เชิดศักดิ์ กู้เกียรตินันท์

CHIRDSAK KUKIATTINUN

Executive Vice President

526 RAMA 5 RD., DUSIT, BANGKOK 10300.
THAILAND. TEL. 243-5300, 241-2334
TELEX . 72195 SHINCOM TH FAX : (02) 241-3160

SHINAWATRA COMPUTER & COMMUNICATIONS GROUP

นงลักษณ์ พินัยนิติศาสตร์

NONGLUCK PHINAINITISART, D. Eng.

Senior Department Manager
Satellite Communications

526 RAMA 5 RD., DUSIT. BANGKOK 10300,
THAILAND. TEL. 243-5300, 241-2334
TELEX : 72195 SHINCOM TH FAX : (02) 243-5822

SHINAWATRA COMPUTER & COMMUNICATIONS GROUP

ดำรง เกษมเศรษฐ์

DUMRONG KASEMSET, Ph. D.

Senior Manager Business Development

526 RAMA 5 RD., DUSIT. BANGKOK 10300,
THAILAND. TEL. 243-5300, 241-2334
TELEX : 72195 SHINCOM TH FAX : (02) 243-5822

SHINAWATRA COMPUTER & COMMUNICATIONS GROUP

Shinawatra Satellite Co., Ltd.
THAICOM SATELLITE STATION
41/103 Rattanathibet Rd.,
Nonthaburi 11000
THAICOM
Tel: (66-2) 591-0736-49 Fax: (66-2) 591-0705

June 17, 1993

Mr. Clay T. Whitehead
Vice Chairman
Alpha Lyracom
Pan American Satellite
1320 Old chain Bridge Road
McLean, Virginia 22101
U.S.A.

Dear Mr. Whitehead,

It has been a long time since we last met. I believe the development of PANAMSAT is proceeding quite well.

As you know, THAICOM I is scheduled for launch in December 1993 while PANAMSAT 2 is scheduled for May 1994.

I would like to propose an open dialogue for discussion on how THAICOM can cooperate with your global network. If possible, I would like to invite you to Bangkok for a meeting. I sincerely believe that THAICOM's local and regional footprint can complement PANAMSAT's global coverage.

Dr. Thaksin Shinawatra has always been a strong proponent of the private international satellite system as a better alternative to Intelsat. Although we are a small company, we would like to consider some involvement in your global network.

I look forward to your comments and kind consideration.

Sincerely yours,

C. Kukiatt.

Chirdsak Kukiattinun
President

- fit into trip (china)
- CTW will respond or Fred

Faxed to Fred
6/17/93

JUN 18 '93 11:53 FROM PAN AMERICAN SAT. TO [illegible]38478804 PAGE.001

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To T. Whitehead	From FAL
Co.	Co.
Dept.	Phone #
Fax #	Fax #

VIA FACSIMILE 011-662-591-0705

June 18, 1993

Mr. Chirdsak Kukiattinun
President
Sinawatra Satellite Co., Ltd.
Thaicom Satellite Station
41/103 Rattanathibat Road
Nonthaburi 11000

Dear Mr. Kukiattinun:

Your letter of June 17th to Mr. Whitehead was forwarded to my office for a response. I am wholeheartedly in support of your suggestion that we have an open dialogue or discussion on how Thaicom and PanAmSat can cooperate. I would like to personally explore these opportunities with the Sinawatra Group. Unfortunately, I just returned from an extensive trip to Asia and do not plan on travelling to Asia again until September. If you have any plans of visiting the U.S., I'd like to see if we could arrange a meeting. If not, during my next visit to Asia we can meet.

In the meantime, could you elaborate on what possible forms of cooperation you envision. Please forward your preliminary thoughts to my attention.

Sincerely,

Frederick A. Landman
President

FAL:mf

** TOTAL PAGE.001 **

ฮิเดฮิโกะ ไซโต้

H. SAITO

GENERAL MANAGER
AEROSPACE & ELECTRONICS DIVISION

66-2-
/

CI (THAILAND) CO.,LTD.
C. ITOH & CO., LTD.
THANIYA BLDG., 9TH FLOOR
62 SILOM ROAD BANGKOK
P.O. BOX 337

TEL : 236-9127/34
TELEX: 87232 CITHAI TH
: 87311 ITOHCHU TH
FAX . 236-3521, 236-5385

ฮิเดฮิโกะ ไซโต้

斉 藤 英 彦

宇宙・情報部長

CI (THAILAND) CO.,LTD.

（伊藤忠商事（株））

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Pan American Satellite
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U.S.A.

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C. Kukiatt.

Chirdsak Kukiattinun
President

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Pan American Satellite
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McLean, Virginia 22101
U.S.A.

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Sincerely yours,

C. Kukiatt.

Chirdsak Kukiattinun
President

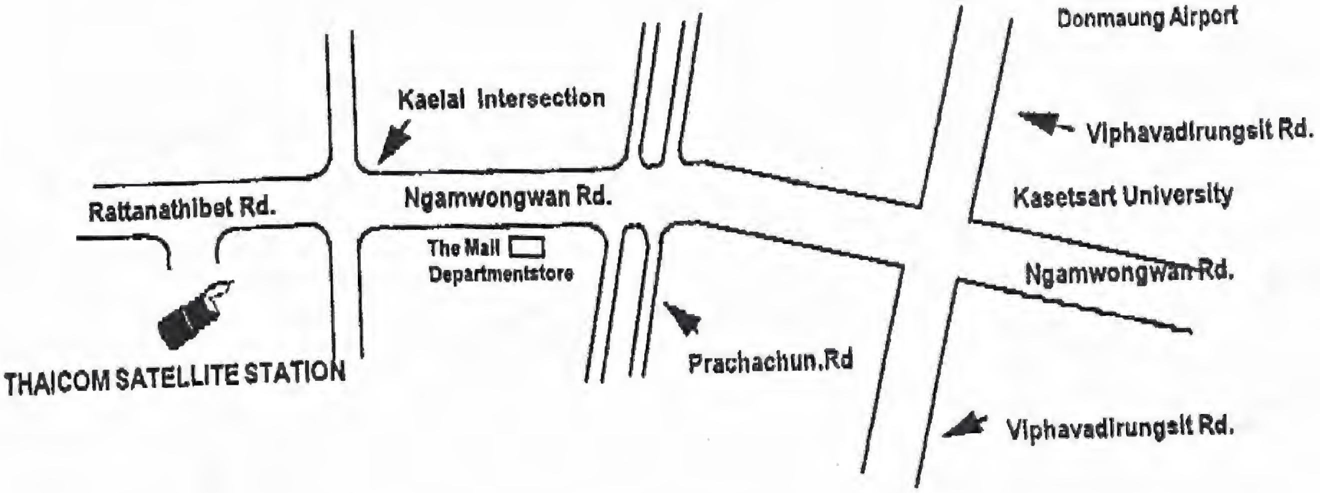
Shinawatra Satellite, Co., Ltd. A Subsidiary of Shinawatra Computer & Communications Group.

TO Clay T. Whitehead

COMPANY Alpha Lyracom Pan American Satellite.   FAX NO. (703) 947-8804

THAICOM

Effective from April 1,1993
The new address of Thaicom Satellite Station,
Shinawatra Satellite Co.,Ltd.
will be as follows



Map to Thaicom Satellite Station

THAICOM SATELLITE STATION
Shinawatra Satellite Co.,Ltd.
41/103 Rattanathibet Rd.
Nonthaburi 11000

TEL: (662) 591-0736-49

FAX: (662)591-0705 (General) , (662)591-0706 (Commercial Dept.) , (662)591-0719 (Marketing Comm.)

Clay Whitehead Associates

1320 Old Chain Bridge Road, McLean, Virginia 22101
Phone: (703) 847-8787
Fax: (703) 847-8804

Clay T. Whitehead
President

June 28, 1993

√

VIA FAX 011-66-2-591-0705

Mr. Chirdsak Kukiattinun
President
Shinawatra Satellite Company, Ltd.
41/103 Rattanathibet Road
Nonthaburi 11000
THAILAND

Dear Mr. Chirdsak:

Thank you for your letter of June 17. Inasmuch as I was travelling, I forwarded your letter to Mr. Fred Landman who has replied to you.

For your information, I am not a officer or employee of PanAmSat; the Vice Chairman title is strictly honorary. The above letterhead is my actual business affiliation.

I am pleased to hear of your progress, and I share your belief that Thaicom and PanAmSat have complementary coverage and should be cooperating in their business endeavors. I believe at this stage your best contact at PanAmSat is Mr. Landman, although I would be happy to meet with you should I be in Southeast Asia on my travels.

Sincerely,

THAICOM
Shinawatra Satellite Co., Ltd.
THAICOM SATELLITE STATION
41/103 Rattanathibet Rd.,
Nonthaburi 11000
Tel: (66-2) 591-0736-49 Fax: (66-2) 591-0705

June 17, 1993

Mr. Clay T. Whitehead
Vice Chairman
Alpha Lyracom
Pan American Satellite
1320 Old chain Bridge Road
McLean, Virginia 22101
U.S.A.

RECEIVED
JUN 2 1 1993
STEVEN R. KOLTAI

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Sincerely yours,

C. Kukiatt.

Chirdsak Kukiattinun
President

END

FACSIMILE COVER SHEET

CLAY WHITEHEAD ASSOCIATES
1320 OLD CHAIN BRIDGE ROAD
McLEAN, VIRGINIA 22101
FAX: (703) 847-8804
VOICE: (703) 847-8787

TO: Mr. C. Kubiatkimun
COMPANY: Shinawatra Satellite Co
FAX #: 011-662-591-0705
DATE: 6/28/93 TIME: ______

FROM: Clay T Whitehead

Pages following this cover sheet: 1 pages.

COMMENTS:

SC&C
SHINAWATRA COMPUTER AND COMMUNICATIONS GROUP
528 Rama 6 Road, Dusit, Bangkok 10300 Tel. 241-2334, 241-1118, Fax. No. (02) 241-3100 243-5822

June 30, 1992

Mr. Clay T. Whitehead
Vice Chairman
Alpha Lyracom
Space Communications
1320 Old Chain Bridge Road
McLean, Virginia 22101

Dear Mr. Whitehead,

Thank you very much for your letter of June 19, 1992 and the time you kindly spent with our team during our visit to Washington.

I am very much impressed by the global system plans of PanAmSat. Based on the information received from you, Shinawatra Satellite Company will be willing to provide cooperation to PanAmSat, subject to future technical and commercial arrangements.

I will be very pleased to meet with you and Fred Landman in Bangkok to further discuss the potential cooperation and strengthen our relationship.

Sincerely yours,

Thaksin Shinawatra
Chairman

ALPHA LYRACOM
SPACE COMMUNICATIONS

Clay T. Whitehead
Vice Chairman

1320 Old Chain Bridge Road
McLean, Virginia 22101
Phone: (703) 847-8787
Fax: (703) 847-8804

June 19, 1992

Pol. Lt.Col. Thaksin Shinawatra, Ph.D.
Chairman
Shinawatra Computer Group
526 Rama 5 Rd., Dusit
Bangkok, 10300
THAILAND

Dear Dr. Thaksin:

It was good to see you again here in Washington and to hear of your successful arrangements with the Ex-Im Bank.

I am enclosing the latest description of the PanAmSat global system plans. As we discussed, our coverage of Southeast Asia and connections to Europe and North America is complementary to yours, and it would seem to make sense to have some sort of joint marketing arrangement.

Next time Fred Landman or I are in Southeast Asia, we will try to come to Bangkok to discuss our potential cooperation in more detail.

Sincerely,

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

SC&C
SHINAWATRA COMPUTER AND
COMMUNICATIONS GROUP
526 Rama 5 Road, Dusit, Bangkok 10300 Tel. 241-2334, 241-1118, Fax. No. (02) 241-3160, 243-5822

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Chairman

SC&C
SHINAWATRA COMPUTER AND COMMUNICATIONS GROUP
[illegible]

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Sincerely yours,

Thaksin Shinawatra
Chairman

7/10/92
cc: F. Landman
R. Anselmo

THAI SATELLITE

Its Design, Capabilities and Applications

SCG 910282

HUGHES AIRCRAFT COMPANY

For nearly 4 decades, Hughes Aircraft Company has specialized in advanced electronics systems, focusing particularly on high technology products and services. Today, Hughes products are used throughout all sectors of the scientific, commercial, and military communities. Hughes has long been recognized as the world's leading supplier of geosynchronous communications satellites. The company began developing geosynchronous communications satellites more than 25 years ago and launched the world's first operational communications satellite, Syncom, in 1963. Since filling the first order, placed by INTELSAT in 1964, Hughes has contracted to build 101 revenue bearing commercial communications satellites. Of those successfully launched by the boosters (Figure 1) all but one have functioned successfully beyond their contracted lifetimes or are expected to exceed their contracted lifetimes. Some, including a Marisat (nominally, a spacecraft with a 5 year lifespan) that is still operating after more than 13 years, are still generating revenues for their owners many years beyond the expected mission lives.

The HS 376 spacecraft bus proposed for THAISAT is the centerpiece in the family of commercial communications satellites produced by Hughes. This family comprises more than half of the communications satellites produced by the United States, Europe, Far East, and other manufacturers combined. Measured in orbital years of experience—a gauge of a satellite builder's record with revenue producing satellites—the Hughes commercial communications satellite performance is unique and outstanding. Hughes commercial satellites have amassed 487 years of orbital experience, more than the satellites of all other manufacturers in the western world combined.

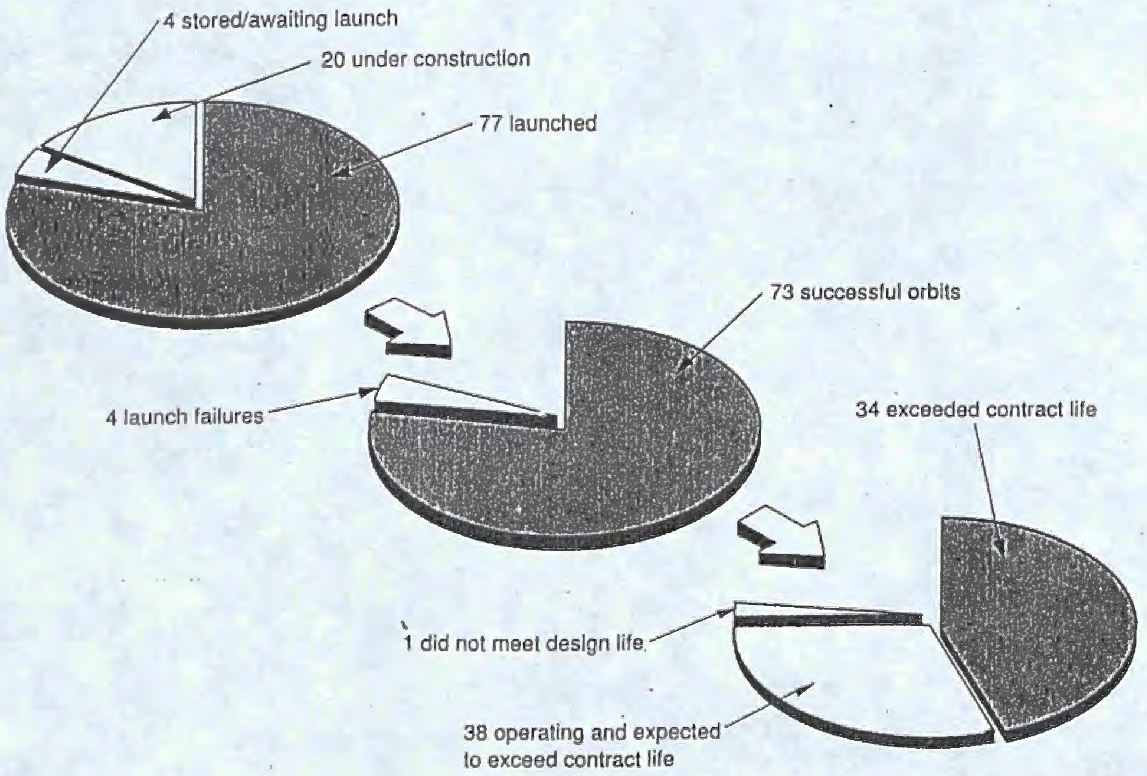


Figure 1. Hughes In-orbit Success History

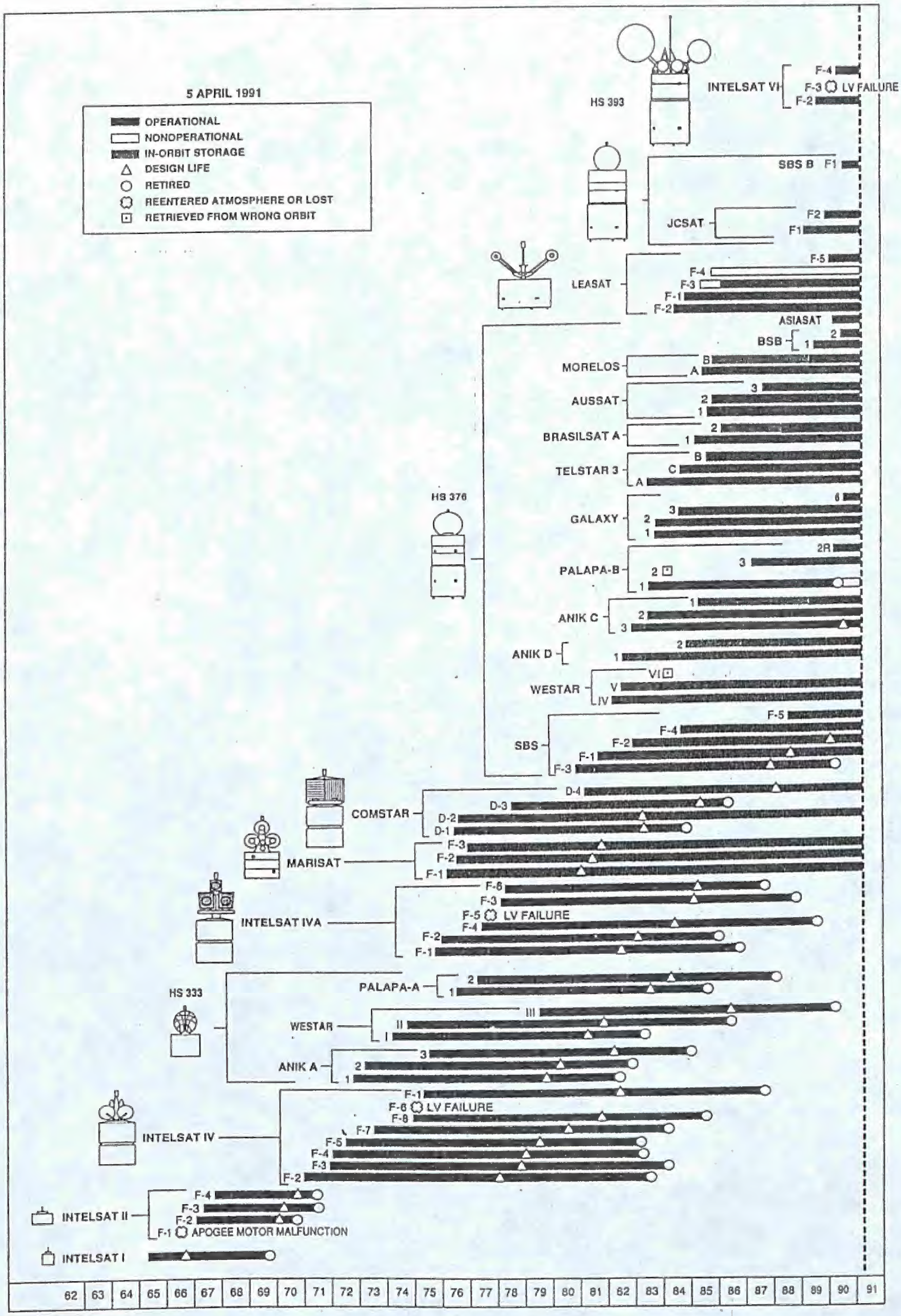


Figure 2. Hughes Satellites Operating History

In-orbit reliability and longevity are proven characteristics of our communications satellites. Figure 2 shows the operating record of Hughes commercial satellites up through September 1990. Many are still operating and those that have been retired have all exceeded their design lifetime. Only one spacecraft, Leasat F-4, failed to provide full service. Two were positioned in a wrong orbit due to malfunctioning perigee assist motors (Westar VI and Palapa B2) but were later recovered using the STS. They have been subsequently refurbished, relaunched successfully, and are now in commercial service as Asiasat I and Palapa B2R.

HS 376 SPACECRAFT

The HS 376 is the world's most successful and most used spacecraft. Its success is due, to a great extent, to the fact that it is also the world's most reliable and easiest to use and operate satellite. Ease of operation is afforded by its simple design and straightforward subsystem architecture. Its historic reliability is due in large part to this design simplicity, the level of Hughes' quality control, and incorporation of adequate levels of redundancy in all subsystems. Thirty-five have been purchased by 12 different operators for a variety of services throughout the world. As shown in Figure 3, 32 are currently in orbit, having accumulated over 160 orbit years of service through mid-1990. This spacecraft, more than any other in the world, offers off-the-shelf design maturity and reliability. There have been no HS 376 spacecraft failures in 183 spacecraft-years of operation. There have been only 6 HS 376 transponder failures out of a total of 618 HS 376 transponders flown. As shown in Figure 4, the HS 376 product line will be active through and beyond 1995.

The versatility and adaptability of this spacecraft are demonstrated by the wide variety of missions the HS 376 has successfully performed. Even after contract go-ahead, as technical

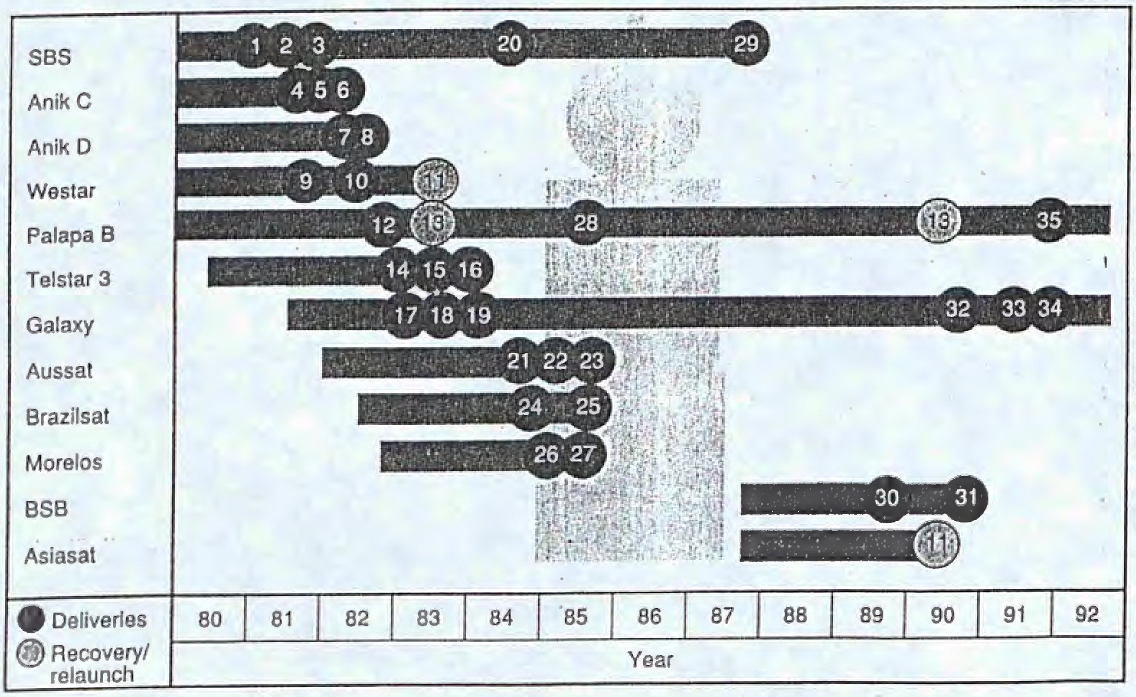


Figure 3. HS 376 Spacecraft Deliveries

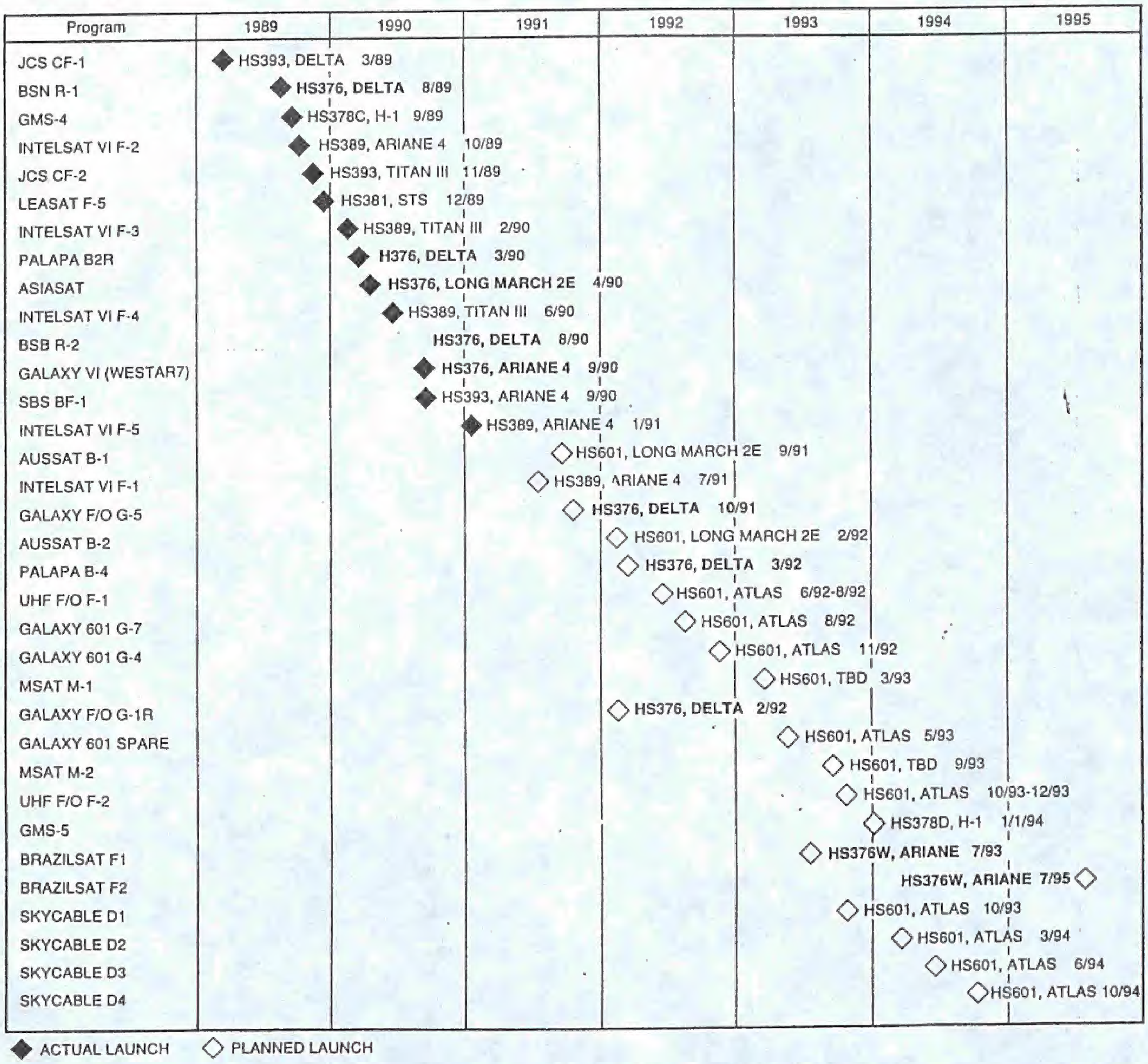


Figure 4. Planned Commercial Spacecraft Launches

requirements and market needs crystalize, the spacecraft has the proven growth capacity and flexibility to accommodate needed mission changes.

The success of the HS 376 product line has enabled it to be further refined and developed with each new generation. The features that are appreciated by its users and that provide its unsurpassed reliability are retained and refined, while the most modern technologies are continuously being evaluated and incorporated into the basic design. These latest technological advances are most evident in the payload being offered here. This emphasis on payload technology allows our customers to retain the greatest competitive edge.

THAISAT DESIGN

Table 1 summarizes the performance of THAISAT. The effective isotropic radiated power (EIRP) contours are shown in Figure 5. Excellent performance has been obtained for all of Thailand with a minimum EIRP of 39.5 dBW. A very tight, high performance beam has been produced for Ku-band coverage giving a minimum EIRP of 50.5 dBW for Thailand.

Table 1. Performance Summary

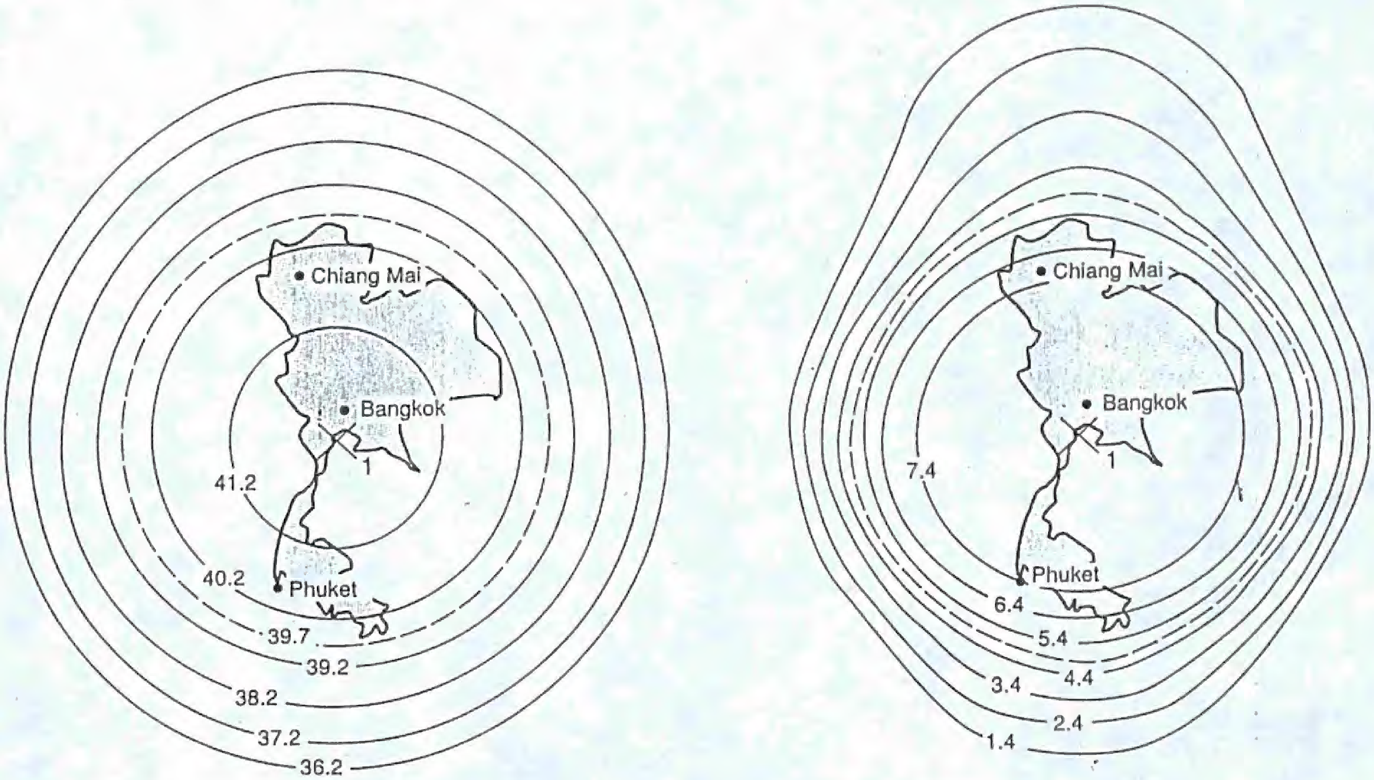
Parameter	*Spacecraft Performance*
Channels	10 at 36 MHz (C-band) 2 at 54 MHz (Ku-band)
EIRP, dBW	
C-band	39.5
Ku-band	50.5
Mission life, yr	15
Launch vehicle compatibility	Complies (compatible with all major launch vehicles)
Repeater redundancy	12 for 10 SSPAs (C-band) 4 for 2 TWTAs (Ku-band) 2 for 1 receivers

The basic HS 376 design (Figure 6) consists of telescoping solar panels and a deployable reflector to provide a compact design compatible with all major launch vehicles. The spun section provides a platform for the power, attitude control, and propulsion subsystems. The payload is mounted on the despun section. As for previous HS 376 missions, an integral Thiokol STAR 30 solid apogee motor is used to boost the spacecraft into final geosynchronous orbit.

The second HS 376 THAISAT satellite will be almost identical to the first except the communications channels will operate at the opposite polarization to those on the first THAISAT and transponder center frequencies will be interleaved (staggered), to permit the satellites to operate at the same orbit position, as if they were a single satellite. The frequency/polarization plans for THAISAT 1 and 2 are shown in Figures 7 and 8.

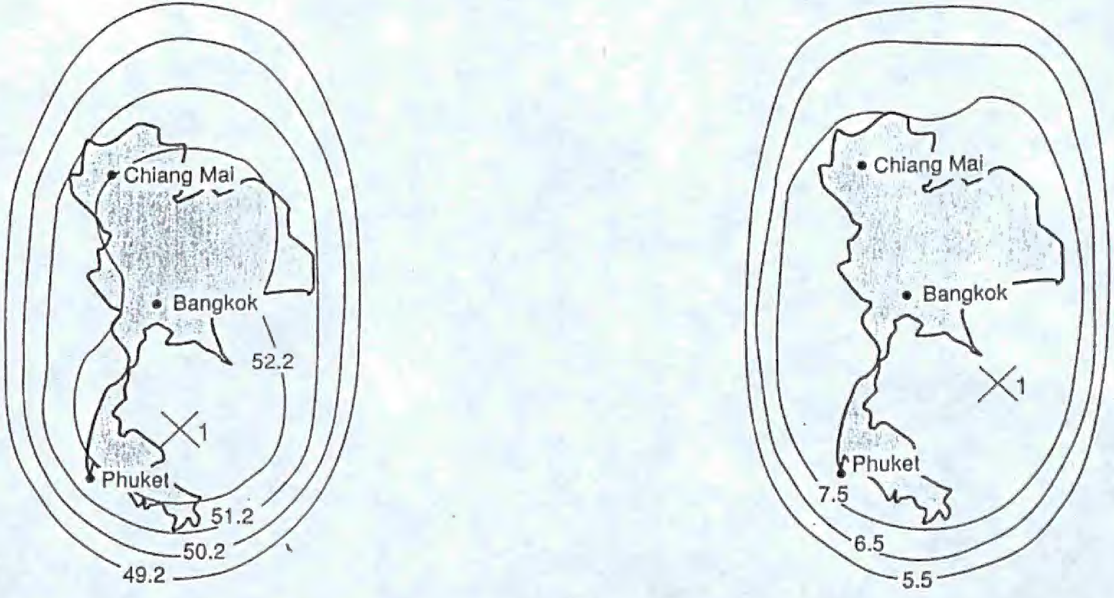
The C-band channels utilize one sense of polarization for transmit, and the Ku-band channels utilize the opposite sense. C-band channels receive on the opposite polarization as they transmit, while Ku-band channels receive and transmit on the identical polarization. Following the antenna and bandpass filters (see Figure 9) are two receivers, one primary and one redundant for each of the two frequency bands. These receivers amplify and downconvert the received 14 GHz and 6 GHz signals to 12 GHz and 4 GHz, respectively. These signals are then separately channelized and the signals passed through the channel amplifiers, which consist of step attenuators, driver amplifiers, and 50 watt TWTAs for the Ku-band channels and 8 watt SSPAs for the C-band channels. The signals are then filtered and combined in output multiplexers and are downlinked with the same polarization sense as when received.

The 50 watt TWT proposed will be supplied by either Hughes Electron Dynamics Division (EDD), or Thomson CSF. Both are world class suppliers of high power, high efficiency Ku-band



EIRP G/T

a) C-band



EIRP G/T

a) Ku-band

Figure 5. Thaisat Antenna Patterns

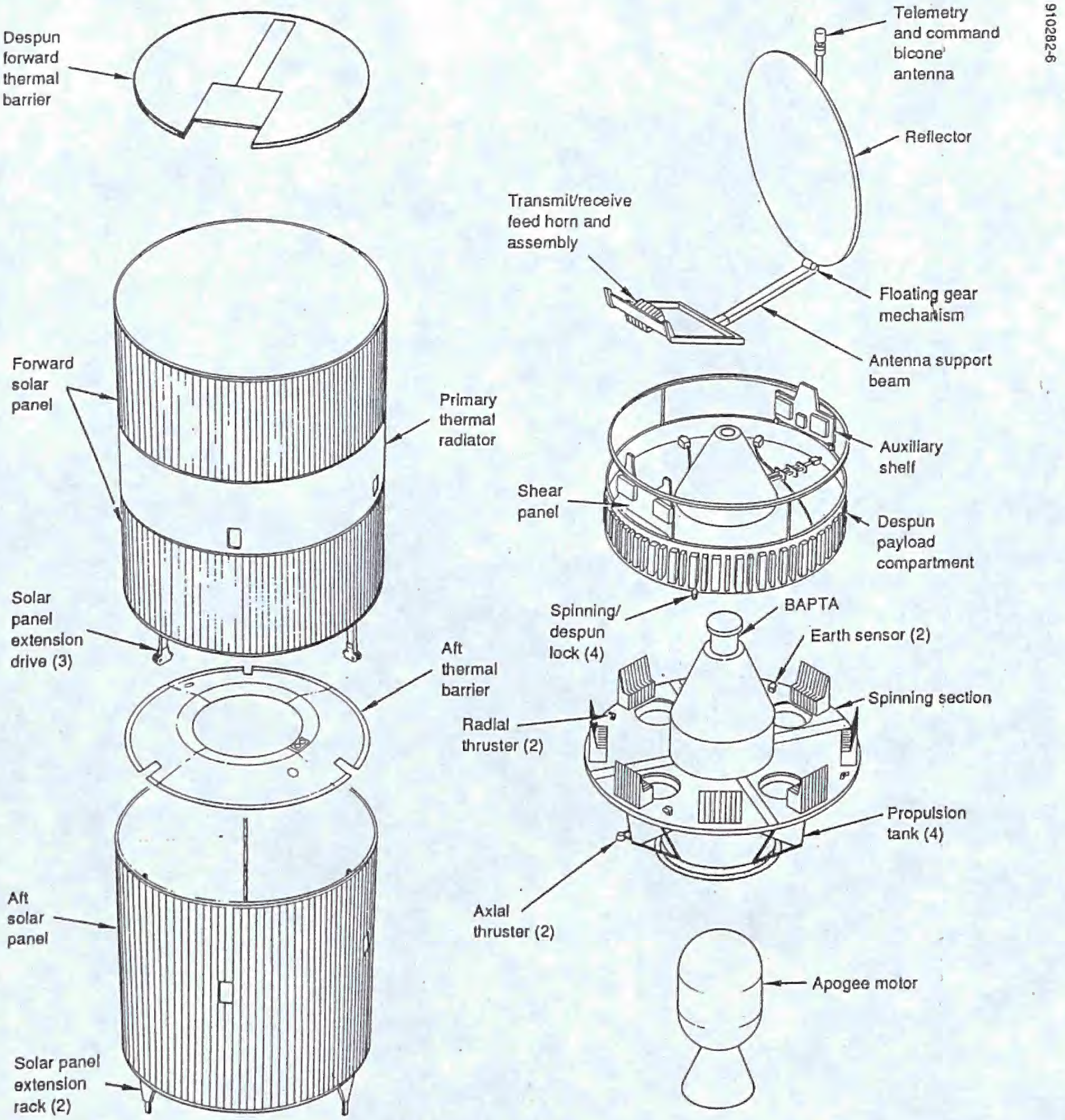
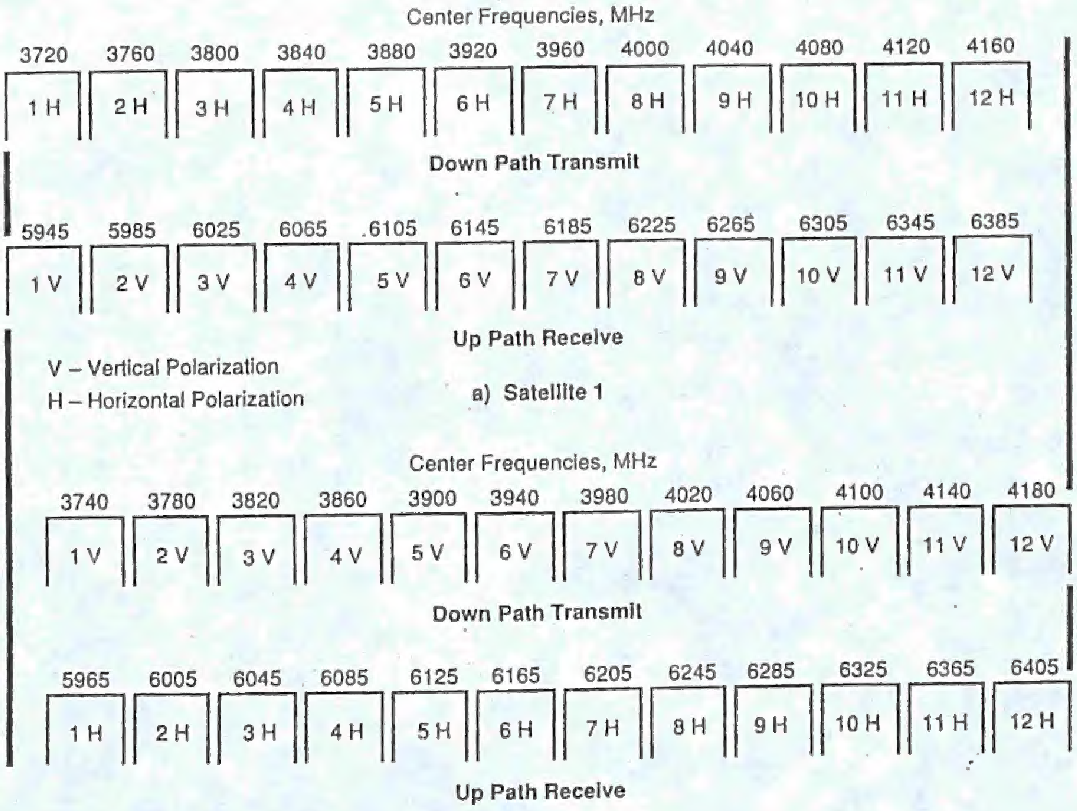


Figure 6. ThaiSat Exploded View



a) Satellite 1

b) Satellite 2

Figure 7. C-band Frequency and Polarization Plan

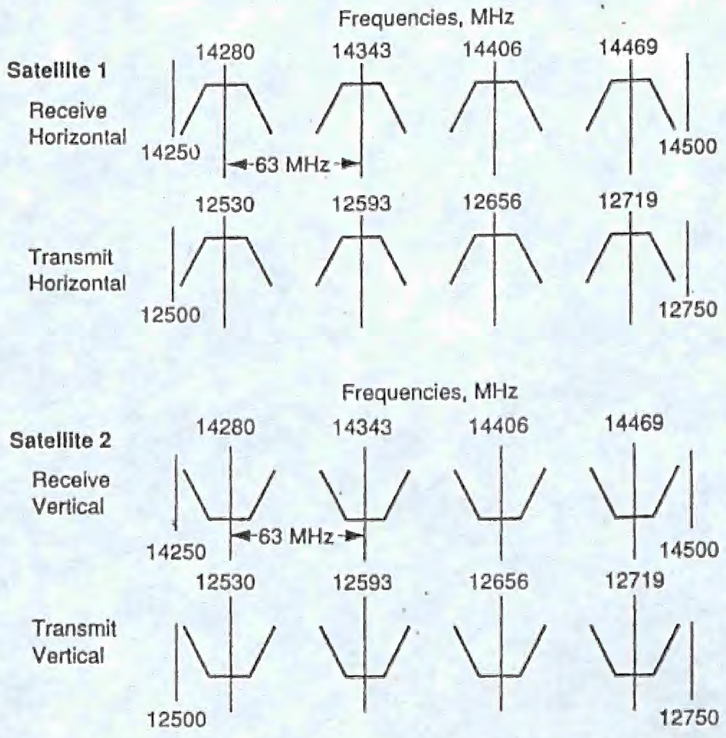


Figure 8. Ku-band Frequency and Polarization Plan

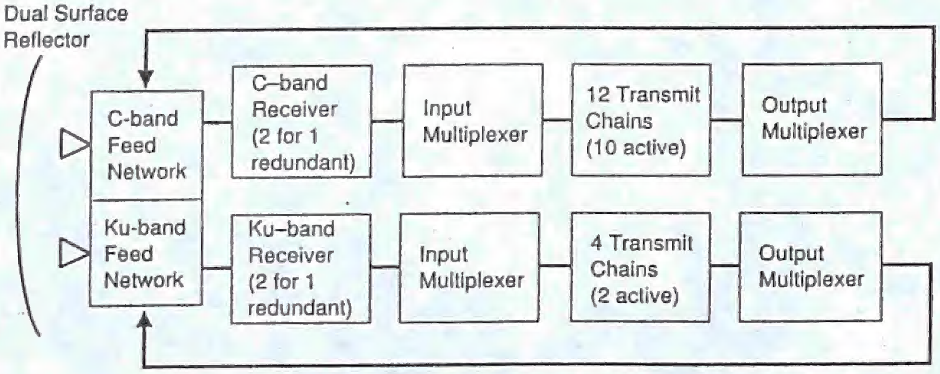


Figure 9. C/Ku-band Communications Repeater

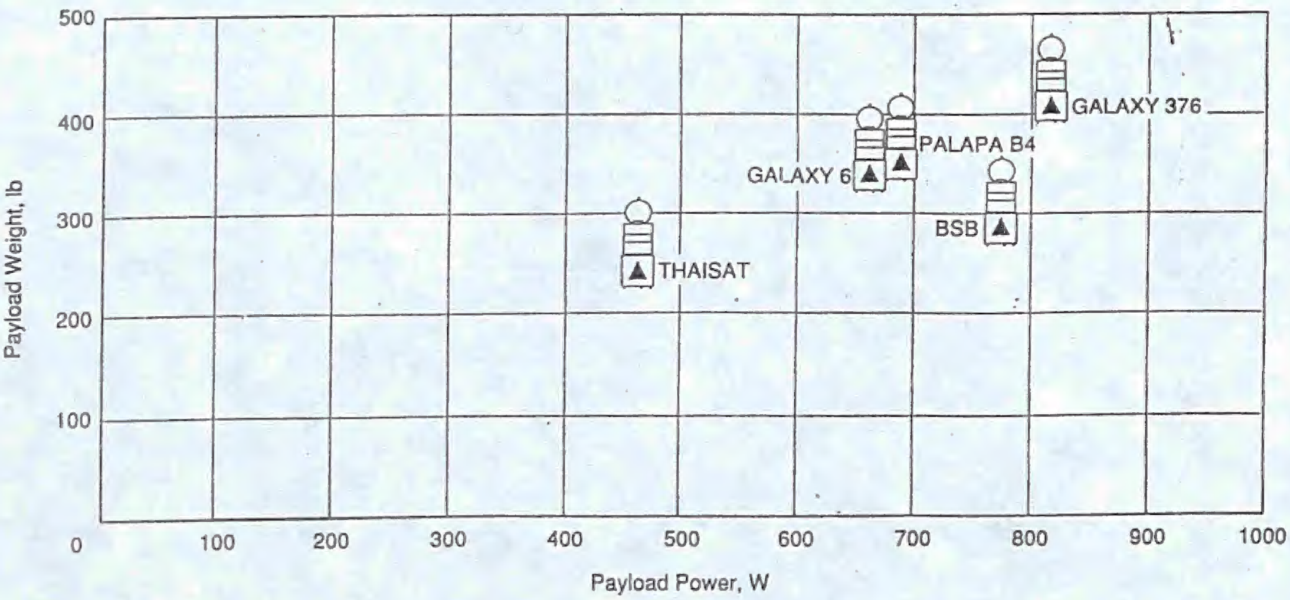


Figure 10. Payload Weight Versus Power

TWTs and have qualified designs from which the proposed TWT for THAISAT will be derived. The SSPAs proposed will be supplied by Hughes Space and Communications Group, one of the world's leading suppliers of these devices.

As shown in Figure 10, THAISAT's payload power and weight are well within the capability of the HS 376 satellite, also employed for BSB, Galaxy 6, Palapa B4, and Galaxy 376.

SPACECRAFT BUS

The spacecraft bus subsystem designs stress simplicity and redundancy and are essentially identical to those used on the 32 HS 376 spacecraft built to date. The attitude control subsystem (ACS) uses rotor-mounted sun and earth sensors, nutation accelerometers, and shaft angle encoders developed and flown on previous spacecraft to perform attitude determination functions. Nutation stabilization is provided in the attitude control electronics (ACE) by two flight proven loops that damp transient nutation and provide stabilization. Spin axis attitude, rotor spin rate, and spacecraft orbit are controlled by pulsed or continuous firing of selected thrusters during ground controlled maneuvers. In addition, the ACE provides for two modes of antenna despin, relative rate, and earth mode.

Telemetry and command (T&C) are provided via both spot beam and omni antennas. Command operates at 6.4 GHz for on-station operations and at 5.9 GHz for the transfer orbit phases of the mission to allow use of the existing control station network. Telemetry operates at 4.2 GHz for all phases of the mission, using two of the 8 watt SSPAs to provide the necessary power for omni operations during transfer orbit and the direct transmitter output coupled with the spot antenna gain for on-station operations.

The reaction control subsystem (RCS) will be the standard highly reliable HS 376 non-propellant hydrazine system. Two radial thrusters provide east-west stationkeeping and spin change maneuvering, and two axial thrusters provide north-south stationkeeping and attitude control. The axial thruster provides a small spin-up/down component to provide spin change redundancy for the axial thrusters. The simplicity of this design leads not only to a high subsystem reliability but also to ease of ground operations.

The electrical power system uses the standard HS 376 solar panel with the improved large solar cell technology. The improved Ni-Cd battery has been qualified to 80 percent depth of discharge (DOD) and will provide full eclipse operation of the bus and payload.

Heaters and passive heat rejection techniques that have been successfully used in flight on previous HS 376 missions allow thermal control. The primary payload heat rejection surface is a 20 inch long cylindrical quartz radiator opposite the TWTA mounting surface.

TTC&R GROUND STATION

The THAISAT TTC&R ground station is a state of the art, cost effective design that provides efficient operations of the THAISAT spacecraft in on-station functions. Hughes' design provides reliable equipment similar to that designed by Hughes for control of the many other HS 376 satellites.

Hughes brings to THAISAT a 20 year heritage in design and operation of satellite control systems. To match the simple, reliable operation of the HS 376 spacecraft, Hughes offers the "string" approach to baseband equipment and real time computers, a system that involves dedicating a complete set of the standard baseband ground equipment needed to operate the satellite and the necessary radio frequency (RF) equipment. Each string consists of all nonredundant components necessary to perform telemetry, commanding, and ranging (TC&R) on the spacecraft. In the event of equipment failure, the backup string can be brought online immediately to enable satellite operation to continue while the problem with the failed string is being identified off-line. This string concept, further developed and proven on the Galaxy, Aussat A (Australia), JCSAT (Japan), BSB (England), and Asiasat (Hong Kong) programs, has been extended to the HS 601 generation on the Aussat B program and the design for the Brasilsat B program. The THAISAT approach builds on this history, adapting it as necessary to meet Thailand's unique requirements. The THAISAT ground control station configuration is depicted in Figure 11.

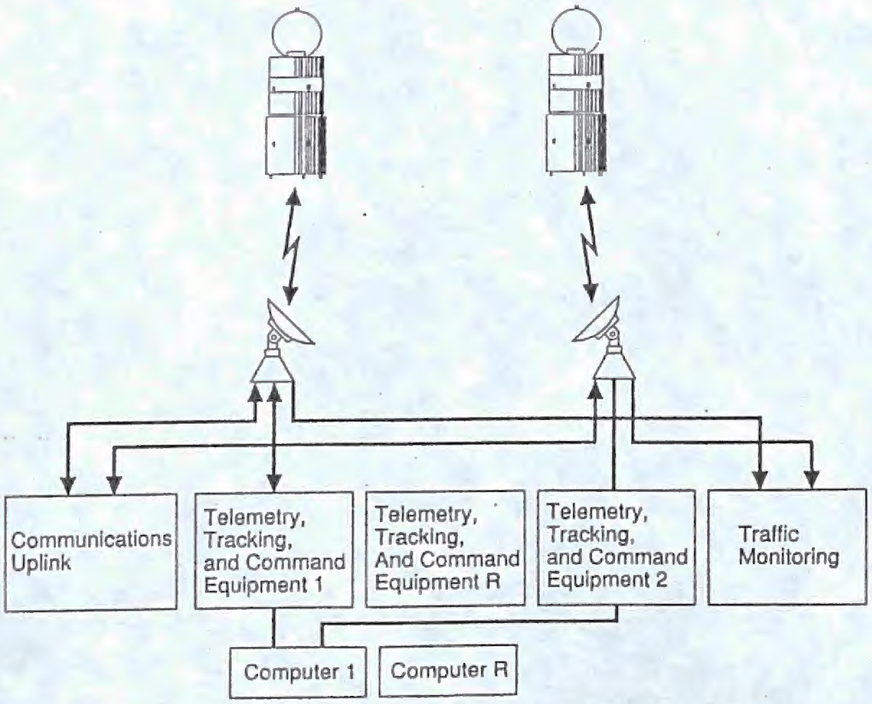


Figure 11. Thaisat TTC&R and Traffic Monitoring Station

RELIABILITY

The proposed HS 376 spacecraft bus for THAISAT is the latest model based on five generations of spin stabilized satellites designed by Hughes. Characteristically, subsystem technology overlaps between generations, with emphasis on retention and refinement of flight proven hardware. This strategy has contributed to progressively higher subsystem reliability and lower risk. Analysis of in-orbit data from our earlier satellites, covering 26 years from 1963 to present, indicates that most of the relatively minor anomalies and failures observed in orbit are design related. The number of such design related events occurred in the earlier models of a spacecraft family and has progressively decreased with each subsequently launched spacecraft in which remedial measures have been incorporated.

Figure 12 compares predicted and actually observed bus reliability for Hughes satellites. Hughes commercial communication satellites have achieved an impressive bus reliability of 0.954, based on actual in-orbit data, and a 10 year life extrapolation.

This excellent performance can be directly attributed to the simplicity of the spin-stabilized HS 376 design, the design refinements that have resulted from the ~500 in-orbit years of flight experience accumulated by the HS 376 spacecraft bus, and the built-in level of redundancy in critical areas of the design.

THAISAT APPLICATIONS

THAISAT may be employed in any satellite application which operates in either C- or Ku-bands. These applications may be categorized as

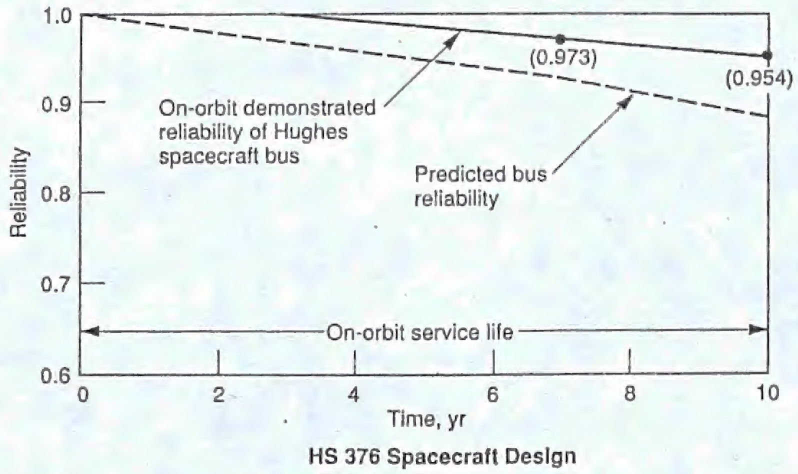


Figure 12. Predicted Versus Demonstrated In-orbit Reliability

1) Television (TV) distribution and backhaul
2) Video teleconferencing
3) Radio distribution and backhaul
4) Multipurpose very small aperture terminal (VSAT) networks
5) Telephony: trunk and thin route

THAISAT, as a simple frequency-changing satellite (i.e., no on-board processing of communications signals) acts like a bent type. In other words, it receives, amplifies, and retransmits any type of signal from one or more uplink locations within its receive footprint to one or more downlink locations within its transmit footprint.

THAISAT will be positioned at the geosynchronous altitude of approximately 22,300 miles, in the geostationary orbit — a geosynchronous circular orbit at the equator. This geostationary orbit allows THAISAT to appear at a fixed position so that inexpensive non-tracking ground antennas may be used. In the most southern part of Thailand, THAISAT will appear at an angle above the horizon (elevation angle) of approximately 85° toward the south. In the most northern parts of Thailand, THAISAT will appear at an elevation angle of approximately 65° (at Bangkok the elevation angle to THAISAT will be approximately 73°). Therefore, THAISAT is easily visible from all parts of Thailand.

THAISAT will simultaneously receive and transmit at both C- and Ku-bands over all of Thailand. Therefore, THAISAT's users within its coverage pattern (or footprint - which contains all of Thailand) can set up point-to-point communications links via THAISAT without concern for distance between the transmit and receive locations. As a result, the same quantity of satellite capacity would be used for a link from the north to the south of Bangkok as would be used for a link from the north to the south of Thailand.

THAISAT users can also set up point-to-multipoint (broadcast) links or multipoint-to-multipoint networks from (and to) anywhere in THAISAT's footprint. This allows ultimate flexibility in network configuration since changing the terminal locations or adding new terminals only requires relocation or installation of a ground station. The same flexibility is not available in a terrestrial communications system.

THAISAT will take advantage of the Hughes HS 376 satellite bus, the most reliable satellite ever built—based on its performance history. Palapa B, Aussat, and Asiasat are South-east Asia regional examples of use of the HS 376 by satellite operators in Indonesia, Australia, and Hong Kong. As THAISAT has been designed specifically for Thailand, its performance for Thai domestic communications will surpass that of any other satellite available in the region.

APPLICATIONS

TV distribution is convenient via satellite because of the flexibility and economy previously described. The following categories of television distribution take advantage of different aspects of THAISAT (see Figure 13):

1) Network TV distribution for rebroadcast over VHF/UHF channels

2) Cable TV distribution for rebroadcast over cable systems

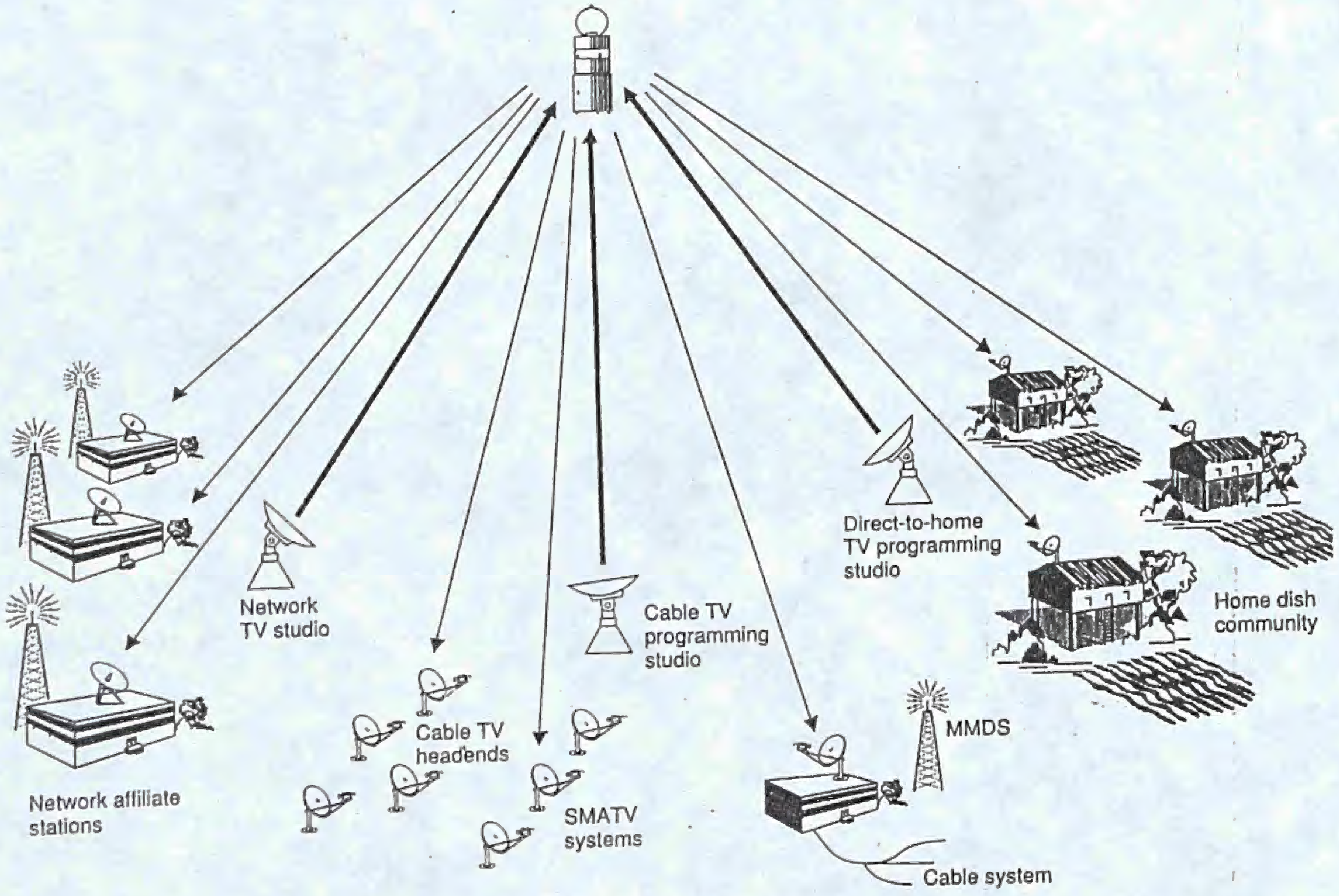


Figure 13. TV Distribution

3) Direct-to-home (DTH) TV distribution

4) TV distribution to satellite master antenna TV systems (SMATV) at hotels

Network television employs satellites for distribution of programming real time to its network affiliates who may introduce local advertising or programs before retransmission over the air in the affiliates VHF/UHF coverage region. C-band is the probable choice for network TV distribution.

Cable TV employs satellites for distribution of programming from cable programmers to cable system operators who may introduce local advertising or programs before airing on their cable system. C-band is the probable choice for cable TV distribution.

DTH TV distribution via satellite may occur whenever a television signal is received from a satellite by an individual having a dish (i.e., antenna) at his home. In the United States cable programmers generate additional revenues by charging home dish owners to receive cable-satellite programming. To enforce payments for viewing, cable programmers electronically scramble the satellite TV signal. Dish owners must pay for an electronic descrambler and also a monthly fee to legitimately receive programming. There is a known black market of illegally authorized descramblers which enable home dish owners to receive scrambled programming without paying the monthly fee. Home dish owners also can receive network programming via satellite.

In Europe and Japan there are DTH TV distribution businesses which rely entirely on advertising revenue or viewer subscription fees (or both). To encourage new subscribers, DTH systems are designed to use small dishes (usually around 1 meter or less). This size dish is both cheaper and easier to install.

TV programmers for sports, news, and movie programs may increase their viewership through satellite distribution to SMATV system located usually at hotels. Most SMATV systems receive programming from cable TV transponders.

An ancillary service to TV distribution (usually to cable TV) is audio or data distribution using subcarriers of the main TV carrier, thus sharing the same transponder. Alternative language audio tracks, high-fidelity analog or digital music, weather information, stock market data, etc. are all transmitted in this manner over many cable TV systems. Reception of the subcarrier signal usually requires an additional receiver, which can be activated once the user has paid a monthly subscription fee.

When news, sports, or other special events mandate live coverage from a remote location, satellite backhaul of the TV signal provides real time HAULing of the signal BACK to a studio for editing or direct retransmission over the air (see Figure 14). At sporting facilities, for example, a satellite uplink can expand the veiwership of the event to all cable subscribers or DTH subscribers. News channels can provide live on-site TV coverage using a portable (suitcase outfitted) satellite uplink or transportable (truck mounted) satellite uplink which can readily be sent to the location of interest within the satellite footprint. As an example, off-track betting has become successful in the United States using satellite TV distribution of horse races to large screen TVs located at other racetracks or casinos.

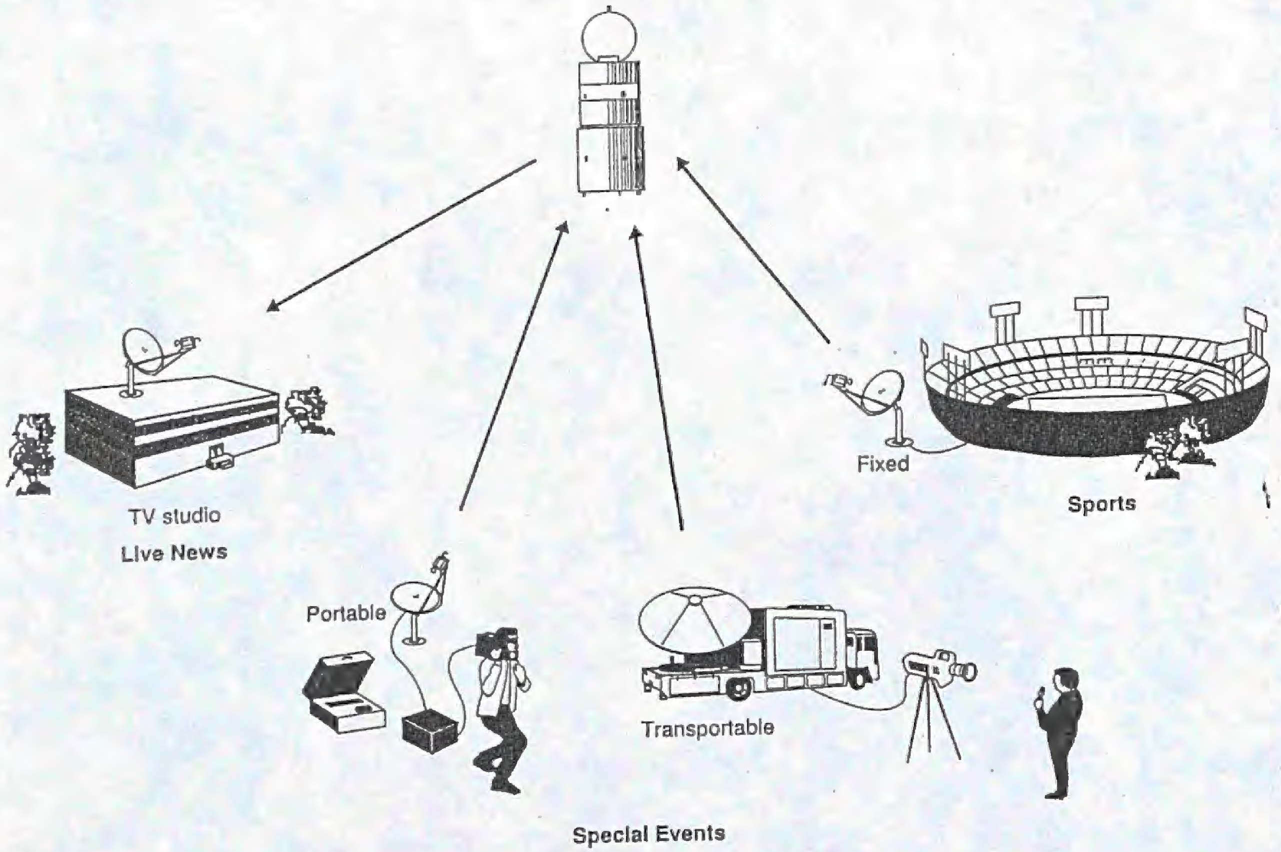
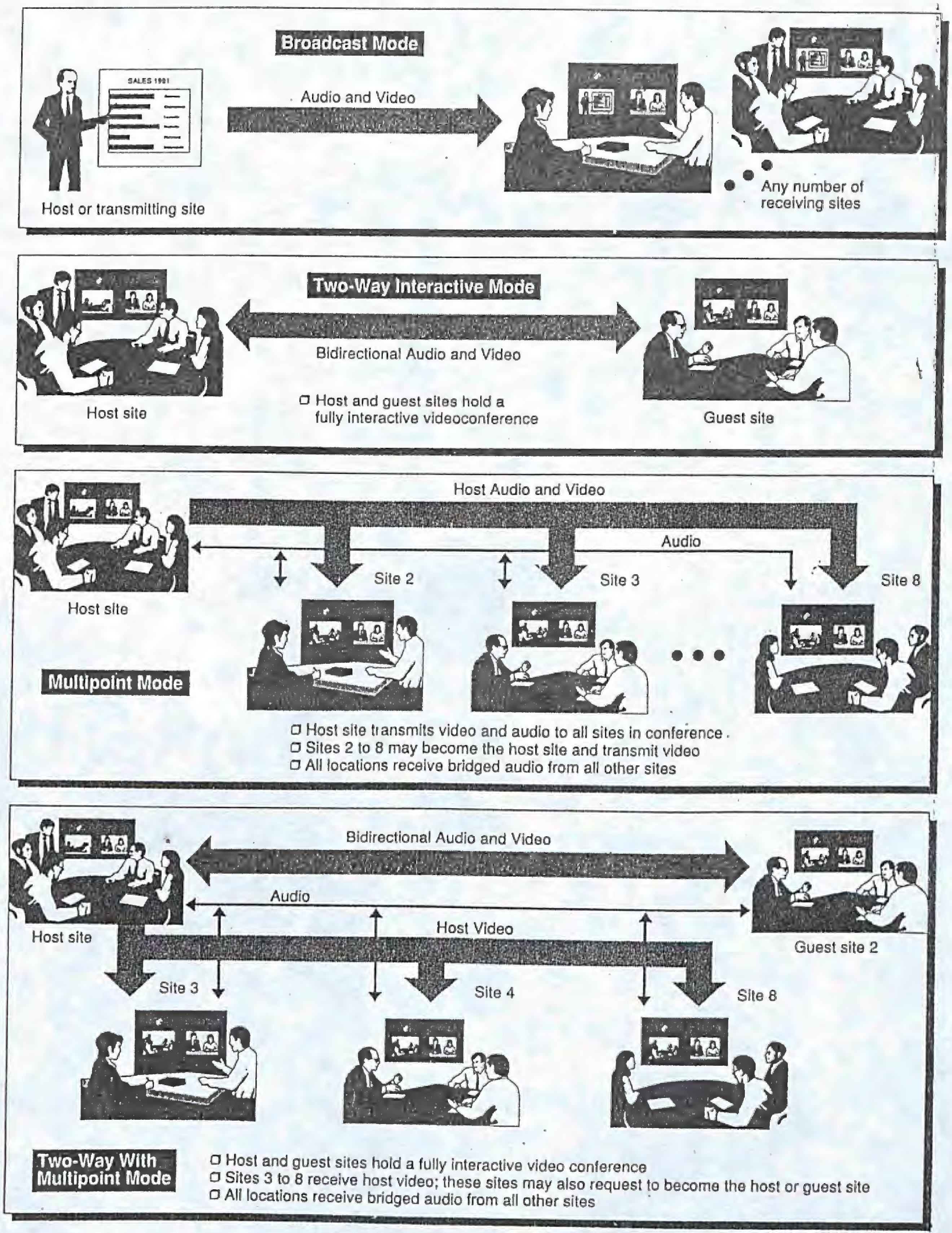


Figure 14. TV Backhaul

Video teleconferencing (VTC) via satellite is rapidly gaining in popularity around the world. VTC reduces the need for travel and enhances long distance face-to-face communications. Typical VTC applications include executive meetings, medical consultations, state-of-the-company addresses, product and service announcements, graduate degree courses, job training courses, marketing presentations, scientific or other special interest conferences, press releases, policy announcements, and video news releases. VTC systems may be privately owned or operated for shared use. As shown in Figure 15, configurations include video broadcast only, bidirectional video and audio, video broadcast with bidirectional audio (multipoint mode), and bidirectional video/audio combined with multipoint mode. VTC, as distinguished from network, cable, DTH, or SMATV usually requires lower picture quality. The others achieve maximum picture quality by using an entire transponder for one TV signal. VTC may fill a transponder with 10 to 100 or more reduced quality video signals.

Radio networks can use satellites for radio distribution to affiliates similarly to TV networks (see Figure 16). Radio (either 7.5 or 15 kHz baseband) transmissions usually require a small fraction of a transponder allowing more than 100 such signals in a C-band transponder. Radio backhaul operates similar to television backhaul but using only the small amount of power and bandwidth required for a radio channel. DTH radio is also possible.



☐ Host and guest sites hold a fully interactive videoconference

☐ Host site transmits video and audio to all sites in conference.
☐ Sites 2 to 8 may become the host site and transmit video
☐ All locations receive bridged audio from all other sites

☐ Host and guest sites hold a fully interactive video conference
☐ Sites 3 to 8 receive host video; these sites may also request to become the host or guest site
☐ All locations receive bridged audio from all other sites

Figure 15. Video Teleconferencing

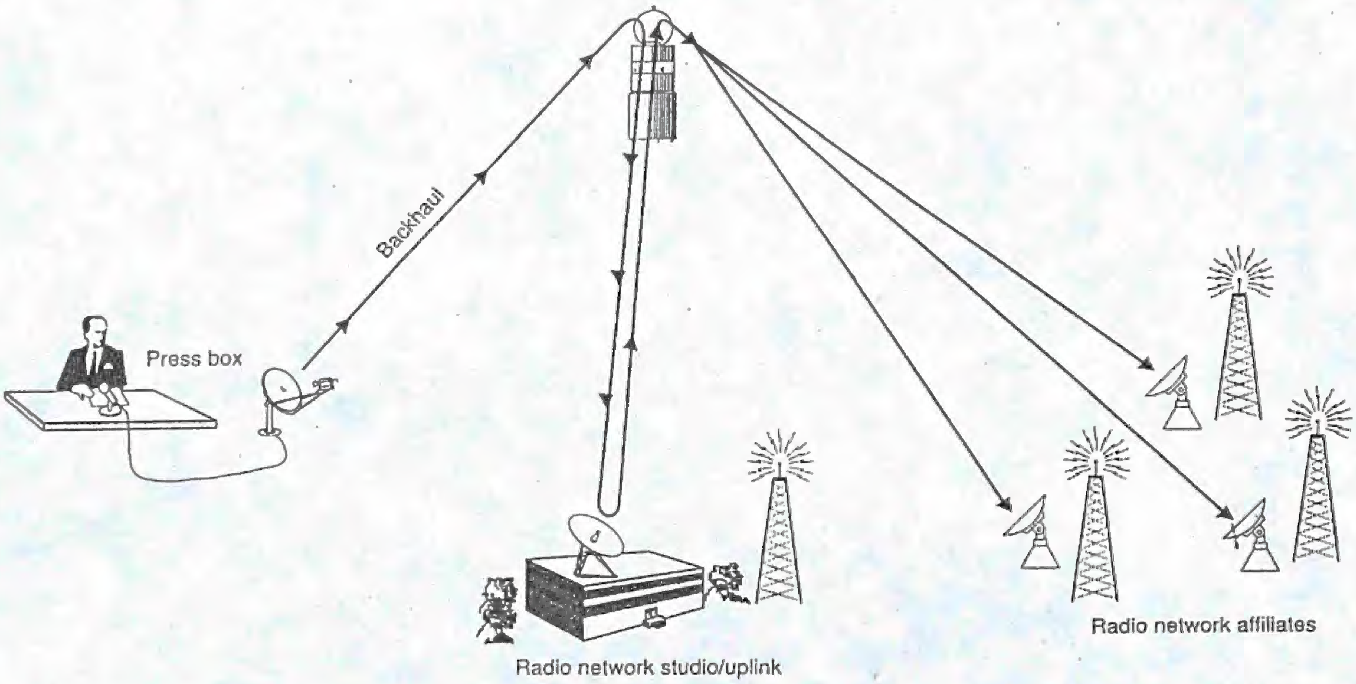


Figure 16. Radio Network Distribution

Multipurpose networks (voice, data, and video) employing VSATs are used for a broad range of applications:

1) Point-of-sale transactions (e.g., credit checking, product information)
2) Private data/voice system (e.g., banking, air traffic control ground station network)
3) Video broadcast for training/product information/corporate meetings
4) Thin-route telephony
5) Centralized business accounting
6) Inventory management

or a combination of the above.

VSAT networks employ either a star or mesh configuration depending on the communications needs of the particular network (see Figure 17). Transmissions from a VSAT hub (the center of the star network) to a remote VSAT are designated outroutes and provide data transmission rates up to 512 kbps in Hughes Network Systems (HNS) VSAT — the personal earth station (PES) (see Figure 18). Transmission from a VSAT to a hub are designated inroutes and provide data transmission rates up to 128 kbps for an HNS PES.

Thin route telephony may use a mesh network with demand assigned multiple access (DAMA) switching to utilize the satellite capacity economically. HNS telephony earth station (TES) is one such example (Figure 19). In general VSAT networks employ both frequency and time division multiple access to share a transponder.

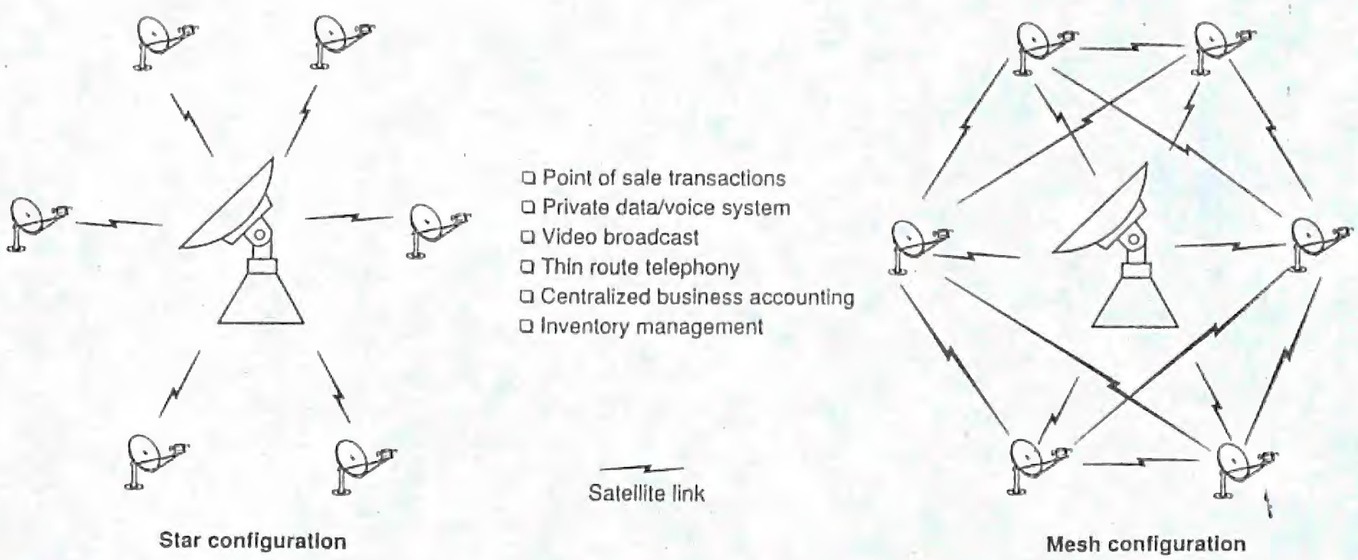


Figure 17. Multi-purpose Very Small Aperature Terminal (VSAT) Networks

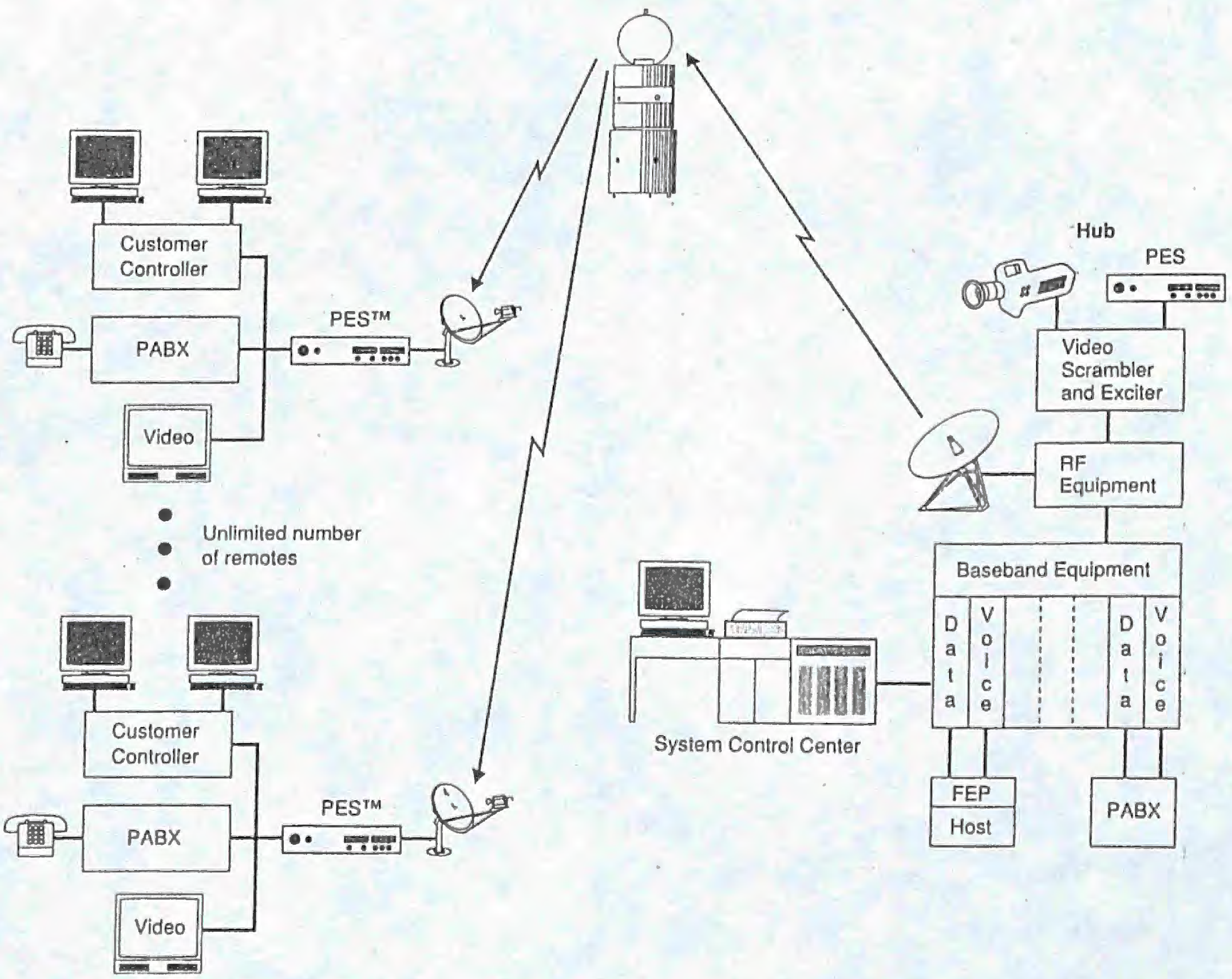


Figure 18. Hughes Network Systems (HNS) VSAT

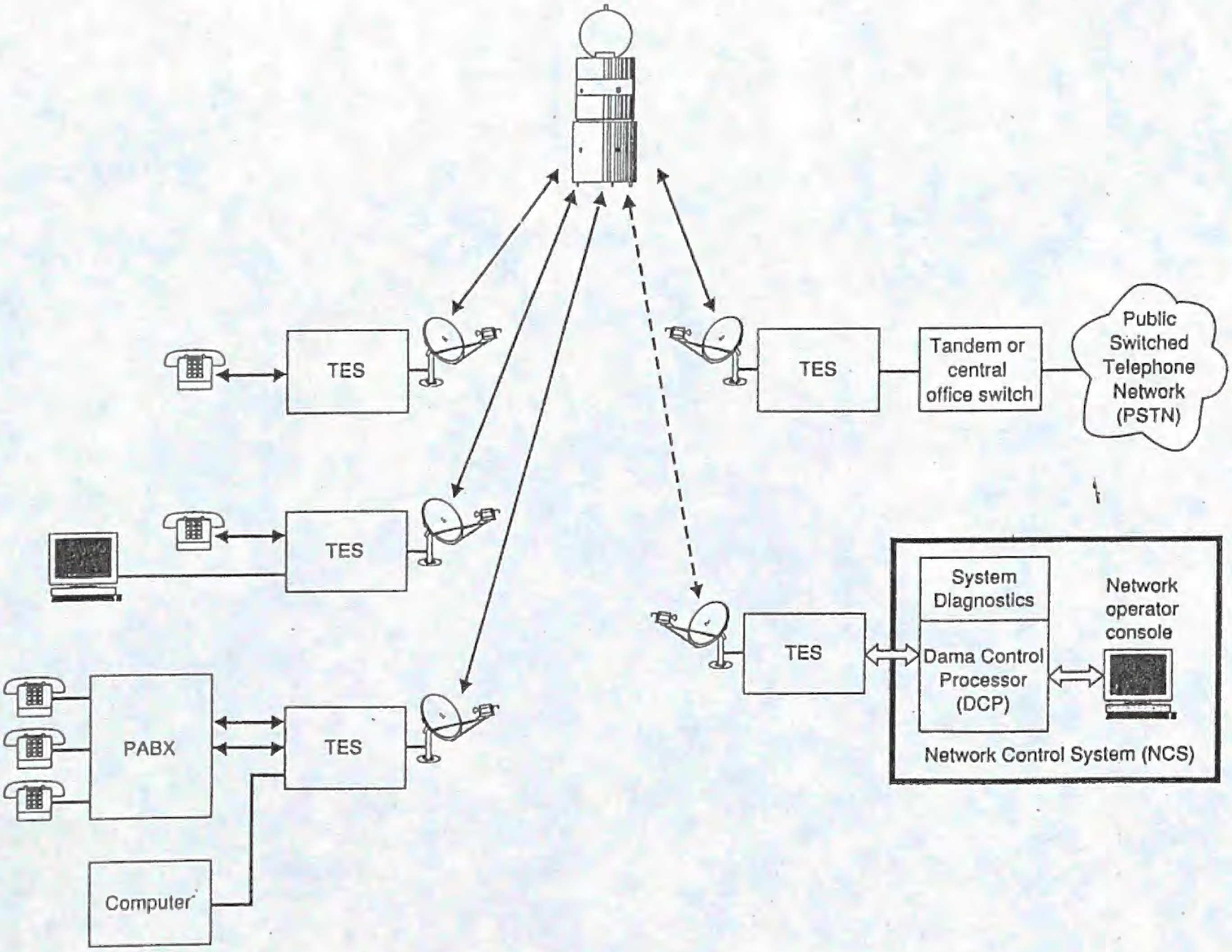


Figure 19. Telephony (Thin Route Mesh Network)

Trunk telephony or heavy routes use larger earth stations to maximize the number of voice circuits per transponder, more than 1000 typically, (see Figure 20). Satellite circuits rarely encounter the euphemistic back-hoe fade of their terrestrial counterparts, but must employ echo-cancellers to attenuate an audible echo at the time interval of a satellite transmission from source to destination and back.

This short introduction to satellite applications is intended to convey the breadth, flexibility, and reliability of satellite communications. As Thailand enters a new phase of sophistication in communications by operating its own satellite, its residents will begin to enjoy greater connectivity with one another and consequentially enjoy greater productivity, greater ease of communication, more variety in radio and TV entertainment, and many other benefits.

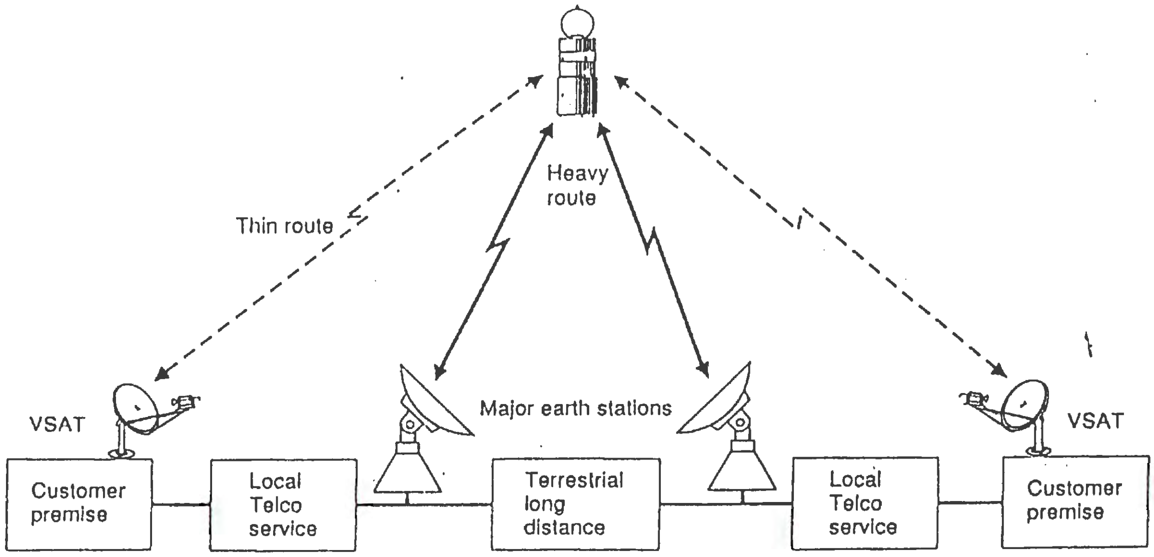


Figure 20. Telephony Trunks (Heavy) and Thin Routes