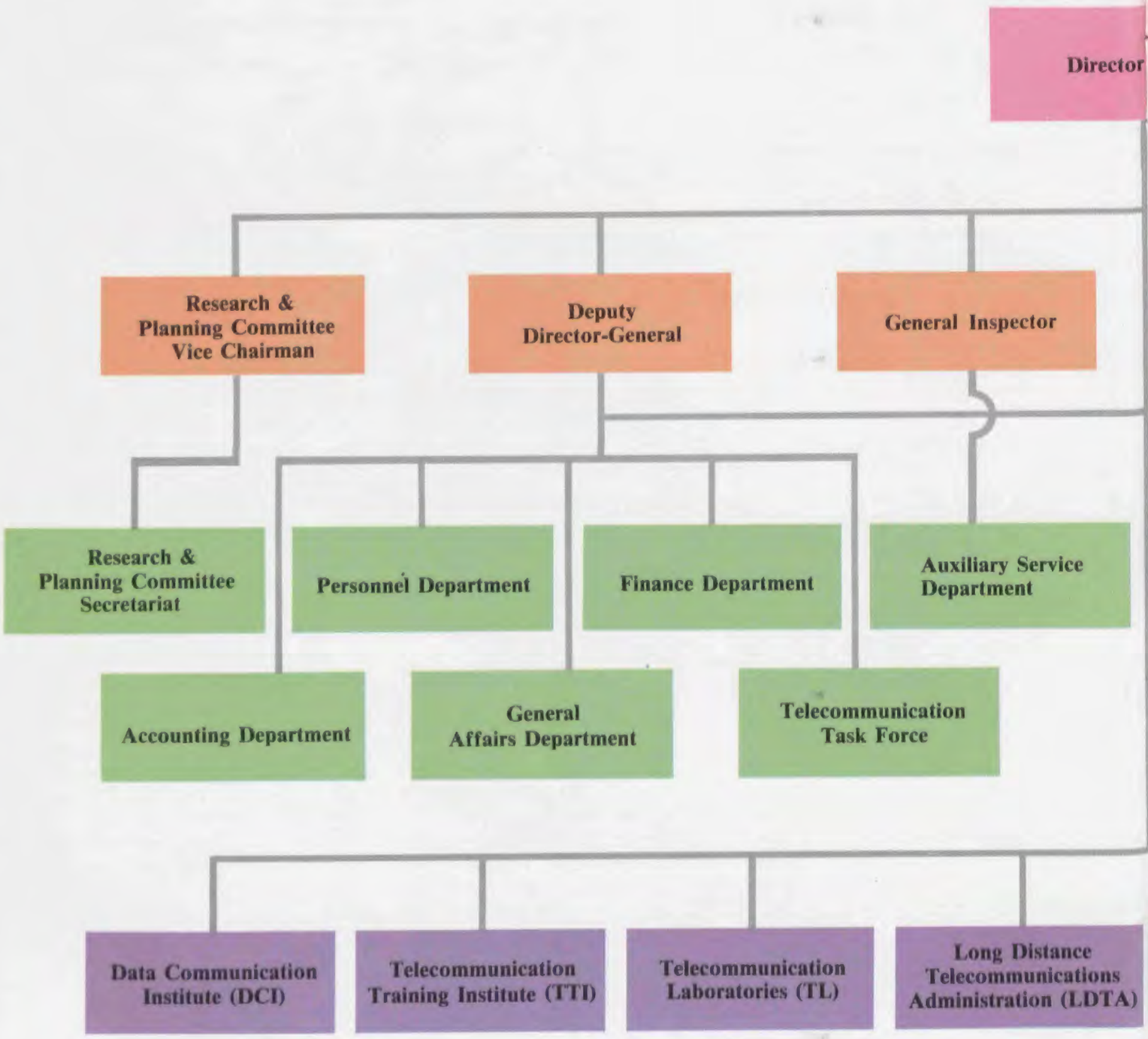
Item	FY1990 (June 30, 1990)	FY1989 (June 30, 1989)
Assets	254,619	230,394
Current Assets	68,211	64,289
Long-term Investment Fund & Receivables	509	516
Fixed Assets	185,791	165,537
Other Assets	108	52
Total	254,619	230,394
Liabilities	30,984	24,058
Current Liabilities	20,243	15,177
Long-term Debt	351	379
Other Liabilities	10,390	8,502
Owner's Equities	223,635	206,336
Capital	14,400	14,400
Suplus & Profit	209,235	191,936
Total	254,619	230,394

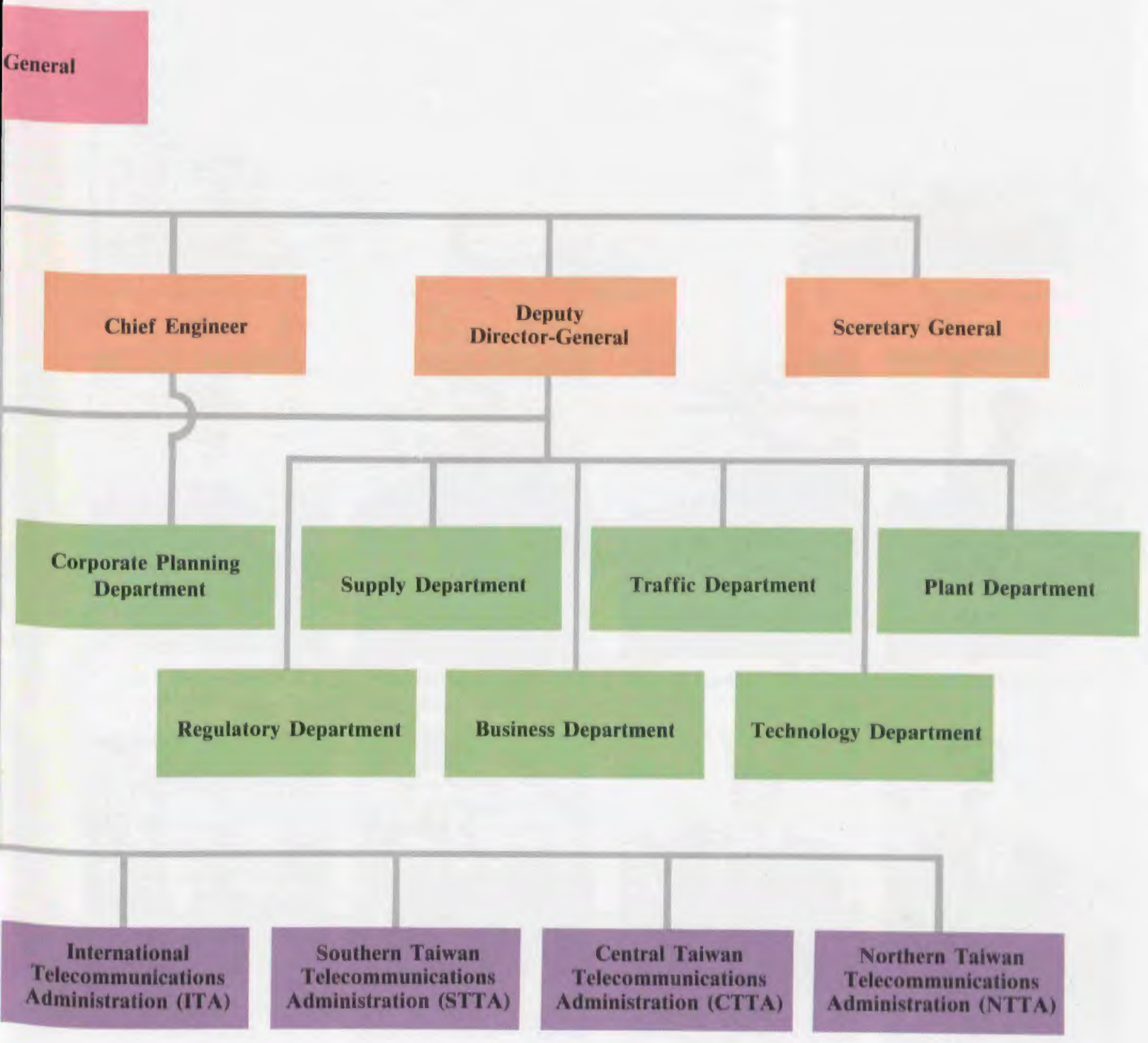
Income Statement

Unit: NT$Million

Item	FY 1990 (July 1989-June1990)	FY 1989 (July1988-June1989)
Operating Revenues	75,003	62,981
Local Telephone Revenues	47,089	45,694
Toll Telephone Revenues	24,065	14,475
Telegraph, Data Communication Revenues	3,652	2,666
Other Operating Revenues	197	146
Operating Expenses	54,915	42,935
Telecommunication Expenses	46,955	36,250
Commercial Expenses	4,287	3,701
R&D, Training Expenses	1,751	1,438
Administrative Expenses	1,386	1,217
Other Operating Expenses	536	329
Operating Income	20,088	20,046
Non-operating Income	3,864	2,416
Surplus	23,952	22,462
National Treasury	11,417	14,108
Retained Earnings	12,535	8,354

Organization Chart




General
Chief Engineer
Deputy Director-General
Sceretary General
Corporate Planning Department
Supply Department
Traffic Department
Plant Department
Regulatory Department
Business Department
Technology Department
International Telecommunications Administration (ITA)
Southern Taiwan Telecommunications Administration (STTA)
Central Taiwan Telecommunications Administration (CTTA)
Northern Taiwan Telecommunications Administration (NTTA)

TELECOMMUNICATION EXECUTIVES

DGT General Inspector
K.T. CHU

DGT Chief Engineer
P.C. CHEN

DGT Research & Planning Committee
Vice Chairman W.P. TSENG

NTTA Managing Director
L.T. TZOU

CTTA Managing Director
S.C. TSAI

STTA Managing Director
C.J. LEE

ITA Managing Director
Y.S. LEE

LDTA Managing Director
C.M. CHEN

TL Managing Director
S.C. LU

TTI Managing Director
Y.N. HUANG

DCI Managing Director
Y.H. JEA

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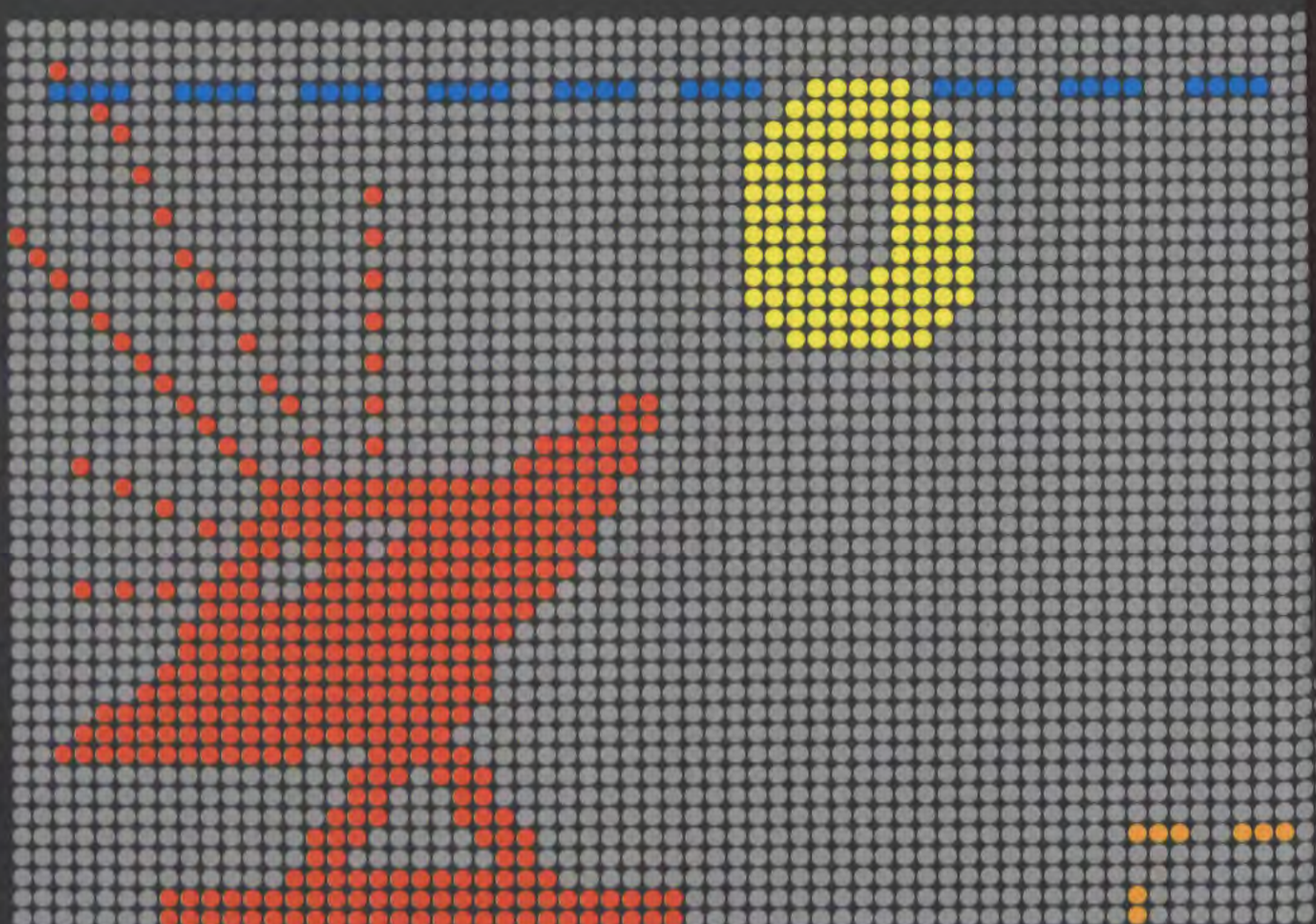
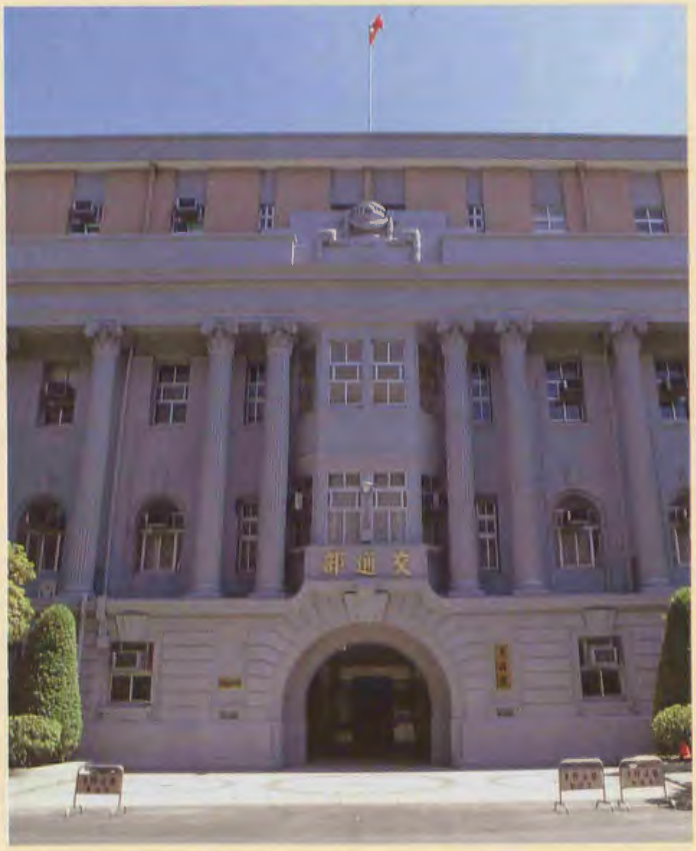


中華民國交通建設概況

An Introduction to Transportation and Communications in the Republic of China



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部長的話

From the Desk of the Minister

交通與人民生活息息相關，交通建設爲國家建設重要之一環，交通設施與秩序之良好，爲一個文明進步國家之表徵。

早期台灣地區百廢待舉，國家資源有限，因此交通投資不足，落於經濟建設之後，近二十年來，各項重大交通建設主要是在配合因應經濟之發展需要，換言之，整個交通建設是以「需求」爲導向。未來國家建設六年計劃投資金額高達八兆二千億元，交通建設投資比例約占三分之一強，居於前導地位，針對台灣地理環境及發展需要，在國家建設六年計劃完成後，可使我國脫胎換骨，成爲一個現代化國家，未來交通建設應改以「供給」爲導向，以交通建設促成新市鎮之開發、產業之升級、都市人口之疏散、區域之均衡發展及生活品質之提昇。

台灣地區之交通問題在於人口密度高、汽機車多、土地資源有限及都市化集中，解決之道，應從硬體與軟體雙管齊下，一方面大力投資交通建設，另方面加強交通管理，使台灣有朝一日能成爲一個交通順暢、井然有序、且美麗清新的人間樂土，目前正在積極進行之國家建設六年計畫有關交通建設計畫，就是朝此目標在邁進，希望在政府與民間共同推動配合下，讓六年後的台灣交通呈現一番新的景象，令人刮目相看。

未來本部將貫徹執行下列四大施政方針：㈠全力推動國建六年計畫，㈡健全交通管理，㈢厚植民營產業，㈣提昇生活品質。並努力建立我國成爲亞太地區海空運之轉運中心，俾藉運輸樞紐之功能，提昇我國在國際經濟活動之地位。

簡又新

Transportation and Communications are an integral part of our daily lives. The development of the communications network is one of the most important tasks of national development. Advanced communications facilities and orderly traffic are the most salient characteristics of a civilized and developed country.

In the old days, due to the urgent demand for constructions and limited national resources, investment in communications was deficient and fell behind the nation's economic development. In the past twenty years, most of the major communications projects were carried out in accordance with the needs for economic development. In other words, the entire communications development program has been dictated by economic demands. In the coming Six-Year National Development Plan, as much as 8.2 trillion NT dollars will be invested, in which more than one third will be allocated to communications development. Communications projects will be deemed a top priority. After the completion of the Six-Year National Development Plan, the Republic of China will be completely transformed and become a truly modernized country. Thus, the coming communications development should be based on the concept of supply, which will lead to the development of cities and towns, upgrade of industries, diversification of urban population, balanced regional development, and improved quality of life.

High population density, saturation of motor vehicles, limited usable land and over concentration of urbanization are at the root of Taiwan's Communications problems. The solutions call for improvement in both software and hardware. A strong investment in communications development coupled with effective communications administration will transform Taiwan into a land of orderly traffic, courtesy and order. At present, we are actively pursuing the Six-Year National Development Plan which includes a series of communications development projects aimed precisely at achieving such a goal. We hope that in the next six years through a joint effort between the government and private sector, communicatins in the Republic of China will enter into a new era.

In the future, this Ministry will execute the following four major administrative policies: (1) Implement the Six-Year National Development Plan; (2) Solidify the communications administration; (3) Cultivate private industries; and (4) Promote the quality of life. Moreover, in establishing our country as a trans-shipment center for surface and air cargo in the Asia-Pacific region, the achievement of this vital function of transportation will undoubtedly promote our country's international economic position.

Eugene Chien

組織與職掌

Organization and Functions

交通部主管全國交通行政及交通事業，部內設路政、郵電、航政三業務司及其他處會室，負責政策、法令規章之釐定和業務執行之督導。

交通事業可分爲通信、運輸、氣象、觀光等四類。

通信事業包括郵政、電信兩項，由本部郵政總局及電信總局監督經營。

運輸事業又可分爲陸、海、空運輸三項。

陸運包括鐵路、公路運輸及大衆捷運系統。臺灣的鐵路、公路運輸、大衆捷運系統是由省市政府及民間經營，高速公路則由本部高速公路局管理與維護。

The Ministry of Transportation and Communications is in charge of the administration of communication and transportation in the Republic of China. This Ministry encompasses the Department of Railways & Highways, Department of Posts & Telecommunications, Department of Aviation & Navigation and other departments, offices and committes which are responsible for the enactment of rules and regulations and the policy making and supervision of all related activities.

The Ministry of Transportation and Communications is currently responsible for the nation's transportation, communications, meteorology, and tourism.

Communications work includes postal service and telecommunications, which are served by the Directorate General of Posts and the Directorate General of Telecommunications, respectively.

Transportation work accounts for land, water, and air transportations.

Land transportation includes railway and highway, which are now run by the Taiwan Provincial Government and private sector. While the North-South Freeway is run and maintained by the Ministry.


YANG MING LINE


206
CHO YANG

空運包括航空公司和航空站。航空公司爲民營，航空站及飛航服務則由本部民用航空局經營。

海運包括船運公司及港埠。船運公司分由公營機構及民營公司經營，港埠則全由臺灣省各港務局經營。

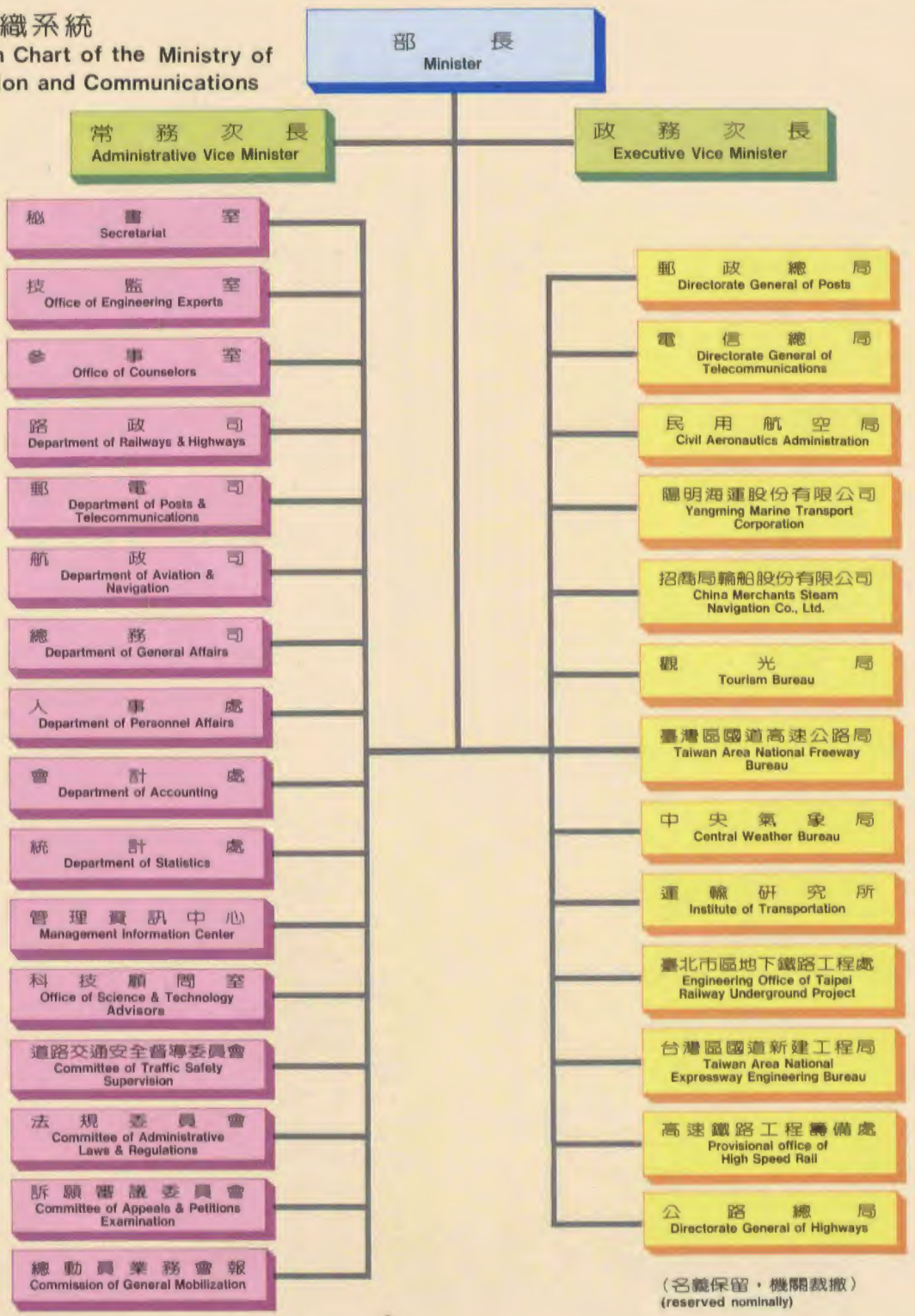
本部設有中央氣象局，辦理全國氣象業務；設有觀光局，規劃督導觀光事業的發展。

Air transportation includes airlines and airports. Airlines are run by the private sector, and airports and terminal services are managed by the Ministry.

Shipping service includes marine transport companies and harbors. Marine transport companies are run by both the government and private sector. Harbors are managed by the Taiwan Provincial Government and individual harbor bureaus.

The Ministry has set up the Central Weather Bureau to engage in the nation's meteorological services. The Tourism Bureau is responsible for the overall supervision and development of the local tourism industry.

交通部組織系統
Organization Chart of the Ministry of Transportation and Communications



（名義保留，機關裁撤）
(reserved nominally)

前瞻性、整體性、均衡性

Forward-looking, Comprehension, Balance

交通爲實業之母，交通建設乃一切產業發展之根基；四十餘年來，政府大力投資完成多項交通建設，造就了今日無遠弗屆、四通八達的通信運輸，不僅促進經濟發展與文化交流，更爲政治與國防上強有力的後盾。

交通建設需要配合國家整體的發展計畫，適時釐定具有前瞻性、整體性及均衡性的政策及計畫，再積極加以推動。在推動整體交通建設的進程中更需要軟硬體並重，能量與品質兼顧。如何加強交通各業之科技研究發展；健全各種管理體系；擴大參與層面，鼓勵民間投資參與重大交通建設；規劃建立完善的整體運輸系統；加強交通各業國際競爭能力；發展大衆運輸，以提高國民生活品質，增進公共福祉，爲本部規劃施政的方向與重點。

Transportation is the mother of industry and transportation construction is the fundamental element for the development of all sectors of business. For more than 40 years the government has completed many transportation projects with significant investment which has enabled us to enjoy the convenient transportation and communication facilities, not only promoting the development of economy and the exchange of the culture but also building up a powerful back-up strength to political affairs and national defence.

The direction and mainpoints for this Ministry to plan and administer are as follows:

(1) Strengthen sci-tech research and development among the transportation and communication industries;
(2) Solidify various management systems;
(3) Enlarge the levels to be involved, while encouraging the civil sectors to invest in the major transportation construction projects;
(4) Plan to establish the perfect and integral transportation system;
(5) Intensify the international competition of the transportation industries;
(6) Develop mass rapid transit systems in order to enhance the living quality of the people and improve public welfare.

郵政
Postal Administration

台灣地區郵政向以便利著稱，由於各地普設郵局，營業時間較長，民衆利用郵政甚爲便利。根據統計，台灣地區已設有郵局1,200處，平均每一處郵局服務的人口約爲17,000人。又由於社會安定，經濟繁榮，文化水準提高，國民通信率亦隨之日漸上升，至七十八年底平均每人每年已達79.3件。

爲配合日益蓬勃發展的業務需要，將繼續加強實施郵遞區號制度，擴大使用電子自動分信機，加速郵件處理，以提高作業效率，朝現代化及自動化的方向邁進。

Due to the widespread post offices and the relatively longer working hours of postal employees, the Chinese Postal Service has been famous for its advantageous service. According to statistics, there are 1,200 post offices in total. An average population up to 17,000 people is served by each office in Taiwan. Based on stable society, prosperous economy and the heightening culture, the correspondence posted per capita averages 79.3 pieces at the end of 1989.

To meet the requirements of the ever-increasing business, the Postal Service has been continually promoting the implementation of postal code system and enlarging the use of integrated mail automation program to speed up mail delivery.


HIGHTLIGHT INTERNATIONAL CO., LTD.
HIGHTLIGHT ENTERPRISE CO., LTD.
HIGHTLIGHT PAPER CUPSA CO., LTD.
KINGWAY GARMENT LTD.,
MONGKOK COMMERCIAL
19th FLOOR,
16 ATGYLE STREET, KOWLOON.
TEL:3-434186
BY AIR MAIL
PAR AVION
TABOR
WEIGHT
POSTAGE COUNT

爲適應經濟發展及國際貿易的需要，郵政總局分別於六十七年及七十三年開辦國際及國內快捷郵件。由於迅速可靠，因此深受工商各界歡迎，業務量呈快速成長，七十九年度共收寄國際 1,215,411 件，國內 2,182,290 件。與我國互換國際快捷郵件的國家及地區，多達69個，國內快捷郵件的通達地區，亦已遍及台北、基隆、台中、台南、高雄等50個以上工商業發達地區的都市及其鄰近城鎮。

在郵政儲金方面，由於設局普遍，服務時間長，因此廣受一般社會大衆的歡迎，業績一直持續成長。至七十九年六月爲止，存簿儲金儲戶多達10,684,751戶，亦即全國國民中平均每 1.9 人即有一本郵局存簿。郵政各項儲金總額高達新台幣8,841億元，存款全部轉存中央銀行統籌運用，因此對鼓勵國民儲蓄風氣及提供國家經濟建設所需資金，具有鉅大的貢獻。

In order to satisfy the need of international trade and economic development, the Directorate General of Posts introduced the international and domestic speedpost service in 1978 and 1984 respectively. Both the international and domestic speedpost are very popular among industrial and commercial circles. They are fast growing; the international service amounted to 1,215,411 pieces, the domestic service to 2,182,290 pieces at the end of June, 1990. The exchange office for international speedpost has reached 69 countries or areas, while domestic service to 50 offices including major cities and their nearby towns.

Postal Savings, one of the most favorite items of the public, has been progressing steadily because of the wide availability of post offices and longer business hours. The depositors of Passbook Savings reached 10,684,751 accounts, i.e. average 1.9 persons hold a Pass-book account. The total balance of various Savings accounts amounted to NT$884 billion at the end of June 1990. The whole amount was deposited in the Central Bank of China as the long-term construction funds.

郵局存簿儲金實施電腦連線作業，目的在加速帳務處理，便利公衆存提款。截至七十九年六月爲止，台灣地區已裝設 645 台自動提款機，儲戶只要一卡在手，便可享受到提款的便利服務。

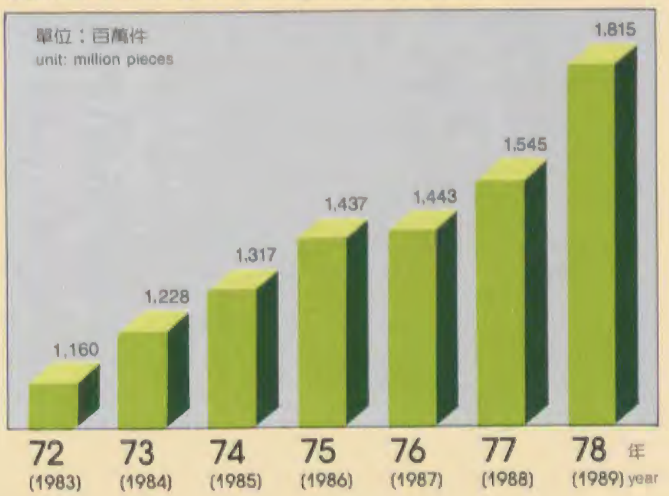
此外，郵局已陸續辦理薪資存款及代繳稅款、水電費、瓦斯費、電話費、交通違規罰款等業務，迎合社會大衆的需要。

郵政業務今後發展的重點，將繼續朝向自動化處理，以提高工作效率。計畫辦理者爲：加強推行郵遞區號、郵件標準化、擴大電腦連線作業網及加強推展快捷郵件、電子郵件、集郵、薪資存款、郵政劃撥等業務，爲社會大衆提供更便捷、週到的服務。

The Pass-book Savings is on-line computerized with a view to accelerating accounting processes and facilitating deposits and withdrawals. Right now there are 645 cash dispensers installed in various offices throughout Taiwan. The depositor can enjoy convenient service on condition that he has a card on hand. Meanwhile, other services such as salary transfer deposits, collecting payments for public utilities, water and power bills, gas fees, telephone bills, automobile license taxes, traffic penalties, etc. have been operated to suit the convenience to customers.

For future developments, emphasis should be put in the automation management and operation so as to improve work efficiency. Future projects include: strengthening the postal code system and standardization of envelopes, enlarging the computerized network, stressing the promotion of speedpost service, electronic mails, philately, salary transfer deposits and transfer savings to provide rapid and considerate service to the public.

台灣郵區收寄函件
Number of Pieces of Correspondence Posted



電信

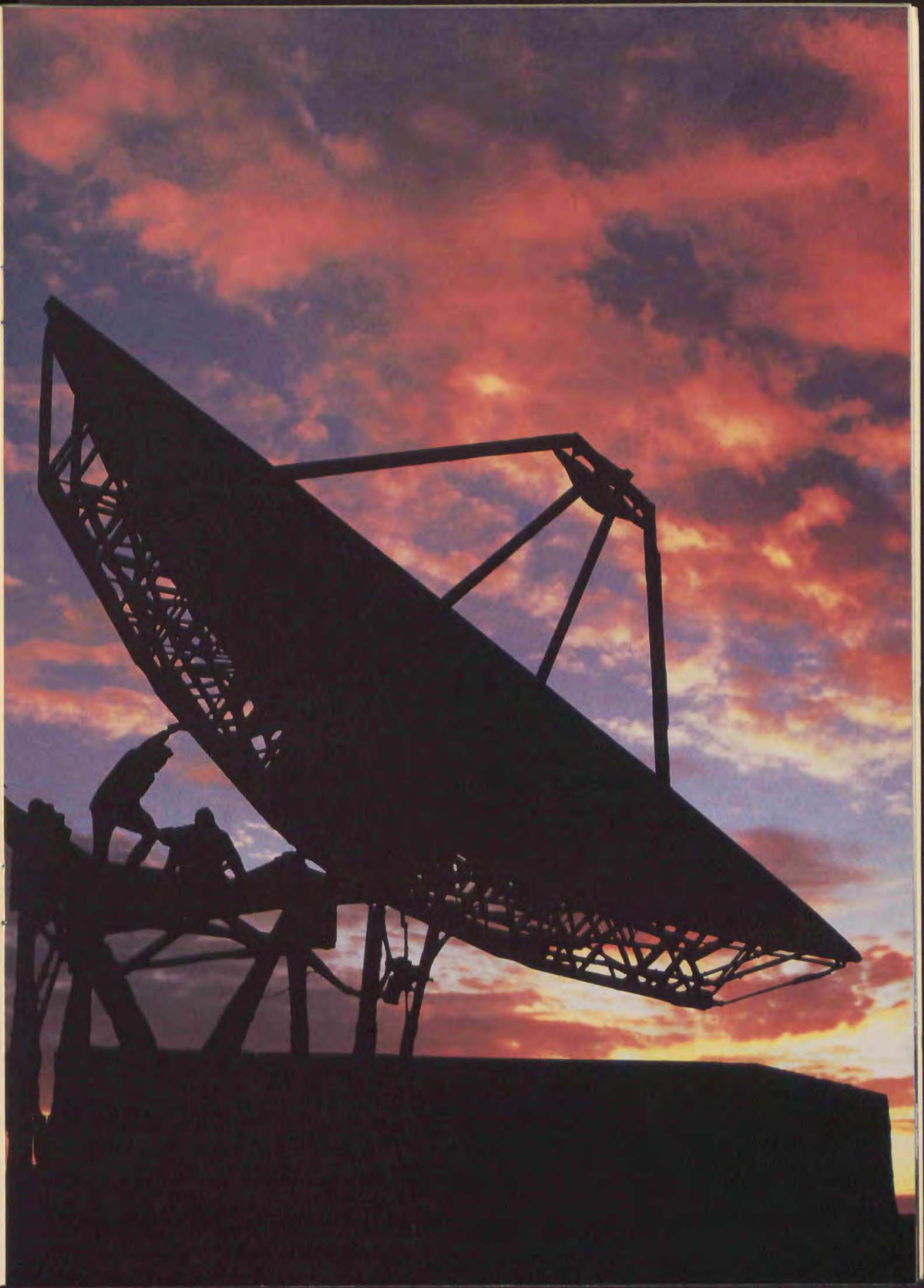
Telecommunications

電信是現代化國家不可或缺的基本設施，電信事業不但是資訊流通、文化傳播與拓展國際關係之利器，而且是開發電子、資訊、光電等技術工業的基礎，對加速我國產業結構升級與輔助國家整體經濟之發展，具有極爲深遠的影響。

在普及電信服務，擴大服務內涵方面，台灣地區（含金、馬）總用戶數，截至七十九年六月底止已達6,089,398戶，居全世界第十五位，平均每百人電話用戶密度爲29.85戶，居全世界第二十二位，公用電話機總數爲106,625具，居第十一位。

In modern countries, telecommunications is one of the most essential industries. Telecommunications is not only the best instrument for information circulation, culture spreading, and the expansion of international relations, but also the base for the development of the electronic and information technologies. Besides, it has long-term influence on the upgrading of the industrial structure and the overall economic development in our country.

About the popularization of telecommunications services, the total number of subscribers in the Taiwan area (including Kinmen and Matsu) reached 6,089,398 as of June 30, 1990, ranking 15th in the whole world; the density was 29.85 subscribers per 100 people, ranking 22nd in the world and the total number of public telephone sets was 106,625, ranking 11th in the world.



國內電話用戶對台灣全區各角落均可直接長途撥號，台灣與金門、馬祖間直撥電話亦預定於八十年間開放。此外全區97%的用戶可直接撥通 178 個國家或地區的國際電話。另透過遍佈各地的電話服務網，便利傳眞機的普遍使用，更擴大了資訊流通的範圍。

電信總局爲便利各項電信新穎業務的推展，現正進行免費換裝按鈕式電話機之工作，至七十九年元月底全區已達90.19%，不久即可全部換裝完成。先後開放的話中插接、無線電叫人及陸地行動電話等多項新業務，大幅提高電話服務效率，邁向機動性、個人化之通信領域。另爲迎接電信與電腦結合潮流，陸續開放了國際百科資料、公衆信息處理、電傳視訊、電傳文件、國際視訊會議、國際分封交換式數據通信、語音存送、報關資訊網路、航空訂位網路、公路監理系統等多項通信業務。

The Subscriber Toll Dialing Service (STD) is now available on the whole island STD service between Taiwan and Kinmen, Matsu was also set up recently. Besides, through the International Subscriber Dialing Service (ISD), 97% of our subscribers can make international phone calls to 178 countries directly. Also, through the convenient telephone service network, Facsimile is widely used, greatly expanding the possibilities of information circulation.

To expedite the promotion of our new services, we have been replacing the dial-type telephones with push-button ones. As of June 30, 1990, the rate of push-button telephone sets reached 90.19% and the program will be completed in the near future. Other new services which have been made available to the public are: call waiting, radio pager, cellular mobile phone, etc., greatly improving the efficiency of the telecommunications services, leading us into a new mobile and personalized communication era. To meet the new trend of the convergency of computer and communication, we have also opened the following new services: Universal Data Access Service

展望未來電信發展趨勢，資訊社會係以電信與電腦的結合運用是賴，而所需電信技術，乃以數位化電信網路爲基礎，增強網路內部功能，再配合終端設備，構成整體服務智慧型網路，藉以提供電視、影像、高速率數據通信等寬頻帶服務，傳輸媒體方面，光纖將逐漸替代銅線電纜。

爲迎合多元化開放社會對高效率、高品質的普遍需求，勢需透過競爭來提升服務水準，因此，未來電信事業經營，將朝向「電信業務自由化」，「電信組織公司化」及「電信經營國際化」等方向發展。

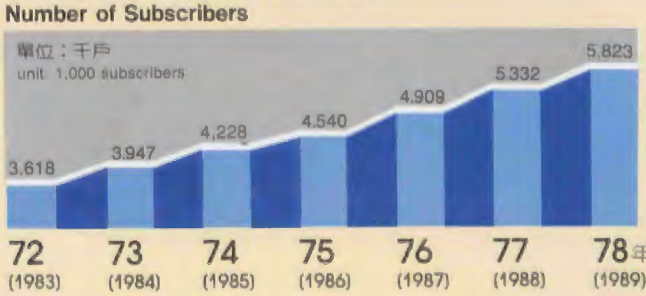
(UDAS), Public Message Handling Service (MHS), Videotex Service, Teletex Service, Video Conference Service, Packet Switching Data Communication Service (PACNET), Televoice Message, Customs Clearance network System, Multi-Access Reservation Network (MULNET), Motor Vehicle Management Information System, etc.

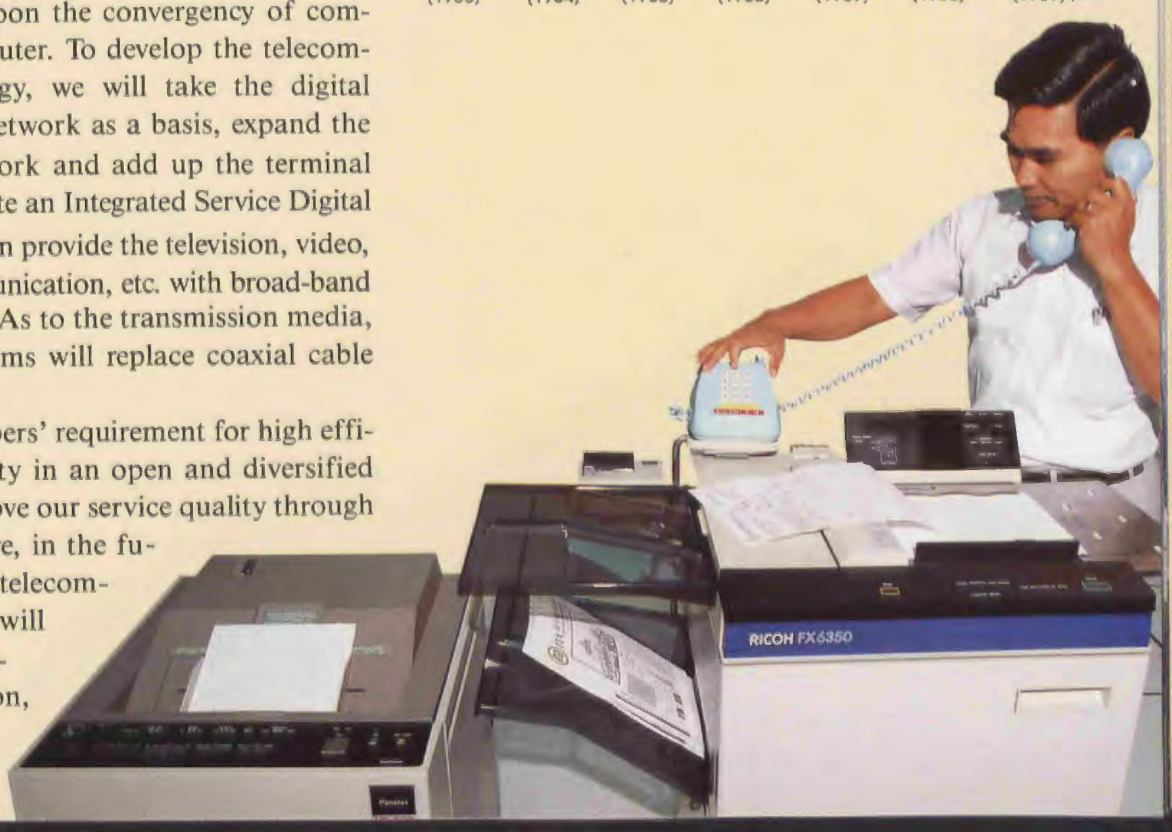
Looking at the future trend of telecommunications development, the information-oriented society will mainly depend upon the convergency of communication and computer. To develop the telecommunications technology, we will take the digital telecommunications network as a basis, expand the functions of the network and add up the terminal equipments to constitute an Integrated Service Digital Network, so that we can provide the television, video, high-speed data communication, etc. with broad-band services to the public. As to the transmission media, the optical fiber systems will replace coaxial cable systems.

To meet the subscribers' requirement for high efficiency and high quality in an open and diversified society, we must improve our service quality through competition. Therefore, in the future the operation of telecommunications industry will march toward the directions of liberalization, privatization and internationalization.

每百人平均電話機數
Number of Stations Per 100 Population

台灣地區市內電話用戶數
Number of Subscribers





鐵路
Railways

台灣地區現有鐵路 2,502公里，由台灣鐵路管理局營的路線有 1,072 公里。平均每日載客人數約35萬人次，貨運量約 8 萬 5 千公噸。

政府爲完成環島鐵路網，促進東部資源之開發，繼北廻鐵路後，更加速興建南廻鐵路，其路段從枋寮經枋山穿越中央山脈，再經金崙、知本到卑南，全長98公里，預定八十年底全線完工通車。

Currently, there are 2,502 kilometers railway in Taiwan, with a total 1,072 kilometers being run by the Taiwan Railway Administration (TRA). On the average, the transportation capacity accounts for 350,000 passengers per day. In terms of commodity transportation capacity, the volume stands at 85,000 metric tons per day.

After building the North-link Railway, the government has decided to set up a South-link Railway so as to complete an around-the-island railway network and to develop natural resources of east Taiwan. With a total length of 98 kilometers, the proposed South-link Railway will begin from Fangliao and pass through the Central Mountain via Fangshan. It will pass Chinlun、Chihpen、and then reach Peinan. This new railway will be completed by the end of 1991.

同時，爲紓解台北地區鐵路沿線的交通瓶頸，配合大台北地區都會捷運系統之建立，目前正積極進行台北市區鐵路地下化工程；其中萬華至華山段工程之完工，有效疏解了中華路段之交通瓶頸，現正繼續辦理延伸至松山之地下化工程，預定於八十七年底全部完工啓用。

除了南廻鐵路與台北市區鐵路地下化工程外，山線鐵路雙軌工程、鐵路沿線老舊橋樑之重建、改善鐵路平交道，亦是目前積極進行中之重要工程。同時，有鑑於近年來陸上運輸能量日趨飽和，爲擴大鐵路之運輸量，本部現正積極籌建南北高速鐵路及北廻鐵路雙軌化工程，並對高雄市鐵路地下化工程進行規劃作業中。

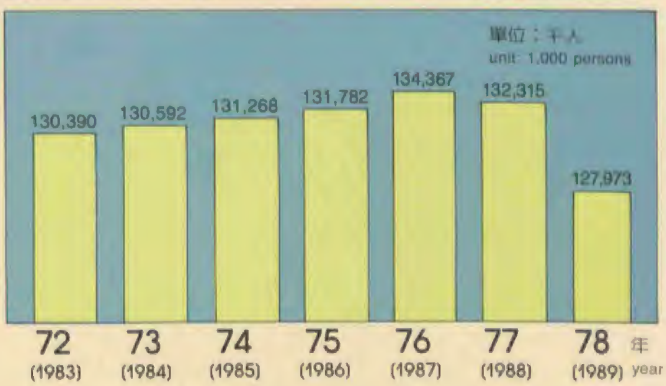
To alleviate the traffic bottleneck along railway area and to be in coordination with the Mass Rapid Transit System in Taipei, the Taipei Railway Underground Project was initiated. The completion of the Taipei Railway Underground Project between Wanhua and Huashan has successfully solved the traffic bottleneck of Chung Hua Road, while the extension from Huashan to Sungshan is currently under construction. The Project is scheduled to be completed in 1998.

With the exception of the above-mentioned two railway projects, MOC will change the current mountain line segment into a double-tracking system and rebuild old bridges and level crossings along the railway. Recently, the capacity of land transportation has almost reached its limit; therefore, the Ministry is planning to build the west Taiwan High Speed Rail, and to replare the single track of the North-link Line with double tracks. At the same time, we planning the Construction of the Kaohsiung Railway Underground Project.

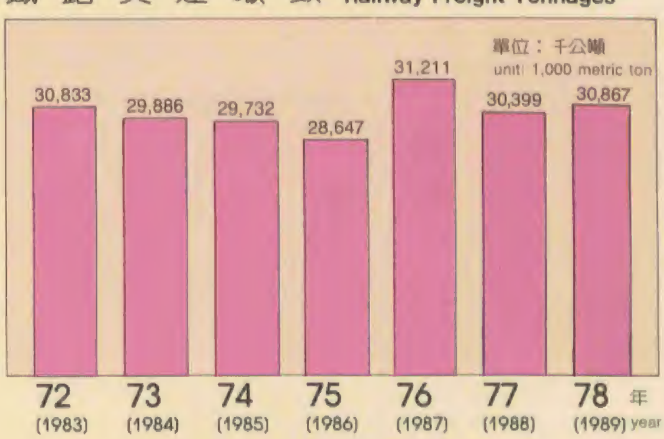
此外，爲配合各項硬體設施工程之完成，本部將致力提昇服務品質及經營績效，並從加強改善鐵路營運管理、增添更新車輛及站場設備、整體規劃各大站地下化、推展電腦售票、及增進行車安全與準時到站方面著手，以期達便民利民之效。

In addition, MOC will strengthen its service quality by improving the management for each railway station and procuring new cars and locomotives. An integrated planning to transfer important stations into underground ones, to computerize the ticket system, and to ensure railway safety and punctuality will be put into practice in the near future.

鐵路客運人數 Railway Passenger Traffic



鐵路貨運噸數 Railway Freight Tonnages



台灣西部走廊高速鐵路
The West Taiwan High Speed Rail (HSR)

公路
Highways

台灣地區的公路建設，可分爲縱貫公路、橫貫公路、環島公路、濱海公路、高速公路、聯絡道路等六大系統，約有 2 萬公里。

目前正積極進行中的重大工程有：北部地區第二高速公路之興建、西部濱海及第三號省道縱貫公路之改善，以及中山高速公路拓寬等。

中山高速公路縱貫台灣西部地區，爲南北交通最大動脈，爲紓解日益擁擠的交通狀況，現正籌劃全線拓寬，其中位於台北都會區之汐止五股段約22公里，擬採高架方式優先施築。

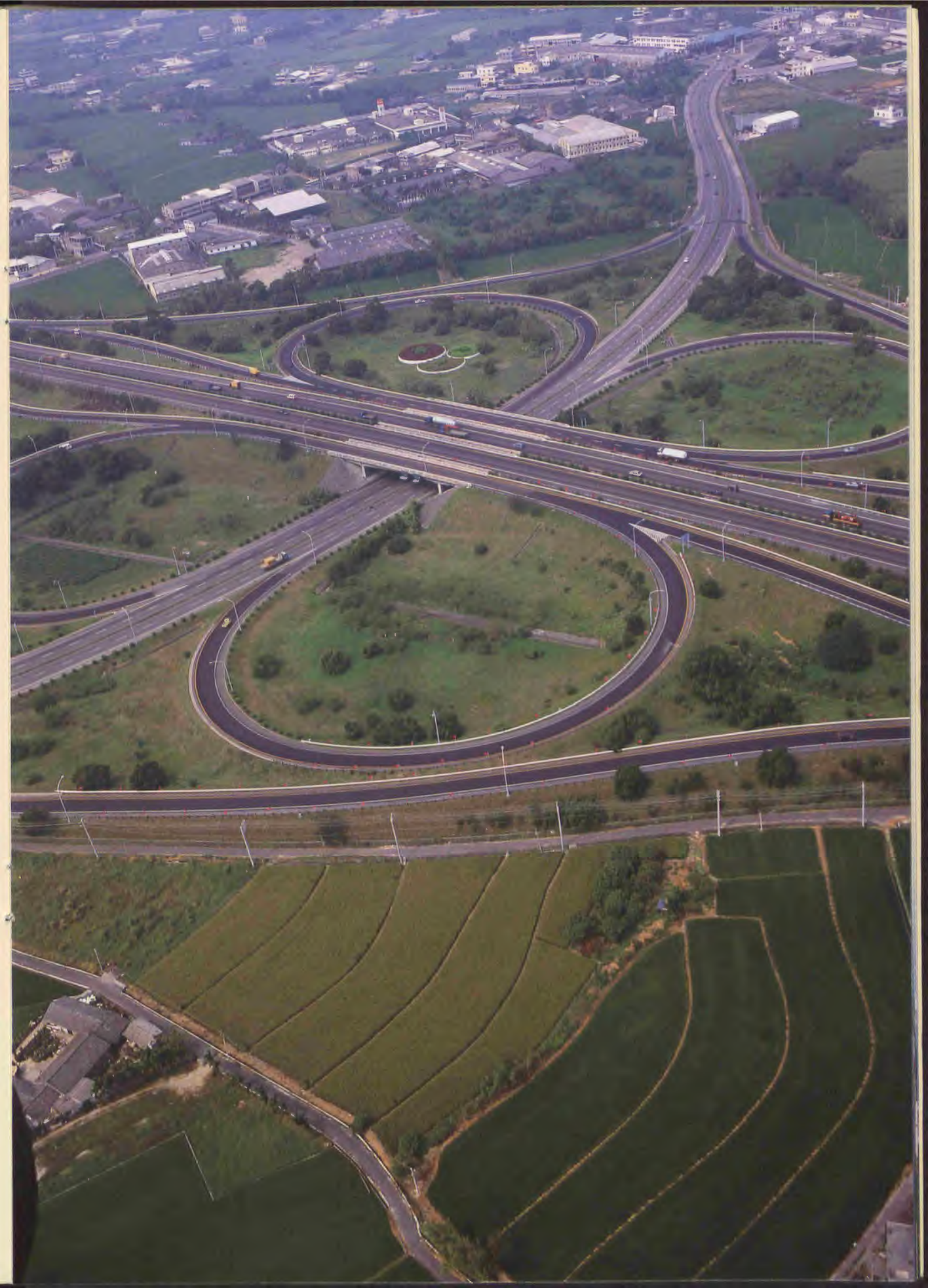
預定八十二年底完工的北部第二高速公路，通車後將有效疏解北部區域公路整體容量之不足。爲使蘭陽平原能納入台北都會區的共同生活圈，現正規劃開闢台北宜蘭高速公路。

There are some 20,000 kilometers of highway in Taiwan, including six systems, namely the freeway, the trunk, the cross-island, around-the-island, the coastal, and the connection systems.

New important highway projects under construction include: the construction of the second freeway in northern Taiwan, the improvement of West-coast and No.3 Provincial North-South Highways, and widening of the Sun Yat-Sen Freeway.

The Sun Yat-Sen Freeway is the major traffic artery on the west coast. To solve the problems of traffic conjection, widening of the entire route is proposed wherein the section between Shichi and Wuku, 22 kilometers in length, will be constructed in an elevated style.

The 2nd Northern Freeway will effectively increase traffic capacity in northern Taiwan by the year 1993. The Construction of the Taipei-Ilan Freeway will help link the Lanyauy plain with the Taipei metropolitan area.



同時積極規劃興建中南部第二高速公路，並研究規劃東部及南橫兩條快速公路，配合現有公路，成爲一個完整的網路系統，以滿足未來城際運輸需要。

發展都會區大衆捷運系統是我國重要運輸政策之一。正在興建中的台北都會區捷運系統初期網路，全長84.7公里，預計於民國八十七年完工，目前正積極進行遠期路網的規劃。

高雄都會區大衆捷運系統第一期發展計畫已規劃完成，全長約77.7公里，預計於八十九年完成。未來將繼續就桃園、新竹、台中及台南等都會區大衆捷運系統進行研究規劃。

Meanwhile The Continuation Second Freeway project is being under planning and design stage. Also, the planned Eastern and Southern Cross-Island Expressways are proposed to create a more complete traffic network to meet future inter-city transportation requirement.

One of Taiwan's transportation policies is to build a Mass Rapid Transit (or MRT) System. The initial network, with a total combined distance of 84.7 kilometers in Taipei will be completed in 1998.

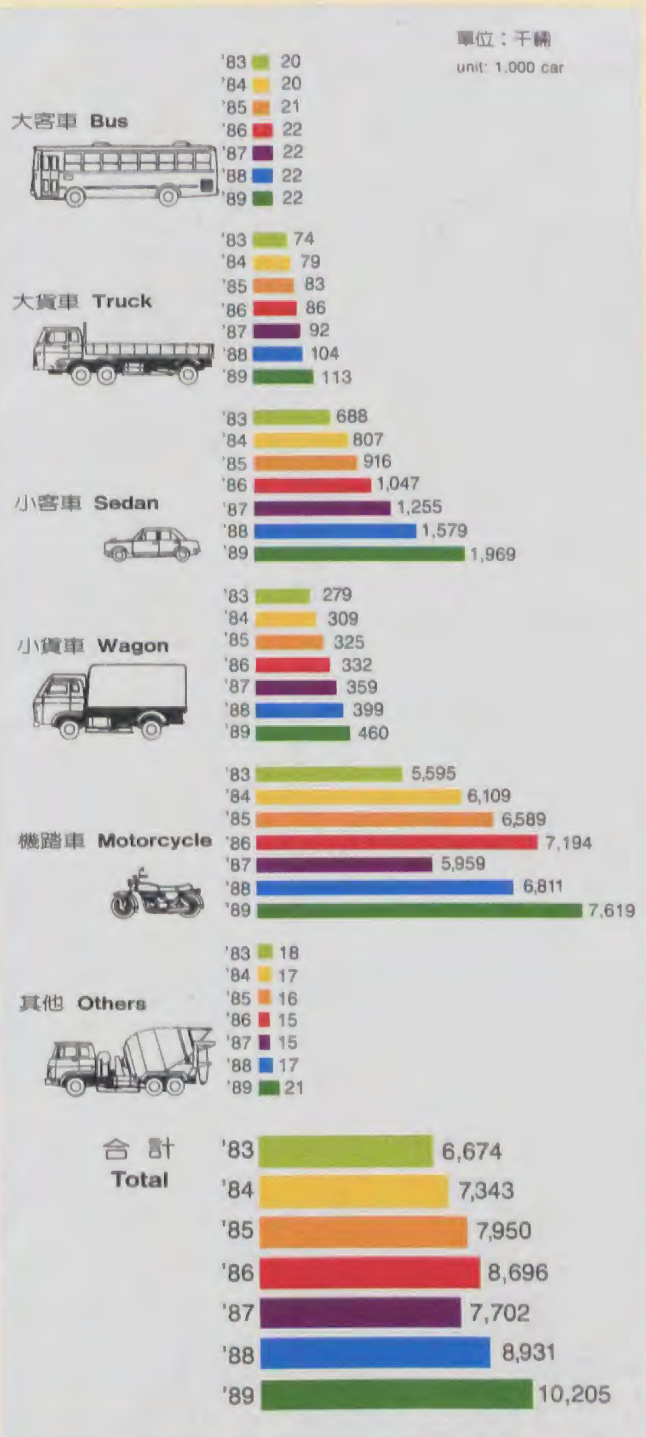
The first-phase of the Kaohsiung MRT System has been proposed. A total distance of 77.7 kilometers will be completed by the year 2000. The project of planning the MRT systems in Taoyuan, Hsinchu, Taichung and Tainan will be finished by 1993.

面對日益擁擠的交通，公路單位近年來加強軟體措施，配合硬體設施的進行，澈底改善交通秩序。包括：㈠公路監理作業電腦化，實施電腦連線作業，提昇監理作業之效率；㈡修訂「道路交通管理處罰條例」，實施違規記點，加強交通管理；㈢繼續實施「道路交通秩序與安全改進方案」，改善交通秩序；㈣改革計程車管理制度，從開放牌照管制、調整費率結構與提昇服務品質等方面著手底改革。

Facing the ever growing traffic, the highway authorities has strengthened both hardware and software facilities to improve the local traffic order. Important measures include: 1. Computerizing motor vehicle supervision and administration. 2. Revising "The Traffic Penalties Rules" by adopting a traffic violation point system. 3. Continuing "The Traffic Order & Safety Improvement Measure". 4. Improving taxi management. The government also adjusted the taxi fee rate and encouraged drivers set up wireless radioes to improve the traffic safety and service quality as well.

北部第二高速公路建設計畫
The Northern Second Freeway Project in Taiwan

機動車輛登記數
Number of Vehicles Registered



水運
Water Transport

我國船舶運輸業，擁有兩百總噸以上船舶之公司有一百餘家，其中招商局、陽明海運公司、台灣航業公司爲公營機構，現有輪船 264 艘，共計 822 萬載重噸。

鑑於我國船運公司多屬小規模經營，競爭力薄弱，本部於民國七十三年九月輔導航運業者，成立「中華民國海運聯營總處」，以充分運用民間組織力量，統一調配船隻，進而增加國輪之服務品質及競爭力。

In the nation's shipping industry, there are more than one hundred shipping companies which own vessels of at least 200 G.T. Of these shipping companies, Yangming Marine Transport Corp. and Taiwan Navigation Company are state-run firms. Presently, there are 264-odd vessels with a total deadweight tonnage of 8.22 million.

Since most shipping companies in Taiwan are small-scale in terms of operations, the Ministry decided to assist them by setting up an ROC Association of Shipping Services, in September, 1984. This move will bring about better organization of the shipping industry and upgrade the service quality and market competition of national fleet.


YANG MING LINE

陽明海運公司爲我國最大的國營全貨櫃船隊，爲配合整體經濟建設，拓展對外貿易需求，開闢連貫歐、亞、美的快速直達航線，與現有航線連結成一體，逐步構成以我國爲中心的輻射航線網。

長榮海運公司爲目前全球最大的貨櫃船運送業者。

在船員方面，經常培育儲訓，供應國輪需用，並辦理船員外僱，增加船員就業機會。

今後水運政策將加強建立穩定海運經營環境，鼓勵培植海運經營管理人才，並配合國際化、自由化之趨勢，維護良好海運秩序，俾配合發展國家經濟。

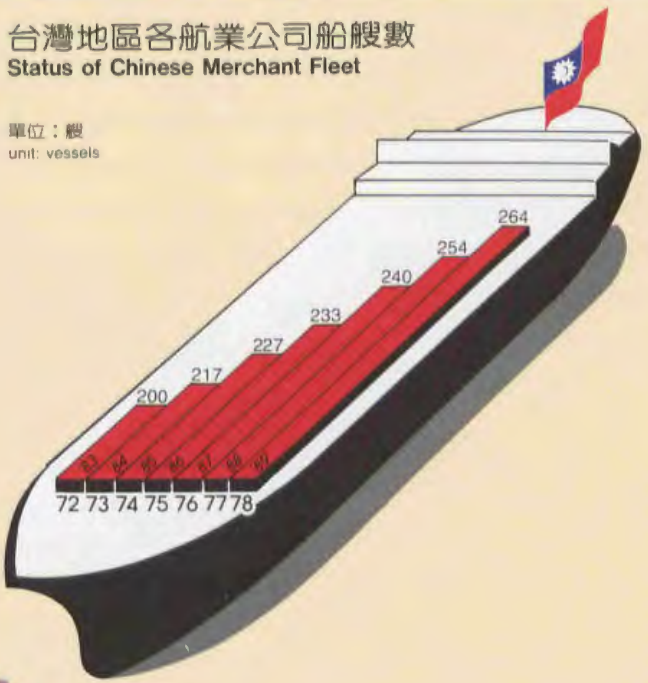
The Yangming Marine Transport Corporation is the biggest state-own all containner marine fleet. To go with ever-growing economic development and needs for promoting international trade, the company has been actively engaged in openning the Europe-Asia-America Express Route, connect with the present routs creating a radiol network with Taiwan as its hub.

The Evergreen Marine Corporation is now the world's largest container forwarder. On-job training for crews of her ships are frequently offered to provide the nation's fleet with sufficient force, and provide seaman with more job for working on foreign vessels.

Emphasis on water transportation management will be the furture policy. Specialized managers with internationalization and liberalization minds will be the country's new force in assuring orderly marine transporation and economic growth.

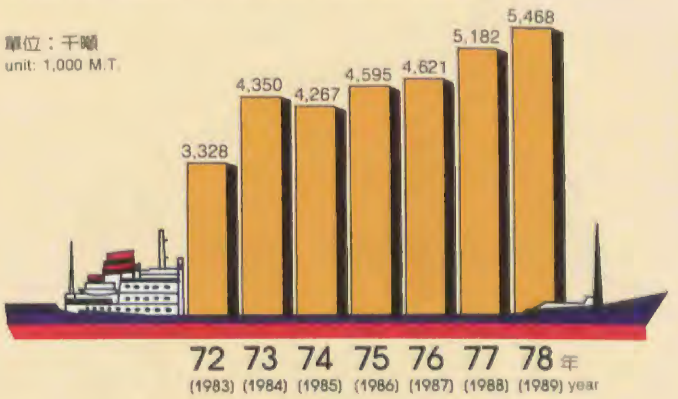
台灣地區各航業公司船艘數
Status of Chinese Merchant Fleet

單位：艘
unit: vessels



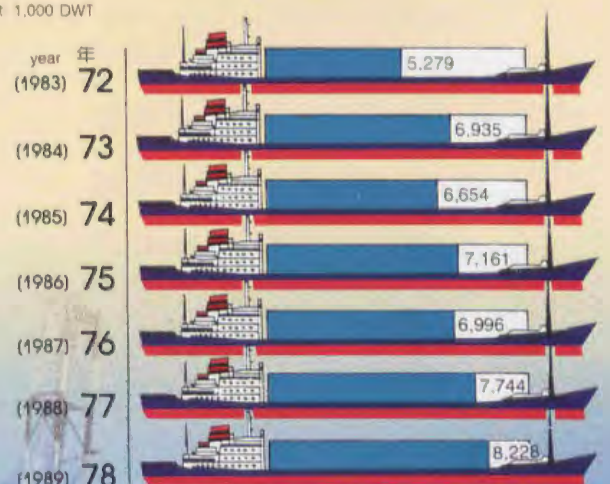
台灣地區各航業公司營運船舶總噸位
Gross Registered Tonnage of National Vessels

單位：千噸
unit: 1,000 M.T.



台灣地區各航業公司營運船舶載重噸
Deadweight Tonnage of National Vessels

單位：千噸
unit: 1,000 DWT



港埠
Harbors

台灣地區現有基隆、高雄、花蓮、台中等四個國際港。每年進出台灣地區各港的船舶約有 4 萬 4 千餘艘，每日平均裝卸貨物 81 萬噸；我國進出口貨物多已貨櫃化，現僅次於美國和日本而居世界第三大貨櫃裝卸國。

高雄港裝卸貨櫃數在世界各大港中名列第四，平均每日裝卸貨櫃 8,000 個 TEU 。基隆港是全球十大貨櫃港之一，另有蘇澳港爲輔助港口。台中港爲貨物進出台灣中部的重要門戶。花蓮港是台灣東部唯一國際港口，肩負東部對外運輸重任。

There are four major international harbors operating in Taiwan, namely Keelung、Kaohsiung、Hualien and Taichung harbors, respectively. Around 44,000 incoming and outgoing vessels pavements are handled by the four ports each year and with an average of 810,000 tons of cargo being loaded and unloaded per day. Among the cargo, a high percentage is containerized, the R.O.C. is the third largest container-handling area in the world next the United States and Japan.

The Kaohsiung Harbor, whick ranks the fourth container port in the globe, handles approximately 8000 TEU per day. Keelung is also one of the top ten container-handling harbors in the world. The Suao Harbor serve as auxiliary port. The Taichung Harbor is the gate for imports and exports of central Taiwan. The Hualien Harbor, the only international harbor on the east-coast, plays an important role in marine transportation.


206
204
CHO YANG

爲加速港埠建設現代化，除硬體設施外，本部亦就各港自動化設備之充實、通關程序之簡化，以及轉運與聯運業務等問題，研擬對策，改進港埠轉運效率。今後，並將從以下三方面積極著手進行：

㈠辦理籌建深水港先期規劃作業，因應船舶大型化及自動化之趨勢。

㈡建立各港機埠管理作業電腦連線系統，促進港、航各項作業的效率化及合理化，達到提高港埠營運效率之目標。

㈢鼓勵民間參與港埠公共建設之投資，以期利用民間財力，促進港埠之建設與發展。

To modernize the nation's harbor service, the Ministry plans to purchase more automatic equipment, simplify customs processes, and facilitate the transit operation Additional proposals are under consideration to enhance our efficiency. In the future, the following three improvements will be conducted:

——Proposing the establishment of deep-water harbor to meet the trend of large size and automatic shipping services.

——Setting up the on-line service for the harbor and warehouse management to improve the efficiency of operations.

——Encouraging the private sector to invest in the harbor construction and business.

台灣地區進出口貨櫃數量

Container Traffic by Ports

空運
Air Transport

國際民航組織將全球空域劃分爲若干「飛航情報區(FIR)」，以便從事飛航服務工作。台北飛航情報區，西南鄰接香港飛航情報區，南與馬尼拉飛航情報區相鄰，東與東北面爲那霸飛航情報區。台北飛航情報區共有14條航路，範圍自北緯21度至29度 、東經117度30分至124度， 提供之飛航服務項目有：飛航管制、飛航情報、航空氣象、航空通訊、搜救業務等。目前約有31個國家之51家航空公司航空器飛航本區。

The International Civil Aviation Organization (ICAO) divides the global air space into several Flight Information Regions (FIR) so as to provide air services to every aircraft which is flying through/in The Taipei FIR, being adjacent to Hong Kong FIR in the south-east, Manila FIR in the south, Naha FIR in the east and north-east, has 14 routes (local and international) with the overall area covering 21 to 29 degrees Latitude, 117.30 to 124 degrees Longitude and can provides air traffic control, flight information, aeronatical meteorology, communication and searching/rescuring services to every aircraft of 51 airlines from 31 nations flying through/in this region.


中華航空公司
B-161

近年來由於國家經濟發展，國民所得大幅提高，觀光旅遊日盛，加以政府採取一連串自由開放政策，導致航空運量需求大增。七十八年飛行架次爲 234,890 架，較七十七年成長 32.34%，客運量爲17,207,031 人，較七十七年成長 16.72%，貨運量爲 608,579.5 公噸，較七十七年成長 12.12%。本部民用航空局爲因應此快速成長之需求，首先規劃場站硬體擴建，計劃未來五年將投資 366 億 9 千 4 百萬元，從事中正、高雄國際機場、國內機場及離島機場之擴建。適度開放新航空公司之申請設立，並訂定十年發展計畫，輔導各航空公司分期引進新機，其中國內線各型機 40 架，國際線36架，以因應未來業務需求。目前國內航線由十家航空公司經營，國際航線現由中華航空公司經營，而長榮航空預定於八十年中開航，首航路線將以遠東地區爲主。

該局另積極推動航管自動化系統計畫，汰換更新助導航裝備以增進飛航安全，擬訂國內航線整體發展規畫，期使臺灣本島與各離島間連成一綿密之交通網，對外可與國際航線配合達成接駁之功能。

Owing to the prosperity of economical development and open sky policy, the business of local air transportation has increased sharply in recent years. In 1989, compared to 1988 the total landings and take-offs in airports amounted to 234,890 flights (32.34% up), with a total about 17.2 million passengers (16.72% up) and 601 thousand tons cargos (12.12% up) being served. To cope with this rapid growth, The Civil Aeronautics Administration (CAA) is planning to invest NT$36.7 billion dollars in airport expanding and terminal facilities updating program, including CKS and Kaohsiung International Airports, local and off-

Also building up an integrated automatic air traffic control system to replace and modernize the navaids equipments. Organizing and developing the local routes as a network to connect with the international routes.

shore island airports. Assisting national airlines to

鑒於亞太地區太平洋盆地邊緣國家之未來航空運量快速發展，本部民用航空局將掌握台灣優越地理位置及利用中正國際機場擴建之設施，積極發展成爲亞太地區空運儲運中心。繼續加強與各有關之國際民航組織間之聯繫，在平等互惠之原則下爭取友好國家交換航權，推動多家指定政策，以增加營運空間。

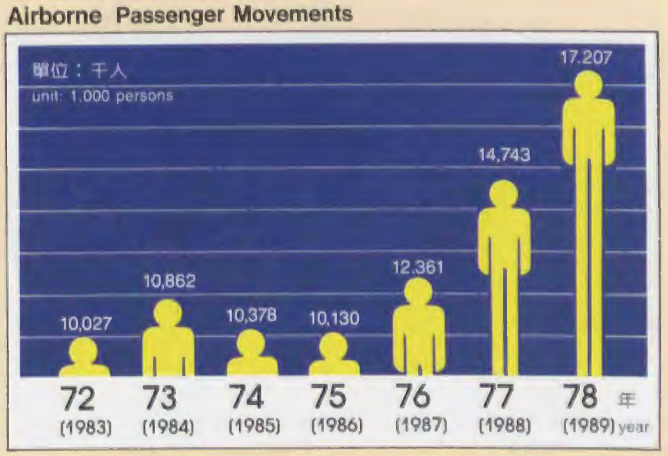
purchase new aircraft, 40 in domestic market and 36 in international market within 10 years. Opening for new airlines' setting up; at present, there are 10 domestic airlines operate domestic routes in Taiwan. Now, China Airlines operates international routes. Eva Airways Corporation, a newly established airline in Taiwan, has scheduled its inaugural flights in 1991 with routes mainly in the Far East region at first.

The Pacific-Asia Region has tremendous demands of air transportation in the next few years. Accordingly, The CCA has taken following major steps to meet the future requirements.

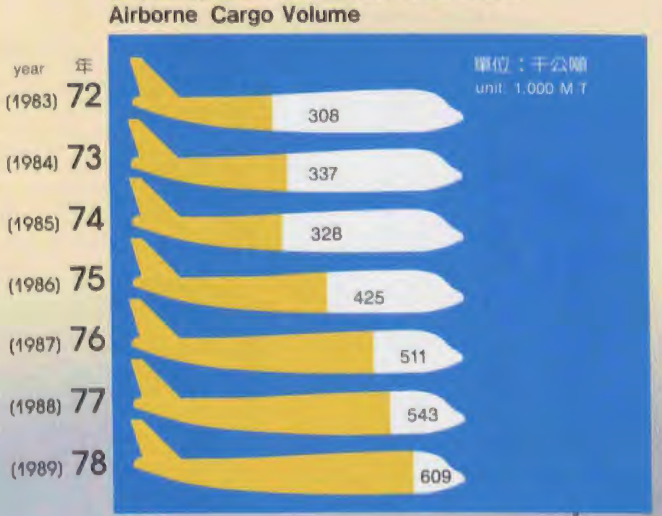
---------to become the hub of air transportation in Pacific-Asia Region.

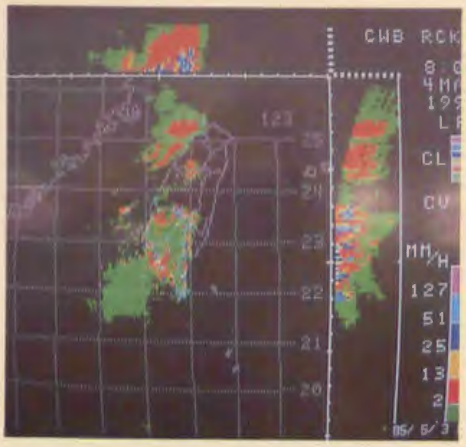
---------to enhance associating with international aviation organizations, try to exchange more traffic rights and to promote multiple designation policy with friendly nations on the basis of equality and reciprocity.

台灣地區民航運輸旅客人數
Airborne Passenger Movements



台灣地區民航運輸貨運噸數
Airborne Cargo Volume





氣象
Meteorology

本部中央氣象局負責辦理全國氣象業務，目前在台灣地區設有廿四個氣象站分布各地，包括玉山、蘭嶼等高山離島偏遠地區，每日定時從事地面及高空氣象之觀測工作。

中央氣象局設有氣象衛星中心，每天廿四小時全天候作業，接收日本地球同步氣象衛星及美國繞極軌道衛星的觀測資料及所拍攝的雲圖，配合花蓮、高雄兩座氣象雷達，可隨時監測各種劇烈天氣系統變化以及颱風動向，提供天氣預報與颱風警報作業的重要資訊。

The Central Weather Bureau (CWB) of the Ministry of Transportation and Communications is in charge of national weather forecasts and meteorological services. Besides the headquarters in Taipei, the CWB has established 24 meteorological stations all over the Taiwan area, including high mountains, Yu-shan and Lan-yu, and off-shore islands. Surface observations are made at all meteorological stations and two stations are capable of upper-air observations.

The Meteorological Satellite Center of the CWB has been in operation since 1981. Its main function is to receive and process the high and low resolution data from the Japanese geostationary meteorological satellite (GMS) and the U.S. polar orbitting meteorological satellites. Two meteorological radars, a WSR-74S and a WSR-81S, are installed at the Hualien and Kaohsiung stations respectively. The cloud images received from the Satellite Center and radar pictures obtained from radar stations provide the CWB with valuable information to keep close watch on typhoons and severe weather activities.

中央氣象局在民國七十六年建置了超大型電腦，同時並分階段積極引進四個數值天氣預報系統，於七十九年元月全面正式作業，大幅提升了氣象預報的能力，使我國氣象業務的發展邁入新里程，目前成爲副熱帶地區第一個擁有全球數值預報作業系統的國家。

近年來中央氣象局爲了加強氣象服務，每日對外提供的氣象預報已增加至十種以上。遇有強風、豪雨、寒潮或颱風來襲時，更不分晝夜加強監視，並適時發布特報或警報，透過大衆傳播媒體及「一六六」國語、「一六七」閩南語氣象服務電話迅速報導，且隨時插播最新氣象消息，以便利社會大衆採取防範措施，減輕氣象災害損失，發揮氣象服務的經濟效益。

The Computer Center was founded in 1987. The computing facility includes a CYBER 205 super computer with two front-end 180/840 computers. Four numerical models have been developed for routine forecasting, they are: a global model, a regional model, a mesoscale model, and a typhoon track model. The CWB has become the only wholly subtropical weather service institute in the world which was sophisticated numerical weather prediction capabilities for real-time operations.

In recent years, the CWB has made great progress towards improving its services. For example, forecast products issued to the public have increased to greater than 10 categories. In particular, through mass media and by keeping all authorities informed with a reliable communication system, severe weather warnings are issued well in advance of strong winds、heavy rains、cold surges、and typhoons. The latest weather forecasts are also available by dialing 166 for information in mandarin or 167 for information in local dialects.

地震測報亦是中央氣象局重要業務之一，該局正積極建立地震遙測網，在台灣地區已設立了卅一個地震遙測站，預計至民國八十年可擴充至四十四個站。目前該局正與中央研究院地球科學研究所的觀測網連線，以加強地震資料之蒐集，提高地震研判的準確性及時效；此外，並與學術機構合作，推動長期研究計畫，進行地震預測研究，以增進地震防災之功能。

氣象與地震測報的重要性，不僅直接關係到人民生命財產的安危，更影響到國家經濟建設。因此，中央氣象局將朝向「充實觀測儀設備」、「改進氣象預報技術」、「培育科技人才」、「加強爲民服務」四大目標努力邁進，積極發展氣象業務，以因應各界對氣象日益殷切的需求；同時並加強與國際間之科技合作與交流，提昇我國氣象之國際地位。

The CWB is also responsible for seismic observations. The Seismological Observation Center was established in 1989. Of the 24 CWB meteorological stations, thirty-one are also equipped with modern automatic short-period and long-period seismographs which comprise a computerized seismic network. The CWB will increase its total number of stations to 44 in 1991. To strengthen the collection of seismic data and to promote the accuracy of analyses, the CWB's seismic network is being linked with Academia Sinica network. Additional seismic research is in progress under the cooperation of the CWB and domestic academic institutes.

Meteorology and seismology not only have a direct impact on the human life and property, but also affect the national economic development. The CWB has invested large sums in improving observational facilities, introducing new forecasting technologies, educating scientific staff, and promoting meteorological affairs. The CWB has entered into scientific and technological cooperative agreements with some foreign meteorological institutes to attack problems of common interests, and to utilize special facilities available to both parties. It has won a great reputation in the international meteorological community.

觀光
Tourism

我國觀光事業之發展，隨著環境、時代的變遷，已邁入轉型及升級階段。面對國人旅遊需求之急遽成長，國際間發展觀光之強勢競爭壓力，「全面改善我國觀光發展之環境」爲本部觀光局當前之工作重點目標。

爲因應此需求與壓力，該局除繼續輔導台灣地區整體開發觀光遊憩設施與活動，來滿足「大衆觀光」外；同時直接參與東北角、東部海岸兩國定風景特定區之建設，並設立澎湖風景特定區，期以開闢具本土特色及符合國際級水準之休閒渡假區，帶動國內觀光遊憩地區設施品質之全面提昇。

Together with the many changes taking place in the Republic of China, the tourism industry has entered a period of transition and upgrading. Faced with the rapidly growing interest in travel of the nation's citizens and with strong competitive pressure in the development of the international market, the Tourism Bureau of the Ministry of Transportation and Communications has taken the "overall improvement of the ROC's environment for tourism development" as the focal target of its current efforts.

To cope with these growing demands and pressure, in addition to continuing its support for the development of integrated tourist and recreational facilities and activities in the Taiwan area in order to satisfy the needs of local tourism, the Tourism Bureau also participates directly in the development of the Northeast Coast and East Coast National Scenic Areas, and establishes a new Penghu National Scenic Area, with the aim of providing vacation sites that offer local characteristics and meet international standards at the same time, In so doing, the Tourism Bureau intends to upgrade the quality of facilities in the nation's domestic tourist and recreational areas.

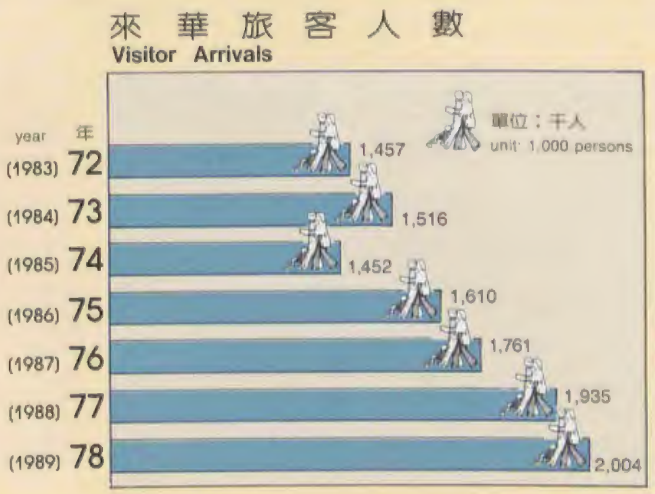
此外，爲爭取國際性會議、活動在我國舉行，亦爲招徠國際旅客之極佳途徑，目前積極籌劃辦理者有：1991年ASTA世界年會暨旅展、1991年F.I.C.C. 世界大露營及1992年PATA旅遊交易會等，希望藉以帶動我國旅遊事業之蓬勃發展。

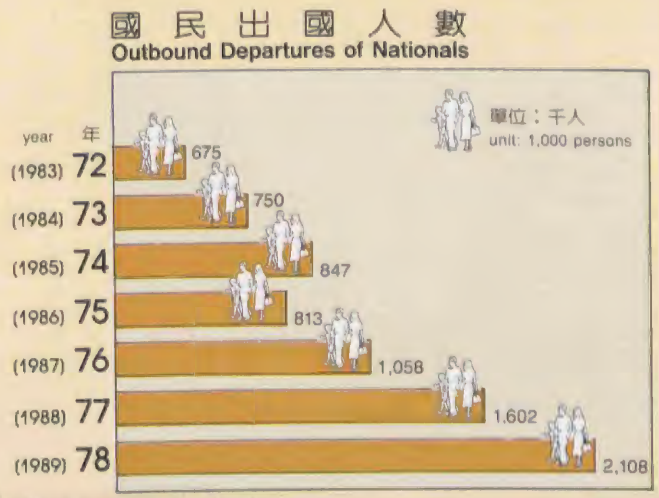
由於出國旅遊人數截至七十八年底已達210萬人次，成長迅速爲亞洲之冠，加以國人消費力強，實爲另一股不可忽視之「國力」，亦成爲各國競相爭取之目標；爲使國人對海外環境有正確之認識，瞭解國際禮儀及旅遊常識，觀光局於松山機場、高雄、台中等地成立旅遊服務中心，設置旅遊資料館，協助各旅行社辦理行前講習會，爲出國旅客提供豐富之資訊服務，以提高國民出國觀光活動之層次，從而成爲促進國際外交，建立國家形象最直接有效之利器。

Another excellent way to attract international travelers is through the holding of international meetings and other activities in the Republic of China. Preparations are now actively under way for a number of major international functions, including the ASTA World Travel Congress and exhibition in 1991, the F.I.C.C. world camping rally in 1991, and the PATA Travel Mart in 1992. It is hoped that these activities, and others like them, will stimulate a more prosperous development of the nation's tourism industry.

The numbers of outbound travelers from the Republic of China have been increasing at the fastest pace in Asia, and a total of 2.1 million ROC citizens took trips abroad in 1989. These huge numbers of travelers, plus their strong purchasing power, have made the ROC a force not to be ignored by the international tourism industry, and a tourist market which many foreign countries are striving to develop. To give the nation's outbound travelers an accurate knowledge of the overseas environment as well as an understanding of international etiquette and travel know-how, the Tourism Bureau maintains Travel Service Centers at Taipei's Sungshan Domestic Airport, Kaohsiung,

and Taichung. Besides offering travel libraries for tourists to use, these centers also assist travel agencies in holding pre-departure seminars for tourist groups bound overseas. The wide range of information services which they offer to travelers going abroad is aimed at heightening the level of the nations's outbound travel activities and, in so doing, promoting people-to-people diplomacy and building up a good image for the ROC throughout the world.





展望未來、追求卓越

Looking Toward the Future Development, Seeking Excellence

近年來由於經濟的蓬勃發展與國民生活水準的大幅提昇，使得台灣地區城際運輸能量日顯不足，且都市交通擁擠現象日益惡化；本部鑒此，已規畫完成未來十年(公元2000年前)我國各項交通建設計畫藍圖（含近程運輸系統整體發展規畫)，其中包括興建南北高速鐵路計畫、第二高速公路建設計畫、國道台北宜蘭高速公路計畫、台北及高雄都會區捷運系統興建計畫、籌建深水港計畫、開拓內陸航空運輸計畫、推動電信現代化建設計畫、改善都市停車問題計畫、中正國際機場第二期航站區工程計畫及高雄機場拓建第二期工程計畫等重大建設，刻正積極推動中，以期符合未來大衆對於高品質之整體交通建設的需求，並提供國人更快捷的運輸網路及現代化設施。

In recent years, the rapid economic development and higher living standards of the people have resulted in an underdeveloped transportation capacity in Taiwan. In view of the ever-deteriorating traffic conditions in the cities, the Ministry plans to complete various transportation and communication projects in the next ten years. These include the North-South High Speed Railways project the 2nd freeway project, the Taipei-Ilan freeway project, the MRT systems project in the Taipei and Kaohsiung metropolitan areas, the deep-water harbor project, the inland air transportation project, the telecommunication modernization project, the metropolitan areas urban parking betterment project, the 2nd phase air station expansion project for CKS international airport, and the 2nd phase expansion project for Kaohsiung airport. All the major projects mentioned above are being planned and constructed with an aim at meeting the standard of the public in the future and providing the people with a faster and more convenient transportation network and modern facilities.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本部期望社會大衆之參與及配合，共同爲我國交通建設開創一個更美好之新局，使我國無論在經濟、社會及生活品質等各方面，皆邁向更現代化之境界。

It is our expectation that with the support and involvment of the public, the transportation and communication constuctions in Taiwan will have a brighter future and that the Republic of China will be able to enter into a modern economy, society and higher living quality.

中華民國交通建設概況

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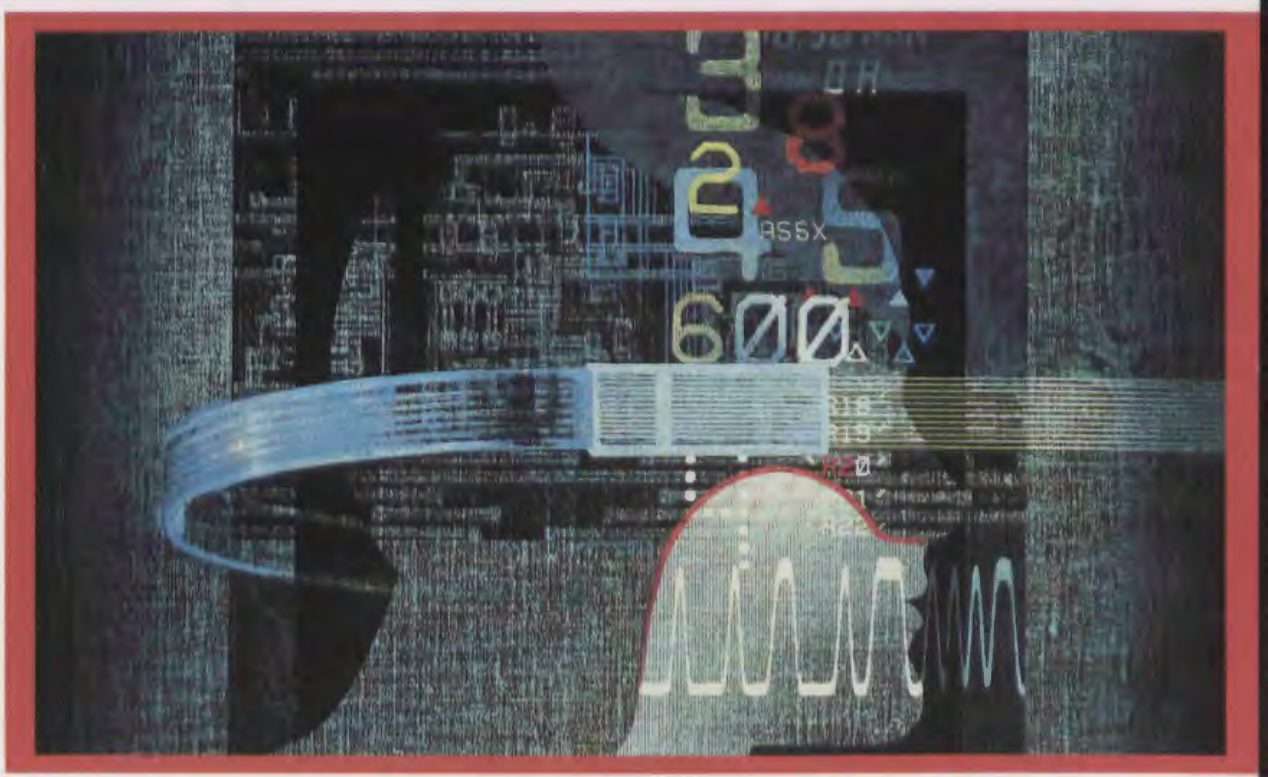

THE DEVELOPMENT OF HIGH TECHNOLOGY IN THE ASIA PACIFIC REGION

FOREWORD

The Asia Pacific region continues to be one of the fastest growing economic areas in the world. It is also one of the fastest evolving, as demonstrated by the dramatic changes in its economic structure during the last decade.

Historically, labor intensive industries have been the engines of economic growth in the region. At some point, however, the more developed nations face competition from the emerging economies in the region that have significantly lower labor costs. As the labor intensive industries, such as textiles and shoes, move to the emerging economies, future economic growth must be derived from industries based on increasingly sophisticated technology. These industries are referred to as high technology.

KPMG commissioned Investec (Taiwan) Ltd. to undertake this study, "The Development of High Technology in the Asia Pacific Region", to help assess the potential of these industries in the region.

It is our belief that high technology will play a large role in shaping the region's future; however, the viability and segmentation of these industries will vary greatly. Only those nations and firms best equipped to manage the challenges posed by these new technologies will define strong competitive positions in this decade and beyond.

"The Development of High Technology in the Asia Pacific Region" demonstrates KPMG's commitment to keep our clients and friends of the Firm abreast of worldwide economic and business trends.

S. Thomas Moser, Chairman
International High Technology Industry Group
KPMG
July 1990

The views expressed herein are those of Investec (Taiwan) Ltd.
and may not necessarily be the views of KPMG or any of its member firms.

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Overview

The Asia Pacific region has been, and continues to be, an environment characterized by change.

In the recent past, we have witnessed a dramatic restructuring of the region's principal economies as the labor intensive industries of Taiwan, Korea, Singapore and Hong Kong have lost their competitiveness to the region's emerging economies.

Japan faced this threshold in the mid eighties and has successfully managed the transition. Now, five years later, Korea, Taiwan, Singapore and Hong Kong face similar challenges.

As these economies have reached the critical juncture, they have recognized that future economic growth is dependent on their success in developing a group of vanguard industries that are commonly referred to as "high technology".

These nations have recognized that high technology will drive the region's economic growth and will play a significant role in defining the level of their nation's future living standards. High technology industries, therefore, have become the focus of the economic development efforts in the Asia Pacific region.

The prevailing view is that many Asian nations are entering this future with promise. This is based, in part, on their record of economic achievement of the last two decades. It is also based on the assumption that the strategies, institutional capabilities, and resources that supported these successes will be adaptable in the decades ahead.

As is often the case, the reality differs from the sentiment. While economies in the region have targeted high technology industries to propel them into the 21st century, none of the economies, except Japan, have the industrial and scientific infrastructure necessary to support the development of more than a few of these industries.

Secondly, the basis of competition in these high technology industries is defined along dimensions which are far more complex and difficult to manage than traditional industries.

In the decade of the eighties, competitive advantage was primarily

defined by lower labor costs. The Asian economies of Hong Kong, Taiwan, Singapore and Korea focused on the export of manufactured goods that could be produced at significantly lower costs than in the United States, their principal trading partner. The trade figures for the nine years from 1979 to 1988 reflect the success of this strategy. In 1979, the trans-Pacific trade was only US$43 billion. By 1988, the trade flow had grown by over six hundred percent to US$268 billion.

The nineties will be different. No longer will competitive advantage be defined by low labor costs. In the high technology industries, labor costs are a far less important determinant of "value". Competitive advantage will increasingly be defined on dimensions that are new to Asian firms. Integrating product technologies, managing multi-channel distribution, meeting sophisticated customer service standards and aggressively segmenting markets are skills that Asian firms must master if they are to succeed.

This study was undertaken to provide an overview of high technology industries in the Asia Pacific region and explore how companies and nations are adapting to the emerging competitive environment.

This study covers Japan, the four newly industrialized economies (NIEs) of Korea, Taiwan, Singapore and Hong Kong, the emerging NIEs, including Thailand, Malaysia, Philippines, and Indonesia, as well as China and Australia.

The study is directed at the national level. It is our belief that while the success of an individual company ultimately depends on management and financial resources, the environment in which companies operate greatly affects their ability to compete on an international basis. This is especially true of the Asia Pacific region, where government is an active participant in industrial development.

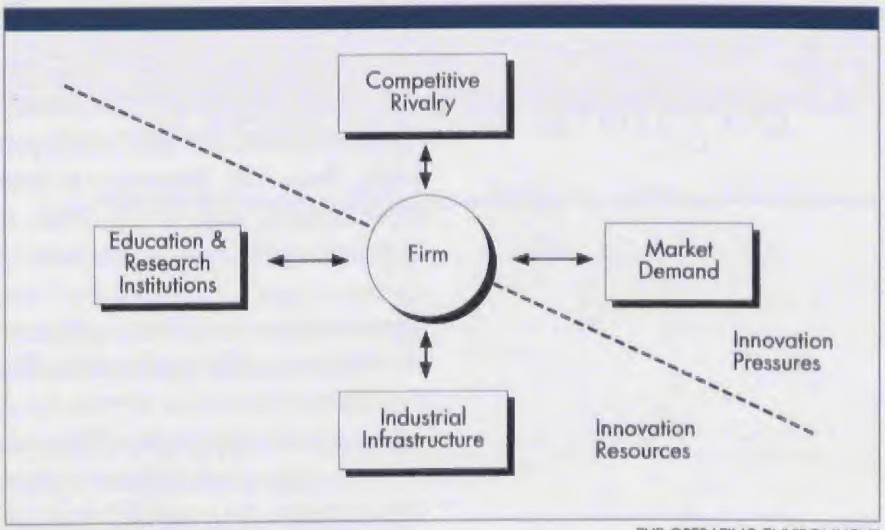
The scope of the study includes those industries which have become the focus of the economic development efforts in the Asia Pacific region. These industries include:

- Electronics and Information Technology
- Factory Automation
- Advanced Materials
- Telecommunications
- Aerospace
- Biotechnology

The methodology that was followed required us to first define the environmental characteristics that are necessary to build and sustain high technology industries.

In the process we observed that successful high technology industries must ultimately be driven by dynamic operating environments. These environments contain both the pressures to innovate and the resources to respond to these pressures.

As the diagram to the right shows, market demand and competitive rivalry are the forces behind the pressures that drive technological innovation. The industrial infrastructure, along with research and educational institutions, provide key resources to support an industry's ability to respond to these pressures for innovation.



THE OPERATING ENVIRONMENT

Sophisticated primary markets are essential for developing high technology industries as customer demands play a critical role in pushing industries to seek product innovation. The more sophisticated the demands, the greater the need to innovate. This need is intensified by domestic competition.

An illustrative case is the Japanese robotics industry. There are currently about three hundred firms in Japan competing in the largest and most sophisticated market in the world. This industry has been driven by aggressive customer demand in the automobile and electronics industries. Since the mid sixties, labor shortages forced these industries to invest heavily in process automation.

By the early seventies, the installed base of robots in Japan comprised over 60% of the world total. From this strong domestic base, the industry has been able to capture over 50% of the global market.

At the same time, we recognize that a dynamic operating environment must provide the resources that industries need to respond to these pressures to innovate. Japan's robotics industry, for instance, has both the industrial infrastructure as well as research and educational institutions needed to support the development of product and process innovation.

HIGH TECHNOLOGY: A DEFINITION

High technology industries are capital intensive industries in which sustainable competitive positions are significantly defined by continually high levels of product innovation.

These industries are characterized by high risk from:

- substantial R&D expenditures relative to sales
- decreasing product life cycles,

But offer participants the potential high returns through:

- market dominance
- market diversification.

All important components for the Japanese robotics industry are supplied by a strong industrial infrastructure of vendors. These Japanese vendors are international leaders in each of their industries, including computer numerical controllers, optical sensors, electronic components and machine tools.

Further support for the Japanese robotics industry is provided by research and educational institutions. More than 150 Japanese universities and colleges have robotics laboratories, and since 1983, the government has sponsored a multitude of research projects.

To summarize, operating environments play a critical role in the development of high technology industries. Specifically, these industries need to be driven by sophisticated domestic demand and intense domestic rivalry. These two factors create economic pressures that stimulate investment in research activities essential for product innovation. To respond to these pressures, industries need to be supported with key resources. These resources include well developed industrial and research infrastructures.

The Alternative Development Strategies

Nations in the Asia Pacific region have followed two distinct development strategies in the creation of an environment that nurtures and sustains high technology industries. The first strategy was pioneered by Japan and followed by Korea, while the second was defined by Taiwan and served as a model for other countries in the region.

In the **Japanese** strategy, the government orchestrated the acquisition and internal diffusion of foreign technology into its nascent high technology industries. At the same time, it protected the domestic markets from foreign competition.

By forcing the diffusion of new technologies into entire industries and by protecting domestic markets, the Japanese government created both competitive rivalries and strong primary markets. In so doing, pressures on individual firms to innovate quickly followed.

The government also played a critical role in developing the resources necessary for firms to respond to the pressures of innovation. Programs to improve the technological capability of small and mid-sized enterprises (SMEs) reinforced the positions of Japan's larger industrial companies. Engineering Research Associations were established by the government to help the private sector acquire the technologies necessary to move up the value curve.

The Japanese experience was characterized by strict government controls on the licensing of technology to ensure diffusion throughout an industry, the development of government supported research institutes to support critical industries, and an understanding of the important role of SMEs in building a dynamic operating environment.

Korea followed a variant of the Japanese strategy in the development of its high technology industries. Through strict controls on foreign investment, the government of Korea granted Japanese and American multinationals access to the Korean market in return for technology transfer and/or licensing.

The government actively directed multinational corporations looking to establish manufacturing operations in Korea into joint ventures or technology licensing arrangements with a small number of government sponsored companies, known as *chaebols*. By directing

foreign technologies and capital resources to a select number of competitors in key industries, the government was able to create both intense competitive rivalries and the scale required to compete on an international basis. The *chaebols* currently account for about 60% of all production and 90% of all exports.

Once the basic product technologies and process engineering skills were obtained from foreign manufacturers, the Koreans excelled in refining these to create very efficient production systems. By simplifying or "stripping" the acquired process technologies of the non-essential features that had been engineered over successive generations of development, the Koreans created a cost-efficient and highly reliable manufacturing base.

Korean companies then leveraged this base by focusing on the manufacture of a limited number of products where economies of scale and low labor costs could lead to significant cost advantages in the global marketplace.

Korea's success, to date, has relied on the transfer of technology from abroad. However, as Korea has emerged as a global competitor, there is an increasing reluctance by multinationals to continue technology transfer. And Korea's capability for creating a sustainable competitive position in many high technology industries is limited by a lack of skilled engineers and researchers necessary to develop indigenous technologies.

The first strategy was pioneered by Japan and followed by Korea, while the second was defined by Taiwan and served as a model for other countries in the region.

Innovation in Korea is also impeded by an industrial structure that has consolidated both research and development and capital resources into the small group of *chaebols*. In Korea, unlike in Japan, the role of SMEs in the creation of competitive high technology industries has not been well understood.

These impediments to the development of high technology industries have now been recognized by both the private and public sectors. The government, working in partnership with the *chaebols*, has defined a set of policy initiatives to address this perceived "crisis".

These policies seek to dramatically improve the training of engineers, to broaden the technology base, and to strengthen the industrial infrastructure through the diffusion of advanced technologies from the *chaebols* to the SMEs.

The **Taiwanese** strategy is characterized by a more passive government role in the development of the country's technology industries. Taiwan's strategy is markedly different from that pursued by Japan or Korea, in that the government played little direct role in the acquisition of foreign technologies.

Unable to force multinationals to transfer technology because of a relatively small domestic market, the government focused on encouraging multinational corporations to set up export processing ventures in Taiwan in the mid sixties.

Multinationals were initially attracted to Taiwan by a set of well conceived investment incentives and the availability of a large pool of inexpensive unskilled labor. However, in the early seventies, foreign investment increased to the point where the pool of available labor decreased significantly. The resulting wage pressures forced multinationals to transfer higher technology to their Taiwan manufacturing operations in an effort to maintain competitiveness.

Taiwan's strategy is markedly diffferent from that pursued by Japan or Korea, in that the government played little role in the acquisition of foreign technologies.

Through this process of technology transfer, skills were acquired by local technical and managerial staff that, by the late seventies, allowed them to leave the multinationals to start competing firms. It was this process of the transference of technical and management expertise from multinationals to local entrepreneurs that facilitated the diffusion of critical technologies into local industry.

As this process evolved with limited direct government involvement, Taiwan's high technology industries have been characterized by large numbers of small, very competitive companies. No Taiwanese manufacturers of high technology products have reached the scale of Korean or Japanese companies, which means that extensive

government support in research and development is necessary to sustain innovation.

The government has, since the early eighties, focused its resources on strengthening the education and research institutions necessary to support Taiwan's high technology industries. These institutes were designed to help local firms acquire "driver" technologies and to assist them in developing the skills required for continual process and product innovation.

The manufacturing base of Singapore continues to be dominated by subsidiaries of multinational corporations.

The Taiwan experience has served as a model for other developing economies in the region. Specifically, these economies have encouraged multinational investment, expecting foreign technology to diffuse through labor mobility into their domestic industries.

Singapore's development of its electronics and information technology industry is representative of the Taiwan experience.

As Singapore's pool of inexpensive, unskilled labor was small, multinationals were, early on, forced to transfer higher technologies into Singapore in order to maintain the economic viability of their subsidiaries. These transfers were particularly successful given the relatively high educational standards of the labor force and the quality of the infrastructure.

Curiously, unlike the development of high technology in Taiwan, this multinational skills transfer did not result in the creation of original equipment manufacturer (OEM) spin-offs by local entrepreneurs. The manufacturing base of Singapore continues to be dominated by subsidiaries of multinational corporations.

The government of Singapore is currently encouraging multinationals to localize research and development activities in Singapore. The government is also promoting indigenous research and development efforts in the information technology industry, as well as attempting to create domestic demand, in part, through a massive civil service computerization program. Through these efforts, Singapore expects

to create a domestic information technology industry that will be competitive in the international marketplace.

Hong Kong has been far more successful than Singapore in developing a broad base of local high technology companies, particularly in the electronics industry. However, we view Hong Kong's success more as the result of historical circumstance than the result of a well conceived strategy.

The development of Hong Kong's industrial base, including electronics, was a result of the large numbers of refugees fleeing the People's Republic of China in the late fifties and early sixties. The influx of over two million people, many of them skilled or semi-skilled, provided Hong Kong a pool of inexpensive labor.

The development of Hong Kong's industrial base, including electronics, was the result of large numbers of refugees fleeing the People's Republic of China ...

At the same time, American industry, under pressure from the Japanese, began to locate production of textile, footwear, toys and consumer electronics in lower cost countries such as Hong Kong, Singapore and Taiwan, generally working on an OEM basis or in cooperation with local trading companies.

Hong Kong's electronics industry is still today almost entirely based on OEM arrangements and as such is ill equipped to make the transition to higher value production. Private research and development funding is insignificant and the government has not taken a significant role in the promotion of technical education or product research. Hong Kong's industry has avoided investment into the research necessary to acquire technical sophistication.

Hong Kong's answer to the competitive pressures that have resulted in increased investment in process technologies in Japan, Korea and Singapore, was to move production to the special economic zones in the People's Republic of China to benefit from lower wage costs.

Therefore, the success of Hong Kong's local high technology companies does not seem sustainable. It is our expectation that Hong Kong will not play a significant role in the future development of the

region's high technology industries, but will instead revert to its traditional economic role as an entrepôt to China.

The emerging NIEs, that is, **Malaysia**, **Thailand**, the **Philippines** and **Indonesia**, are at the early stages of development for their technology industries. All still have large pools of skilled and unskilled labor that are attractive to manufacturers seeking low cost environments for labor intensive production.

The emerging NIEs, that is, Malaysia, Thailand, the Philippines and Indonesia, are at the early stages of development for their technological industries.

As these labor pools are depleted, wages will begin to rise and multinationals will have to increase the transfer of both process and product technologies to their subsidiaries in order to maintain financial returns. Given the availability of trained English speaking engineers, the Philippines is perhaps the best equipped of all the NIEs to assimilate this technology. Political upheaval, however, has severely undermined the willingness of multinationals to expand their investments in the country.

Both Malaysia and Thailand have seen growth in foreign investment, particularly in the electronics industry. As a result, both are now suffering from a severe shortage of skilled engineers. This shortage will inevitably limit both the introduction of foreign technology and its diffusion to the nascent domestic electronics industries.

Indonesia, which until recently has had very restrictive foreign investment regulations, lags behind the other NIEs in the development of high technology industries. As foreign investment continues to increase, the limited supply of engineers and scientists will impede progress, as is currently occurring in Malaysia and Thailand.

Electronics and Information Technology

Electronics and Information Technology (IT) is the principle high technology industry in the Asia Pacific region. While the term electronics covers the components and hardware products in the industry, IT generally refers to software and system designs used for the management and manipulation of information.

Japan has clearly achieved international leadership in the development of many critical technologies in this industry. It has also successfully created the capabilities to promote future technological innovation.

The NIEs, meanwhile, have begun to invest heavily to build the research and industry infrastructures required to support the development of new technologies. Hong Kong, however, is an exception. Its industry continues to move offshore to the low cost labor environment of China rather than invest in the research and development required to maintain competitiveness.

The emerging NIEs are now in the process of trying to leverage the significant multinational investment in their countries in an effort to create domestic industries. Their success will depend on the ability to develop the human resources required to assimilate this foreign technology and diffuse it into their industries.

JAPAN

Japan clearly dominates the industry in the Asia Pacific region. It has established itself in the international market through superior process technology and, increasingly, through product innovation.

Japan's semiconductor industry is particularly noteworthy. It is leading the development of the next generation of microchips, as well as the process technology required to commercially produce them. As such, it provides an excellent example of the development of technology in Japan.

The Japanese electronics industry was built by concentrating on products where economies of scale largely defined competitive advantage. This "cost-leadership" strategy was appropriate given that cost was the only dimension with which Japanese companies could initially compete in the advanced markets of the United States.

The Japanese electronics industry was built by concentrating on products where economies of scale largely defined competitive advantage.

As Japanese companies have moved into high technology industries, they have maintained their initial focus on products such as memory chips where economies of scale can lead to significant cost advantages.

The cornerstone of the Japanese semiconductor industry was laid in 1963 when NEC sub-licensed technology that it had acquired from the US firm, Fairchild. This planar technology was purchased by Kyodo Electric, Mitsubishi Electric, Toshiba, Fujitsu, Oki and Sharp and was utilized for a rapidly developing calculator market.

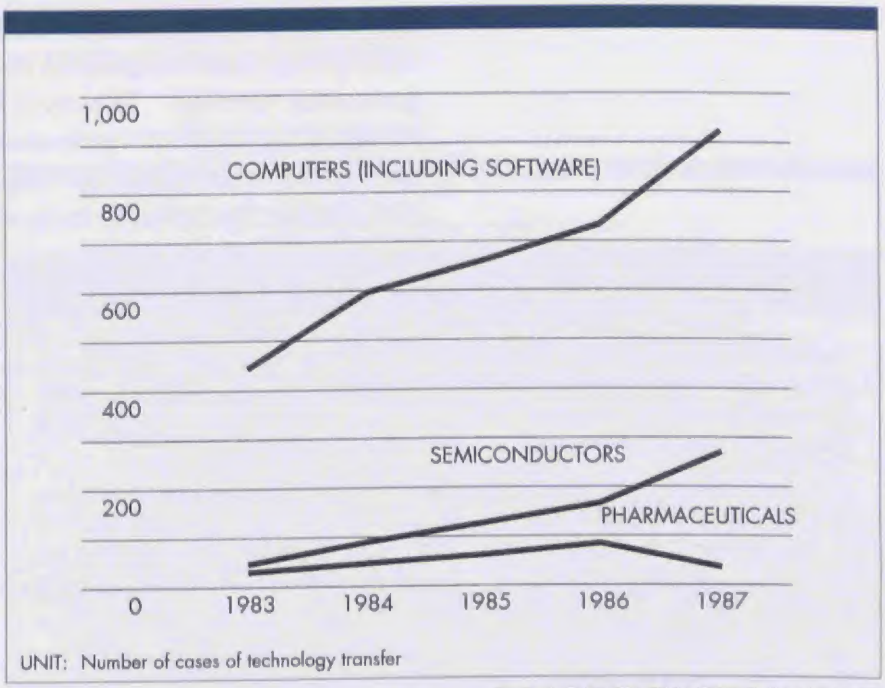
The second major technology transfer to the Japanese industry was in 1968 when Texas Instruments agreed to license its integrated circuit technology to Hitachi, Mitsubishi, NEC, Sony and Toshiba. This agreement was made in return for long denied market access. Under the terms of the agreement, Texas Instruments was allowed to set up a joint venture with Sony and sell limited amounts of ICs to the Japanese semiconductor market.

In the early seventies, the Ministry of International Trade and Industry (MITI) began to lower the protective trade barriers that the Japanese semiconductor manufacturers had enjoyed during the previous decade. These actions were in response not only to political pressure from the US, but also as part of a strategy to transform the Japanese economy from heavy to knowledge intensive industries.

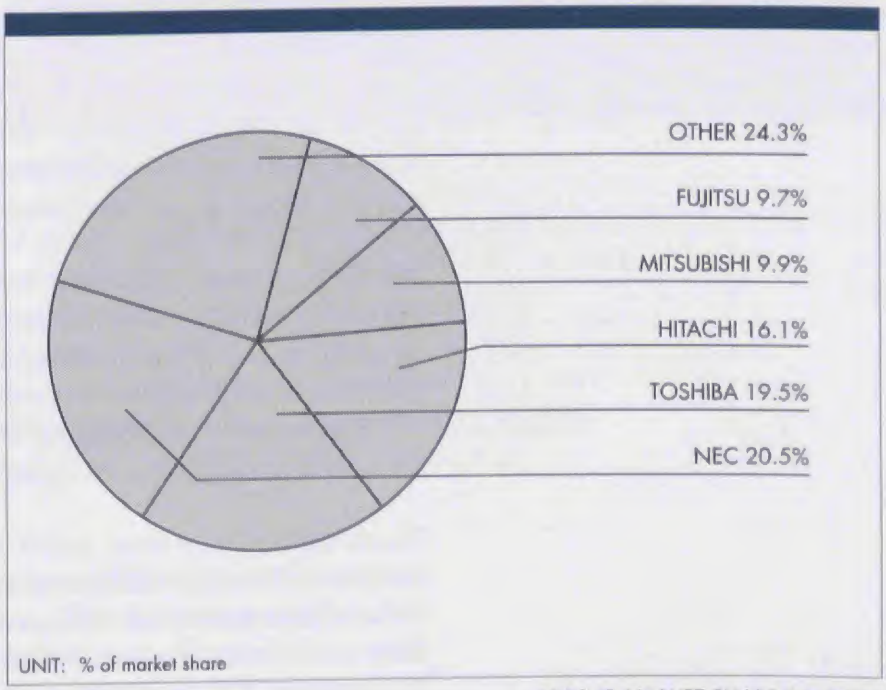
This new competitive environment forced Japanese IC manufacturers to both reduce production costs and dramatically increase research and development expenditures. These expenditures were essential to face the technological challenge from the US.

The Japanese focused their research efforts on the emerging metal oxide semiconductor (MOS) integrated circuit technology, and in so doing conceded the bipolar IC market dominated by the US manufacturers. NEC led this research and by 1975 was able to establish itself as the leading IC manufacturer in Japan.

In 1975, Japan began a program to develop the next generation of ICs, known as very large scale integrated (VLSI) circuits. This program proved to be the watershed for the Japanese IC industry.



TECHNOLOGY TRANSFERS IN JAPAN'S HIGH TECHNOLOGY INDUSTRIES
Source: Japanese Institute of Science and Technology



1988 IC MARKET SHARE IN JAPAN
Source: Japan: An International Comparison, 1990

The program established the VLSI Technology Research Association with a four year mandate to develop the technology for the next generation of chips. The Association was given a US$300 million budget and involved government agencies, Fujitsu, Mitsubishi Electric, NEC and Toshiba. Supplementing the direct government funding were interest-free loans worth approximately US$320 million.

THE 64 MEGABIT CHALLENGE

Japan is a world leader in integrated circuits. Currently 4Mb DRAMs are in production; 16Mb DRAMs are slated for introduction in the next three years. The frontiers of Japan's current research in this field, however, are being defined by 64Mb DRAMs.

A critical technical threshold must be crossed, however, to successfully develop the 64Mb DRAM. Where the line width that is etched in the silicon chip is 0.8 micron for the 4Mb chips, the line width must be reduced to less than 0.3 microns for the 64Mb chip. Optical light sources, however, are incapable of exposing lines this thin during the lithographic process.

Successful etching of the 64Mb chip in a mass-production environment, then, will depend on the development of particle accelerators called "synchrotrons". Synchrotrons permit the etching of very thin lines on chips.

Having recognized the importance of synchrotrons, Japanese firms are investing heavily to develop them. Thus far, an estimated US$500 million has been committed by private industry for this task with Nippon Telegraph and Telephone (NTT) leading the charge. NTT has already built the country's first two synchrotrons, and are now using these machines for etching chips with a line width of 0.35 microns - just .05 microns from crossing the most significant hurdle to the development of the 64Mb DRAM.

The VLSI program helped focus and financially support the research efforts of the Japanese IC manufacturers. From 1976 to 1981, research expenditures averaged 11% to 17% of sales. These investments, combined with massive capital equipment expenditures in the early eighties, allowed the Japanese to establish technological parity and strong competitive positions in the IC industry.

Japanese manufacturers currently command 80% of the world market for dynamic random access memories (DRAMs). Flush with financial resources from a strong world demand in 1987-88, manufacturers are investing heavily to secure the technological and manufacturing advantages necessary to control their market position.

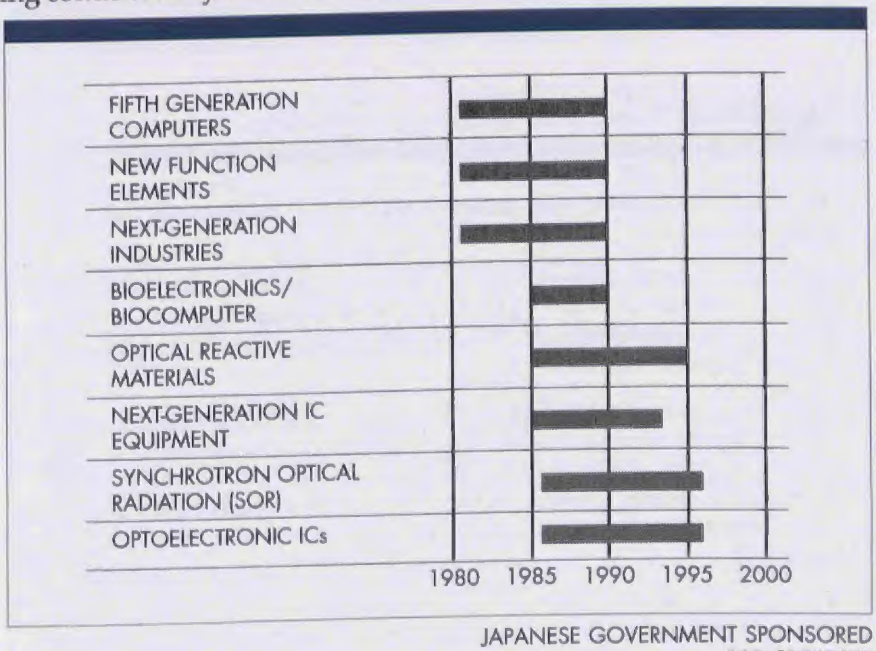
While the Japanese have held a commanding position in consumer electronics and memory chips, they have been relatively weak in developing both computer designs and software. As a result, Japanese chip manufacturers have aggressively sought technology from start-up companies in the United States. These transfers have been structured as licensing arrangements or as direct investments.

These agreements have given the Japanese access to new chip designs, such as application specific integrated circuits (ASICs) and reduced instruction-set computing (RISC). These chips, particularly RISCs, are critical for the next generation of computer design.

To overcome their relatively weak position in computer design and software and thrust themselves into a leadership position at the

technology frontier, the Japanese have embarked on an ambitious plan to design what they refer to as a "fifth generation" computer.

The research for this computer is being conducted by the Institute for New Generation Computer Technology (ICOT). This research is focused on developing software and hardware expertise. ICOT's goal is to create high level artificial intelligence programs that will work in a sophisticated parallel processing architecture.



JAPANESE GOVERNMENT SPONSORED R&D PROJECTS
Source: MITI

The Japanese investment in another area of computer research, however, has more immediate commercial applications. Led by Omron, a Kyoto-based manufacturer of industrial controllers, the Japanese are aggressively investing in "fuzzy" programing and chip design.

Fuzzy systems allow for the analysis of a multitude of inputs. This analysis, in turn, creates outputs that can control incremental change. These systems are expected to find widespread applications in consumer goods, such as air conditioners, cars and cameras, as well as for industrial automation and process controls.

Japanese firms have also invested over US$700 million for the research and development of high definition television (HDTV). The research effort began in the early seventies and has focused on the integration of digital signal processing and image storage techniques with video technology. This early commitment has established Japanese technological leadership and defines a strong competitive position in a market that is estimated to reach US$25 billion by the year 2000.

The Japanese electronics industry is being driven by an increasingly sophisticated domestic market. The Japanese market for supercomputers, for instance, is growing at almost 30% a year. Combined with the strong domestic competition in a multitude of product segments, Japan's electronics industry faces strong pressures for technological innovation.

To meet these pressures, the industry is able to draw critical resources from its highly developed industrial and research infrastructures. Its vendors, for instance, have not only achieved technical sophistication in their own right, but have become closely integrated with the inventory management systems of their customers. The electronics industry has also been supported by a multitude of government research projects. Along with providing financial support, these projects have helped the industry focus its research efforts on the driver technologies that will significantly define future product innovation.

In conclusion, the Japanese electronics industry has developed what is, perhaps, the most dynamic operating environment in the world and is well positioned to sustain future market and technological leadership.

SHORTAGE OF SOFTWARE ENGINEERS

Last year, sales in Japan's software industry topped the one trillion yen mark (US$7.7 billion). Though small by US and European standards, it represents a breakthrough for the Japanese software industry. Sales should continue to grow by a robust 23% or more for the next few years, but these figures would undoubtedly be higher if Japan did not suffer from an acute shortage of skilled software engineers.

Much of the increased demand for programers comes on the heels of deregulation in the financial industry. Japan's big banks and brokerage houses, for instance, need new programers to take advantage of opportunities derived from the changing business environment.

Additionally, many of these organizations use what is known as third-generation on-line integrated computer networks. In the past, software was a small portion of the system cost. With advanced networks, however, software comprises up to 80% of the system. Costing roughly US$500 million each, these computer systems need a small army of programers to meet their specialized software needs.

There are, however, few software companies to meet the increasing need. Software engineers traditionally worked for hardware firms or their subsidiaries to develop software packages for their systems. There was little demand for specialized software designers.

This, however, is changing, and at this point it is still unclear how the industry will meet the increased demand. For the time being, users will undoubtedly bear the cost of the industry's inadequacies. But in the future, look to Japan to develop ways to streamline the programing process.

KOREA

Korea's electronics and IT industry is similar to Japan's in that it has focused on the development and commercialization of products where economies of scale largely defined competitive advantage.

At the forefront of the development of Korea's electronic industry is the semiconductor. In 1989, it was the largest single product group exported from Korea, valued at US$4 billion. It has also been the focus of the research and development activities of the government and the three largest *chaebols*: Samsung, Lucky-Goldstar and Hyundai.

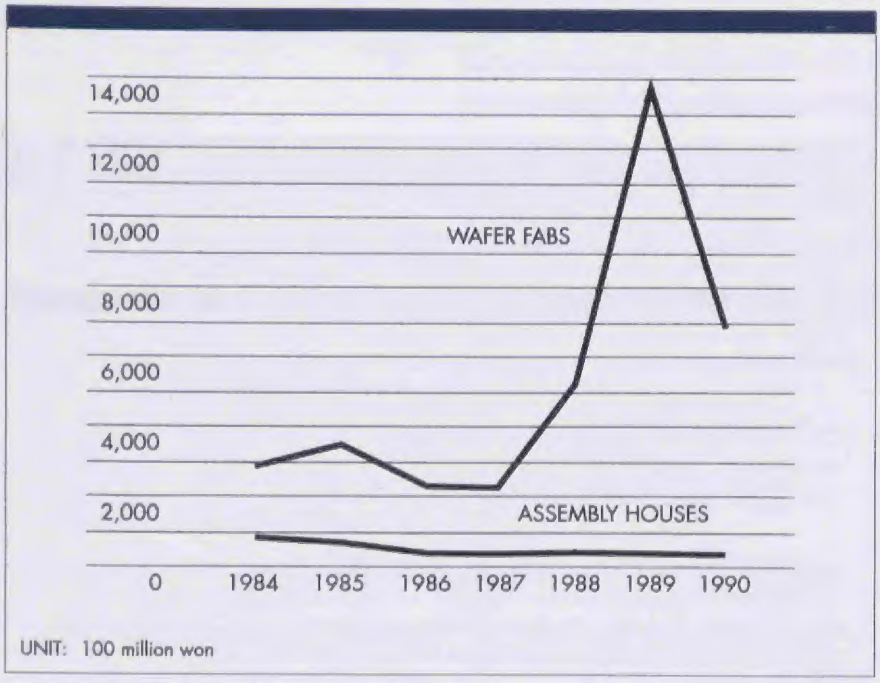
...during the mid eighties Korea aggressively sought licensing agreements with small and medium sized IC manufacturers in the United States.

Initial efforts by Korea to enter the semiconductor industry were focused on the development of logic chips. However, success was frustrated by the lack of design capability and the industry never flourished. To establish the technological base of its industry, then, during the mid eighties Korea aggressively sought licensing agreements with small and medium sized IC manufacturers in the United States. These manufacturers were quite willing to sell their technology as they were struggling for survival in a severely depressed market.

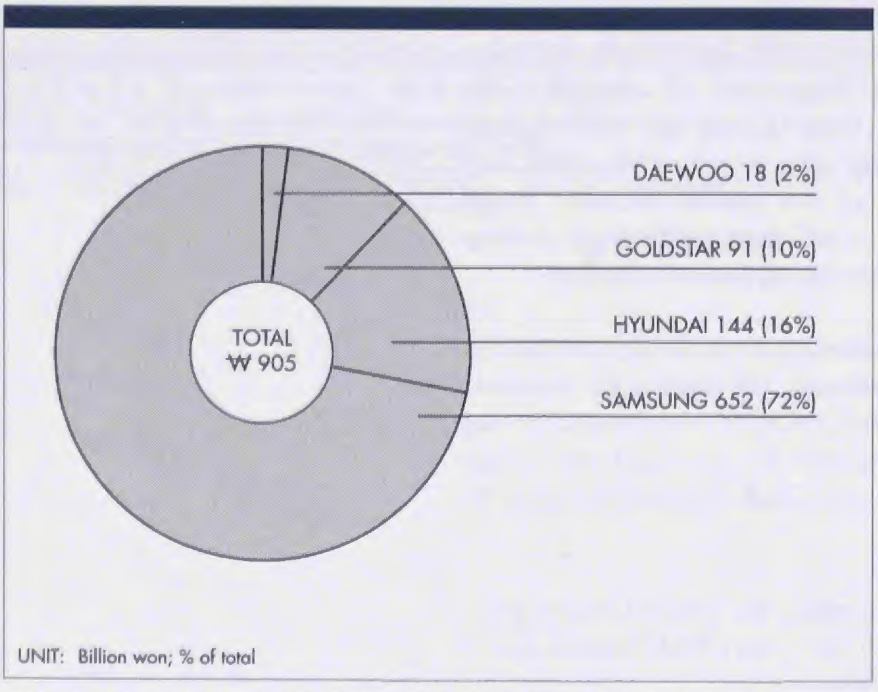
This technology allowed Korean semiconductor manufacturers access to the memory chips market, in particular, the market for dynamic random access memory (DRAM) chips. DRAMs are commodity-like products that offered the manufacturers the opportunity to pursue the cost leadership strategies that they had successfully used to penetrate other industries.

At the same time that Korea was looking for DRAM technology, many American IC producers were looking for OEM manufacturers to act as a second source of production.

Samsung Electronics, for instance, currently has licenses with Texas Instruments, Semiconductor Manufacturing Corporation, Motorola,



INVESTMENT OF KOREAN CHIP MAKERS
Source: MITI



1988 SEMICONDUCTOR SALES OF FOUR MAJOR KOREAN CHAEBOLS
Source: Electronics Korea

Hitachi and Philips. Approximately 70% of its semiconductor business is memory chips. Hyundai Electronics has an agreement with Texas Instruments to produce both 256K and 1Mb DRAMs on an OEM basis. And Goldstar recently signed an agreement with Hitachi to obtain technology and manufacturing expertise for the production of 1Mb DRAMs.

As Korea's *chaebols* have developed, they have found the acquisition of new technology from foreign sources more difficult. Given the manufacturing successes that these companies have achieved, foreign competitors are reluctant to license new technology without some form of reciprocity. The *chaebols*, however, are relatively weak partners for joint development programs or technology exchanges.

As a result of the increased reluctance of foreign companies to license advanced technologies, the private and public sectors have had to focus on the development of indigenous technologies. To develop these technologies, the Koreans formulated a development program that mirrored the industrial policies of the Japanese.

The VLSI program, dedicated to developing the technology

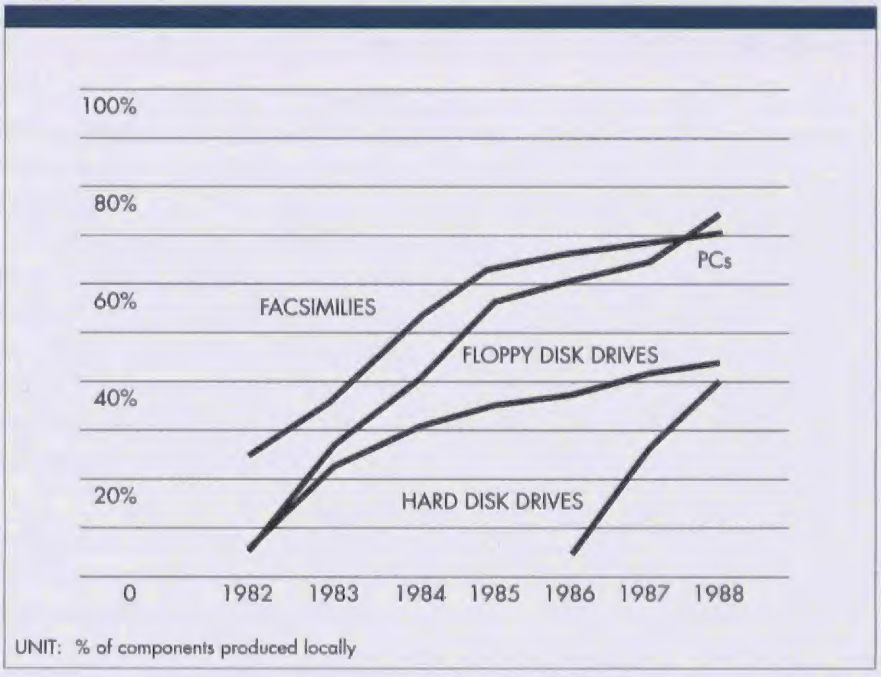
required to manufacture 4Mb DRAMs, is an example of the government's efforts in this area. This program is coordinated by the Electronics and Telecommunication Research Institute (ETRI) under the Ministry of Science and Technology (MOST) and involves Samsung, Goldstar and Hyundai.

The importance of this program was not the public funding that it provided, as government funds represented only about one tenth the total research and development investment, but rather that it helped focus the research efforts of the *chaebols*.

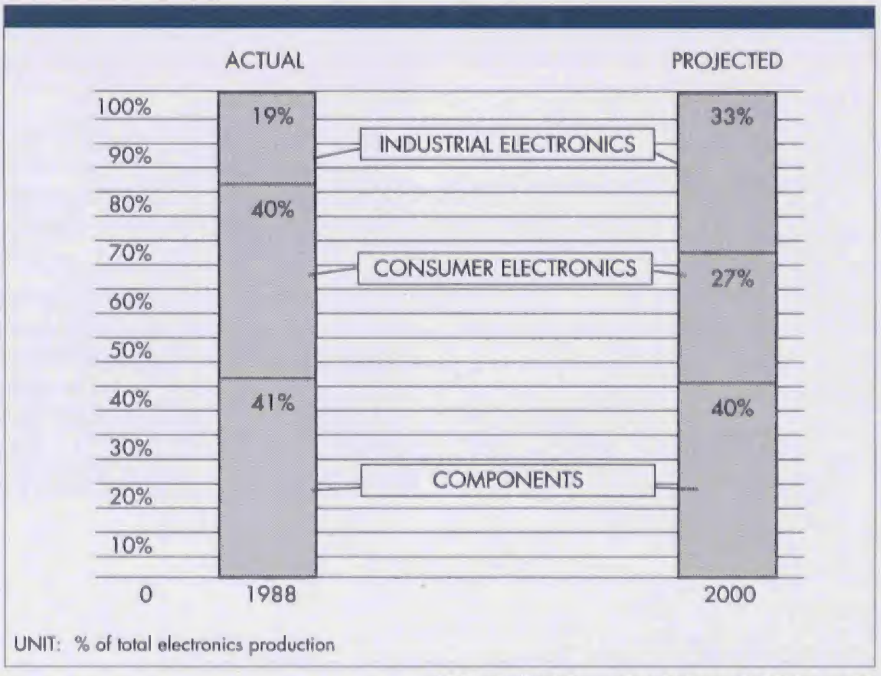
Recently, the results of this research activity have begun to bear fruit. Samsung has been the first to commercialize 4Mb DRAM production. Goldstar has developed a prototype, but has yet to perfect the process technology to translate it into production. As of Spring 1990, only Hyundai had been unable to develop a prototype.

While Korean semiconductor companies have enjoyed some success in developing products like the 4Mb DRAM, it will be some time before Korea will be able to institutionalize the capabilities for new product "inventive" innovation.

Like in Japan, research and development efforts in Korea are concentrated in the major



DOMESTIC CONTENT OF SELECTED KOREAN ELECTRONICS GOODS PRODUCED LOCALLY
Source: Electronics Korea



SEGMENTATION OF KOREAN ELECTRONICS PRODUCTION 1988 VS. 2000
Source: Electronics Korea

GOLDSTAR

Since the early seventies, Goldstar's electronics companies began forming joint ventures to access technology. They sought to reduce their dependence on overseas suppliers by sourcing up to 95% of key components and subsystems from domestic vendors. The vision was to make Goldstar's various electronics sub-groups a contained business organization. Under this policy known as *Inhua*, Goldstar companies would, in effect, source components from "in-house" suppliers.

Although the group has nearly reached its goal, some products are no longer as competitive. While Japanese and domestic competition can source quality components at the best market prices, Goldstar has had to buy from the group, thus locking Goldstar companies into Goldstar component suppliers.

The result is that there is a difference between products made from Goldstar components and those made from imported components. An export bound computer made from foreign components, for example, costs notably less than a computer made from domestic components, and the quality is considered higher.

Recently, company officials have attempted to abandon the *Inhua* policy, but the company's political structure is not conducive to rapid change. Goldstar has also increased its spending on research and development and actively promoted the development of a small and medium sized business class from which to source competitively priced locally made components.

These steps are indicative of Goldstar's sincerity in reducing the dependence on imported technology without sacrificing quality. They are strong signs that Korea's electronics industry is capable of making needed changes toward strengthening its position in world markets.

industrial groups. As with many large corporations, the *chaebols* are not successful in creating the entrepreneurial energy required for "inventive" innovation.

This type of innovation is, instead, generally found in start-up companies. In an attempt to rectify this shortcoming, the three major semiconductor *chaebols* have set up R&D facilities in California to tap the innovations being generated out of Silicon Valley and to move up the technology curve.

Innovation is only one of several significant challenges that Korean semiconductor manufacturers face as they move to develop the technologies for products such as the 4Mb DRAM.

Among these challenges is the large capital investments that the manufacture of higher density chips requires. Not only are the initial equipment costs large, but the economic life for this equipment is extremely short. As an example, the construction of a wafer fabrication facility producing 30,000 wafers per month, is approximately US$250 million. Due in part to the contracted product life cycles for DRAMs, production equipment has only a three year life cycle.

These high capital requirements must be met in a financial market where long term debt costs about 12%, versus 6-7% in Japan.

Research and development costs are also increasing as the design and manufacturing requirements for ultra large scale integrated (ULSI) circuits heighten. Here, again, the Koreans face a strong challenge from the Japanese, as the Japanese are able to support this research with a much larger revenue base. The Japanese currently control about 80% of the DRAM market.

Finally, the market segments in which Korean companies plan to compete require a more complex level of operation. The industry expects that the relative importance of the industrial electronics sector will increase significantly in the next ten years (to 33% of total production in the year 2000 from the current level of 19%) and that consumer electronics will decrease in importance.

This transition of resources from consumer to industrial electronics, however, will hold new challenges for Korea. Industrial electronics require an integration of product technologies, aggressive market definition, and a level of customer service quite different from the commodity-like markets where Korean companies have traditionally competed.

SAMSUNG ELECTRONICS CO.

Recently, Samsung Electronics Company announced that it has completed construction of a research institute for ultra large scale integrated circuits. The goal is to develop 16Mb and 64Mb dynamic random access memory chips (DRAMs).

Mass production of 16Mb DRAMs is significant for Korea's chip industry because it indicates the narrowing of the gap between Korea's chip makers and the industry leaders in the United States and Japan. DRAMs are considered the driver technology behind the electronics industry's most important component - integrated circuits.

The importance of the effort is further reflected in the government's participation. The 16Mb DRAM was designated as a joint research project between the Ministry of Science and Technology and Samsung. The government has pledged about 56 billion won and slated completion for 1993. Later, in light of reports that Samsung has already developed the 16Mb chip, the project was expanded to include 64Mb chips.

TAIWAN

Taiwan's electronics industry is characterized by a large number of small, competitive companies, who have created a significant position in the world's electronics industry. In 1988, Taiwan produced 16 % of the world's computer components and peripherals.

Taiwan's electronics industry has followed a strategy of small firms focusing on selective market niches.

Taiwan's electronics industry has followed a strategy of small firms focusing on selective market niches. Companies have traditionally focused on the manufacture of components or peripherals, where the companies' smaller size and ability to adapt to changing market trends are a source of competitive advantage.

Taiwanese electronics manufacturers have their origins in the multinationals that were attracted to Taiwan in the early sixties. Local entrepreneurs were able to acquire the critical management and technical skills that were necessary to start their own operations by working for multinationals. Unlike Korea and Japan, it was not the government, but Japanese and American multinationals, then, who primarily facilitated the diffusion of critical technologies into local industry.

The first spin offs were engaged in OEM manufacture and assembly of electronic components, primarily transistor radios and televisions. Over time, and with government assistance, these local companies began to manufacture higher margin computer and computer related equipment. Manufacturers went from producing picture tubes to monitors and from television sets to information hardware.

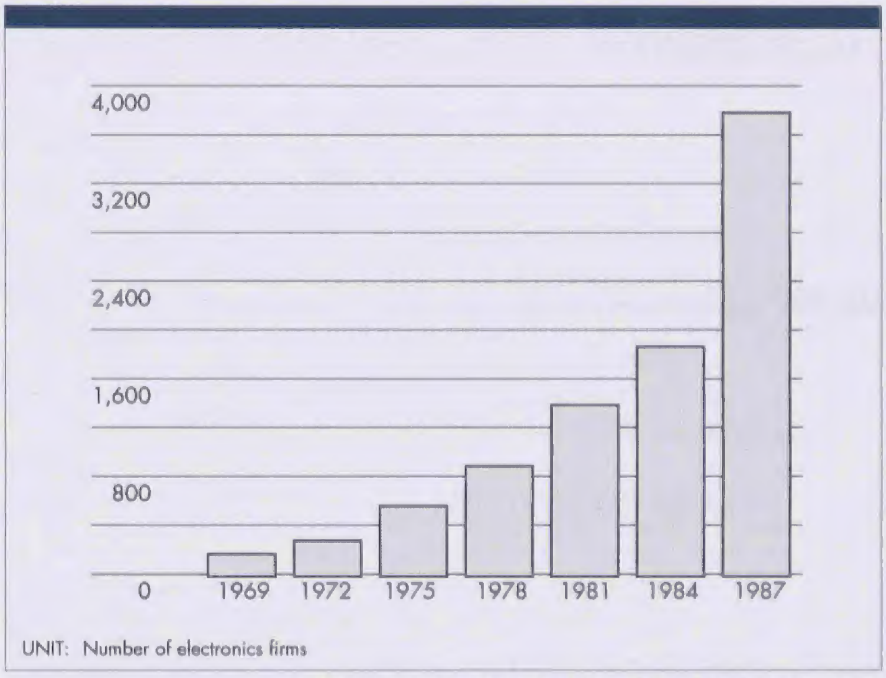
Today, Taiwan's computer industry consists of almost two hundred small and medium sized assembly operations. Of these companies, about 150 are manufacturing 286-based PCs while 125 companies are making 386-based computers. Only a handful are still producing the older generation XT type personal computers.

As the industry has matured, a few firms have made the leap to manufacturing branded products and have emerged as industry leaders. The role of the government-funded research institutes in this process has been critical and is illustrative of the pattern of Taiwan's development.

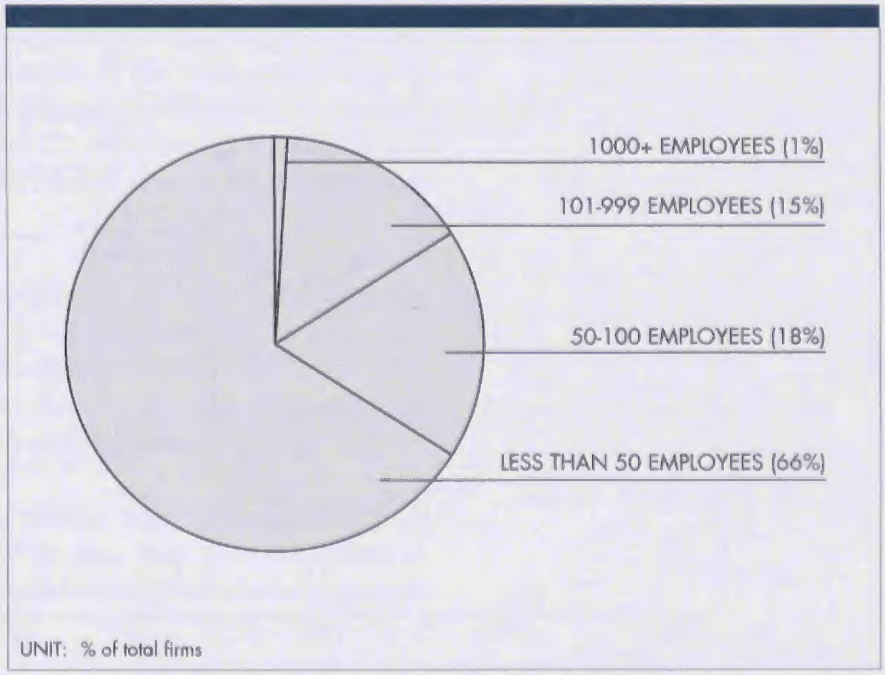
For example, in 1984 Sertec International developed a 16 bit PC system with the support of the Electronics Research & Service Organization (ERSO), a government funded research laboratory. Later, Sertec joint-ventured with Continental Engineering Inc. to form Multitech Industrial Corp. to commercialize this 16 bit PC technology under the Acer brand name.

In 1988, Multitech became the first company in Taiwan to develop a 32 bit PC system and entered into an OEM contract with Texas Instruments to produce the Acer series in the United States. Acer now sells worldwide, 60% under its own brand name.

As was the case with Acer, extensive government support in research and development has been necessary to sustain innovation within Taiwan's IT industry. Government laboratories have allowed industry to gain access to key technologies and product designs. This access was



NUMBER OF TAIWANESE ELECTRONICS FIRMS 1969 - 1987
Source: Taiwan Electric Appliance Manufacturers' Association



TAIWANESE ELECTRONICS FIRMS BY NUMBER OF EMPLOYEES – 1987
Source: Taiwan Electric Appliance Manufacturers' Association

ACER

In Taiwan's PC industry, success is breeding confidence. Acer, Taiwan's largest and most successful computer manufacturer has grown by nearly 100% every year since its founding in 1984 and is now charging overseas to gain world market share.

In the last year alone, Acer was involved in eleven acquisitions and partnership agreements in six different countries - mostly as a move to access foreign markets and technology. This is part of a global strategy that goes back to 1988, when Multitech, Acer's parent company, won an OEM contract with Texas Instruments to produce the Acer series in the United States. Currently, the Acer line is sold worldwide - 60% under its own name brand.

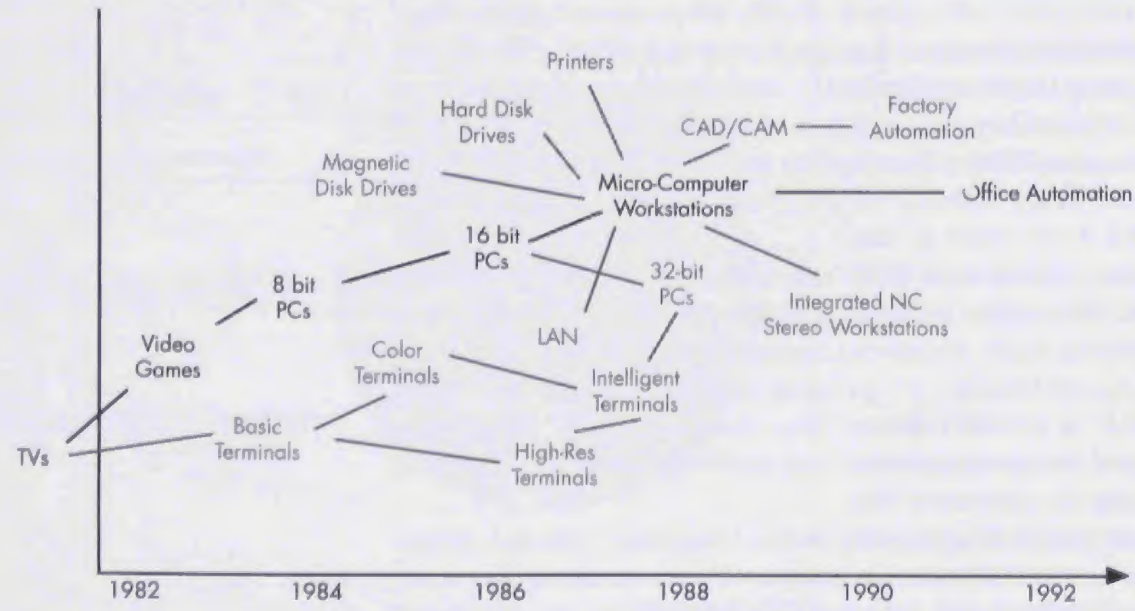
In a recent and as yet its boldest move, Acer is engaging in another joint project with Texas Instruments, this time to manufacture dynamic random access memory chips (DRAMs). Acer will finance most of the US$250 million plant and own 74%. Texas Instruments in turn will purchase all of the chips and supply up to fifty percent of the factory's production back to Acer.

The Texas Instrument/Acer joint venture is seen as a move by Acer to secure its supply of memory chips and strengthen its relationship with Texas Instruments. In 1988, when world supply of DRAMs ran short, it cost Acer up to 25% in lost sales. With this threat removed, and a network of strategic alliances in place, Acer has significantly strengthened its position in the highly competitive personal computer industry.

important as the private sector has historically been unwilling to assume the risks of product research and development.

While the success of Taiwan's computer and peripheral manufacturers has merited praise, the emergence of Taiwan's integrated circuit (IC) sector in the late eighties is, perhaps, a better measure of the electronics industry's future.

In the last ten years, Taiwan's IC industry has grown from simple experiments in government laboratories into a significant world competitor. Taiwan is now home to over 40 design houses and 10 wafer fabrication plants.



INTEGRATION OF TAIWAN'S ELECTRONICS INDUSTRY
Source: National Science Council

The industry was born in 1976, when ERSO contracted with RCA for metal oxide silicon (MOS) technology with which to "seed" IC design and manufacturing capabilities among local companies. Three years later, ERSO transferred the technology and trained personnel to the United Microelectronics Corporation (UMC), the first of several such recipients. Today, UMC is Taiwan's largest IC manufacturer and in 1989, the 33rd largest IC fabricator in the world.

The traditional focus of these local IC manufacturers has been on logic and static random access memory (SRAM) chips. By international standards these are low end chips, for use in electronic games and toys. In a recent effort to upgrade Taiwan's technology base, Acer and Taiwan Semiconductor have established joint ventures with Texas Instruments and Philips to manufacture 4Mb DRAMs.

Taiwan's forty design firms...have been able to develop a profitable base of business by avoiding the volume segments where competition is defined by cost.

These joint ventures provide Acer and Taiwan Semiconductor with the technology and engineering support necessary to make world class chips and ensure a supply of products for Taiwan's computer and peripheral industries. These ventures also provide an interesting contrast to the development of the IC industry in Korea, where foreign manufacturers have been reluctant to license the technologies required to produce DRAMs.

While IC fabrication is gradually developing in Taiwan, the country is unlikely to develop into a world class competitor in this area. The opportunity lies instead in IC design where the nature of the industry allows Taiwan design firms to serve defined market segments that require a high degree of specialized product innovation.

Taiwan's 40 design firms have a strong base of experience in application specific ICs (ASICs). In this area they have been able to develop a profitable base of business by avoiding the volume segments where competition is defined by cost.

The competitive strategy of Silicon Integrated System Corporation (SIS), one of Taiwan's leading design firms, is a representative example. SIS makes 4Mb mask read only memory (ROM) ASIC chips

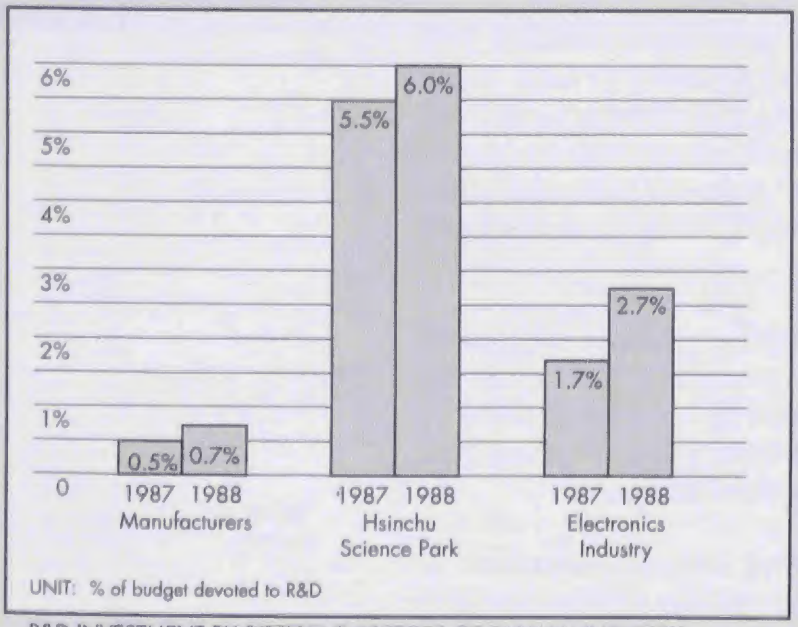
HSINCHU SCIENCE PARK

Possibly the most tangible result of the government's high technology promotion strategy is the Hsinchu Science Park. Located 70 kilometers south of Taipei, the Park hosts most of Taiwan's high technology companies and is the nucleus of high technology in Taiwan. Purposely located near the Industrial Technology Research Institute and Taiwan's two major engineering universities, firms in the Park have access to Taiwan's best and brightest engineers and researchers.

Established in 1980, the Park was designed to reduce some of the risks and startup costs for firms in high technology industries. Prefabricated facilities known as "incubators" are available for small firms who otherwise could not afford to get started, and established firms can lease rather than buy land on which to build.

Additionally, Taiwan's venture capital industry was originally established to help firms in the Science Park get started. Roughly 40% of the Park's startups received venture capital funding.

Perhaps more important, however, the Park's dynamic and "modern" environment is spearheading the national effort to attract overseas Chinese. Engineers and marketing managers, toting years of decorated experience in top US firms, including Intel and IBM, are drawn back to their mother country partly by the call of patriotism, but more so by the opportunity to manage or play a significant role in a new wave of very progressive companies. Already there are an estimated 600 US trained managers and engineers working in the Park.



R&D INVESTMENT BY DIFFERENT SECTORS OF TAIWAN INDUSTRY
Source: Far Eastern Economic Review

and 386 based chip sets. Without its own foundry, SIS has been forced to concentrate on segments too small for its Japanese and Korean competitors. The company focuses on secondary markets in Asia where it can define a competitive advantage through service and quality of design rather than cost.

It should be noted, as with the development of the 16 bit PC technology, that the government research institutes have played a major role in establishing Taiwan's IC design houses. ERSO is credited not only with providing the technology for Taiwan's multitude of IC design houses, but also for providing the core of researchers and IC designers to staff these firms.

This fact highlights the government's increasing role in the development of high technology industries. Given the small size of Taiwanese companies and their historical reluctance to commit resources to research and development, government support has been and will continue to be critical. As a comparison, the level of government funded research and development as a percentage of total research and development expenditures is 60% in Taiwan versus only 40% in Korea and 35% in Japan.

This continued reliance on government funded research

projects, the small size of the companies and weak linkages to overseas end-user markets are factors that limit the strategic directions available to Taiwan's electronics and IT industry.

Taiwanese companies, in their role of OEM suppliers, have had little experience in managing distribution, marketing or customer service. Equally important, they have traditionally stood at arms length from their end-user markets. Thus, few Taiwanese companies will ever grow to the scale where they are competitive on an international basis in finished products, such as workstations, high-end computers or high definition television (HDTV). In those product areas where they do manufacture finished products or commodity-like products, such as DRAMs, Taiwanese manufacturers will continue to focus on secondary markets or will join with foreign multinationals.

VALUE OF TAIWAN'S INFORMATION INDUSTRY EXPORTS
Source: 1989 Information Industry Yearbook

Balancing this somewhat guarded assessment, is the quality of engineering talent upon which the nation can draw on. Unlike Korea or Japan, Taiwan has a long history of sending promising students to the United States for graduate studies. In the Silicon Valley alone, the Taiwan government estimates there are more than 20,000 Taiwanese engineers employed by technology companies.

From our perspective, the research and product development capabilities of Taiwan's pool of Japanese and American trained engineers, a vibrant venture capital industry and recent Japanese investment into research and development facilities are indicative of Taiwan's future role as a center for product innovation in the region.

While in the near term the industry will continue to be shaped by OEM relationships, we see it pioneering a new role for itself in the international marketplace as original design manufacturers (ODM). In this role, Taiwanese firms will emerge as an excellent complement to the manufacturing capabilities of Japanese and Korean companies.

SINGAPORE

The electronics and IT industry is Singapore's most important and fastest growing manufacturing sector, accounting for almost 40% of manufacturing output. Computers and peripherals are the largest and most dynamic product groups. From 1983 to 1988 the combined output of these product groups increased five-fold.

Singapore would like to position itself as the premier research and development center for information technology (IT) in the region.

Multinationals continue to play a strong role in this industry. They were originally attracted to Singapore in the sixties by low wages. Over the next several decades, however, these multinationals invested heavily in their local subsidiaries.

Technologies developed in multinationals' facilities elsewhere were transferred to Singapore and extensive training of Singaporean staff was undertaken. These investments not only maintained the economic viability of the subsidiaries in the face of rising wages, but positioned them to play a pivotal role in their Asia Pacific manufacturing strategies.

Complementing the investments from multinationals have been concerted government development programs. Singapore has invested heavily in its industrial infrastructure and in its universities in order to encourage multinationals to continue their investments into increasingly higher value production. The government is also encouraging these firms to establish research and development facilities, particularly for software and system design. Singapore would like to position itself as the premier research and development center for information technology (IT) in the region.

Several research and development centers have already been set up by multinationals. These include regional centers established by Nixdorf to develop Unix-based applications and communication software; Data General, with two divisions to develop software for data communication, office automation and Asian language

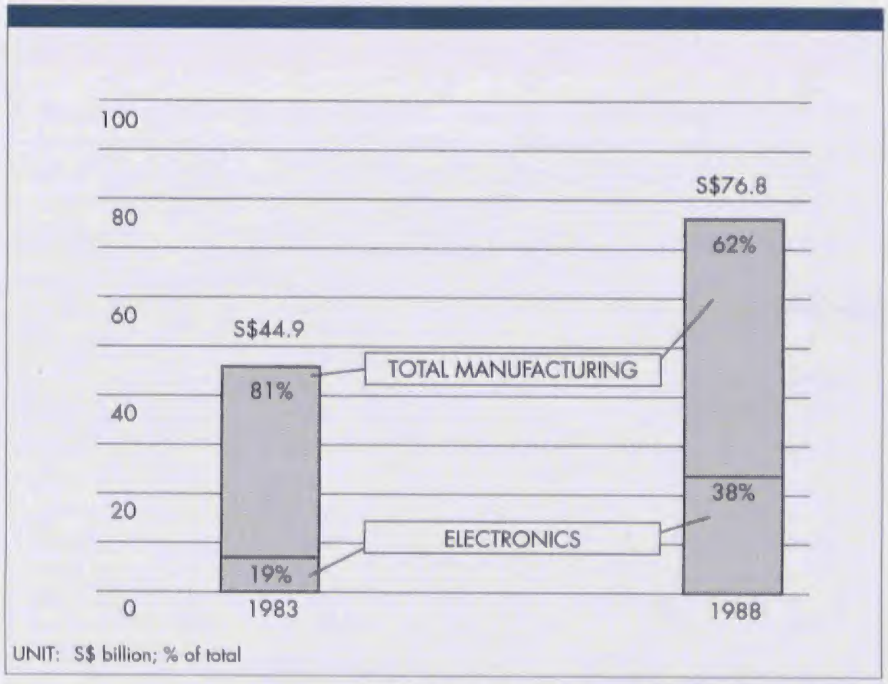
applications; and Hewlett-Packard to develop network and application software.

Rank Xerox has also set up a research and development center in Singapore, the first center it has established outside of the US. Rank Xerox is designing product and system software for printers and "expert" systems. Expert systems are sophisticated data management tools that employ artificial intelligence software.

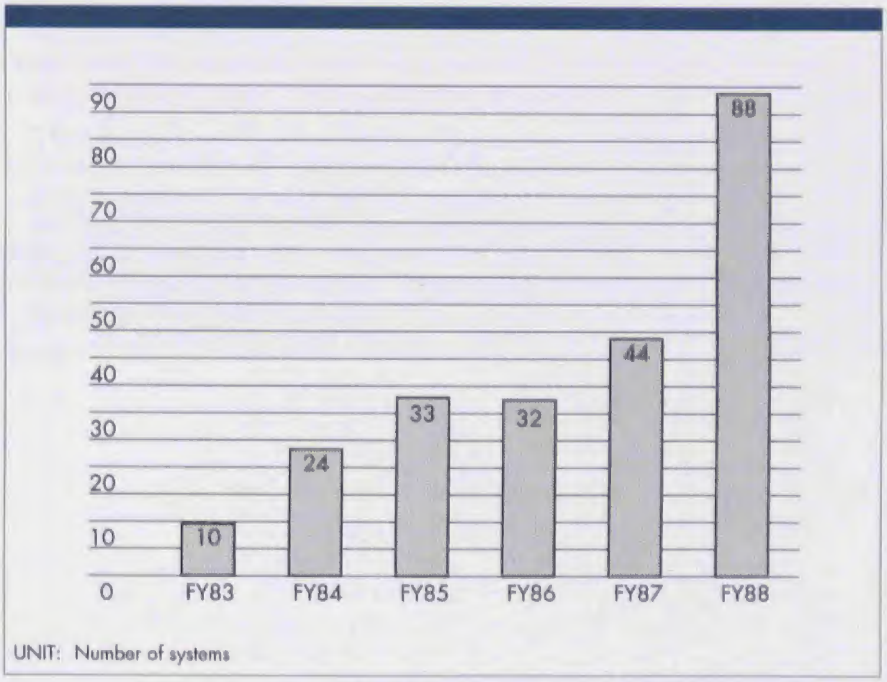
Singapore sees these multinationals' research centers as integral components in its strategy to build a viable domestic information technology industry. These centers provide new technologies and extensive training for the local workforce in the area of software and system design.

The strategy to build the IT industry began in 1981 with the creation of the National Computer Board (NCB). The mandate of NCB was to help create the programs to train IT professionals and to establish the institutions to conduct research and development projects. The NCB was also directed to guide the government and private sector computerization programs.

With NCB's support, Nanyang Technical Institute and Singapore Polytechnic have



SINGAPORE ELECTRONICS SALES AS A PERCENTAGE OF TOTAL MANUFACTURING SALES
Source: Report on the Census of Industrial Production



SINGAPORE'S GOVERNMENT INSTALLED COMPUTER SYSTEMS
Source: NCB Yearbook

RANK XEROX CHOOSES SINGAPORE

After a careful search, Rank Xerox has chosen Singapore as its first research center outside the US. According to a Xerox official, the company opted for Singapore because of its strong information technology infrastructure, its excellent telecommunication facilities and adequate copyright protection laws.

The selection is also undoubtedly partly the result of the aggressive promotion by the National Computer Board which is actively trying to attract companies to Singapore to undertake research and development, particularly in information technology.

The center's initial projects include the design of very large scale integrated (VLSI) circuits and the design of systems software for printers and expert systems. Later, however, Xerox expects to develop software for its intelligent copier systems.

Xerox's move points out two interesting trends. First, companies are beginning to look to Asia not just as a manufacturing base but as an appropriate research and development center to serve the region. For Xerox, the process was encouraged by the current shortage of skilled IT personnel in the United States.

Second, it indicates the coming of age for Singapore's information technology industry. The government has targeted software design as an industry in which Singapore can compete, and the arrival of Xerox, among others, will help guide the industry's future development.

played a critical role in the training of IT professionals. Over the last eight years, the number of programers in Singapore has increased ten-fold, to over 7,000.

The NCB has also embarked on a program to retain workers already in the private sector. This program reimburses companies for most of the salary of workers who enroll in approved IT training courses. These courses are offered at the Institute of System Science and at the Information Communication Institute of Singapore.

The Information Technology Institute (ITI) is the research arm of the NCB. This institute promotes the transfer of foreign technology to domestic companies and works closely with these companies to undertake joint research and development projects.

Several products have already been released from these research and development projects. These include software products such as a computer aided engineering system and an expert system for loading and unloading container ships that was developed for the Port Authority of Singapore, as well as peripherals, such as a facsimile card for personal computers.

To access foreign research expertise, ITI also undertakes joint research projects with

multinationals. The projects are coordinated by the Knowledge Engineering Resource Centre that was set up by ITI in 1987.

The Centre has, for example, engaged in a project sponsored by Hewlett Packard to develop a system to diagnose faults in integrated circuit testers. In another program with Matsushita Electronic Components, the Centre developed a system to diagnose faults in switch-mode power supplies.

Singapore recognizes that the size and sophistication of its domestic market for IT are critical for the long-term viability of its industry. To support this IT industry, the country has embarked on an ambitious program to computerize the government civil service. It has also established programs to support the computerization of small and mid-sized companies in the private sector.

The government computerization program has set out to create an extensive computing and database infrastructure. Along with the hardware acquisitions, including 67 mainframes and minicomputers, the program called for the development of over 200 application systems. Among the projects in this program are the computerization of immigration control at Changi Airport, the national libraries, and the national hospital system.

THE TRIANGLE OF GROWTH

Originally proposed by Singapore in December 1989, the concept of a growth triangle involving Singapore, Batam Island (Indonesia) and Johor province (Malaysia) is now becoming a reality. The triangle was proposed to promote economic cooperation among the three participants to create an attractive business environment for local entrepreneurs and foreign corporations.

Each of the participants has reached a slightly different level of industrialization. Singapore, one of the original overseas bases of electronics multinationals, has several decades of experience in the electronics and IT industry. Today it offers that experience to the growth triangle in the form of highly qualified managers and technicians. As labor costs in Singapore rose, its production in the electronics industry moved across the causeway to mainland Malaysia's Johor province. However, Johor's pool of cheap labor is beginning to dry up. Like Singapore earlier, the companies in Johor must begin to target specific market segments or move up to higher value technologies. The electronics and IT industry is now looking to Indonesia (Batam) to provide it with an inexpensive labor force for the future. Each partner in the triangle, then, will provide different commodities to contribute to the success of the whole. Batam and Johor may supply land, gas, water and labor, while Singapore may provide the technical and management expertise.

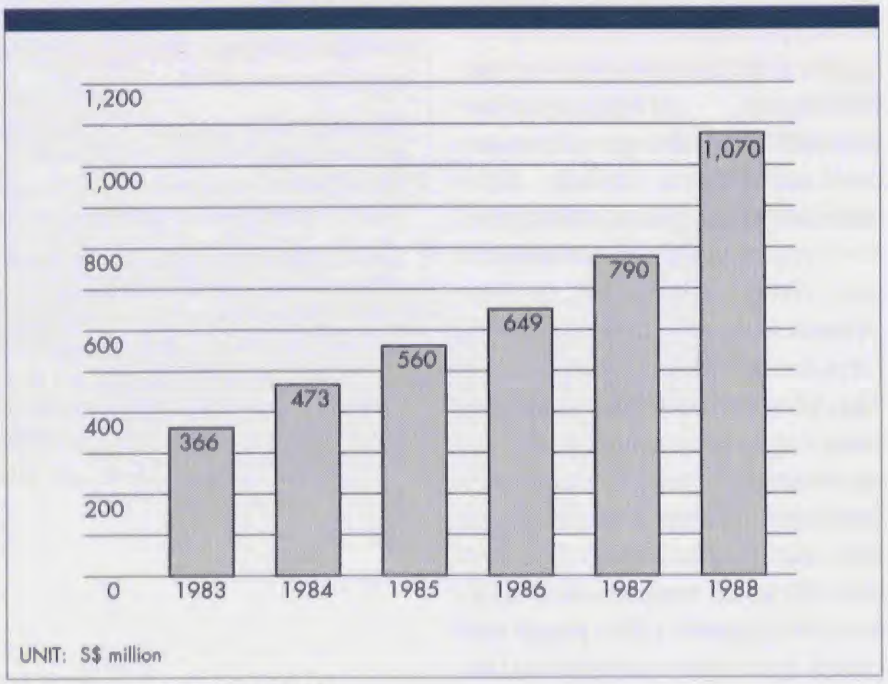
In progress before the idea of the triangle was conceived, the industrial development of the island of Batam, 12.5 miles off the coast of Singapore, is now at the center of the triangle's growth. The Indonesian government has so far invested more than S$1billion in Batam's infrastructure, including port, road and telecommunication facilities.

Although the final stage of the development plan will not be reached until 2006, the first phase, suitable for light industries, such as the assembly of electronic and electrical components, will be ready in early 1991. Later phases include a deep water port, heavy industry and tourist facilities.

The triangle of growth is seen as a particularly promising new location for high technology industries, combining, as it does, one of Asia's lowest average wage rates in Indonesia with the highly developed management and technical skills of Singapore, while offering excellent transport links and communication facilities. Interest in the triangle has already been shown by South Korean, Taiwanese and Japanese companies who are keen to move overseas, as they are faced with acute labor supply problems and rising costs at home.

A second program to help computerize small and mid-sized firms in Singapore was initiated in 1986. Working in conjunction with the Economic Development Board and Institute of System Science, the NCB provides both financial training and support. This project has involved more than 100 firms and has provided a critical opportunity for software developers to acquire expertise in writing programs for business applications.

Singapore, recognizing the inherent limitations due to its size, has wisely targeted IT for its development efforts. And it has now successfully built a strong operating environment for this industry that is growing at twice the rate of the whole electronics and IT industry. A dynamic and sophisticated primary market, driven by both the private and public sectors, has been created. With the multitude of software development firms, competition is keen. A well developed industrial infrastructure exists, as do significant research and development programs. The Singapore IT industry, then, is well positioned to develop quickly and to assume a leadership role in the region.



SINGAPORE IT INDUSTRY SALES
Source: NCB Yearbook

HONG KONG

Hong Kong's electronics sector accounts for 23% of total production and 26% of the territory's exports. Like Taiwan, this industry is composed mostly of small firms. Approximately 80% of all electronics firms in Hong Kong have less than 50 employees.

But, unlike Taiwan, this industry has not developed the research capabilities to move to higher value production. Manufacturing continues to be centered around medium technology products such as toys, watches and low-end consumer electronics and most manufacturers are currently ill equipped to increase the value content of their production. Manufacturers are not only reluctant to invest in long term research and development but they are also currently suffering from a severe shortage of skilled engineers.

Manufacturers are not only reluctant to invest in long term research and development but they are also currently suffering from a severe shortage of skilled engineers.

Hong Kong's investment in research and development is the lowest of any of the NIEs in the Asia Pacific region. It is only about 0.6% of GNP compared to 1.2% in Taiwan and 2% in Korea.

The primary reason for this unwillingness to invest in the resources necessary for future product innovation has been the manufacturers' ability to maintain competitiveness as OEM suppliers by moving production across the border to Guangdong province in China. Due to lower wage and land costs, production costs in Guangdong are only a quarter of those in Hong Kong. Nearly 90% of all electronics manufacturers now have production facilities in Guangdong.

Hong Kong manufacturers are also constrained by the lack of skilled engineers. Each year, of the 5,000 degrees awarded by Hong Kong's tertiary institutions, only 20% are in engineering. And less than 40%, about 400 graduates, actually enter the industrial sector. Taiwan, by comparison, has 8,000 engineers entering the workforce every year.

MOTOROLA'S SILICON HARBOR

The world's fourth largest chip manufacturer, Motorola, is bullish on Hong Kong. Despite popular hesitations amongst the business sector regarding political uncertainties once Hong Kong is under the rule of the People's Republic of China in 1997, Motorola has decided to go ahead with its 326,000 square foot, three story semiconductor wafer fab in Hong Kong's new territory. The cost of the project has been estimated to be around US$500 million.

Located on the waterfront, it is dubbed Silicon Harbor and and will manufacture dynamic random access memory chips, application specific integrated circuits (ASICs), and bipolar integrated circuits. According to company officials, the computer aided design, manufacturing and integration technology employed at Silicon Harbor positions Motorola a generation ahead of plants in the United States and Europe.

Some industry observers feel, however, that Motorola's plans are perhaps overly ambitious and that some obstacles may prove too large to overcome - the largest of these being the acute shortage of trained engineers. Hong Kong's future political uncertainties coupled with the availability of higher wages in other countries are driving an exodus of talent to places like the United States and Canada.

To provide the engineering and design expertise it needs, Motorola is taking an active role in Hong Kong's new government funded ASIC training center. By providing the center with its ASIC library and the chance to use Motorola's advanced facilities, the center teaches students to use Motorola systems. This ensures Motorola an edge over the competition in recruiting trained personnel. The ASIC training center will provide over 250 engineers a year beginning in late 1990.

With over twenty years of history in Hong Kong, Motorola feels that Hong Kong is appropriate to serve its regional strategy. Not only is it in an ideal position to serve today's fastest growing chip market - the Asia Pacific region- Motorola is also geographically and politically situated to take advantage of what might be tomorrow's fastest growing chip market, Mainland China.

High turnover rates further limit the development of human resources. Corporations are reluctant to invest heavily in training programs as the annual turnover rate in the industry is over 15%. This turnover rate will most likely increase as more residents emigrate from Hong Kong before the territory is turned over to China in 1997.

A fundamental attractiveness of Hong Kong's business environment has long been the lack of government interference in the economy. But this attitude has, until recently, prevented the government from assuming any role in the promotion of public and private sector research. As we have seen throughout the NIEs, these government programs play a critical role in the development of industrial and research infrastructures required for indigenous technological innovation.

The government has, however, recently supported the creation of the University of Science and Technology and plans to create the Hong Kong Technology Centre which will act as a conduit for technology transfer to the territory. But the financial resources being committed by the government are limited. Similarly, the government's financial commitment for a recently organized application specific integrated circuits (ASICs) design training center has been insignificant.

Hong Kong, then, is unlikely to be a significant competitor in the emerging high technology sectors of the electronics industry as we move into the next century. As its industrial base moves offshore, it will more than likely revert to its historical role as an entrepôt to China.

MALAYSIA

Malaysia is one of the most dynamic production bases for multinational electronics companies in the Asia Pacific region and has recently emerged as the world's largest manufacturer of semiconductor devices.

Malaysia is one of the most dynamic production bases for multinational electronics companies in the Asia Pacific region...

Multinationals have built the electronics industry in Malaysia. They were first attracted there in the early seventies by government incentives and the prospect of low labor costs. Since then, on average, the industry has grown almost 20% per year.

Most of the industry's production capacity is, concentrated in semiconductor devices. These products are responsible for 80% of the total electronics production and 90% of the country's electronics exports.

The manufacturing of semiconductor devices is extremely labor intensive, in most part involving the delicate alignment and packaging of integrated circuits. The value added in this process tends to be quite small, averaging only about 15% of the final price.

Malaysia's nascent domestic electronics industry has extremely little upstream or downstream integration with these foreign manufacturers. More than 80% of inputs for the semiconductor industry are imported and almost all the production is exported.

While the Malaysian government has tried to encourage the formation of joint ventures as a means of transferring technology into a domestic industry, its efforts have met with limited success. The domestic market at this point is not significant enough to entice most multinationals to invest in joint ventures as a means of gaining market access.

Currently, as most of the production in Malaysia's electronics industry requires relatively low level skills on the part of the local workers, the

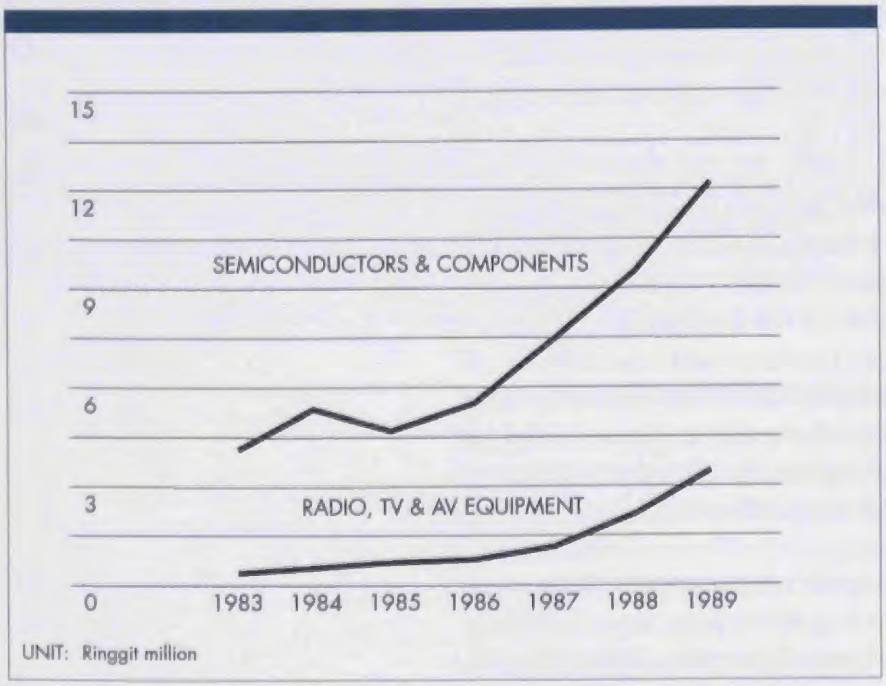
NATIONAL SEMICONDUCTOR

Malaysia is the world's largest exporter of semiconductors. Under a plan to attract foreign companies, primarily for job creation, Malaysia has successfully encouraged foreign companies to open plants in its free trade zones. Semiconductor manufacturers chose Malaysia because of government incentives as well as the availability of cheap labor and the relative political stability.

National Semiconductor Corporation (NSC) was one of the first semiconductor manufacturers to set up operations in Malaysia. Headquartered in Santa Clara, California, NSC established a wholly owned subsidiary for the production of semiconductor components in Malacca in 1973. With roughly US$282 million in sales per year, the company primarily manufactures semiconductor electronic components - ICs and transistors.

NSC sources its raw materials, such as frames, dice, gold wire and moulding compound, primarily from the US and Japan. Other materials, including rails and carriers, are sourced from Hong Kong and Taiwan.

Furthermore, NSC performs no R&D activities in Malaysia, and sells all of its finished products to the parent company in the US and Europe.



MALAYSIA'S ELECTRONIC PRODUCTION
Source: MIDA

country has yet to receive a significant transfer of technical expertise from foreign companies.

Without this process of transference of technical skills from multinationals to the workforce, the Malaysian government has found it difficult to encourage startups in the electronics industry. To help bridge this technological gap, Malaysia has recently established the Malaysian Institute of Microelectronic Systems. This Institute is mandated to support private industries' efforts to acquire foreign technologies and to create the research and development infrastructures necessary to develop indigenous technological innovation.

Given the limitations of research and industrial infrastructures, it may take some years before Malaysia successfully develops a viable domestic electronics industry.

THAILAND

While still relatively small, employing less than five percent of the country's manufacturing workforce, Thailand's electronics industry has witnessed spectacular growth in the last five years. This growth has been driven by large foreign investments, primarily by Japanese multinationals.

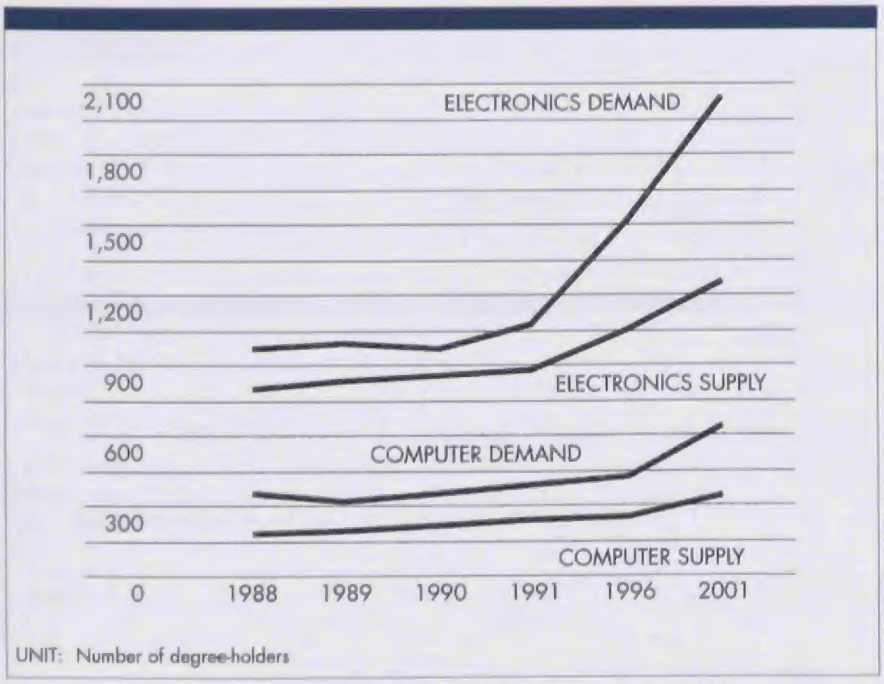
For many years the electronics industry in Thailand consisted of simple assembly operations for consumer electronics. The operations were originally established by foreign companies as a means to access to the domestic market.

Thailand was identified by the Japanese government and business leaders as an attractive environment for investment.

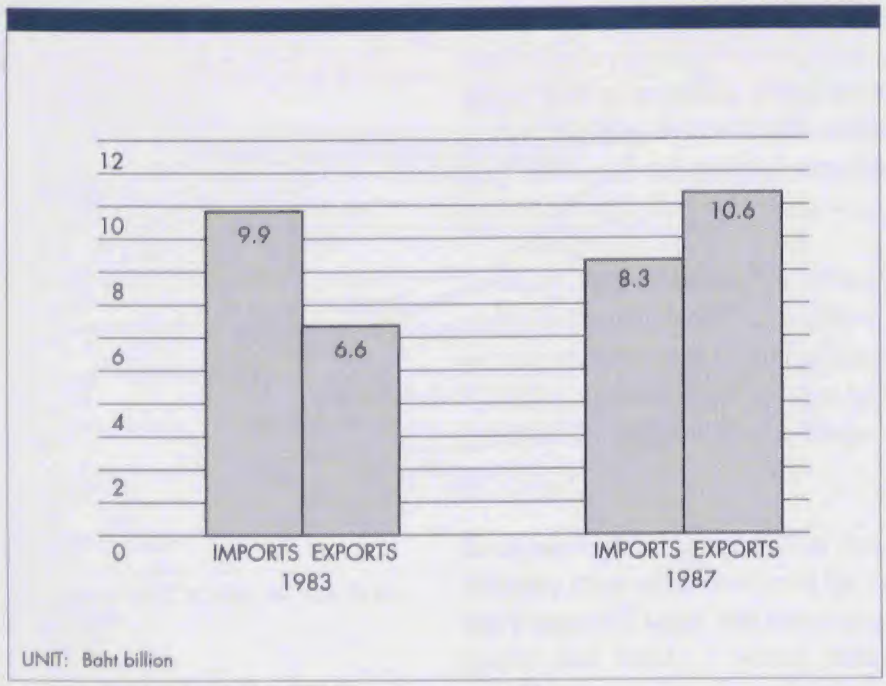
The industry changed dramatically, however, in the mid eighties. With the huge yen appreciation at that time, the Japanese recognized that the production of many of their commodity-like consumer electronics products that had high labor content would have to move offshore to low wage countries in order to remain competitive. Thailand was identified by the Japanese government and business leaders as an attractive environment for investment.

Not only were land and labor costs low, but Thailand, unlike several of its neighbors, offered reasonable political stability. The stability is due to an informal system of checks and balances that exists between the civil service bureaucracy, the army and the business community. The King and the institution that he represents have played a critical role in maintaining this balance.

As foreign owned companies could not, until recently, purchase land in Thailand, most multinationals set up joint ventures with passive Thai partners. These partners, in many cases the large Chinese-Thai industrial groups, not only provided access to land but, more importantly, connections in the government bureaucracy. These connections, particularly with the Board of Investment, were essential for expediting regulatory approvals.



THAILAND'S SHORTAGE OF ELECTRONICS AND COMPUTER ENGINEERS
Source: Thailand Research and Development Institute



THAILAND'S IMPORTS AND EXPORTS OF ELECTRONICS
Source: The Development of Thailand's Capability in Industry

While consumer electronics has been an important segment in Thailand's blossoming electronics industry, semiconductors have emerged as the major single product group. As with Malaysia, most of this production is focused on labor intensive packaging of semiconductors. Major components, such as chips, gold leads and frames are imported.

At this point, there is limited integration between the multinationals' operations and Thailand's domestic electronics industry. While this industry will strengthen as it assimilates technologies introduced by multinationals, this process may take several years. The speed of this assimilation will be hampered by a severe shortage of engineers. While over 7,000 engineers are needed each year, only 2,800 now enter the workforce.

This shortage of engineering talent will not be remedied quickly. Not only are there limited spaces in the universities, but there is a shortage of engineering professors. Few engineers are entering the teaching profession, and those already there are being lured away to the private sector.

The limited physical infrastructure is another impediment to future growth in Thailand, not only for the electronics sector,

but for the economy as a whole. The road and rail systems are unable to sustain the rapidly increasing demands placed on them and electricity supplies are also being severely strained.

The development of an indigenous high technology industry in Thailand is further hampered by the absence of a clear government program to support it. As a result, few incentives have been given to domestic private industry to invest in research and development, or to build the research institutions required to promote the acquisition and diffusion of technologies in the country. This absence of clear policy direction is now being addressed and new programs are being formulated.

As the example below illustrates, it will take some time before Thailand will be able to build the critical mass of research scientists and engineers needed to develop a viable domestic industry.

NECTEC

The National Electronic and Computer Technology Centre (NECTEC) is an organization formed by the Ministry of Science and Technology to develop electronics and computer technology in Thailand. One of its major priorities is to leverage the currently foreign controlled integrated circuit industry, which is the country's sixth largest export revenue earner, and develop Thailand's domestic capability in this booming industry.

In light of increasing regional demand for integrated circuits, experts predict that countries such as Thailand will be able to support their own domestic IC industry in the near future. Those with domestic capabilities in place could profit greatly, and NECTEC is gearing up for the challenge.

Given the increasing popularity of application specific integrated circuits (ASICs), NECTEC set out to develop ASICs design capabilities. With advice and software from Australia, four professors worked on this project for two years. The result was the design of Thailand's first ASICs, which were fabricated and successfully tested in Australia.

Although the professors' efforts signal a strong first step for Thailand's development, the ASICs program's future is still unclear. NECTEC, for instance, is looking for private sector research and development support, but the expense and current availability of trained personnel is blocking progress. Until there is a pool of trained personnel to facilitate the diffusion of this technology, it will be very difficult for IC technology to reach Thai firms.

CHINA

China's electronics industry is driven by a large domestic demand for consumer electronics and a growing demand for personal computers.

The Chinese electronics industry stands before a chasm that separates it from the market opportunities in the global economy.

This industry is concentrated in Beijing, Huizhou, Xian and around the Shenzhen Special Economic Zone, near Hong Kong.

The industry was originally focused on the assembly of finished goods to satisfy the domestic market. It has slowly, however, acquired foreign technology and supplemented it with domestic research. Most technology is acquired through joint ventures.

Stone Computer was at the forefront of China's computer industry. Founded in Beijing, the firm established itself as a domestic assembler at a time when most personal computers were imported as finished units. All critical components for these computers were sourced from abroad and units were sold through stores that were opened around the country.

Huizhou and Xian have developed as centers for electronic components manufacturing. The technology for hard disk drives has been transferred to state owned firms in Huizhou, and semiconductor packaging operations have been set up in Xian. Xian's participation in the electronics industry is largely due to its historical role as the manufacturing base for China's military.

Shenzhen, however, leads the country in the manufacture of electronic goods. The industry was originally built in the early eighties with capital and technology invested by Hong Kong manufacturers who set up assembly operations in Shenzhen to reduce labor costs.

Most of the original Hong Kong investment in Shenzhen was in joint ventures with Chinese companies. Over time, however,

manufacturers began setting up processing ventures that were simply contractual agreements for labor and factory space. These arrangements allowed them to avoid the necessity of a Chinese partner and thereby ensured full management control.

While most processing ventures were established outside of Shenzhen, where the regulatory environment was less cumbersome, Chinese firms from other provinces flocked to the municipality to set up manufacturing operations. Shenzhen offered firms access to imported components and foreign technology unavailable elsewhere.

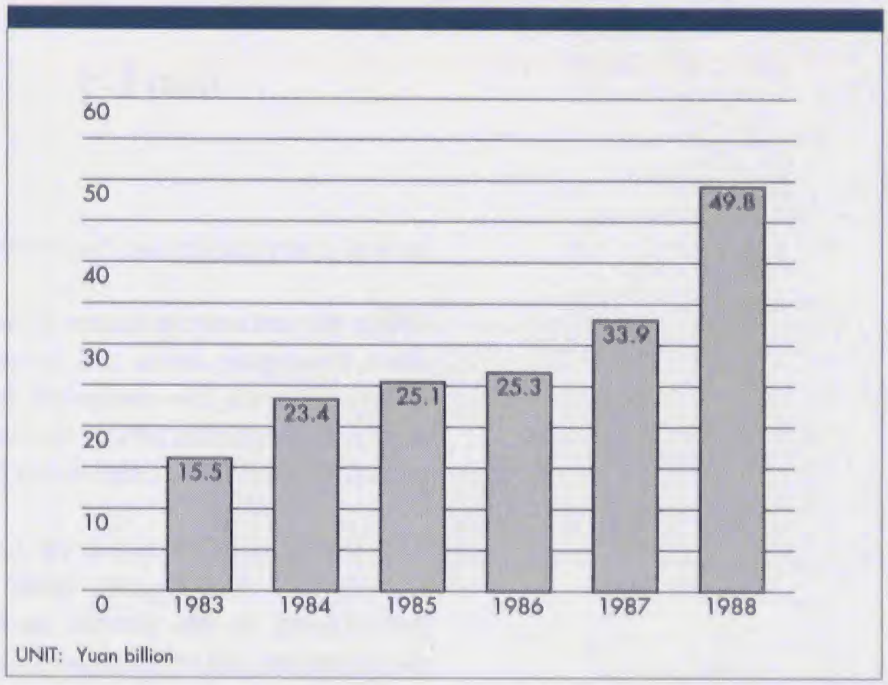
Of Shenzhen's total annual output of US$1.37 billion, 43% is from the electronics industry. In order to coordinate the manufacturing and marketing activities of the industry, the Shenzhen Electronics Group was established in 1985. Over 70% of Shenzhen's electronic output is under the Group.

Currently, the Group is comprised of over one 150 companies. Some companies are wholly owned, others are supervised and the rest, about 45, are joint ventures.

Most of the output from the Group is in consumer electronics, including television sets, radios, and tape recorders. There is also production of semiconductor packaging.

The Chinese electronics industry stands before a chasm that separates it from the market opportunities in the global economy. Even in Shenzhen, with its proximity to Hong Kong, international market linkages are weak. Export sales from Shenzhen are dependent on distributors in Hong Kong. In the rest of the country, export sales are almost non-existent.

The industry, then, has focused on the large domestic market. This market, however, is far less sophisticated than those found internationally. Therefore, while China has research and development resources available to the industry, the development of its technological innovation will be limited for the foreseeable future.



CHINA'S ELECTRONICS INDUSTRY SALES
Source: Statistical Yearbook of China

AUSTRALIA

The Australian electronics industry is still quite small and developing at a much slower pace than in many of the other nations of the Asia Pacific region.

As with the computer industry, the software industry is responsible for only ten percent of the domestic market.

The domestic computer industry in Australia is growing at about eight percent a year and accounts for less than ten percent of the total domestic market. Its primary production is terminals, though in the last few years the the production of personal computers has increased. Most of the firms manufacturing these personal computers, however, are small, with less than 30 people and have focused on the final assembly of units. Almost all critical components for the computer industry are imported.

While the software industry in Australia has seen far higher growth rates, averaging about 20% a year, its growth is from a very small base. As with the computer industry, the software industry is responsible for only 10% of the domestic market. Imported software packages account for the rest of the market.

The future development of Australia's electronics industry is uncertain. The country lacks a strong research infrastructure, particularly in the private sector. Private sector research and development, for instance, accounts for only 20% of the total research and development expenditures in the country. Further, the linkages have historically been weak between the research departments of universities, where most public sector research is undertaken, and the private sector.

In an attempt to build a foundation for its electronics and other technology industries, the Australian government recently announced a program to establish cooperative science and technology research centers. This program, supported by a US$73 million allocation, will establish 50 centers, with 15 to be opened in the first year.

While these centers hope to stimulate cross disciplinary research, at this point the research focus is unclear. The potential areas of study include radio astronomy, remote sensing, and information technology. The ability to commercialize the new technologies developed in these research centers is also uncertain.

Clearly, the Australian electronics industry lacks many of the critical components essential for long term technological leadership, including competitive rivalry, a strong industrial infrastructure, and research and educational institutions. There is also not a particularly sophisticated domestic market. We do not expect, then, that the industry will emerge as a major participant in the region or the global marketplace.

Factory Automation

The factory automation industry in Asia Pacific has become increasingly important as labor rates in the more advanced industrial countries undermine historical cost advantages.

Japan's industry has established a leadership position in both the region and the world. It is driven by sophisticated customer demand and an intense rivalry among domestic manufacturers. At the same time, the industry is supported by a technologically advanced and well integrated industrial infrastructure. Further, private sector research efforts are supplemented and, in part, guided by government supported research projects.

Korea, faced with an accelerating domestic demand, is now establishing alliances with foreign manufacturers to gain access to the technologies necessary to launch its factory automation industry. While Korea's factory automation industry is currently several years behind Japan's, it will potentially develop quickly.

Taiwan nascent industry, on the other hand, is severely handicapped by weak domestic demand. None of its indigenously developed technologies have been significantly commercialized, in large part due to the difficulty of integrating automation into production lines designed for small volume runs.

JAPAN

In the area of factory automation, the Japanese have established themselves as leaders in the world market. Their manufacturers have been able to introduce new product innovation as fast or faster than any of their international competitors. This industry centers on two areas, computer numerical controllers (CNCs) and robotics.

...manufacturers in Japan have been far more aggressive in their efforts to automate production lines than their competitors in other countries.

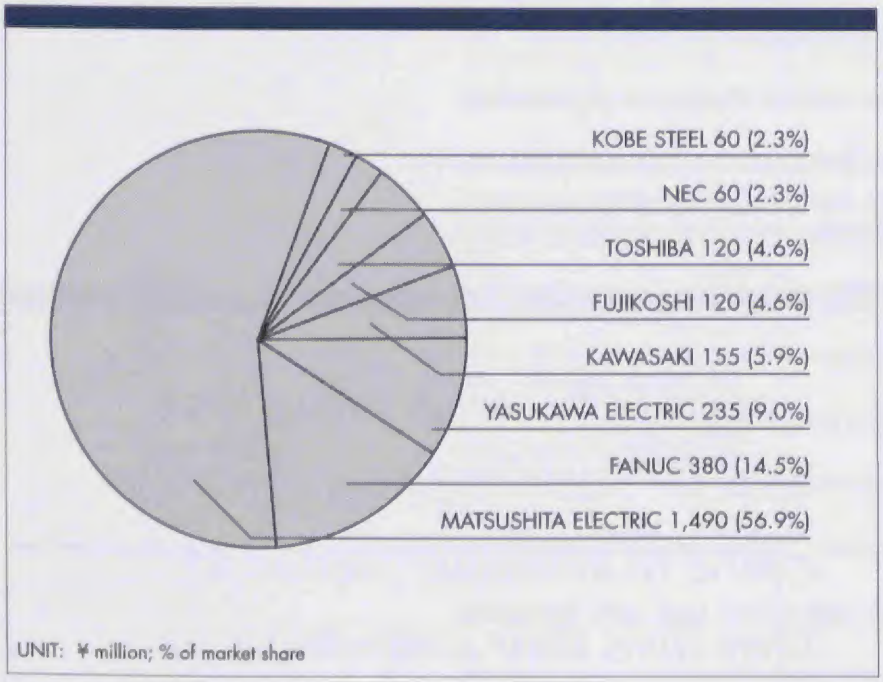
The robotics industry in Japan is driven by a strong and sophisticated domestic market. Recent production of robots has been primarily concentrated on numerically controlled and playback robots.

Japan is currently the leading producer and exporter of robots in the world. This industry has grown rapidly and now contains almost 300 manufacturers with an annual output of over US$2.3 billion.

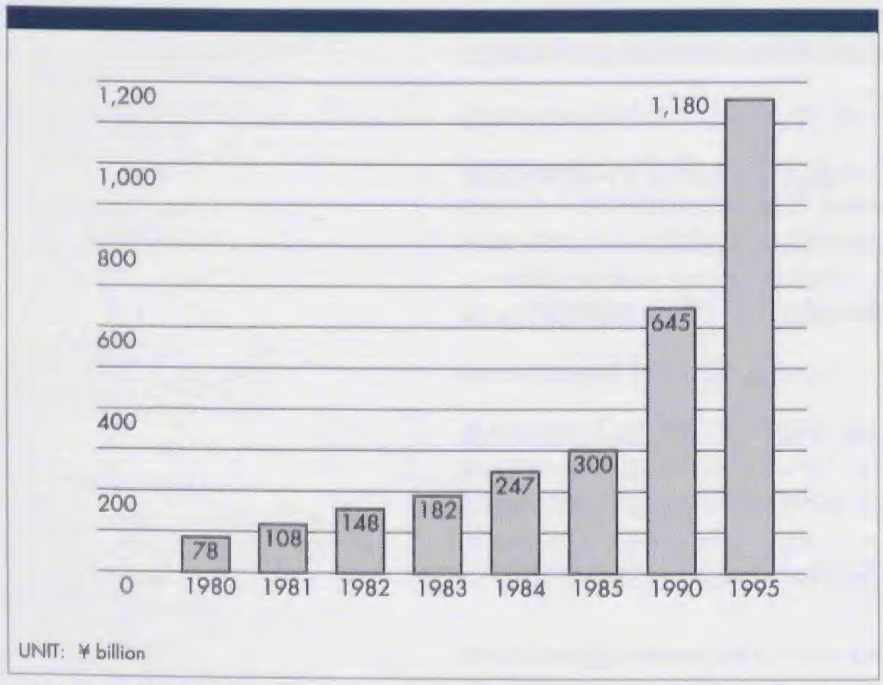
The Japanese robotics industry began in 1968 with the licensing of technology by Unimation to Kawasaki Heavy Industries. A year later, Kawasaki released its first robots. Quickly following the early lead in this new field were several other Japanese manufacturers, including Kobe Steel, Ishikawajima-Harima Heavy Industries, Hitachi and Toshiba Precision Machinery.

This industry was propelled by strong domestic demand, primarily from the automobile and electrical appliance industries. As early as the mid sixties, the country faced labor shortages that placed tremendous strains on Japanese manufacturers. In 1965, for instance, there was a shortage of almost two million skilled workers.

As a result, manufacturers in Japan have been far more aggressive in their efforts to automate production lines than their competitors in other countries. By the early seventies, Japan had the largest installed base of robots in the world, comprising over 60% of the world total. These installations were not only in the large industrial groups, but



1989 ROBOT SALES BY MAJOR JAPANESE MANUFACTURERS
Source: Nihon Keiza: simbun



JAPANESE ROBOT PRODUCTION
Source: R&D in Japan, British Chamber of Commerce

also in small and medium sized firms. These smaller firms were particularly hard hit by the labor shortages.

The Japanese robotics industry has been supported by a strong industrial infrastructure. Its vendors, including manufacturers of numerical controllers, machine tools, optical sensors and electronic components, are themselves world leaders.

For instance, the computer numerical controller (CNC) market is dominated by Fanuc Co. By improving on both the process and product technology originally licensed from Siemens, Fanuc has become the largest CNC manufacturer in the world. Its competitive position has been sustained not only by economies of scale, given an annual capacity of 50,000 units, but also by technological advances.

Further, the industry can utilize the resources from highly developed research and education infrastructures. Not only are there about 180 Japanese universities and colleges that have set up robotic laboratories, but the government has provided support for specific research programs.

The first research project supported by the government commenced in 1983 with the sponsorship of the Ministry of International Trade and Industry

(MITI). This project sought to develop special purpose robots that could operate underwater, in outer space, or in dangerous industrial situations such as in nuclear power generation plants.

Another major research project has been sponsored by the Agency of Industrial Science and Technology, a semi-independent agency under MITI. With a US$34 million annual budget, this research project is developing intelligent robots.

Clearly, the Japanese CNC and robotics segments of the factory automation industry in Japan are well established and positioned for continued growth both in domestic and international markets. At this point, increasing attention is being paid to the area of computer integrated manufacturing (CIM) and the development of robotics for special purposes. These areas are seen as the emerging segments of the factory automation industry.

KOREA

Korea's factory automation industry is just getting off the ground. In the past, the country was almost entirely dependent on imports from Japan. Domestic demand, however, is developing quickly, offering new opportunities for domestic manufacturers.

Koreans have set up joint ventures and signed technology transfer agreements...to manufacture products such as computer numerical controllers (CNCs) in Korea.

Lacking their own technologies, the Koreans have set up joint ventures and signed technology transfer agreements with leading US and European companies to manufacture products such as computer numerical controllers (CNCs) in Korea.

In Korea, the market for CNCs has doubled in the last two years, reaching US$1.5 million. And according to a report from the Korea Productivity Center, 88% of Korea's companies have incorporated CNC machine tools into their plants.

But the factory automation market is dominated by Fanuc Co. of Japan. Fanuc currently controls over 80% of the domestic market. The size and potential growth of the local market, however, is creating opportunities for local manufacturers.

The 20 largest domestic manufacturers produce 90% of the locally made CNCs. These manufacturers include Daewoo Heavy Industries, Tongil, Goldstar Industrial Systems, Whacheon Machinery Works, Kia Machine Tool, Doosan Manufacturing and Hyundai Motor Company.

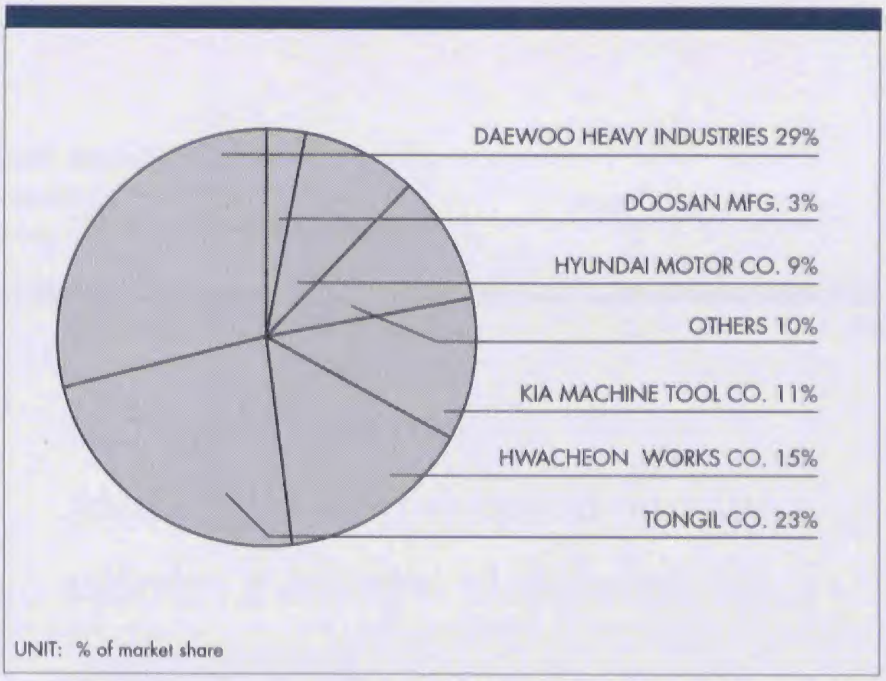
As this industry in Korea has lacked the sophistication to challenge Fanuc, three alliances with foreign companies have been established to acquire key technologies:

- A joint venture formed with Allen Bradley of the US and seven local CNC machine tool manufacturers, including Daewoo Heavy Industries and Kia Machine Tool

• A technology transfer agreement between Goldstar Industrial Systems and Siemens. Goldstar will be supplying Siemens with CNCs on an OEM basis

• A technology transfer agreement between Hyundai Electrical Engineering Company and Cincinnati Milacron.

The potential, then, for the emergence of dynamic domestic rivalries in an increasingly sophisticated market is quite good, particularly since the participants in the industry are the leading industrial groups that are already involved in both the machine tool and electronics industries. Future integration with a developed industrial infrastructure is also expected. What is unclear, however, is the future role that research institutes will play in helping the Korean industry define and conduct product development.



KOREA'S CNC PRODUCTION BY COMPANY
Source: Ministry of Trade and Industry

THE FANUC CHALLENGE

Korea's computer numerical control (CNC) industry is getting a boost from its dominant Japanese neighbor - Fanuc Co. Fanuc, which has controlled the Korean market for CNCs since the late seventies, has demonstrated to domestic manufacturers that CNCs can be a profitable business.

Drawing from Fanuc's success, the Koreans have made some significant inroads into the market. From 1981 to 1986, Korea produced on average about 1,000 CNC metal-working machines annually. In 1987, production jumped to 1,700 machines and by 1988, Korea's output exceeded 2,200 machines.

One Korean firm, Tongil Co., recruited Japanese expertise in 1985 and began producing CNCs known as the "Tepsil Series". Much to Fanuc's chagrin, the Tepsil is doing quite well. Thus far, about 800 Tepsils have sold locally, and another eight have been ordered from the United States. Even firms in Japan have reportedly placed orders for Tepsil CNCs.

At this point, however, Tepsil CNCs are only made with an 8-bit CPU versus the more powerful 16-bit processor used by Fanuc. But with the announcement of its new "Tepsix Series", Tongil will have new arsenal. According to analysts, the Tepsix will give Tongil the power to compete head-on with Fanuc.

TAIWAN

The Mechanical Industrial Research Laboratories (MIRL) under Industrial Technology Research Institute (ITRI) is spearheading Taiwan's effort to develop domestic capability in factory automation. As ITRI's second largest research group, MIRL places a great deal of attention on developing both robotics and CNC technology.

As Taiwan manufacturers continue to face higher labor costs, the pressure to introduce robotics will increase.

Currently, however, only a few firms have incorporated these advanced techniques. Included are a handful of firms manufacturing robotics based on MIRL technology.

MIRL's first technology was transferred in the mid eighties to TECO Electric Machinery Company, a domestic appliance maker. This transfer was made with the understanding that TECO would develop robots not only for its own production lines, but that it would also acquire the manufacturing capability to enter the robotics market. The company, however, soon found that this market in Taiwan could not sustain the manufacturing scale necessary to achieve cost competitiveness. Therefore, after selling just a few robots, TECO suspended its program.

In 1989, MIRL transferred technology for its third generation robots to both Ta Tung, Taiwan's largest appliance manufacturer and Mirle Automation, a spin-off from MIRL. Neither of these companies has established significant production capacity for robotics.

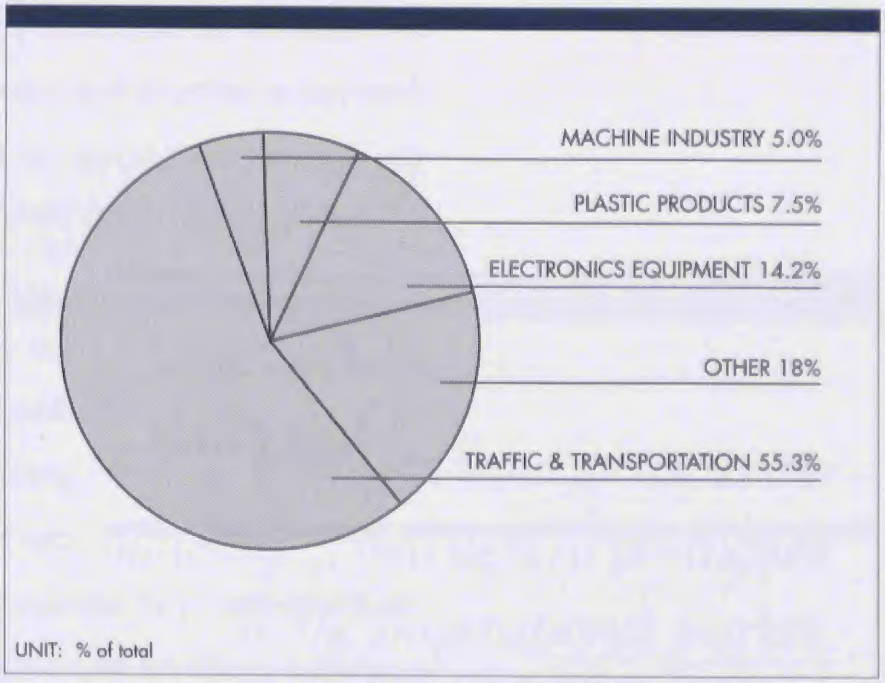
This hesitation to invest in production capacity is due to a weak domestic market. In Taiwan, the installed base of robots is less than 700, as compared to over 175,000 in Japan. Domestic suppliers have provided only about 10% of these robots.

The Taiwan market has been slow to develop in part because of the absence of application expertise. To be successfully integrated into production lines, robots need sophisticated applications software and a variety of peripheral equipment. As most Taiwan manufacturers

lack the means to acquire this expertise, many of the country's robots have failed to meet original expectations.

Mirle Automation seeks to meet this need by specializing not only in robots but in automation systems. With over one hundred automation experts recruited from MIRL, the company is working with Taiwan manufacturers to redesign production lines to maximize the efficiencies available from robotics. The firm is also now developing technology for intelligent robots, including a robot with vision and perception capabilities. At this time, however, Mirle is the only company in Taiwan specializing in automation systems.

As Taiwan manufacturers continue to face higher labor costs, the pressure to introduce robotics will increase. But we feel that this industry will develop at a far slower pace than in Korea. Not only is there greater resistance on the part of many companies to invest in capital equipment, but as most firms work with smaller production runs, it makes it much more difficult to design integrated mass-production systems. We do not expect, then, for an internationally competitive robotics industry to emerge in Taiwan in the foreseeable future.



1988 INDUSTRIAL APPLICATIONS OF ROBOTS IN TAIWAN
Source: International Federation of Robots

MIRL'S TECHNOLOGY TRANSFER

The Mechanical Industry Research Laboratories at ITRI has recently developed two new third generation robots.

The type A robot is a five-axis articulated robot that is capable of assembling, gluing, soldering and handling parts. With 64K of memory, the robot is capable of handling up to twenty jobs.

The type U robot has a payload of ten kilograms, five times that of the type A robot. Its memory is also significantly larger, with 265K RAM. While also designed as a general purpose robot, it can store the instructions for up to one hundred jobs.

Japan is the only country in the Asia Pacific region to have developed an advanced materials industry. While Korea and Taiwan have begun to invest in research projects, most of the materials being developed are several years away from commercialization.

Advanced Materials

Japan's advanced materials industry has been defined by strong domestic demand in the electronics and sporting goods industries. It recognizes, however, that future growth will be dependent on the development of an aerospace industry. The country, then, has committed significant financial and research resources to the FSX fighter program. It hopes that this program will, in part, spur future technological innovation, particularly for materials such as ceramic fibers, metal matrix composites and functionally gradient materials.

Korea's and Taiwan's research efforts in the advanced materials industry are also focused on the development of materials for the electronics, aerospace and sporting goods industries. But commercialization, at this point, is limited. Korea's research program is being directed by a newly created institute at Seoul National University, while the Materials Research Laboratory is helping guide the development of new technology in Taiwan.

JAPAN

The Japanese advanced materials industry includes ceramics, both structural and electronic, carbon fibers and metal matrix composites. This industry has been driven by the electronics industry, in the case of ceramics, and the sporting goods industry for carbon fibers.

Once Japan has successfully created a sophisticated domestic market for advanced materials, it will have in place the major components for a strong industry, that is, a high level of domestic rivalry, a sound industrial infrastructure and well financed research and development efforts. Japan's advanced materials industry, therefore, will be well positioned in the international market.

Japan's advanced materials industry ... will be well positioned in the international market.

Japan entered the carbon fiber market almost from the onset. In 1961, only a few years after the invention of carbon fibers by Union Carbide, researchers at the Government Industrial Research Institute in Osaka discovered a material, polyacrylonitrile (PAN), that produced stronger, stiffer fibers than the Union Carbide process. Japan now supplies about half of the world demand for carbon fiber. Toray and Toho Rayon dominate the domestic markets with 40% and 38% market shares, respectively.

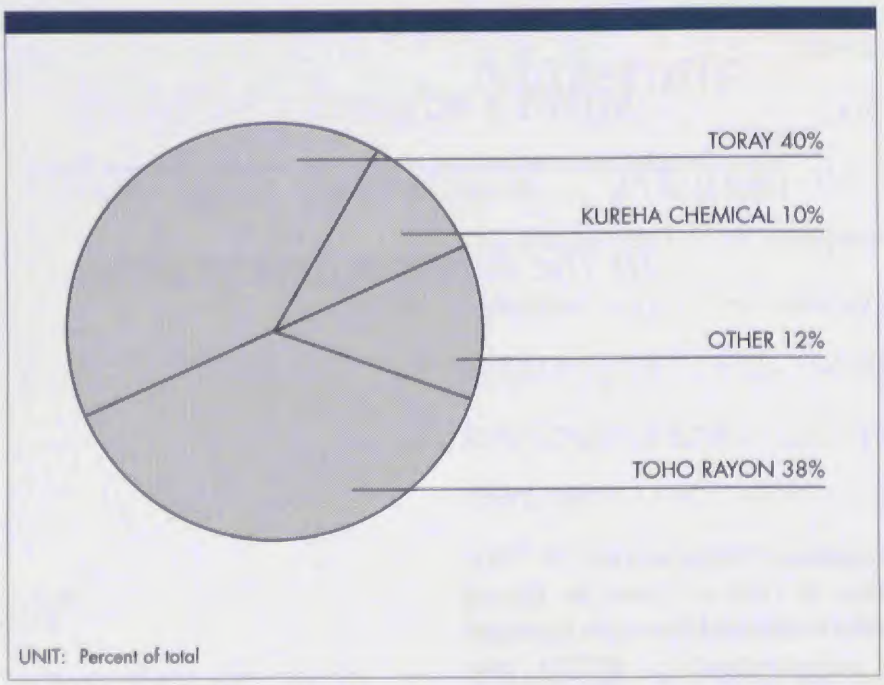
Given the absence of a domestic aerospace industry, where these fibers are used in making composites for non-critical structural components, domestic manufacturers have focused on the sporting goods industry. Carbon fiber is used for the manufacturing of tennis rackets, golf clubs, and fishing rods. While aeronautics and sporting goods industries are both responsible for about 40% of the world market, the sporting goods makers accounts for 70% of the domestic market in Japan.

The Japanese recognize, however, that the long term competitiveness of their industry is dependent on developing a strong domestic

aerospace industry. This industry, by demanding far greater technical specifications, will drive future technological innovation.

Building on its strong position in ceramics for the electronics industry, Japan has assumed technological leadership in the development of both fine ceramics and ceramic fibers.

Ceramic fiber is made of silicon carbide, a material invented by Seishi Yajima, a professor at Tohoku University. These fibers maintain their strength at high temperatures and are used in making metal matrix and ceramic matrix materials. These materials are expected to find wide application in the aerospace industry, particularly for jet engines.



1987 MARKET SHARE OF JAPANESE CARBON FIBER PRODUCERS
Source: Japan Economic Almanac

Only Japanese companies have developed the process technology for the continuous manufacturing of ceramic fiber. Nippon Carbon, a manufacturer of graphite electrodes for steelmaking furnaces, has been the first company, however, to produce more than demonstration quantities.

On the horizon for development are functionally gradient materials. These materials combine the properties of metal on one side with the properties of ceramics on the other. There is a gradual transition of properties between the two sides. The research into these new materials is spearheaded by Japan's National Aerospace Laboratory.

Two other research institutes in Japan are focused on the development of advanced materials: the Japan Defense Agency's Technical Research and Development Institute and the Institute of Metals and Composites (IMC). The Defense Institute is primarily responsible for the development of the composite wing-building technique for the FSX fighter program, while the IMC focuses on polymer and metal composites, metal matrix composites, intermetallic compounds and advanced carbon-carbon. IMC was founded in 1981. It is sponsored by MITI and has 38 corporate members, including Toray, Nippon Carbon, Nippon Steel and Nissan.

The Japanese advanced materials industry is well developed. While the electronics and sporting goods segments have been responsible for directing the technological development in the past, the aerospace segment will increasingly shape the industry. The industry is investing heavily in research that is supported, in part, by military and civilian research institutions. Our expectation is that Japan will be able to maintain its leadership position.

KOREA

Korea's advanced materials industry is in the formative stage and lags behind the US and Japan. Given the growing domestic demand, however, there is increased commitment to develop local sources of manufacturing for materials such as high performance magnets, carbon fiber, and ceramic microchip packaging. Currently, 80% of the domestic market is dependent on imported supplies.

...the industry will ultimately be well positioned because of the increasing sophistication of its domestic demand.

To support the development of the advanced materials industry, the government created a new institute in 1989. This institute, at the Seoul National University, received a government commitment of US$30 million for its joint public/private research projects.

And another research institute is now on the drawing boards. This one, to be funded by the Ministry of Defense, will focus on materials required for the developing aerospace industry.

Within the private sector, Poohong Iron & Steel has led the research efforts to date. In 1977, it set up the Research Institute of Industrial Science and Technology. This institute now employs over 400 scientists. The institute focuses on four areas: metals (including aerospace alloys), inorganics (including ceramics), organics (including carbon fibers and engineering plastics), and electromagnetics (including ferrite).

Korea's advanced materials industry is only now receiving the investment in its research infrastructures necessary to develop its foundation. While it may take some time to develop both its research and manufacturing capabilities, the industry will ultimately be well positioned because of the increasing sophistication of its domestic demand. This demand, in both the electronics and aerospace industries, will require domestic manufacturers to continually invest in product innovation in order to sustain competitive positions.

TAIWAN

Taiwan has traditionally had very limited demand for advanced materials outside of applications for nuclear power plants, but with recent developments, particularly in sporting goods, the domestic demand for advanced materials is increasing.

The Materials Research Laboratory (MRL) of the Industrial Technology Research Institute has contributed significantly to the development of Taiwan's capabilities in advanced materials. In addition to the numerous projects it has undertaken that have resulted in technology transfers to the private sector, it is undertaking research that will give Taiwan access to some key technologies. Taiwan, for example, has made substantial progress in the study of high temperature superconductivity. Its efforts, concentrated on processing and molding of the material, has achieved worldwide recognition.

The Materials Research Laboratory of the Industrial Technology Research Institute has contributed significantly to the development of Taiwan's capabilities in advanced materials.

Giant Bicycle Company is a prime example of a company that has benefitted greatly from the efforts of MRL. With the transfer of carbon fiber technology developed by MRL, Giant was able develop into an internationally recognized bicycle manufacturer.

Also, in light of Taiwan's intent to develop a domestic defense and aerospace industry, several small firms are acquiring materials technology to produce a range of products in support of these projects. Many of these materials could eventually be supplied on an OEM basis to multinational aeronautics firms.

We do not expect, however, that the advanced materials industry in Taiwan will develop rapidly. The domestic market is still relatively unsophisticated. As a result, firms have been reluctant to acquire new technologies, even with assistance from MRL.

While production of telecommunication equipment is found throughout the region, only a few countries have invested the resources to develop indigenous technology. Japan has established clear technological leadership in this industry.

Telecommunications

Japan's efforts have been broad based, directed to the development of integrated sound data networks (ISDN), private branch exchanges (PBXs), and transmission equipment. The Japanese industry is driven by a particularly sophisticated domestic market and is supported by the concerted research efforts of the private and public sectors.

Korea's research efforts have been directed toward the development of switching centers that will lay the foundation for their ISDN network. While the initial efforts to develop exchanges only began in 1982, they expect to soon release a digital switching center that will be able to ultimately support a wide band ISDN network.

Taiwan is also investing in the research capability to develop indigenous technology for a ISDN system. As its domestic market is too small, the research is focused on developing peripheral equipment and value added services.

JAPAN

Japan has a strong international position in the telecommunications industry due to a sophisticated domestic market and extensive government support for research projects.

As in other advanced countries, Japan has invested heavily in the creation of Integrated Sound Data Networks (ISDN). These networks are capable of transmission of sound, video and data. Nippon Telegraph & Telephone (NTT) has played a role in this project by developing much of the required technology, including video coding, data transmission and switching equipment.

Given the strong operating environment for the Japanese telecommunications industry, it is well positioned for growth.

To support the telecommunications market, Japan enacted the Key Technology Research Promotion Law in 1985. This law established research institutes and national testing facilities. It also created the Japan Key-TEC Center to promote research in basic technology within the private sector.

One area of research promoted by Japan Key-TEC is space communications. The center, for example, is collaborating with several companies, including NTT, NHK, Mitsubishi Electric, Toshiba, Hitachi, Toyota and NEC, to create a research and development company to develop microwave technology.

The Ministry of Post & Telecommunications has also taken a lead role in supporting telecommunications research. Its Teletopia project, for instance, provides financial support in the research and development of both systems and services, including local area networks (LANs), high-speed data networks and translation telephones.

Given its strong operating environment, the Japanese telecommunications industry is well positioned for growth. Its domestic market is sophisticated and supported by extensive research activities and a well developed industrial infrastructure.

KOREA

Korea seeks to establish itself as an information society by the turn of the century. To accomplish this goal, it is investing in the development of switching centers and digital networks necessary for the installation of an ISDN system. This effort focuses on switching centers referred to as time division multiplexers (TDXs).

Korea gained the essential technological capability to develop these switching centers from technology transfers from multinational telecommunication companies.

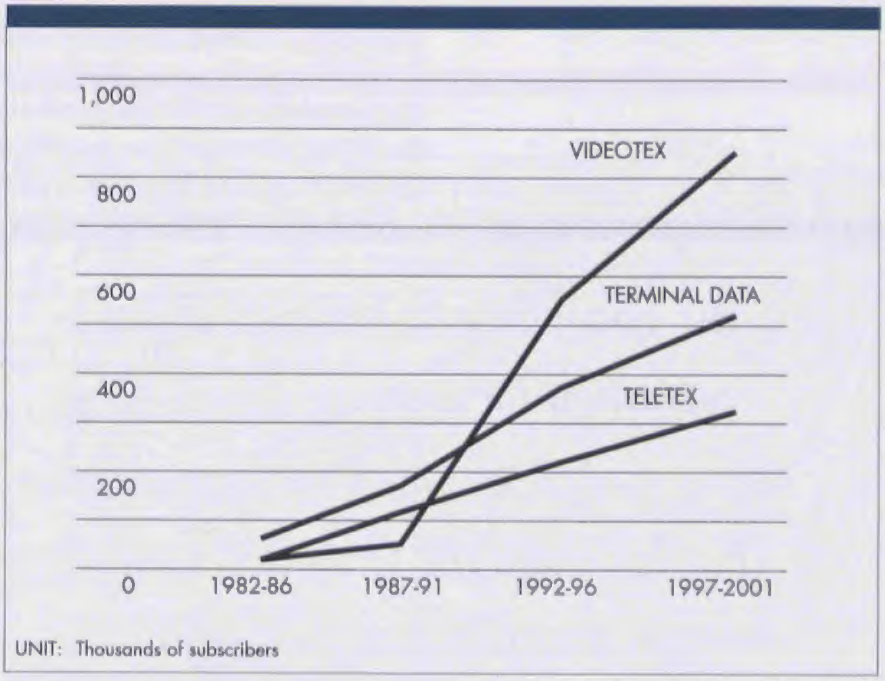
The Ministry of Communication has a three stage plan for the development of Korea's telecommunications industry. This plan calls for the development of an ISDN system built around the TDX-10, a domestically produced switching center. During the first phase, to be completed in 1991, Korea will lay the groundwork for a narrow band digital network that includes the development of a high speed line switching network. By 1996, Korea expects to finish the second phase that will include the implementation of a digital network. A wide band network and the realization of an ISDN is slated for the year 2001.

The Korean effort to develop switching centers began in 1982, with a US$36 million commitment to develop its first exchange, the TDX-1. This small exchange was ready for commercialization by the late eighties. While the Korea Telecommunication Authority was the principal purchaser of the units, Korea started to export the exchange to countries in Southeast Asia and the Middle East in the late eighties.

In the mid eighties, the Koreans embarked on a program to develop a second generation switch, the TDX-10. So far, the government has spent over US$81 million to develop this distributed architecture digital switch that has a 100,000 line capacity. As with the TDX-1, the research for the TDX-10 is being coordinated by the Electronics and Telecommunication Research Institution and includes the participation of Samsung Semiconductor and Telecommunications, Goldstar Semiconductor, Daewoo Telecom and OTELCO. This exchange is expected to be introduced in 1992.

Korea gained the essential technological capability to develop these switching centers from technology transfers from multinational telecommunications companies. The government secured these agreements as concessions in return for granting the multinationals access to the local market.

Goldstar Semiconductor for instance, has a memorandum of agreement with AT&T for technology transfer and supplies a switching system that was developed by AT&T. Samsung Semiconductor and Telecommunications is supplying an exchange developed by Alcatel. As part of the agreement, 65 Samsung engineers were trained overseas in fields ranging from design to installation.



DEMAND FOR TELECOMMUNICATIONS SERVICES IN KOREA
Source: EIAK

Complementing the government's program to build an ISDN system is a program to develop a national computer information system. This program, initiated in 1985, is mandated to develop a system that has six components: a resident's information system, a housing and land information system, a customs clearing information system, an employment information system, a vehicle information system, and an economic statistics information system.

To support this system, the Electronics and Telecommunication Research Institute established a research program to develop a super-mini computer. This project, funded with US$50 million, will end in July 1991. Its goal was access key technologies for developing the network systems for a national computer information system.

As the above examples illustrate, the Korean telecommunication industry is driven by a quickly developing domestic market. As a result, it has invested heavily in the development of the critical switching technology required for narrow band digital and wide band ISDN systems. This technology acquisition has been expedited by technology transfers from multinationals. Future competitive positions depend on the capability to develop indigenous technology. It is unclear at this point how successful these efforts will be.

TAIWAN

Taiwan's telecommunications industry is in the early stages of development. Forty years of martial law have effectively stunted the development of telecommunications in Taiwan. Only recently, with the lifting of martial law in 1988, has a domestic telecommunications market begun to develop in earnest.

...the government has developed a strategy focused on developing value added services and products that leverage the installed base of foreign manufactured equipment.

Even though the domestic industry is in its infancy, Taiwan understands the importance of becoming a world class competitor in telecommunications. In an effort to accomplish this, the government has developed a strategy focused on developing value added services and products that leverage the installed base of foreign manufactured equipment.

Currently, three foreign companies manufacture and supply switching equipment in Taiwan: ITT, AT&T and Siemens. To gain market access, these companies established joint venture operations with the Taiwan government and local companies.

Though there are three companies, it is debatable whether the economy is large enough to support this number. Industry participants feel that better support and service would be provided if there were fewer companies in the market. For this reason, it is very unlikely that another company could enter the market.

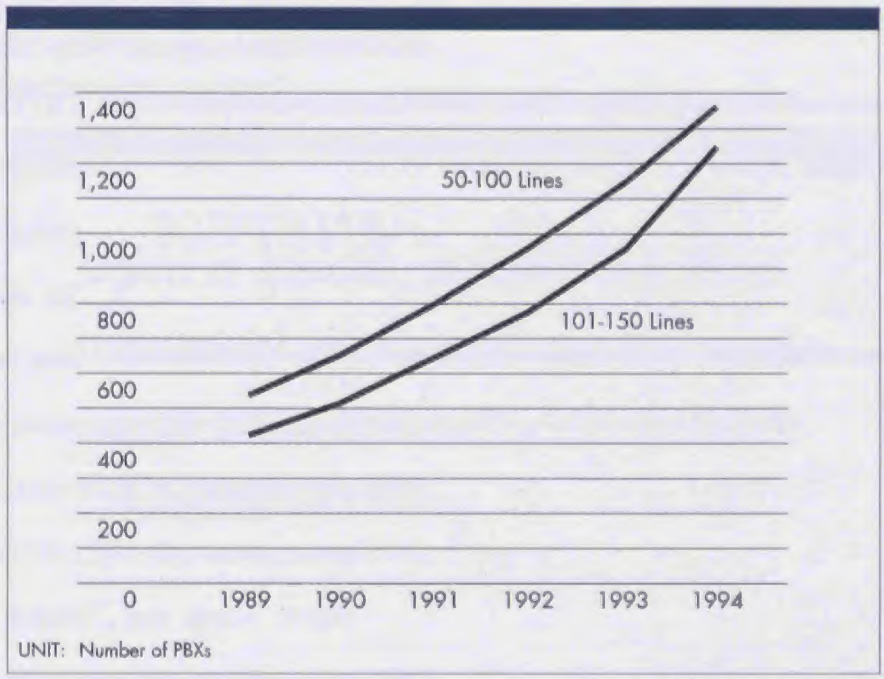
The attention of these foreign manufacturers and local industry is on the government's plans to develop an Integrated Services Digital Network (ISDN). The Directorate General of Telecommunications, Taiwan's government controlled telecommunications monopoly, has targeted the year 2000 for completion of a narrow band ISDN in the metropolitan areas of Taipei, Taichung and Kaohsiung.

To facilitate local participation in the construction of the network, the government set up the Telecommunication Lab (TL) to develop or

acquire the technologies required to support ISDN development. The lab has a staff of about 800, over 600 of whom are engaged in ten research projects focused on developing ISDN technology.

In the Hsinchu Science Park, the Telecommunication Lab has set up a trial ISDN. Known as the Fiber Metropolitan Area Network, it is currently being used by firms in the Park, ITRI research labs and two local universities. TL is also engaged in the development of broadband service technology, to conform to international telecommunications protocols.

The Electronics Research Service Organization, in conjunction with the Telecommunication Lab and ten local vendors are working on the development of an ISDN. The project is attracting support from industry, given the anticipated market demand for ISDN exchanges .



FORECASTED SALES OF PBXs IN TAIWAN
Source: Investec

In other areas of telecommunications, the industry is not well developed. Local companies are primarily involved in the manufacturing of transmitters, small PBX systems and station apparatus (i.e., phones). Many of these are still imported from Japan, but the domestic capabilities are increasing.

In contrast to other NIEs, such as Hong Kong and Singapore, which have widespread use of cellular communication, Taiwan has only recently begun offering the service and tight government control has limited this sector's rapid growth.

Taiwan's telecommunications industry, by focusing its research efforts on ISDN, has the opportunity to develop technologies that will be driven by a rapidly growing domestic market. This market should be large enough to develop competitive rivalry and will find the support of a vibrant industrial infrastructure derived from the diverse electronics industry. We expect that the telecommunications industry in Taiwan, in the area of ISDN, will be able to define a future sustainable competitive position in the world marketplace.

Aerospace

The aerospace industry has been designated by the governments of Japan, Korea and Taiwan as a critical element of their long term high technology strategies. Japan is building the Fighter Support Experimental (FSX) fighter, Korea has its Korea Fighter Program (KFP) and Taiwan is developing its Indigenous Defense Fighter (IDF). This industry is viewed as important not only for military and economic reasons, but also for its role in stimulating other high technology industries, most notably electronics and advanced materials. With the exception of Indonesia, aerospace industries are not being developed in either the NIEs or the other emerging NIEs at this time.

Japan, Korea and Taiwan are primarily using their fighter programs to drive the acquisition of foreign technologies by their domestic companies. It is unlikely, however, that they will soon develop the system design capabilities for a full scale aerospace industry. Instead, the hope is that these companies will emerge as OEM suppliers to foreign manufacturers.

JAPAN

The aerospace industry is being built around the FSX program. The FSX will be Japan's main jet fighter for the 1990s. The program, scheduled to begin in 1988, was held up by disagreements between the US and Japan over the issue of technology transfers.

Japan is expected to spend over US$7 billion to develop and manufacture this fighter. Of that, US$3 billion will be contracted to US manufacturers. Mitsubishi Heavy Industry has been designated as the general contractor for the project and General Dynamics of the US will serve as the principal sub-contractor.

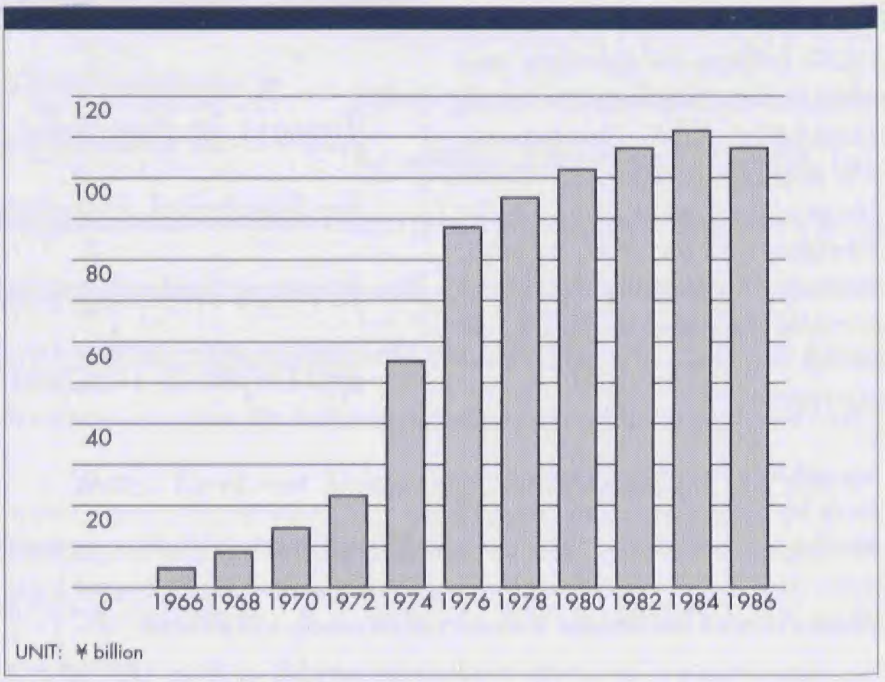
Japan is quickly assembling the industrial infrastructure required for an internationally competitive aerospace industry.

Six prototypes are planned to be built by 1994, four of which will be used in test flights. The remaining two will be used for ground tests. Initial delivery of the FSX fighters is slated for 1998, and total production of the fighter is expected to reach 130 aircraft.

Along with the FSX program, the Ministry of International Trade and Industry (MITI) has recently announced a plan to develop a new engine capable of propelling a plane at five times the speed of sound. This project is extremely ambitious, much like the "fifth generation" computer project, with funding of US$194 million. The project is meant to develop the basic technologies that will firmly establish the Japanese jet engine industry in the future. The success of this development project rests on the ability to integrate turbofan-style engines with the ram jet designs currently under development. Commercialization is at least ten years away.

In the past, Japanese engine manufacturers have been relegated to supporting roles in international development consortia. For example, when International Aero Engines was established in 1983, the Japanese participants, including Ishikawajima-Harima Heavy Industry, Kawasaki Heavy Industry and Mitsubishi Heavy Industry, were junior partners to Rolls-Royce and Pratt & Whitney.

Japan is quickly assembling the industrial infrastructure required for an internationally competitive aerospace industry. Initially, it hopes to drive this industry with its project to build a fleet of sophisticated fighters. As this project will demand a high level of product innovation, it is expected to create a research infrastructure that will allow Japan to challenge the current leadership in the aerospace industry.



JAPANESE GOVERNMENT'S AEROSPACE EXPENDITURES
Source: R&D in Japan, 1987

KOREA

The Korean aerospace program has two components, the Helicopter Acquisition (HX) program and the Korea Fighter Program (KFP). The KFP will play a far greater role in the development of Korea's aerospace industry. With its domestic content requirements, the program promises to spur the transfer of technology to the domestic industry. At this stage, the helicopter program is focused on assembly.

...the Korean aerospace industry will most likely be relatively slow in developing and for the forseeable future will be largely dependent on foreign technology.

The HX project is driven by the Korean army and is expected to last through the 1990s. Major manufacturers of helicopters, such as Sikorsky, Bell and Agusta have aligned themselves with Daewoo, Samsung and Hyundai in order to secure production contracts. Letters of intent have been signed and some joint ventures have been established.

The long-term viability of this market, however, is unclear. Beyond the military, the Korean market is too small to support a helicopter industry. The Korean companies are hoping, then, that these alliances will develop into ongoing OEM relationships.

Korean manufacturers have similar goals for the KFP program. This program is a multi-billion dollar Air Force modernization program structured to gain key technologies from McDonnell Douglas and its vendors for the F/A-18 fighter.

The program calls for the acquisition of 12 assembled planes from McDonnell Douglas, 36 planes to be assembled from kits in Korea and the co-production of 72 planes. The prime contractor for the project is Samsung Aerospace. Also participating will be Daewoo Heavy Industries and Korean Air.

The government seeks to transfer critical technologies and has selected 20 items relating to the auxiliary equipment and 12 items from the avionic electronics for technology transfer. These targets,

however, are viewed as being overly optimistic as Korea is expected to be able to absorb only about half of these technologies.

While this project is viewed as critical for the development of Korea's aerospace industry, it is not clear if the US$5.9 billion that will be invested over the next ten years will be sufficient to create a viable industry.

Longer term, the viability of the industry will be dependent on the transfer of technology to the small and mid-sized enterprises that serve as vendors to the these major industrial groups. Given the current limitations in the technical capabilities of these companies, opportunities for technology transfer will be limited. And, while Korea has established research and development institutions for aerospace, these linkages to the private sector are still relatively weak. Therefore, the Korean aerospace industry will most likely be relatively slow in developing and for the forseeable future will be largely dependent on foreign technology.

TOUGH TRANSFERS

The transfer of technology is not an easy process - especially in the aerospace industry. Korea, for example, has been negotiating with US aircraft manufacturers for seven years and has only recently made the first step toward receiving technology. As a foundation, Korea selected McDonnell Douglas' F/A-18 Hornet on which to build the Korea Fighter Program (KFP).

This selection, however, marks only the beginning. Korea must now undergo tedious negotiations with McDonnell Douglas and its many subcontractors on terms such as price, domestic content ratio, transfer of technology and specifications - a process which could delay the KFP another few years.

Additionally, Korea must receive approval from the United States Congress. Laws regarding the transfer of defense technology can be both cumbersome and costly. Defense related technology is closely governed to prevent technology from benefitting "unfriendly nations", and to protect the US technology edge. The obvious gray areas of the laws also make them ready ammunition for US manufacturers to use in negotiations.

Out of 200 core technologies required for the KFP, Samsung Aerospace, the program's coordinator, targeted 32 for domestic production. Though these are seen as critical to Korea's fledgling aeronautics industry, many believe that the cost of domestic production will be prohibitively expensive and, therefore, many of these technologies will also have to be transferred in from foreign sources.

TAIWAN

On November 29, 1989, Taiwan test flew the locally built Ching-kuo or Indigenous Defense Fighter (IDF), and officially marked the commencement of the government's ambitious plans for a local aeronautics and aerospace industry. Over the next nine years, the government plans to spend US$5.5 billion to make 250 IDFs.

Taiwan's plans to build its aeronautics industry are bold. By supporting the fighter and satellite programs, the government hopes to create a sizable and sophisticated demand.

Although the critical technologies in Taiwan's fighter come almost entirely from the US, Taiwan hopes to leverage relationships with vendors to create its own domestic manufacturing capabilities. Taiwan has signed purchasing agreements with Boeing, Pratt & Whitney and McDonnell Douglas for US$340 million to supply many key components for the IDF fighter. These agreements contain the requirement that qualified local manufacturers will supply some of the parts and components.

Pratt & Whitney, for example, placed a US$385 thousand order for gears with the Machinery Industry Research Laboratories and with Chen-Tech Taiwan Industries for forged generator parts.

Along with the IDF, Taiwan has a program to put a low-orbit satellite into space by the middle of the decade. Although, a low-orbit satellite has limited market value, it is hoped that the technology and experience gained through this ambitious project will promote technological innovation in other high technology segments such as electronics, telecommunications and advanced materials.

In support of these programs, Taiwan's government plans to set up an aeronautics industrial zone fashioned after the Hsinchu Science Park. This zone will concentrate the research and development efforts for the industry. It will also support the emergence of start-up firms by reducing many basic overhead costs.

Taiwan's plans to build its aeronautics industry are bold. By supporting the fighter and satellite programs, the government hopes to create a sizable and sophisticated demand. While this demand will potentially lay a strong foundation for a viable domestic industry, Taiwan has yet to develop the research infrastructure to support it. Success will depend on its ability to quickly build this infrastructure by attracting native scientists and engineers who are currently working in the US, similar to the strategy followed for the electronics industry.

TAIWAN'S SPACE PROGRAM

Taiwan is undertaking an ambitious space program. At an initial cost of US$383 million for the first five year phase, officials hope to launch a low-orbit satellite by the mid nineties.

Plans for the program, however, are receiving mixed reviews. Critics claim that the money could be better spent elsewhere. They point to various other "strategic" industries that could bring a return on investment much quicker than the space program.

Advocates, however, point out some virtues of the project. The tangible rewards of the program, according to Hu Chin-piao, the director of engineering at Taiwan's National Science Council, are the development of knowledge about large-scale, interdisciplinary projects and the ability to lure back some of Taiwan's overseas scientists.

With the right people and a strong understanding of systems integration, the argument goes, Taiwan could become an international base for the manufacturing of aerospace components and eventually develop a competitive indigenous space program.

INDONESIA

Indonesia's state-owned aircraft manufacturer, IPTN, has the largest and most developed aircraft design and production facilities in Southeast Asia.

Indonesia has targeted aeronautics as a strategic industry and has dedicated large resources to the effort. It hopes to eventually develop the capability to domestically design and manufacture entire airplanes to service the Asian region.

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IPTN was established under a joint venture agreement with the Spanish aircraft manufacturer, CASA, in 1984, to assemble light airplanes and helicopters. Later, it developed a 35 seater aircraft for domestic use. IPTN also has a joint venture agreement with West German airplane manufacturer Messerschmitt-Bolkow-Blohm.

In support of its efforts, IPTN has set up the Laboratory of Aerodynamics, Lab of Gasdynamics and Vibration, and the Wind Tunnel Laboratory. In these labs, IPTN is conducting research in areas such as aircraft performance during take-offs and landings and the application of advanced materials for structural elements.

IPTN's first wholly designed and produced aircraft, a twin-engine, 50 passenger turboprop plane, is expected to be available for commercial service in 1994.

IPTN has recently been awarded OEM contracts with various US aircraft manufacturers including GE, Pratt & Whitney and Boeing. Under the contracts, parts for the F16 fighter are manufactured for GE and engine components are supplied to Pratt & Whitney. Boeing has licensed IPTN to make wing trailing edge flaps for its 737 aircraft.

In another ambitious program, the government has announced plans to build both a low orbit satellite, as well as a launch system.

Known as the Satellite Self-Sufficiency Program, the first phase is to establish testing facilities for rocket engines. The government is also reportedly in negotiations with a Japanese concern to jointly develop radar tracking stations.

IPTN, with significant government support, has been able to establish a foundation for an aerospace industry in Indonesia. While this firm's capabilities were originally limited to the assembly of aircraft, it has been able to assimilate the manufacturing technologies required to move to higher value production. At the same time, the firm is now being supported by the efforts of research institutes. It remains unclear, however, how well Indonesia will be able to support the the creation of a broad based industry, particularly as its industrial infrastructure is not well developed.

Biotechnology

The biotechnology industry in the Asia Pacific region is still in its formative stage. While government resources are now being directed to build up the research infrastructures, these efforts are being hampered by a shortage of skilled researchers. Further, financial institutions and venture capital firms are unwilling to invest in this industry.

Japan's industry is the most developed in the region. While less than ten years old, it was able to develop quickly due to access to foreign technology through licensing agreements and investments in startup companies in the US.

The industry in Taiwan is quite small. The industry was launched to support development of a hepatitis B vaccine, but has since expanded. However, the small domestic market is a limiting factor.

Singapore has embarked on an ambitious plan to become a regional center for agriculture-based biotechnology industries, but suffers from the lack of a large domestic market for biotechnology products, sufficient interested venture capitalists and skilled researchers.

Malaysia has a relatively long history of biotechnology research, focused on its agricultural resources, including palm oil and rubber. But little has been done to develop an indigenous industry. Thailand and the Philippines are also now laying the research infrastructures for an agricultural-based biotechnology industry. At this point, however, the absence of skilled researchers limits their efforts.

JAPAN

Since 1981, when the Ministry of International Trade and Industry (MITI) earmarked biotechnology as a key industry, Japanese companies have committed significant resources to developing their research and commercialization capabilities. Accordingly, it is expected that the biotechnology market in Japan could reach upwards of ten percent of GNP by the year 2000.

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Most of the industrial reseach and development has been undertaken by large pharmaceutical and chemical companies. These companies include Takeda Pharmaceutical, Shionogi Pharmaceuticals, Mitsubishi Chemicals and Ajinomot. Almost 80% of all research and development investment undertaken in Japan is directed to the pharmaceutical sector.

While the Japanese have a well developed research capability, most of the products currently on the market have been acquired through licenses with foreign companies. But the dependence on foreign technology in the last few years has slowed as Japan's research labs are becoming more successful in creating new products and production processes.

Research efforts in recombinant DNA have focused on the manufacture of natural proteins from human cells. In the area of cell fusion and mass cell culture technology, research has concentrated on the production of monoclonal antibodies that are used for a variety of diagnostic and treatment applications.

As would be expected, the government has played an active role in promoting the biotechnology industry. It has established a total of seven government-private research associations in the field. By building the research infrastructure, Japan hopes to develop a competitive domestic biotechnology industry. Given the strength of its domestic market, Japan is well positioned to achieve this goal.

TAIWAN

The biotechnology industry in Taiwan is only now emerging. There are currently ten firms participating in it, most of which are still dependent on financial support from the government.

The Development Center for Biotechnology (DCB) was established in 1984 and is the primary body responsible for promoting the development of a biotechnology industry in Taiwan. Through loans and equity investments, the DCB supports the startup of biotechnology firms. The DCB also helps direct the transfer of technology from abroad and from research institutes to the domestic industry.

Despite minor successes...the biotechnology industry still faces formidable impediments to future development.

Life Guard Pharmaceutical Inc. was the first biotechnology firm established in Taiwan. Started with the help of the DCB in 1985, it purchased technology from a French pharmaceutical company for the production of a hepatitis B vaccine and is currently still the only manufacturer of vaccines for human consumption in Taiwan.

Taiwan now produces a number of products, most of them for the domestic market. These include a vaccine for hepatitis B, animal vaccines and diagnostic kits for cancer screening and pregnancy testing.

Despite minor successes, however, the biotechnology industry still faces formidable impediments to future development. Not only is there a shortage of trained researchers, but Taiwanese firms lack the financial resources to bring new technologies to market. Given the high level of risk involved, the country's venture capital markets are unwilling to invest in most biotechnology startups. Additionally, there is weak coordination of the research projects undertaken by government research institutes, the universities and the private sector.

SINGAPORE

Singapore plans to become the premier biotechnology center in Southeast Asia. This strategy is driven by the belief that biotechnology, particularly in agriculture, will become a major Southeast Asian market by the end of this decade.

Singapore has stepped up its research and development efforts at the national level while encouraging private sector participation through various incentives.

To realize this potential, Singapore has stepped up its research and development efforts at the national level while encouraging private sector participation through incentives. It hopes to develop core technologies through the efforts of research institutes and universities and nurture a critical mass of personnel by increasing investment in bioresearch.

The Primary Production Board (PPD) is the principle government body responsible for the development of Singapore's biotechnology industry. With a staff of over one thousand, the PPD oversees efforts to link government, university and private sector efforts for research and development. The PPD is also charged with the development and implementation of a series of planned agrotechnology parks.

Singapore's biotechnology industry faces several impediments. For one, its primary markets are beyond its borders, greatly increasing market entry costs. Additionally, it is particularly difficult for startups to get financing in Singapore. The long-term investment associated with biotechnology conflicts with the investment profiles used by Singapore's venture capital firms.

Finally, Singapore lacks sufficient skilled researchers for the transfer of technology from abroad for development of indigenous technologies. The success of Singapore will ultimately depend on its ability to develop and serve small, well defined market segments.

In short, Singapore can develop as a regional power, particularly in crop specific farming, but lacks the resources to establish a broader based biotechnology industry.

MALAYSIA

As with most of the other countries in Southeast Asia, the biotechnology industry in Malaysia has yet to become established. Not only is there a lack of venture capital financing but Malaysia has yet to legislate an adequate patent system to protect intellectual property rights for biotechnology.

Research activities in Malaysia are directly related to its resource industries. The principle institutes for these industries are the Palm Oil Research Institute, the Rubber Research Institute and the Malaysian Agricultural Research and Development Institute. Most of the basic research in biotechnology is conducted at the University of Malaya, but little research has been commercialized due to the virtual absence of a domestic industry.

Research activities in Malaysia are directly related to its resource industries.

THAILAND

Thailand is undertaking research projects that it hopes will create the foundation for a biotechnology industry. These projects are attempting to develop biotechnologies for agribusiness. Much of this research effort is conducted at the Plant Genetic Engineering Lab, which focuses on tissue cultures, the diagnosis of plant diseases and the development of viral resistant and drought resistant plants.

Thailand is undertaking research projects that it hopes will create the foundation for a biotechnology industry.

Thailand, however, has no intellectual property regulations for drugs or biological organisms. Multinationals, then, are extremely hesitant to set up biotechnology joint ventures in the country. Domestic startups are also unlikely in the near future given the lack of interest on the part of venture capital firms for the high risks associated with these firms.

PHILIPPINES

As an agrarian-based economy, the Philippines has recognized the importance of developing a biotechnology industry. It was the first country in the Association of Southeast Asian Nations (ASEAN) to commit itself to develop a research and development program. While research activities are on-going, no biotechnology firms have been established in the country.

Although the current program is quite small, it is clearly focused, concentrating on the areas of agriculture and the food industries. This program is better coordinated than those in Thailand and Malaysia.

While the current program is quite small, it is clearly focused, concentrating on the areas of agriculture and the food industries.

Responsibility for overseeing the development of biotechnology in the Philippines is shared by the National Institute of Biotechnology and Applied Microbiology and the National Institute of Science and Technology (NIST).

The NIST is a multidisciplinary industrial research institute that is undertaking seven research projects, two of which are related to the biotechnology industry. The primary focus of these programs is the development of technologies for microbial based industries including fuel alcohol, food/feed substitutes and fertilizer substitutes.

While the research programs have achieved some successes, particularly in the area of rice production, the Philippines faces serious impediments in developing a viable biotechnology industry. For one, all research activities are being undertaken in public research laboratories that have limited budget allocations. There is also a severe shortage of trained researchers. We do not expect, then, that the Philippines will become a major base of biotechnology in the foreseeable future.

Founded in the late 1970s to address problems being experienced by multinational corporations, Investec differs from other consulting companies in that they are a support organization that advises and assists corporations to identify and achieve their strategic objectives. They do not attempt to offer solutions to internal management problems but rather advise senior and middle management in the total decision making process with regards to operations in Asia.

Investec has had extensive experience working with high technology and related industry clients to formulate corporate and business strategies which reflect the realities of the Asian environment. They have consequently built up an extensive knowledge of high technology companies' strategic planning for Asia; their market entry strategy development, and their marketing, market planning and distribution analysis.

If you have any questions on "The Development of High Technology in the Asia Pacific Region", please contact either Michael McNabb or Thompson Morrison at:

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High technology is the most dynamic and global industry today. Computer systems and software, semiconductors, advanced communications, aerospace and space commercialization, biotechnology and pharmaceuticals, medical technology, new materials and chemicals, electronic equipment - these fields are changing our lives in dramatic ways and creating the advances vital to economic growth and productivity in all industries.

KPMG is a leading provider of accounting and consulting services to the high technology industry. Our professionals are specially trained in industry issues, experienced in serving technology-based companies and committed to the highest quality service to our clients.

We believe the future of the high technology industry is bright and have made a special commitment to assisting technology businesses with the many opportunities and challenges that lie ahead.

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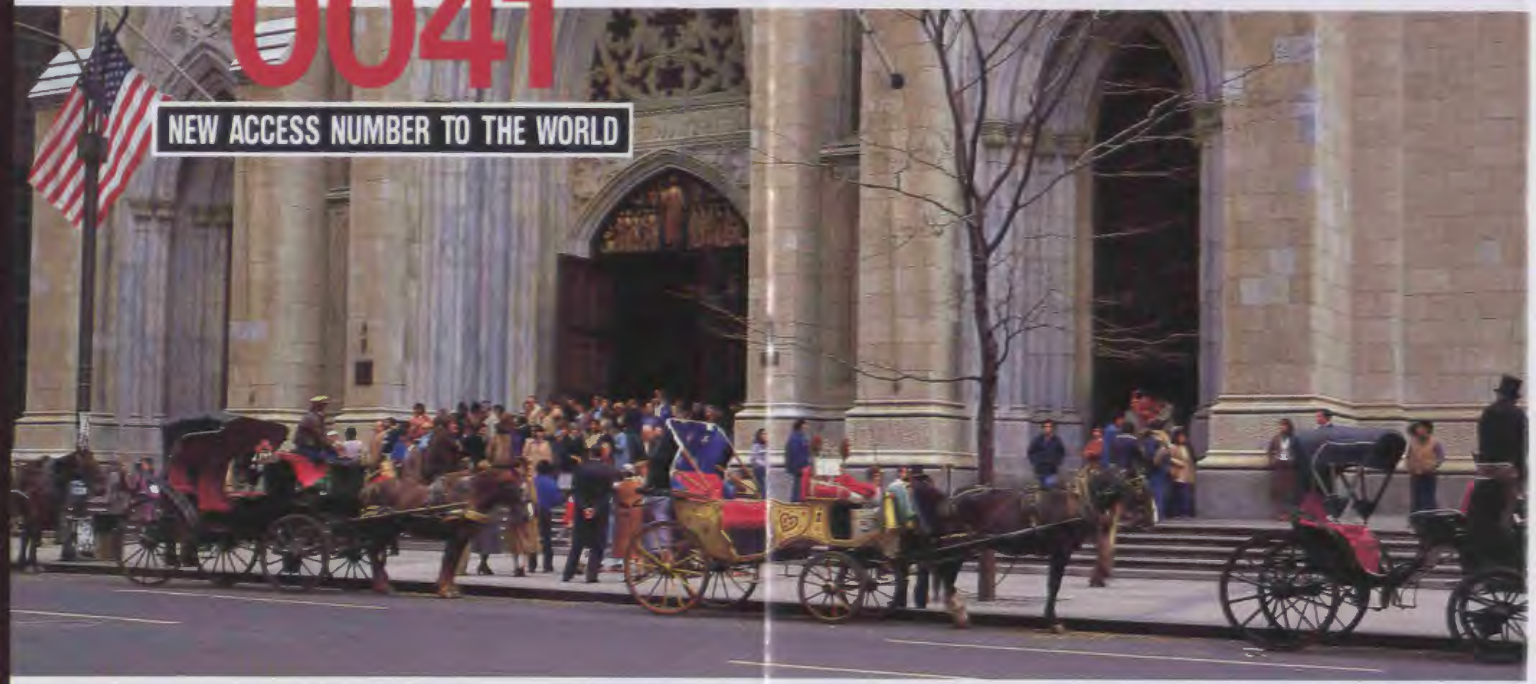

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世界の人々の胸に
勇気と希望の灯をともす。

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Dial 011 at first, then Japan's country code (81), the area code and the desired phone number in that order. (The prefix "0" of area codes is not needed.)

アメリカから日本へ

最初に011をダイヤルして下さい。その後、日本の国番号(81)、市外局番、相手先の電話番号の順にダイヤルします。(なお、市外局番の0は不要です。)

Example: To dial (Tokyo, Japan) 03-123-4567　例) 東京の03-123-4567番へダイヤルする場合

011 (Access code) ▶ 81 (Country code (Japan)) ▶ 3 (Area code) ▶ 123-4567 (Telephone number)

Major area codes 主な市外局番

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- Directory assistance (nationwide), etc.
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Example: To dial (New York City) 123-4567
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● Just substitute 0041 for 011 ● 従来の011のかわりに0041をおすだけでOK。

ITJ

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Chicago (ILL)	708	Miami (FLO)	305	San Francisco (CALIF)	415
Detroit (MICH)	313	Hawaii	808	Seattle (WASH)	206
Houston (TEX)	713	Las Vegas (NEV)	702	Washington (DC)	202

時刻(LOCAL TIME) →

10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	8	9
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	1	2	3	4	5	6
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	1	2	3	4	5

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INTERNATIONAL TELECOM JAPAN

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American Colleges Come To Japan

Going overseas to attend an American university is nothing new for the Japanese. But do you know that today, in increasing numbers, American colleges and universities are coming to Japan? In 1990 alone, nine American colleges are opening campuses in Japan. These include three that responded to eager invitations from local governments: Minnesota State in Yuwa-machi, Akita Prefecture; Texas A&M in Koriyama City, Fukushima Prefecture; and Oklahoma State in Kameoka City, Kyoto Prefecture. In each case, students who study at the Japanese campus can enroll overseas when they meet certain basic requirements. Besides the obvious benefits to their surrounding economies, the new American colleges in Japan make an important contribution to expansion in international exchanges and deepening friendships. They also help to make today's younger generation of Japanese better prepared for the challenges of the globally oriented future.

米国大学の日本校開校が相次いでいます。

1990年、米国大学の日本校が九校も開校されることをご存じですか。このうち、地元自治体が中心となって誘致したものが三校あります。

秋田県雄和町に開校するミネソタ州立大学機構秋田校、福島県郡山市のテキサス州立A&M大学郡山校、そして姉妹都市関係を発展させた京都府亀岡市のオクラホマ州立大学京都校。いずれの日本校においても、一定の条件が整えば米国の本校に編入が可能です。

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