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<th><strong>Title</strong></th>
<th>Satellite communications in the Pacific hemisphere.</th>
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<td><strong>Author(s)</strong></td>
<td>Wedemeyer, Dan.</td>
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Satellite Communications In The Pacific Hemisphere

By

Dan J Wedemeyer
Satellite Communications in the Pacific Hemisphere
Dan J. Wedemeyer, Ph.D.
Associate Professor
University of Hawaii-Manoa

Introduction

Satellite communications, along with other telecommunication technologies, hold great implications for the future of commerce, cultures and communication in the Pacific hemisphere. The technology and the expanding services base are engineering a connectiveness that is so rich that we now speak in terms of a Pacific Telecommunity. The vastness of the Pacific is being "bridged" electronically to solve problems, share information and trade our wares. The communication satellite resources have the ability to promote information-oriented opportunities on an equal basis regardless of location or traffic volume within a basin encompassing 64 million square miles (40% of the Earth's surface) and one-half of the world's population (17). This is done, on the surface in a purely technical manner, but a rich array of domestic, regional and global organizations have coordinated the development of these linking resources. This paper sets out the technical and organizational aspects of satellites serving within and around the Pacific hemisphere.

The long-haul communication network in the Pacific is comprised of two basic systems: satellites and undersea cables. This configuration provides the pathways and redundancies required to serve basic and enhanced telecommunication services for a wide range of users. Undersea cables link nearly 25 locations and provide services to a large number of thick-route locations. Presently the Pacific hemisphere's cable systems are being expanded by the addition of the ANZCAN (Australia/New Zealand/Canada) coaxial copper cable...
providing 1380 circuits and the Japan-Hawaii-U.S. mainland undersea fiber-optic system forecast to provide up to 40,000 circuits by the end of this decade. While undersea cables are essential to Pacific-wide communication, the focus of this paper is on satellites, their technical aspects and the national activities organizing their use.

Global satellite communication in the Pacific is only 18 years old. The earliest system, INTELSAT II (Lani Bird), dates back to October 26, 1966. Presently there are seventeen communications satellites (excluding North American domestic satellites and military systems) and more than 80 transponders serving the Pacific hemisphere. These serve domestic, regional and global users.
By 1987 it is estimated that seven countries in the region will have nationally-dedicated satellite services, and many more will be leasing INTELSAT circuits for domestic telecommunication. These countries with dedicated domestic satellites include: Australia (2), Canada (5), India (2), Indonesia (2), Japan (2), Mexico (2), Pakistan (2) and the United States (42).

While dedicated domestic satellite service is particularly important in serving national needs and identity, some countries have chosen cooperative ventures. The leading example of this is the Palapa system based in Indonesia. Palapa I and II have transponders leased to Thailand, the Philippines, Singapore, and Malaysia. AUSSAT is another system which projects shared satellite resources between Australia and Papua New Guinea.

Global systems which serve within the Pacific hemisphere includes, INTERSPUTNIK, INTELSAT and INMARSAT. This paper will include sections on INTELSAT and INMARSAT, but will not deal in much detail with the military or public telecommunication systems provided by INTERSPUTNIK. In short, though, INTERSPUTNIK has 14 signatories: The Soviet Union, 6 Warsaw Pact nations, Afghanistan, Laos, Mongolia, South Yemen, Syria, Vietnam, and Cuba. The Gorient satellite operates in the C-Band (6/4 Ghz) and voice circuits to reach the limited number of earth stations are leased at about 60% of what it would cost to lease INTELSAT circuits(4).

The remainder of this paper describes some technical aspects of communications satellites and satellite systems, major international and domestic satellite activities and some of the future plans for satellite-based systems in and around the Pacific.
Technical Overview of Communication Satellites

Communication satellites are artificial satellites which amplify and convert the frequency of signals received from earth stations. The resulting signal is then retransmitted back to ground-based receivers. Communication satellites operate in geostationary orbit 36,000 km. (22,300 miles) in space. Today's communication satellites primarily operate in two frequency bandwidths, the C-Band and the Ku-Band. The C-band satellites utilize frequencies in the 6/4 G/Hz range, while the Ku bands are much higher, operating in the 14/11 GHz range. Frequency bands which are less often used for satellite communication include the S-band (2.5 GHz), X-band (8/7 GHz, military use only) and the Ka-Band (30/20 GHz).

<table>
<thead>
<tr>
<th>LETTER BAND</th>
<th>EARTH TO SPACE (UPLINK)</th>
<th>SPACE TO EARTH (DOWNLINK)</th>
<th>SHORT NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>2.555 - 2.690</td>
<td>2.500 - 2.650</td>
<td>2.5</td>
</tr>
<tr>
<td>C</td>
<td>5.925 - 6.425</td>
<td>3.700 - 4.200</td>
<td>6/4</td>
</tr>
<tr>
<td>X</td>
<td>7.500 - 8.400</td>
<td>7.250 - 7.750 *</td>
<td>8/7</td>
</tr>
<tr>
<td>Ku</td>
<td>14.000 - 14.500</td>
<td>10.950 - 11.100 **</td>
<td>14/11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.450 - 11.700 **</td>
<td></td>
</tr>
<tr>
<td>Ku</td>
<td>14.000 - 14.500</td>
<td>11.700 - 12.200 ***</td>
<td>14/12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.200 - 12.700</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>17.300 - 18.100</td>
<td>17.700 - 20.200</td>
<td>DBS ****</td>
</tr>
<tr>
<td>Ka</td>
<td>27.500 - 30.000</td>
<td>20.200 - 21.200 *</td>
<td>30/20</td>
</tr>
<tr>
<td></td>
<td>30.000 - 31.000</td>
<td>42.500 - 43.500 *</td>
<td>30/44</td>
</tr>
</tbody>
</table>

In the Pacific, most international satellites are C-band systems, while most of the domestic satellites and the latest INTELSAT models are operating...
Operating in Ka band will enable future communications satellites to avoid interference with existing C-band and Ku-band satellites.
in the higher frequencies. Many late-model satellites are hybrids, capable of operating in both C and Ku bands. In general, the higher the frequency, the higher the information carrying capacity. However, higher frequency satellites have significantly higher signal loss due to atmospheric absorption or rain. The high frequency satellites will require higher transmission power in order to counter signal attenuation. Station keeping, or keeping the satellite in proper orbital position, is also more delicate in higher frequency satellites. For example, a C-band satellite can be "seen" from earth if it occupies an in orbit cube of 90 miles, while a Ku-band satellite must be within an area one-half the size. The following diagram indicates the number and position of C- and Ku-band geosynchronous satellites:
The required orbital separation or spacing of the C- and Ku-Band satellites also varies. Proper orbital spacing ensures against one satellite signal interfering with an adjacent satellite signal. C-Band satellites have recently changed from 4 to 3 degrees spacing, while the Ku-Band requirement is 2 degrees. Thus, domestic and international technical regulations establish how many satellites can legally occupy the geostationary orbital arc, making it, in this sense, a finite resource.

Other technical characteristics are also important. The power of the satellite, for example, determines the requirements of earth station size. If greater investments in on-board satellite power are made, then the ground stations can be lower powered and less expensive. The relationship is also true in the reverse situation. That is, low power satellites require higher powered, larger and more expensive earth stations. Other technical tradeoffs are evident with regard to narrow-beam and broad-beam "footprints." Spot-beams concentrate the footprint on a relatively small area of the earth, usually high-traffic areas, and therefore perform much the same as a cable would, serving a select group of users. Global-beam coverage on the other hand, is less discriminating, but more costly, in terms of satellite power and groundstation requirements.

Another rule of thumb also prevails with regard to the footprint. That is, the closer one is to the center of the footprint the higher the E.I.R.P., the smaller and less expensive, the earth station can be. Higher latitudes also dictate larger, more expensive groundstations due to atmospheric interference and angle of elevation. The angle of elevation is the angle at the antenna between the satellite and the Earth's horizon. Usually 5° is the minimum practical angle of evaluation for reliable communication. Therefore reception at high latitudes is very different.
Man-made interference is also a problem in lower-frequency satellites. The C-band satellite operates within frequencies that are near to those of terrestrial microwave. This terrestrial interference may require locating earth stations away from urban areas or constructing relatively expensive earth station shields. This means that many users cannot have their own ground stations if they require reliable communication service.

All of these technical tradeoffs and more must be taken into consideration if appropriate satellite systems are to be configured. Each location or application, then, is unique. The system must be designed specifically for each user. With these tradeoffs in mind, it is useful to examine a number of the national, regional or global solutions to these problems.

The INTELSAT System

The International Telecommunication Satellite Organization (INTELSAT) originated in August of 1964 when 11 countries agreed to form a global commercial communication satellite system. In 1984 the number of countries holding investment in INTELSAT totals 108 with an equity of $1.4 billion (U.S.). Each shareholder is required to invest based upon use, with a minimum of 0.05%. Presently the largest owner of Intelsat is the Communication Satellite Corporation (COMSAT) with 24.35%, British Telecom follows with 12.99% and France owns 5.45% (6).

INTELSAT is headquartered at 490 L'Enfant Plaza, N.S., Washington, D.C. 20024, U.S.A. The present Director General is Richard Colino.

The organization is responsible for the space segment, design, development, construction, operation and maintenance of communication satellites. The ground stations are owned and operated by entities within the country where they are located. INTELSAT provides service to 170 countries, territories and
possessions (thirty-two) of these locations are within the Pacific hemisphere. In order to participate, most locations purchase a standard A, B, C earth station. The Standard A earth station is 29.5 - 32 meters, and operates at 6/4 GHz, Standard B 11 - 13 meters and operate at 6/4 GHz and, Standard C is 16.7 - 18.9 meters and operates at 14/11 GHz, and are designed to function with increased spot beam coverage of INTELSAT V and future satellites. Two other standard earth stations are available, the Standard Z antennas, designed for leased domestic service and Standard E's for operations with INTELSAT's international business service. Costs vary significantly, but as an example, a Standard E (large, 11 - 13 meters) would cost $1.0 - 1.5m (U.S.) and a Standard E (small, 6-8 meters) $150 - $300k (14). A T.V. receive-only (TVRO) runs about $20k. All require $50 - $75k additional equipment costs. Growth of INTELSAT Domestic lease has been rapid--from 10 transponders in 1980 to nearly 60 by 1985.
GROWTH OF INTELSAT DOMESTIC TRANSPONDER LEASES
Three classes of services are provided/planned by INTELSAT. These are the conventional services, new services and future potential services. (7)

![INTELSAT Satellite Systems Diagram]

All conventional and new services are available in the Pacific. These are offered on the current satellite serving the region, the INTELSAT IV-A, located at 175 E and 179 E degrees.
This satellite has a capacity of 6000 circuits and two TV channels, yielding the equivalent of 20 transponders. Built by Hughes, launched in January and March 1978, they have a design life of seven years.
Two INTELSAT IV-A's are in orbit, one acting as primary and the other in back-up position, offering pre-emptable service.

The INMARSAT System

Headquartered in London, England, the International Maritime Satellite Organization (INMARSAT) is an international joint venture charged with providing satellite communication to shipping and offshore industries around the globe. Created in 1979, operations began in 1982 and utilized the existing MARISAT satellites to serve maritime communications needs. Today, much higher capacity satellites, MARECS and INTELSAT V MCS, provide telephone, telex, facsimile and data communication to membership totaling 40 nations. The United States is the largest shareholder in the system (23.4% is owned by COMSAT General), the Soviet Union owns 14.1%. Others holding major shares include...
Japan, U.K. and Norway. Globally, more than 85% of all commercial ship tonnage is carried by members of INMARSAT (2).

Pacific Ocean communications are sent to and from Santa Paula, California (U.S.), Ibariki (Japan), Singapore, Nakhoda (USSR). Planned coastal earth stations include Hong Kong (1985/86) and Lake Cowichan (Canada, after 1985).

On-board ship signals are received and transmitted via a random-enclosed 1.2 meter antenna. The on-board ship standards for INMARSAT antenna fall into four categories. Each varies with respect to antenna diameter and types of services offered. These can be summarized as (11):

### Inmarsat Satellites

<table>
<thead>
<tr>
<th>Satellites</th>
<th>Owner</th>
<th>Manufacturer</th>
<th>Mass at BOL (kg)</th>
<th>First Launch</th>
<th>Mid-band Frequencies, MHz</th>
<th>Receive</th>
<th>Transmit</th>
<th>EIRP (dBW) in Each Band</th>
<th>Oceans Served</th>
<th>Number of Satellites</th>
<th>Fail Circuits</th>
<th>Stationary (St)</th>
<th>Rate</th>
<th>See Satellite Comm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic</td>
<td>MARSAT F1</td>
<td>COMSAT Gen Inc</td>
<td>267</td>
<td>1976</td>
<td>4 (bandwidth, MHz)</td>
<td>1640.5 (4)</td>
<td>1640.25 (4.5)</td>
<td>1640.25 (4.5)</td>
<td>All</td>
<td>All</td>
<td>10</td>
<td>32</td>
<td>January 1983</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MARSAT F2</td>
<td>Hughes</td>
<td>597</td>
<td>1976</td>
<td>6422 (4)</td>
<td>6422.25 (4.5)</td>
<td>6422.25 (4.5)</td>
<td>6422.25 (4.5)</td>
<td>Atlantic</td>
<td>All</td>
<td>10</td>
<td>32</td>
<td>January 1983</td>
<td></td>
</tr>
<tr>
<td>Indian</td>
<td>MARSAT F3</td>
<td>COMSAT Gen Inc</td>
<td>297</td>
<td>1976</td>
<td>1539 (4)</td>
<td>1539.25 (4.5)</td>
<td>1539.25 (4.5)</td>
<td>1539.25 (4.5)</td>
<td>All</td>
<td>All</td>
<td>10</td>
<td>32</td>
<td>January 1983</td>
<td></td>
</tr>
<tr>
<td></td>
<td>INTELSAT V-F/MCS</td>
<td>Ford Aero</td>
<td>528</td>
<td>1981</td>
<td>4197 (4)</td>
<td>4197.25 (4.5)</td>
<td>4197.25 (4.5)</td>
<td>4197.25 (4.5)</td>
<td>All</td>
<td>All</td>
<td>10</td>
<td>32</td>
<td>January 1983</td>
<td></td>
</tr>
<tr>
<td>Pacific</td>
<td>MARSAT F2</td>
<td>COMSAT Gen Inc</td>
<td>267</td>
<td>1976</td>
<td>1640.5 (4)</td>
<td>1640.25 (4.5)</td>
<td>1640.25 (4.5)</td>
<td>1640.25 (4.5)</td>
<td>All</td>
<td>All</td>
<td>10</td>
<td>32</td>
<td>January 1983</td>
<td></td>
</tr>
<tr>
<td></td>
<td>INTELSAT V-F/MCS</td>
<td>Ford Aero</td>
<td>528</td>
<td>1981</td>
<td>4197 (4)</td>
<td>4197.25 (4.5)</td>
<td>4197.25 (4.5)</td>
<td>4197.25 (4.5)</td>
<td>All</td>
<td>All</td>
<td>10</td>
<td>32</td>
<td>January 1983</td>
<td></td>
</tr>
</tbody>
</table>

The two satellites used in the Pacific region are MARISAT, launched in 1976, and owned by COMSAT General; and, INTELSAT V-MCS, launched in 1981, and owned by INTELSAT. MAREC-B2 will be available in January of 1985. The footprint of the Pacific maritime satellite is as follows:
Services are provided to improve the ability to manage maritime and offshore business operations as well as promoting safety of property and life at sea. A wide range of services are offered. General classes of service include telephone, telex, facsimile and voice/data services. Specifically these include (2):

**From Ship**
- Estimated Time of Arrival
- Navigation Data
- Daily Reports
- Weather Routing
- Cargo Stowage Plans
- Maintenance Scheduling
- Spare Parts Inventories
- Payroll Data
- Passenger/Crew Social Calls

**Private Business Calls**
- Well Log and Mud Log Data
- (Measurement While Drilling)
- Engine, Fuel Monitoring Data
- Emergency and Distress Calls
- High-Speed Seismic Data
- Offshore Early Warning Data
- Slow Scan Television
From Shore

Weather Forecasts  Fueling Information
Fleet Management  Port Conditions
Ship Agent Coordination  Medical Advice
Group Calling  Provisions
Ship Rerouting  Crew Rostering
Spot Market Charters  News Reports (Maripress)
Cargo Plans  Voyage Planning

As of September 1984, 2475 ships were listed in INMARSAT Ship Earth Station Directory (6).

Other Major Pacific Satellite Players

There are a number of nations engaged in major satellite activities in and around the Pacific. Each of these national entities deserve mentioning as they are foci of resources and activities which constitute a major telecommunication development effort.

Some of these major players are Japan, South Korea, Pakistan, China, Australia and New Zealand. The scope of this paper precludes detailing the very important and abundant North American satellite resources in Canada, the United States and Mexico. Although I will not specify these systems a matrix of the systems is included here (11).
The Japanese Situation

The Japanese are very much the leader in Asian space technology. Japan started experimenting with Direct Broadcast Satellite Technology (DBS) in 1977. At that time the Mitsubishi/Ford Aerospace built satellite named Sakura was launched. This medium capacity broadcasting satellite proved that color video and audio could be received by a simple parabolic antennae. In 1983 CS-2a and 2b were launched. While each of these advanced satellites carried signals in the C-Band, six transponders operated in the Ku-band (30/20 GHz). Future CS-2 satellites will use 30/20 and 50/40 GHz "integrated transponders." This means that multibeam antennas with onboard signal regeneration and satellite switching will be used to obtain a high capacity satellite (11). A summary of CS Antenna Coverage and technical details is as follows:
Another series of Japanese Direct Broadcast satellites was launched in 1978. The "Yuri" satellite series, BSE, BS-2a, and BS-2b, can be received on earth stations ranging from 1.6-4.5 meters. The outlying regions of the "footprint," including Korea, require the 4.5 meter dish. Spill-over problems brought protests from the South Korean government. While BS-2a allows reception at remote individual homes far from the main island of Japan, cries of "cultural aggression" were launched from Korea. While transponder failures have quieted Japan's neighbors, a next generation satellite waits to be launched in the summer of 1985. The following figure depicts the footprint of these satellites and summarizes some of the technical characteristics.
Japan's Broadcasting Satellites
BSE (Yuri), BS-2a & BS-2b

Summary Table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer</td>
<td>National Space Development Agency</td>
</tr>
<tr>
<td>Launches</td>
<td>1978</td>
</tr>
<tr>
<td>Orbit Locations</td>
<td>110</td>
</tr>
<tr>
<td>TV Transmitters</td>
<td>2</td>
</tr>
<tr>
<td>Mass at Beginning of Life</td>
<td>354</td>
</tr>
<tr>
<td>Power at End of Life</td>
<td>200</td>
</tr>
<tr>
<td>Minimum Lifetime</td>
<td>3</td>
</tr>
<tr>
<td>Mass at End of Lite</td>
<td>56.3</td>
</tr>
<tr>
<td>Power at End of Life</td>
<td>260</td>
</tr>
<tr>
<td>Minimum Lifetime</td>
<td>3</td>
</tr>
<tr>
<td>Mass at End of Life</td>
<td>56.3</td>
</tr>
<tr>
<td>Power at End of Life</td>
<td>350</td>
</tr>
<tr>
<td>Minimum Lifetime</td>
<td>3</td>
</tr>
<tr>
<td>Mass at End of Life</td>
<td>56.3</td>
</tr>
<tr>
<td>Power at End of Life</td>
<td>800</td>
</tr>
<tr>
<td>Minimum Lifetime</td>
<td>3</td>
</tr>
<tr>
<td>Mass at End of Life</td>
<td>56.3</td>
</tr>
<tr>
<td>Power at End of Life</td>
<td>800</td>
</tr>
<tr>
<td>Minimum Lifetime</td>
<td>3</td>
</tr>
</tbody>
</table>

Japan now plans to build even more powerful DBS systems in the 22 GHz-27 GHz frequency range and will deploy them in the early 1990's. Accompanying these powerful satellites will be a wide variety of high-performance receiving antennae which are targeted for non-Japanese markets in such locations as Latin America, the Middle East and Western Europe. More about future satellite application will be provided later in this paper.

Indonesia's Satellite Environment

The Indonesian's can be credited with a bold decision regarding national satellite development. As a result, Indonesia was the first Asian country to
initiate its own domestic communication satellite system. The Palapa system went into operation in 1976, providing television, telephone and telex services to 5000 widely scattered islands. The Palapa system was planned and is operated by PERUMTEL. Hughes has built the Palapa A and B series which now serves domestic as well as regional communication needs. Presently, the system is being used by other Asean countries, first by Thailand and now by Singapore, Malaysia and the Philippines. The second generation Palapa (B1) was launched in 1983 and recently the B2 was lost after its launch from the U.S. space shuttle. In November 1984, the B2 satellite was recovered from its incorrect orbit and returned to Earth for repair and relaunching.

Presently more than 40 small earth stations (less than five meters) constitute the domestic system serving more than 120 million people. Projections of 100 or more earth stations will be realized in the near future. Financing for the $75 million system comes in part from U.S. banks and Eximbank. The following figure describes Palapa-B's coverage and Palapa-A and B's characteristics (11).
Palapa's success has inspired other countries (e.g. Thailand) to plan in implement their own national satellite systems.

India's Satellite Experience

Satellite experimentation began in India with the SITE project, 1975. SITE stood for Satellite Instructional Television Experiment, a project which beam ed health, family planning and farming information into six Indian states via the NASA ATS-6 satellite. SITE proved that rural areas could successfully receive television-based information using small antennae (less than three feet) constructed from simple materials (e.g., chickenwire). This led to
follow-on experiments in 1981 when APPLE was launched from the European Space Agency's Ariane rocket.

INSAT-1A was launched in 1982, but failed to achieve long-term service. After this malfunction the Soviet Union permitted access to its Statsionair satellite until INSAT-1B was launched by the U.S. space shuttle in 1983.

Plans call for a second operating satellite in 1986 financed by insurance money ($65.5 Million) resulting from the loss of INSAT 1. At mid-year, 1984, about 1000 direct reception sets were in operation with plans for 8000 by the end of the year. By mid-1985 India projects it will reach 70 per cent of its
population with broadcast satellite programming. By 1990 (INSAT-1B is projected to fail by the first quarter of 1991) the government intends to operationalize a fully domestic-developed, next generation, INSAT system.

The Australian National Communication Satellite System

Australia will soon join the national satellite arena with its scheduled U.S. space shuttle launch of the first AUSSAT in July of 1985. A second satellite will be put in orbit in October of the same year. A total of three satellites will be manufactured by Hughes, the third will be kept available on the ground and will serve anticipated future needs as traffic increases.

AUSSAT will provide a comprehensive set of telecommunication services covering all of Australia and selected offshore location. Originally this will include Papua New Guinea (PNG), New Britain and New Ireland, but later decisions may incorporate New Zealand and parts of the South Pacific.

Several classes of services will be provided. The include Homestead Community Broadcast Service (direct-to-home service) and two-way, primarily voice, telecommunication. Voice and data services will also be provided to the Department of Aviation, banks, mining companies, education departments, police and other public sector organizations. The system was designed to complement the existing terrestrial system operated by Telecom Australia (1).

The satellite signal will operate in the Ku-Band and will be accessed using several classes of ground stations. The primary earth station will be smaller than 1.5 meters. Eight larger, major-city earth stations, are being built under contract with Mitsubishi Australia in factories established at North Ryde near Sydney. Telecom Australia will also operate 65 earth stations around the country which allows automatic connection to the existing terrestrial network.

Satellite coverage, which is based upon five spot-beams, is as follows (1):
The entire AUSSAT project was established, owned and operated by AUSSAT Pty. LTD. The Commonwealth Government is the primary shareholder, with options to Telecom Australia of 25%. Other AUSSAT characteristics can be summarized as follows (11):

**AUSSAT**

**AUSSAT Summary Table**

<table>
<thead>
<tr>
<th>Name of Operator</th>
<th>Manufacturer &amp; Family</th>
<th>Mass at BOL (kg)</th>
<th>Planned Launch Date</th>
<th>Launch Vehicle</th>
<th>Launch Vehicle</th>
<th>Frequency Bands</th>
<th>No. of TWTA's</th>
<th>Stationkeeping (E/W &amp; N/S)</th>
<th>Solar Array Power</th>
<th>Verted</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUSSAT Proprietary Ltd.</td>
<td>Hughes HS 376</td>
<td>650</td>
<td>1985</td>
<td>Shuttle or Ariane</td>
<td>UpLink</td>
<td>14.0 - 14.5 GHz</td>
<td>11</td>
<td>± 0.05 degrees</td>
<td>1200 watts (BOL)</td>
<td>June 1983</td>
</tr>
</tbody>
</table>
The American Pacific

While this paper has not focused on the satellite systems serving the Americas, a substantial amount of U.S. trade and economic growth is now concentrated on the Pacific, primarily north of the Equator. These interests in the Pacific are focused on territories historically tied to the United States: Hawaii, American Samoa, Guam, the Northern Marianas and the Trust Territories/Federated States of Micronesia.

The American Pacific INTELSAT earth stations as follows (16):

The satellite system used to maintain communication is based upon INTELSAT, Comsat and Hawaiian Telephone resources. Comsat and Hawaiian Telephone have
built "standard B" earth stations, utilized INTELSAT circuits and Hawaii-based, Hawaiian Telephone-owned switches to the global telecommunication network. In this way, Hawaii acts as a gateway into international and national networks for a full range of telecommunication services.

Other Nations Considering Satellite Options

There are a number of Asia/Pacific countries planning the acquisition of national satellite systems. These include China, Pakistan, South Korea and New Zealand (21).

CHINA: The China National Satellite Corporation is now established under the Ministry of Radio and Television. Recently, the Chinese established an agreement with MBB of West Germany to acquire a direct broadcast satellite system in 1986. The system will be a mix of imported and domestic technologies, but China is gaining its own experience in launching orbital spacecraft. On April 8, 1984, China launched the "Long-March'3" utilizing a modified military missle. China has requested the ITU to reserve three slots for national satellites applications. Projections are that 90% of the population will have DBS by 1990.

PAKISTAN: The Space and Upper Atmosphere Research Commission (SUPARCO) of Pakistan is seriously pursuing the establishment of a satellite system that will support educational and entertainment broadcasting and telephone communication. Orbital slots have been selected (38 and 41 degrees over the equator) and the ITU has been notified. The system could be operational by 1988 if decisions are made this year.
SOUTH KOREA: The South Korean government have been exploring the possibility of developing a domestic satellite system. Preliminary design contracts for a satellite to support three television and 4000 telephone circuits are being sought in the United States and Canada. However, competition for national development funds may delay the project for up to ten years.

NEW ZEALAND: The New Zealand Communications Advisory Council completed in July of 1984 a Report on Satellite Services for the Cabinet Committee on Communication. The report considered the use of satellites for telecommunications and remote sensing and discusses the benefit potential for satellite technologies. The conclusions of the report were that "within the immediate future there will not be sufficient demand for satellite capacity to justify a satellite exclusively for New Zealand's requirements." Nevertheless it foresees the "early need for provision of satellite facilities using shared satellites." Shared facilities for telecommunications services would be appropriate, but not for domestic direct broadcast satellites. "This would require either a dedicated domestic satellite for New Zealand, or negotiation of appropriate facilities on AUSSAT II due to be launched in early 1990's."

Future Satellite Services in the Pacific

Scenarios for the future of satellite services in the Pacific Hemisphere are, for the most part, optimistic. It still remains to be seen to what extent undersea optical fibers will impact the projected growth of satellite circuits
and user earth stations. Trends point to higher and higher powered satellites and with them, the development of smaller and less-expensive ground terminals. For Pacific Basin Island countries, INTELSAT projects almost an eight-fold increase in voice circuits from the period 1985-1995 and a five fold increase in basic user earth stations (14).

A TYPICAL GROWTH SCENARIO FOR THE PACIFIC BASIN ISLAND COUNTRIES

Economic studies conducted by the Maitland Commission, IDATE, RITE and others point out that good international links are vital to future economic growth. Pelton (14) has pointed out that the projected growth of ASEAN countries' overseas communication traffic over the next 15 years (1999) will be nearly equivalent to the total U.S. overseas traffic today—about 20,000 equivalent voice channels.

The Japanese, too, have projected tremendous increases in intercity traffic involving teleconferencing, transborder telephone, high-speed facsimile and high-speed data (18). They have forecast that by 1994 that 75% of the band-width available will be utilized for teleconferencing applications. Half of the required band-width after 1990, they project, may be supplied by satellite.
From 1987 to 1994 they have estimated that Pacific region intercity traffic will grow from 11.6 Mbps to 725 Mbps (one way). All classes of service are projected to contribute to this growth.

In line with these optimistic outlooks, it is no wonder that INTELSAT and the Japanese, just to name two, are looking to the Pacific hemisphere with a number of new services in mind. INTELSAT has great hopes for the new service introductions which include IBS (INTELSAT BUSINESS SERVICE), data services (INTELNET), video services which include preemptible and non-preemptible services and proposed digital T.V. distribution and integrated video and data. Other new services included leased domestic transponder service, cable restoration services, VISTA (thin route telephony for isolated towns and villages, etc.), proposed electronic document distribution, diversified telephony service and mobile services (7).
INTELSAT seems increasingly aware of the needs of developing countries. Specifically, INTELSAT has proposed a number of new services which point to their concern for thin-route services. Beyond VISTA, Pelton (14) points out that INTELSAT is exploring the possibility of very small microterminals. These may be as small as 1.2 meters and capable of transmitting data communication from remote locations at a per terminal cost of $5000 to $10,000.

During a period from January 1985-April 1986 INTELSAT has introduced a 20th anniversary program called "Project Share." Satellite capacity, during these 16 months, will be available free of charge for service organizations around the world for projects involving tele-education and tele-health in developing countries.

The Japanese are also looking at the Pacific as a hemisphere for increased satellite development. In January of 1983, the Research Institute of Telecommunications and Economics (RITE) released a Study on the Pacific Regional Satellite Communications System (18). This project proposed the creation of a Pacific Region satellite to "enhance communications in the Pacific Hemisphere" with thin-route services as well as thick-route services between major trading points in the hemisphere.
The system would be independent from space development programs of any particular nation and have two sub-systems, A and B. The A subsystem would serve the needs of the Mariannas, Marshals, Solomons', Fiji and Tahiti. System A would service remote areas providing telephone, T.V. program relay, health care, disaster warning and tele-education. System A's costs would be subsidized by System B users. System B would be used for intercity, high speed services, (data communications higher than 48 kbps), high-speed facsimile, teleconferencing, T.V. program relay and tele-education. System B locations would include Tokyo, Seoul, Beijing, Hong Kong, ASEAN, Australia, New Zealand,
Hawaii and North America. System A and B antenna would be 4 to 5 meters in diameter.

The following diagrams show the coverage areas for both classes of service:

The estimated cost of developing the system is between $300 and $400 million dollars (U.S.). The expected revenues are projected to be about $400 million/year.

A full range of services are envisioned. These would be general broadcast video, data, facsimile and telephony as they apply to industry, education, medical, security and protection and administration. These possible services can be depicted as follows (18):
The Japanese believe that by 1994 satellites weighing one ton in geostationary orbit will be required to meet the projected traffic.

**Summary and Conclusion**

The Pacific hemisphere is a vast area and for that reason satellite communication may play an even more important role in development than it is in other regions of the world. Many countries in the region are already enjoying the benefits of modern communication, others are planning to do so in the near future. Because satellite communication is such a dynamic arena, it is difficult to know where to stop in providing an overview. INTELSAT will no
doubt continue to play the leading role in international satellite development. To the extent that the organization can meet the real needs for high-quality, reliable and affordable services, competitors will have a difficult time in launching new offerings. Thin-route communication remains a problem in the Pacific. Many of the new offerings are attempts to address this class of problems. As higher and higher capacity/powered satellites are developed and placed in orbit, earth station size and costs will drop. One thing seems relatively clear, until first-rate communication channels are widely available, economic and social development will be inhibited. Any single location in the Pacific may not be able to cost-justify involvement in satellite communications, however, integrated into a total hemispheric network no one could afford to ignore the combined economic, social and political power.
Pacific Ocean Region
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