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The Progress Of Satellite Technology And Its Role
In The Development Of The Asia-Pacific Region -
The Case Of Indonesia

By

Jonathan L Parapak
THE PROGRESS OF SATELLITE TECHNOLOGY AND ITS ROLE IN THE DEVELOPMENT OF THE ASIA PACIFIC REGION - THE CASE OF INDONESIA

by Jonathan L. Parapak

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1. INTRODUCTION

Today we are living in a small world. Distance is no longer relevant to our way of life. With a telephone we can contact anyone at any time and at any place around the world. With a computer, a modem and a telephone we can access almost any kind of information stored in computers in major centers of this world. With a television set we can witness "live transmission" of almost any event around the world.

All these developments have been made possible through the incredible progress in electronics, computers and communications. The development of telecommunications technology has been further stimulated by progress in the field of electronics and computers. Developments in the electronics field have presented us with ultra-high integration enabling thousands of components to be deposited on a single semiconductor chip. In the field of computers we are witnessing the emergence of super computers with intelligent processing and almost unlimited capacity and capability. The widespread use of personal computers has created new awareness and stimulated new demand for interconnection.

The global communications network enables us to access, collect, process and deliver information from an office or a terminal to almost any place in the world. Indeed we are now part of the global connectivity, global mobility and global information society.
Within this environment, a nation or a region can no longer progress or have a competitive advantage without the support of high-quality communications networks. One of the systems which has played a very significant role in the improvement of communications services is the satellite system. Satellite technology offers wide coverage, high-quality transmissions, multi-service offerings and high speed of implementation.

This paper will briefly describe this progress of satellite technology and services, the socio-economic impact of communications via satellite with a focus on the development of Indonesia and the challenges faced by many of us in the future use of satellite communications.

2. THE PROGRESS OF SATELLITE TECHNOLOGY

a. Historical Development

The idea of using a satellite to relay radio signals around the Earth dates back to October 1945, when Arthur C. Clarke introduced it in an article published in the British journal Wireless World. The article accurately estimated the energy needed to put a satellite into an orbit approximately 36,000 km above the equator, at which distance it would move around at the same angular rate as the Earth and so appear to a ground-based observer to be in what is known as the "geostationary" orbit.
This article named "Extra Terrestrial Relays" also discussed his theory that if these satellites were positioned over each ocean region in geosynchronous orbit they could provide global communications to the world.

In December 20, 1961 the United Nations General Assembly adopted resolution 1721 stating that Global Satellite Communications should be made available on a non-discriminatory basis.

The stage was thus set for the development of satcoms more or less as we know them today. The first communications satellite capable of relaying messages immediately - or "in real time", as the jargon has it - was launched in 1962. Called Telstar, it circled the Earth at heights between 950 km and 5,600 km, an orbit known also as "highly elliptical". This enabled it to connect ground stations in the USA and UK, for example for only about half an hour each day.

Telstar was funded entirely from private sources and represented a significant step towards the commercial realization of Arthur Clarke's prediction. But the principal contribution to the early development of satcoms in the 1960s came not from the private sector but from space agencies.

In the United States of America a significant event occurred on August 31, 1962 when President John F. Kennedy signed into law a Communications Satellite Act, setting forth policy for establishing an international cooperative satellite system and authorizing COMSAT, a new private company of the USA to represent the United States of America in the coming new organization to be named Intelsat.

Following the development of the international satellite system, International Telecommunication Union (ITU) conducted the first World Space Radiocommunication Conference in 1963.

The fixed satellite services were the first network system to develop, and there was rapid recognition that these new global possibilities necessitated the creation of a new kind of international organisation. This led to the creation of Intelsat, an international organisation now having 119 members and based in Washington. Its task is to provide fixed satellite communications services all over the world.

Interim arrangements for a global system were agreed on as early as August 20, 1964, but it took until 1973 for the definitive agreements to be negotiated and to come into force.

Intelsat I, known as Early Bird, was launched on April 6, 1965. It weighted under 40 kg in orbit and offered 240 telephone circuits or one television channel. This marked Intelsat's Early Bird as the world's first commercial communications satellite for television, voice and facsimile.
The Soviet Union, which is not a member of Intelsat, in 1971 created a similar organisation, Inter-sputnik, which provides fixed satcoms services for its 14 member states and a number of other countries. Inter-sputnik uses the various families of Soviet communications satellites: Molniya, Raduga and Gorizont. It operates in much the same way as Intelsat, except that both geostationary and highly elliptical orbits are used. One advantage of the latter is that they offer polar coverage.

In the early 1970s the International Maritime Organisation (IMO), then known as the Inter-Governmental Maritime Consultative Organisation (IMCO), began to consider the possibility of using satcoms to improve maritime communications, not least for safety purposes.

Towards the end of 1973 IMCO convened a conference to decide on the principle of establishing an international maritime satellite system and to conclude the necessary agreements.

The work of the conference culminated in September 1976 in the adoption of what became the Inmarsat Convention and its complementary Operating Agreement. This Convention and Operating Agreement which required Inmarsat always to act exclusively for peaceful purposes, came into force on July 16, 1979. Thus was born the world's first mobile satcoms supplier.

Inmarsat Convention and Operating Agreement were amended in 1985 to extend the mandate to aeronautical services, which had been foreseen during the preparatory international conference. Further amendments ratified at the beginning of 1989 permitted land-mobile services; that is, services to trucks and trains.

Keen to offer a maritime service as soon as possible Inmarsat took advantage of existing developments by leasing three Marisat satellites from Comsat General in the United States and, subsequently, two Marecs spacecraft from ESA.

These were later supplemented by maritime communications packages on Intelsat satellites, to give a 1989 total of eight dedicated payloads - three operational and five spares - distributed in geostationary orbit so as to give near-global coverage. The system officially went into operation on February 1, 1982.

b. Fixed Satellite Systems

Intelsat undoubtedly is the global satellite networks provider in the world. The 13 satellites of the INTELSAT system keep pace with the growing demand of the world's population for high-quality, reliable global communications. The satellites of the INTELSAT global system provide dynamic electronic communications links over which a variety of voice, video, and data messages constantly flow.
It all started when INTELSAT’s first satellite, Early Bird, was launched in 1965. Early Bird revolutionized the communications world. It demonstrated that commercial services via satellite in geosynchronous orbit were feasible. It made live transoceanic television possible. It expanded communications resources in the North Atlantic. It proved that satellite technology offered vast potential for expanding global communications resources.

When Early Bird began operation in 1965, communications were possible via only one earth station-to-earth station pathway. The first five INTELSAT earth stations -- Andover, Maine, U.S.A., Fucino, Italy, Goonhilly Downs, United Kingdom, Pleumeur-Bodou, France and Raisting, Federal Republic of Germany, took turns communicating with each other via Early Bird. Now INTELSAT users communicate via 13 satellites, through more than 2,000 earth station-to-earth station links, among more than 800 antennae, at more than 600 earth station sites. These antennae range in size from as large as 30 meters to less than 1 meter in diameter. They are located in the countryside, at urban teleports, and on the rooftops of downtown office buildings. Some are transportable, shipped to remote locations for use wherever a voice or video requirement arises.

Early Bird provided capacity for voice, record, and television. Television transmissions could be carried, however, only if voice and record traffic were relinquished. Over the past 25 years, INTELSAT has responded to an evolving communications market to offer international, regional and domestic services to meet a range of telecommunications needs. From specialized business networks, to data collection and distribution services using very small aperture antennae (VSATs), to broadcasting on a full-time or as-needed basis, to regional and domestic systems, INTELSAT’s goal is a system that meets members’/users’ wants and needs and that makes members’/users’ wants and needs the system.

Figure 2: Intelsat Channels Used
During the past 25 years, the communications traffic carried on the INTELSAT system has experienced phenomenal growth. At year end 1965, Early Bird carried only 150 full-time channels. As of December 1989, INTELSAT satellites carried almost 120,000 full-time channels. In addition, there were 116 full-time leases of bulk capacity in operation -- 65 for domestic services, 34 for video services, 14 for different business applications, one for cable restoration, and two for United Nations peacekeeping operations. INTELSAT was also leasing capacity to the International Maritime Satellite Organization (INMARSAT) for the provision of communications to ships at sea.

These services are provided by a combination of 13 INTELSAT IV, V and V-A satellites in geosynchronous orbit at an altitude of approximately 22,240 miles (35,780 kilometers).

During 1988 this system achieved 99.997 percent continuity of service for the INTELSAT space segment, 99.972 percent average earth station continuity and 99.937 percent average path reliability. This means that communications services carried on the INTELSAT system are the most reliable in the world, far superior to those of any other medium, including fiber optic cable. This record continues the high level of service for which the INTELSAT system has become recognized around the world.

c. Mobile Satellite Services.

The International Maritime Satellite Organization, INMARSAT, was started with a relatively small membership but expanded to have a wide international membership. By April 1990 it had 59 members including Eastern European countries such as the USSR. It is similarly financed to INTELSAT, has its headquarters in London and in its initial years used transponders on various satellites available from INTELSAT, the European Space Agency (ESA) with its MARECS satellite, and the MARISAT Joint Venture providing the MARISAT satellites. In 1982 INTELSAT V (F-5) was the first of a series launched with a MCS (Maritime Communications Subsystem) specially for INMARSAT.

INMARSAT’s primary mission is to provide a service to ships and platforms. By July 1984, more than 2600 ships were equipped with ship earth stations. The service includes low rate (2.4 kbit/s) and high rate (up to 56 kbits) data, voice and emergency services. During mid-1983 INMARSAT launched an ambitious plan to procure a world-wide satellite system for most remote mobile platforms and appeared to be offering the potential of an air traffic communications and control service.

After many years of study and a couple of false starts, the aviation community is finally on the threshold of accepting mobile satellite communications. In October 1985 the Inmarsat Assembly approved amendments to the organization’s convention and Operating Agreement empowering it to provide aeronautical services.
By 1989 these amendments were coming into force, having been accepted by almost all of the required number of member countries. Many of the same principles that formed the basis of Inmarsat’s Maritime Services were being applied to the aeronautical sector as the organisation began to offer commercial aviation satellite communications in 1989.

Figure 3: Inmarsat System

The demands of safety, operational efficiency, air traffic control and improved passenger services are now proving too much for the traditional communications on which aviation has relied over the years. The single most important advantage of satellite systems is their ability to provide high-quality, long-distance communications all over the globe. No matter where on Earth an aircraft is flying, apart from the extreme polar regions, satellites will guarantee instant, automated communication with any location.

Inmarsat is now planning for land-mobile services. In January 1989, following the 1987 decision by the ITU Mobile Administrative Radio Conference to allocate land-mobile satellite frequencies, the Inmarsat Assembly adopted amendments enabling the organisation to provide such services.

The size of the land-mobile market remains hard to assess. In the mid-1980s the common wisdom was that cellular radio was an urban phenomenon only, that it would be too costly to extend service into rural areas, and that land-mobile satellite terminals would soon populate the countryside.
But by 1988 cellular radio had covered 85% of the geographical area of Great Britain and was set to attain similar penetrations in France and other major European countries. The areas still to be covered are thinly-populated and likely to generate little demand. Mobile satcoms may yet play an important part in the rural and remote areas of developing countries.

d. Domestic and Regional Satellite Systems.

1. Domestic Satellite of the USA.

The United States has several different programmes that provide national links.

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U.S. Systems (December 1984)

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The WESTAR network has been operational since 1974. Its satellites were operated by the Western Union Telegraph Company, manufactured by Hughes Aircraft Company and used for telephone, broadcasting of television and high quality audio programme material, and data services. These satellites have 12 or 24 C-band (6/4 GHz) transponders each of 36 MHz bandwidth.

The RCA Corporation initially leased transponders on WESTAR and ANIK, then in 1975 and 1976 constructed and launched its own satellites (SATCOM 1 and SATCOM 2).
These satellites each weigh approximately 400 kg at beginning of Orbit Life (BOL), use three-axis stabilization and have a capacity of 24 channels of 36 MHz bandwidth in the C-band (6/4 GHz) with frequency reuse by cross-polarization. SATCOM 1 operation terminated in June 1984 while SATCOM 2 is still in service. Two additional C-band satellites were launched in December 1981 and January 1982. In October 1982 the first all-solid-state satellite, SATCOM 5, was launched, soon followed by SATCOM 1R and SATCOM 2R.

The American Telegraph and Telephone Company (ATT) leased four satellites manufactured by Hughes Aircraft Company at the request of Comsat General Corporation. These COMSTAR satellites offer 24 repeaters with 36 MHz bandwidth and use twice the C-band (6/4 GHz) by means of frequency reuse by cross-polarization. The TELSTAR satellites are due to replace the aging COMSTAR satellites, which were launched in 1983. These are improved 24 transponder C-band satellites.

The satellite Business System (SBS) satellite was in orbit in 1980. This project was funded by a consortium of Comsat General, IBM, and Aetna Life and Casualty Inc. It is designated to provide services such as telephone, video conferencing and data transmission for a large number of almost entirely business users. SBS-1 and SBS-2 (or USASAT) operate in the K-band (14/12 GHz) and use digital transmission.

In SBS-3 two of the ten transponders provide 40W of transmitting power each and are leased to COMSAT to provide programme distribution services to the NBC television network. In SBS-4 the output of five transponders can be concentrated via spot beams on the east or west coasts of the USA and may be used for direct broadcast television services.

SBS-5, planned for launch in 1986, has 14 transponders, the extra four with 110 MHz of bandwidth.

2. The Canadian Domestic System.

Canada has been operating domestic satellite systems since 1973, with the first of the ANIK satellite series. Some 130 earth stations, ranging from 1.2m to 30m, are operated by TELESAT. They provide a variety of sound and television broadcasting, data, message and record services, including a medium density telephone service to communities in the high Arctic using 8m or 10m antennae. The ANIK D satellites are gradually replacing the former A and B series.
ANIK D satellites were built by SPAR Aerospace Ltd. in cooperation with the Hughes Aircraft Co. ANIK D satellites weigh 1217 kg (BOL) and are designed for a 10-year lifetime. They offer 24 channels with 36 MHz of bandwidth at C-band (6/4 GHz). ANIK C-3, launched in November 1982, is the first satellite of the C series operating at Ku-band (14/12 GHz). Four down-link spot beams share sixteen 54 MHz bandwidth channels equipped with 15-W TWTAs. Each channel has a basic capability for one 90 Mbit/s digital message carrier or two analogue television signals.

3. EUTELSAT Regional System.

The European international organization which provides telecommunication services by satellite is named EUTELSAT and consists of 20 member states (signatories) who are represented by their Telecom administrations (including Post when these are combined and called PTT).

The EUTELSAT satellites are used for main route telephony in Europe, TV distribution services, and exchange of TV programmes within the European Broadcasting Union (EBU). In addition, special services are provided (Satellite Multi-service Systems: SMS) for the purpose of data transmission and teleconferencing required by the international business community, using small dish terminals.

The European programme started with an experimental satellite - OTS - and moved to the operational phase with the launching in June 1983 of EUTELSAT 1 (F-2). EUTELSAT 1 (F-2) with its SMS payload was launched in August 1984.

EUTELSAT is now considering the implementation of a three-satellite space segment

4. ARABSAT Regional System.

The Arab Satellite Communications (ARABSAT) Organization was formed in 1976 as a consequence of the decision of the League of the Arab States to set up a satellite communications system dedicated to the Arab region, when it became obvious that building a terrestrial network for this region would be both too expensive and too time-consuming.

The first ARABSAT satellite was launched in February 1985 by the Ariane launcher. The system is to provide a variety of communications services such as telephone, low and medium data transmission, multiplexed telex/telegraphy, radio and television distribution, community TV reception. It operates in the C-band (6/4 GHz) using twenty-five 33 MHz bandwidth channels.
A specific channel is dedicated to community television which operates at 6 GHz in the up-link and at 2.5 GHz (S-band) in the down-link. The satellite lifetime is at least seven years. Earth stations for the C-band communications services are: major earth stations with 11-m diameter antennae, implemented in large metropolitan areas; transportable earth stations with antenna diameter of 1.6 m, used for emergency communications; earth stations with 4.5-m diameter antennae used for TV reception in remote areas. For community television, down-link reception is obtained from small receive only S-band earth stations with antennae of 3 m diameter.

e. The Progress of Satellite Technology.

Satellite communications first became a true commercial proposition in 1965, with the launch of Early Bird (Intelsat). It had a launch mass of 68 kg and capacity for 204 two-way calls, or circuits. Successive Intelsat spacecraft were developed, each outstripping the last in performance. Today's Intelsat VI has a launch mass of 3,500 kg and a capacity of 33,000 circuits.

With the exception of Intelsat V all of these US-built spacecraft were spin-stabilized. It was left to the European Space Agency to investigate the advantages of three-axis stabilization for communications satellites, culminating in the successful launch of the Orbital Test Satellite (OTS) in May 1978. OTS had a launch mass of 865 kg and capacity for 7,200 circuits. It led to the European Communications Satellite (ECS), which in turn was used as the basis for Olympus. With a maximum launch mass of 3,500 kg and 7.5 kW of power, this large, multi-purpose communications satellite is capable of providing five direct-broadcast television channels.

Intelsat VI and Olympus are particularly large examples of the breed. In order to take advantage of the dual-payload capability of current launchers, most notably the European Ariane, most commercial communications satellites weigh 2,000-3,000 kg at launch.

Whether capacity is concentrated in a few large spacecraft or spread among smaller platforms, the market for satellite communications continues to grow. Satellite payloads will become more efficient, using spot beams to illuminate centres of high-density traffic. The beams will be steerable, allowing them to be switched to any new high-traffic area to emerge during the life of the satellite. Operational lifetimes continue to grow: 10 years is a common requirement, 15 years has been demonstrated and will be the future standard.
Inter-satellite links, providing more direct communications, are being developed. Their first application will be communications between the low-Earth-orbiting space stations, both US and European, and geostationary data-relay satellites. The high-data-rate link will be optical, using laser technology, and an obvious future development is inter-satellite communication in geosynchronous orbit.

As the demand grew it also diversified from trunk telephony, provided initially by international satellite networks, to new services (video communications, data transfer, direct broadcast) often based on digital facilities, and first offered within regional or domestic systems.

The ground segment similarly underwent a change, from the large and expensive earth stations with antennae diameters in the range of 3 to 10 m for telecommunication applications, and 0.6 to 1.2m for direct broadcast applications. As the organization of the satellite become more complex, earth stations simplified and increased in number.

**What can we foresee in the future?** The simplest approach to this 'guessing game' is to imagine the future as an extrapolation of the present spacecraft configurations that would lead to multiple payload satellites, offering a wide diversity of services, with mass in the range of 3000 to 5000 kg, launched by either the Shuttle or ARIANE 5. The present state of the art of 10 years' design lifetime would probably be extended to twelve years.

The above scenario is appealing as, even though the cost per spacecraft increases with size, the specific cost (cost per kg, or better per channel-year) decreases with growing mass. Market studies indicate that beyond 1995 the demand for such satellites should be in order of about 20 to 40 per year.

However, this scenario is constrained by two factors: the maximum capacity of the available launch vehicles, and the geostationary orbit crowding which will lead to intolerable interference between satellite systems. To face the ever increasing demand for more communication channels and services, new configurations must be envisaged.

**Modular platform assemblies with automatic docking of payload modules:** they consist of a common service module providing the power supply and other support functions for a number of payload modules. The total mass would be in the range of 5000 to 10000 kg. The payload modules would incorporate apogee propulsion, rendezvous and docking systems.

**Large platforms with in-orbit assembly:** such platforms are permanent stations with servicing and repair (modules exchange) operations. The mass ranges from 20000 to 100000 kg, span is of the order of 100 m and power is 30 to 250 kW.
The advantages of geostationary platforms would be a higher capacity per orbital slot by combining the functions and operations provided by many satellite systems into one orbiting platform, lower costs per unit of capacity, and improved communications networks as a result of inter-connection facilities. However, a significant penalty of geostationary platforms is that, to achieve a small number of launches, it is necessary to put large payload capacities into orbit well in advance of the time they are needed.

**Cluster concept**: it consists of placing a group of six to twelve geostationary satellites in orbit, connected via radiofrequency or optical intersatellite link to a central switching satellite, and spaced about 100 km apart. Each satellite would be equipped with a large diameter antennae producing several spot beams, with beamwidth of about 0.1°, allowing transmission to the earth stations with low power transmitters. The links with the switching satellite would ensure the required interconnectivity between all satellites.

The system would be deployed progressively through successive launches as the need arose. It could use relatively small satellites as a result of low power requirements, and in the case of a failure of one of them the faulty satellite could be replaced at a reasonably low cost. The main difficulties are: the station keeping the individual satellites within the cluster, because relative motion may entail the loss of antenna tracking and shortage of the intersatellite links, and the implementation of the switching device in the central satellite.

3. **THE ASIA PACIFIC REGION**

The Asia Pacific Region is undeniably the fastest growing region in the world. Not only has the region become a new growth center but economic interdependence among the member countries in the region has also significantly increased reflecting great potential and dynamism within the region itself.

Five hundred years ago, the world trade-centre moved from the Mediterranean to the Atlantic. Currently, it has moved back from the Atlantic to the Pacific. Many cities in the Asia Pacific like Sydney, Singapore, and Tokyo are now taking over the role of the established cities such as New York, Paris and London.

The scope of the Asia Pacific area is expanding almost as rapidly as that of Europe and the USA area. The total population is almost half the population of the world. And toward the year 2000, it will reach 2/3 of the total population of the world, whereas Europe has only 6% of the world's population.
The Asia Pacific market is now the world's biggest market with a value of almost US$ 3 trillion and a weekly growth rate of US$ 3 billion.

As we move towards the 21st century there will be a continuing increase in the international restructuring of production and gradual improvements in the transportation and telecommunications infrastructures.

Although the Asia Pacific region has almost three-fifths of the world's population, telephone penetration is only around 3 percent. In urban areas the situation is even worse. All PTTs in the region have made the shift from analog to digital technology. Most countries in the region are embarking on major replacement programs. According to a Pyramid Research study, about 5 million digital switching lines were installed in the region during 1984-1988.

The region's installed base of digital systems is expected to reach nearly 15 million lines by the end of 1992.

More than 20% of Intelsat's Pacific service has been converted to digital technology in the past year or two, reflecting a trend in INTELSAT operations worldwide.

Submarine cable networks in this region have also been expanding to accommodate the increasing communications demand.

Starting in the 1960's, some analog submarine cable systems were constructed in this region such as:

- the Guam-Philippines Cable (1964) and the Seacom Cable connecting Singapore, Malaysia, Hongkong, Guam, Papua New Guinea and Australia (1965).

- Luzon (Philippines)-Okinawa (Japan) Deep Water Bay (Hongkong) were completed in 1977 whereas the Taiwan- Luzon Cable was inaugurated in 1980.

- The Asean Submarine Cables, such as Asean Philippines-Singapore which was completed in 1978 and Asean Indonesia-Singapore (1980); the Asean Malaysia-Singapore-Thailand Submarine Cable was inaugurated in 1983.

- Other Submarine Cables include: the IOCOM cable system, connecting Madras in India with Penang in Malaysia which was completed in 1981.

- the MENANG (Medan-Penang) cable system, connecting Medan in Indonesia and Penang in Malaysia was put into service in 1984.
- the SEA-ME-WE (South East Asia-Middle East-Western Europe) cable system, connecting landing points in 8 countries (Singapore, Indonesia, Sri Lanka, Djibouti, Saudi Arabia, Egypt, Italy and France) was commissioned for service in 1986.

- the A-I-S (Australia-Indonesia-Singapore) cable system, connecting the 3 countries was ready for service in 1986.

- the SIN-HON-TAI (Singapore-Hongkong-Taiwan) cable system, 1380/480 circuits capacity connecting the 3 countries, was ready for service in 1986.

In line with the general trend towards the era of Integrated Services Digital Networks (ISDN), the digitization of switching and transmission facilities is taking place rapidly. In the future submarine cable networks will no longer be using analog coaxial cables, but instead they will be using digital optical submarine cables.

With the increase in the power of laser diode transmitters and the increase in sensitivity of photo diode receivers, repeater spacing of 200 km could be achieved in the near future using low loss mono-mode optical fibre at 1.55 micro-meter wavelength. This would greatly reduce the cost of optical fibre submarine cable systems and would make them very competitive with satellite link even for long distance intercontinental communications.

In this region, several optical fibre submarine cables are already in service whereas others are being constructed.

Figure 4: ASEAN Optic Submarine Cable Network
The following are the submarine cable systems in the Asia Pacific region:

- The HAW 4/TPC3 cable system (1988)
- Guam-Philippines-Thailand cable system (1989)
- HJK (Hongkong-Japan-Korea) cable system (May 1990)
- Asean Cable Network which comprises several links which have connection to the HAW4/TPC-3 and UK cable via the GPT and Hongkong-Philippines cable:
  b. Brunei-Philippines (1991)
  c. Indonesia-Singapore (1993)
  d. Thailand-Malaysia (Kuantan) (1992)
  e. Malaysia (Kuantan)-Singapore (1993-1999)
  f. Malaysia (Kuantan)-Malaysia (Kota Kinabalu) 1990.
  g. Brunei-Malaysia (Kota Kinabalu) 1991.
  h. Malaysia (Kota Kinabalu)-Philippines 1991.

- Tasman cable (December 1991)
- TPC-4 (October 1992)
- HAW-5 (January 1993)
- Pac Rim West (March 1993)
- Japan-Taiwan (August 1993)
- Pac Rim West (December 1994)

Satellite communications services in the Asia-Pacific region are served by several satellite networks, consisting of Intelsat satellites, Inmarsat satellites and domestic satellites.

There are 3 satellites in the Pacific Ocean Region (POR) at the positions 174°E, 177°E, 180°E and 3 satellites in the Indian Ocean Region (IOR) at the position 60°E, 63°E, 66°E providing public communications services such as telephone, telex, facsimile and new Intelsat services such as IBS, IDR, Vista.

During 1987-1989, this region experienced 26% traffic growth, as compared with 22% growth in the Atlantic and lower growth in the Indian region. During the last five years, this trend has been even more dramatic, with the Pacific Ocean region achieving a 178% growth in traffic, as compared to 60% for the Atlantic and 69% for the Indian Ocean regions.

For mobile communications, INMARSAT uses the Intelsat V-MCSD for the Pacific region and Intelsat V-MCS A for the Indian Region with the location at 180°E and 63°E respectively. 11 coast earth stations currently are operated in the Indian and Pacific Regions.
Several countries in the Asia-Pacific Region have started to operate their own satellites either for regional or domestic purposes. AUSSAT I consists of 3 operational satellites in the Ku-band while AUSSAT II will include L-band for mobile services.

In Japan, satellite networks consist of 2 operational CS3 satellites (Ka and C bands), 1 operational JCsat (Ku-band), 1 operational SCC (Ku + Ka bands) while 1 operational BS2 and 1 BS2X were launched in 1989. In China, Chinasat operates 2 operational satellites in C-band. Asiasat Private system for domestic services is operated with the coverage for South East Asia Region using 1 satellite which was launched in April 1990.

4. THE PALAPA SATELLITE SYSTEM

Indonesia is geographically situated at 95° to 141° East in longitude and 6° North to 11° South in latitude, corresponding to 5000 kilometer in the East West direction and about 2000 kilometer across the Equator making the surface area about 10 million square kilometer.
The complexity of the archipelago's situation forced the telecommunications systems planners to explore space communications as an alternative technology for domestic communications. Indonesia decided to implement its own Satellite Communication System for domestic services and became the first developing nation to operate its own Satellite Communications System.

The PALAPA satellite communications system was inaugurated in August 1976, with the PALAPA A satellite. The replacement PALAPA B satellites ordered in 1979 were launched by the Space Shuttle in June 1983 and in February 1984. Due to upper stage failure, this latter launch was unsuccessful but the satellite was recovered during a subsequent flight in November 1984 by the Shuttle's crew.

This satellite after refurbishment and thorough testing was re-launched successfully in April 1990 and has been in operation since the end of May 1990. Presently the Indonesian Satellite Communications System consists of PALAPA B-1 which is located at 108°E and PALAPA B-2 at 113°E and PALAPA B-2R at 118°E.

In providing domestic services, there are 232 ground stations managed by PERUMTEL. These consist of main earth stations serving larger cities, medium earth stations for medium traffic cities and small earth stations for remote areas. The coverage of the satellites extend from Indonesia to ASEAN countries as well as Papua New Guinea.

Currently the PALAPA is utilized mainly for domestic purposes. The system could provide point to point and point to multipoint C-band satellite services for either domestic or transborder communications users in the ASEAN countries. The users include broadcasters, television program distributors, government and private corporations. In Indonesia major PALAPA users are banks, industries, PERTAMINA, airlines, and TVRI.

The current status of utilization of Palapa satellites by other countries is as the following:

a. In operation

<table>
<thead>
<tr>
<th>User</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domsat, Philippines</td>
<td>TV</td>
</tr>
<tr>
<td>RTM-1, Malaysia</td>
<td>TV</td>
</tr>
<tr>
<td>TV-3, Malaysia</td>
<td>TV</td>
</tr>
<tr>
<td>TVDD, ASEAN</td>
<td>TV</td>
</tr>
<tr>
<td>Thailand</td>
<td>SCPC, Compunet, Samart</td>
</tr>
<tr>
<td>ASEAN</td>
<td>Border Communications</td>
</tr>
</tbody>
</table>
b. Future users

<table>
<thead>
<tr>
<th>User</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam</td>
<td>SCPC</td>
</tr>
<tr>
<td>Australia</td>
<td>TV</td>
</tr>
<tr>
<td>Philippines</td>
<td>ABS/CBN</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>TV</td>
</tr>
<tr>
<td>Macau</td>
<td>SCPC/FDM-FM</td>
</tr>
</tbody>
</table>

5. THE ROLE OF SATELLITE COMMUNICATIONS IN THE DEVELOPMENT OF THE ASIA PACIFIC REGION - THE CASE OF INDONESIA

It is difficult, if not impossible, now to talk about development without communications networks. An ITU study has found that there exists a close correlation between the number of telephones and the GDP of a nation. Communications integrate and modernize a nation. The archipelagic concept of Indonesia (Wawasan Nusantara) lays down several basic principles of a United society covering a unified national economic system, socio-cultural system, political system and security and defense system. Communications improve national efficiency and productivity, enhance equitable distribution of development, help energy conservation, expand market opportunities, increase the quality and coverage of national education, stimulate development of high-tech industries and enhance dissemination of information to a wider cross section of the society.

Figure 6: Correlation Between Telecommunications & Income Per Capita
The excellent communication links amongst the Asean member countries serve as the vital infrastructure for solid economic cooperation in the Asean region. The incredible development of optical fiber networks and satellite facilities in the Asia Pacific area is a proof of the high economic growth in the region.

The Palapa domestic satellite with its links to the global network has played a vital role in the economic and socio-cultural development of Indonesia. Palapa has contributed significantly to the effective management of the family planning/population control program in Indonesia. Palapa has been one of the main instruments from the management of the national development in Indonesia.

Figure 7: Education Network

Palapa has been used for the Open University in Indonesia and for the universities in the Eastern part of Indonesia.

Palapa has widened the outlook of education in Indonesia. Through communications via Palapa, educational institutions, research and development institutes can access global information on technology and sciences.
In summary, Palapa has been an invaluable asset for the development of Indonesia.

6. THE FUTURE CHALLENGES

Technology will continue to progress at an even faster pace than before. Technology will produce and stimulate a more sophisticated demand for services.

We now anticipate the implementation of wideband Integrated Digital Services Network (ISDN) which will facilitate transport of integrated information whether it be voice, data, text or video.

Satellite systems are also increasing. Separate systems outside Intelsat are being planned in some regions which will offer competing services, even offering non-standard services through standard communication satellites.

The increasing number of satellite systems is also posing a new problem of GSO location as well as non-interference coordination.
Satellite operation will in the future compete on the basis of price, service offerings and very specialized services for education, commerce and industrial activities.

The market environment will be made even more complex with the completion of many optical submarine cables around the world, offering global information highways at a very competitive price.

The challenge then for each organization is to choose the appropriate technology and to develop the most suitable information that will support the competitive needs of that organization.

The question of a regional satellite in the ASEAN or Asia Pacific regions is a real one. Perhaps it is logical to think of Palapa being developed into a regional satellite.

7. CONCLUSION

Satellite technology is progressing very rapidly creating networks that are available for developmental activities in many countries. Satellite systems have contributed significantly to national development, regional development and in particular the enhancement of the quality of education in many regions. Indonesia has benefited from the satellite technology and will further develop the network for future national development.

Jakarta, July 26th 1990

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