ANNUAL HISTORICAL SUMMARY
(Reports Control Symbol CSHIS-6(R2))

UNITED STATES ARMY
SATELLITE COMMUNICATIONS AGENCY

1 July 1970 - 30 June 1971

BACKGROUND

The U. S. Army Satellite Communications (SATCOM) Agency, as Army Project Manager for satellite communications, is responsible for providing the ground environment for the Department of Defense satellite communications system. The SATCOM Project Manager also acts as the Army's agent for all international military satellite communications systems and represents the Army in special Department of Defense satellite projects not specifically communications. In addition, the SATCOM Project Manager exercises complete life-cycle responsibility for the military satellite communications ground environment which are tri-service operated and some of which have international implications.

The Agency is an integrated facility for engineering, research and development, testing and evaluation, and systems operations. From its headquarters at Fort Monmouth, N. J., the Agency directs the operations of a field station at Lakehurst (N. J.) Naval Air Station which is used as the staging and testing area for tactical satellite communications for SATCOM's global commitments.

ANNUAL HISTORICAL SUMMARY--1 Jul 70 - 30 Jun 71

Major advances in Phase II of the Defense Satellite Communications Program and in the development of small tactical satellite communications terminals marked Fiscal Year 1971 at the Army Satellite Communications (SATCOM) Agency.

In Palo Alto, California, the 60-foot reflector assembly of a Heavy Transportable Terminal was erected on the test site of Philco-Ford's Western Development Laboratories. The terminal is being designed and fabricated under Contract No. DAAB07-70-C-0234 awarded to Philco-Ford 10 June 1970 for one Heavy Transportable Terminal and one Medium Transportable Terminal in the Phase II program.

Fabrication of the Medium Transportable Terminal's antenna pedestal and reflector assembly was completed and preliminary testing of ancillary equipment for both terminals was successfully carried out. The terminals are scheduled for delivery during the 2d quarter of CY 1972.

In the first half of Fiscal Year 1971, the practicability of satellite communications terminals aboard Army aircraft was demonstrated through a test program involving both ultrahigh frequency (UHF) and superhigh frequency (SHF) TACSAT terminals installed in UH-1D helicopters. As a result of this test program, it was determined that a UHF half-duplex voice satellite radio would be feasible using only a fraction of the equipment provided in the test model.

When satellite equipment functions and performance requirements were analyzed, it was found that a large portion of required equipment was already, or soon available, aboard Army aircraft in the form of the AN/ARC-116 UHF radio. Satellite operation, however, requires some modifications, primarily the addition of a frequency modulation (FM) modulator and demodulator and a special antenna. Such a modified radio could perform both the normal UHF line-of-sight and satellite functions. During this testing, an SHF voice circuit was established between a helicopter flying over Lakehurst, N. J., and an Air Force EC-135 aircraft in flight over Australia.

A major technical advance which made the satellite mode practical for helicopters is the unique antenna system mounted above the rotor. In this position, the rotating blades do not block the signals' path to and from the helicopter.

DEFENSE SATELLITE COMMUNICATIONS SYSTEM

In conformance with Defense Communications Agency (DCA) direction to provide a smooth operational transition for the Phase I to Phase II of the Defense Satellite Communications System, interim Stages 1a and 1b of Phase II call for the development of communications subsystems and earth terminal modification to accommodate these subsystems. Because of the many interrelated and interacting subsystems involved in this modification program, SATCOM Agency prepared a DSCS Phase II Ground System Plan to outline the development, deployment, maintenance, test evaluation and control concept for the ground environment of the Phase II system. The plan addresses all these areas in detail and is useful both as a development plan and a system description of Stages 1a and 1b of Phase II. The Agency will prepare an extension of the plan covering Stage 2 of Phase II at the appropriate future date.

On 27 April 1971, Contract No. DAAB07-71-C-0224 for $5.57 million was awarded to Philco-Ford for the design and fabrication of 14 Contingency Communication Subsystems, 8 Nodal Communication Subsystems and 7 Non-Nodal Communication Subsystems. These subsystems are the modulation portion of a satellite earth terminal and will interface with users of conventional military systems, either direct or through a Defense Communications System Technical Control Facility in Stage 1b, Phase II DSCS.

The Contingency Communications Subsystem will be a shelter configuration deployed as part of the AN/TSC-54 earth terminal. The terminal will be capable of providing 12 voice channels or 11 voice channels and 16 teletype channels and interface with the microwave portion of the earth terminal at 70 megahertz.

DSCS

This subsystem provides the necessary modem and multiplex equipment to support up to 7 satellite communication links simultaneously to non-nodal terminals through a single satellite repeater. The Nodal Communications Subsystem interfaces with the microwave portion of the earth terminal at 70 mhz and with the user via a Technical Control Facility.

The non-nodal subsystem consists of a kit for the modification and upgrading of the Armadillo multiplex shelter and OCV portions of the AN/MSC-46 earth terminal. The non-nodal system provides a 12-channel voice capability expandable to 24 channels.

To meet an urgent Defense Communications Agency requirement to provide a 12-channel contingency capability at the time of the initial launching of the Phase II satellite, SATCOM Agency undertook the in-house design and fabrication of two Interim Contingency Communication Satellite Subsystems. These subsystems will be used as part of the AN/TSC-54 terminal until delivery of replacement units being developed by Philco-Ford under Contract No. DAAB07-71-C-0224. All the logistics and provisioning items such as spare parts, technical manuals, and programs of instruction are being prepared in-house.

Design, fabrication and system integration were completed in the AN/USC-28( ) Advanced Development program. The program's objective is the development of an advanced spread spectrum modulation-demodulation communications equipment for use in the earth terminals for increased antijamming protection with the Phase II, DSCS high power satellites.

DSCS

The AN/USC-28( ) equipment comprises two major units. One is the Group Order Wire (GOW) which provides a duplex teletype command and control link, has antijamming protection, and provides highly accurate (submicrosecond) timing signals at each earth terminal relative to all other terminals using the same communications satellite. The second unit, the receiver/transmitter, will provide a full duplex communications link with a baseband capability of 75 bits per second to 5 megabits per second, including voice or teletype. Two Advanced Development Models of the AN/USC-28 were delivered under this contract for system integration tests prior to entering the engineering development stage.

The final report for the operational evaluation and over-the-satellite verification test for the AN/URC-61 Radio Communications Subsystem was published. This evaluation report discusses work performed at the SATCOM Agency Terminal Equipment test facility at Fort Monmouth from January through June 1970. The report concludes that the AN/URC-61 can be operationally deployed subsequent to the upgrading of equipment, logistics and software. It is also shown that electrical changes to several basic circuit functions are required.

During the period cited, equipment modifications recommended in the report were designed, breadboarded and successfully verified by tests through a satellite link at the SATCOM Ground Subsystem Evaluation Facility. In addition, AN/URC-61 and AN/URC-61X equipment was returned from field sites to Magnavox Research Laboratories for incorporation of these modifications.

On 28 June 1971, Contract No. DAAG05-71-C-0669 for $1,798,000 was awarded to Magnavox for the upgrading of the AN/URC-61, 61X equipment and the concurrent upgrading of associated software and logistics.

DSCS

A concept for the communications control of the operation of the DSCS Phase II system was developed. The concept is based upon providing maximum operating reserve in the satellite so that reserve power can be assigned to links having difficulties. The heart of the system is an automatic, digitally controlled, quantitative spectrum analyzer associated with a major terminal in each area of satellite coverage, which measures the satellite down link power and frequency distribution and compares these parameters with authorized values. The procurement of an evaluation model was initiated.

A system concept was developed for Time Division Multiple Access applicable to the latter stages of the Phase II satellite of the DSCS. This concept establishes the techniques, system parameters, and operational plan for highly efficient time sharing of the satellite by a multitude of ground terminals handling all digital traffic. It allows for the flexible and efficient multiple access to the satellite without the severe problems of transmitter power control normal to the present Frequency Division Multiple Access systems now in use and to be continued in the early stages of Phase II.

The Agency processed the majority of contracts required to modify the AN/TSC-54, AN/MSC-46 and AN/FSC-9 terminals. The modification program encompasses changes in the frequency generator systems, parametric amplifiers, up and down frequency converters, and power subsystems of the AN/TSC-54 and AN/MSC-46 terminals and changes to the power monitoring of the AN/FSC-9. The modification equipment will be installed on-site by teams of site personnel, SATCOM field engineers and contractor personnel. Twenty-nine terminals are included in this modification program.

DSCS

A contract was awarded to Radiation Inc., Melbourne, Florida, for the fabrication of Phase Shift Keying modems to be used by ground terminals utilizing the Phase II DSCS satellite to handle digital traffic in the Frequency Division Multiple Access mode. The modem operates at selectable rates from 19.2 kilobits per second to 1.8 megabits per second. It incorporates internal error correcting coding to increase the operation margin over satellite links.

A concept was developed for the utilization of error correcting coding with Time Division Multiple Access to increase either satellite link margin or to double link capacity over that possible during the early Frequency Division Multiple Access stages of Phase II. The concept visualizes a family of medium and high speed error coding systems operating at a speed intermediate to the low speed baseband (N^X kbps) and extremely high speed burst (80 to 160 mbps) rates.

A multichannel wide-band secure voice trunking capability between Autosevocom switches in the Pentagon and Hawaii was installed during June. The system, called Muscle Trunk, allows wide-band, high quality trunking among secure subscribers of widely separated switches, eliminating the earlier standard narrow-band trunking which required vocoder operation. This system, on an interim basis, time shares the Phase I DSCS link with Compass Link. It includes two wide-band secure trunks and two clear voice links. The Agency provided wide-band communications circuits, test equipment and technical personnel to conduct tests and establish criteria for Muscle Trunk.

DSCS

To accomplish the required broad-banding of the DSCS ground terminals, a 3-kilowatt traveling wave tube was developed with ultra flat gain and phase characteristics never before achieved. Bandwidth was increased to 500 megahertz as specified.

A Terminal Equipment Test Facility (TETF) at SATCOM Agency headquarters is a major component of the SATCOM Ground Subsystem Evaluation Facility (GSEF). The AN/MSC-46, Serial No. 8; AN/TSC-54, Serial No. 2; Lincoln Experimental Terminal (LET), and related support facilities known as the Engineering Test Facility (ETF), located behind SATCOM headquarters complete the GSEF make-up.

The TETF is an engineering test complex comprised of various modems, multiplex, converter, power, test and data acquisition equipment. The TETF and the various terminals interconnected by low loss coaxial cables, multipair telephone cables and instrumentation cables provide a cohesive and versatile test facility capable of supporting satellite system performance tests and terminal and/or modem testing either independently or in concert.

The TETF includes the Philco computer-to-computer interface modem together with the peripheral equipment necessary to interconnect two Honeywell DDP 516 computers via appropriate satellite and ETF terminals. This complex, using Honeywell 316A computers, will be realigned to support Data Acquisition Facility (DAF) requirements associated with the System Evaluation Network (SEN).

DSCS

Space also is occupied by spread spectrum modems (AN/URC-61) and tactical Pseudo-Noise modems. The modified AN/MSC-46 Link Terminal Simulator provides functional simulation of a Defense Satellite Communications Program Phase II, Stage 1b terminal. It is capable of simultaneous transmission of 3 frequency-division multiplex and 8 spread signals and the reception of frequency-division multiplex and 8 spread signals within a 40 megahertz band. The TETF equipment complement is a product of SATCOM Agency's progressive development and/or evaluation of the various modulational techniques and equipment having application in the Defense Satellite Communications System.

The performance of subsystems such as multiplexers, modulators, demodulators and other equipment can be quickly determined in the Terminal Equipment Test Facility and the Systems Evaluation Network.

Further testing of the subsystems with various settings of alignments, adjustments and configurations would permit optimization of operating procedures or techniques. Extending beyond the subsystem, the TETF/SEN can establish terminal performance by means of loop testing either through each terminal's self-testing translator or establishing the performance of the link through a satellite. Tests under various satellite link conditions include power-sharing, multiple access effects and jamming, satellite conjunction, and eclipse tests.

DSCS

Complete foundation drawings for the AN/MSC-46 and AN/TSC-54 terminals' rigid radomes were provided to the U. S. Army Strategic Communications Command for Landstuhl, Germany; Asmara, Ethiopia; Ba Queo and Nha Trang, Vietnam; and Seoul, Korea; to the Navy for Guantanamo Bay, Cuba, and Norfolk, Virginia; and to the U. S. Army Signal Center and School at Fort Monmouth. The SATCOM Agency also served as consultant to the Army, Navy, Air Force and the North Atlantic Treaty Organization on site preparation and installation of satellite communications earth terminals.

During the course of the fiscal year, there was a total of 123 Engineering Test Facility tasks established. Of these, 112 tasks involved field change bulletin kit trials, maintenance bulletin verifications, systems tests and special projects of which 72 were assigned to the AN/MSC-46 and 40 to the AN/TSC-54. There were three tasks involving MSC-46 and TSC-54 interoperability. Eight miscellaneous tasks did not involve either terminal.

There were 16 on-site technical visits by SATCOM Agency and/or contractor personnel to deployed MSC-46 and TSC-54 terminals for various problems beyond the capability of site personnel to resolve.

Agency personnel assisted in site surveys for satellite communications earth terminals at Fort Dix, New Jersey; Fort Ritchie, Sharpsburg, and Fort Detrick, Maryland; Helemano, Hawaii; Fingayen, Guam; Stuttgart, Vaihingen and Boeblingen, Germany; Londonderry, Ireland; and Rota, Spain.

DSCS

The SATCOM Agency supported more than 47 operational satellite communications terminals throughout the world and a multitude of development engineering systems. Operating terminals include the AN/MSC-46, AN/TSC-54 and SHF and UHF tactical satellite communications terminals. Developmental systems include spread spectrum equipment AN/URC-55 and AN/URC-61.

Spread spectrum equipment, specifically, AN/URC-55, AN/URC-61 and AN/URC-61X was developed and supported by Magnavox Research Laboratories through SATCOM Agency controlled, contractor operated depot supply and repair facilities.

A complete, on-site configuration review was made of all AN/URC-55 equipments.The over-all system, including power supplies, oscillators, and each printed circuit board was checked for configuration level. The total quantity of site and system boards, oscillators, and power supplies also was checked. All data were annotated in the configuration control records at Magnavox and have been continuously updated. Normal depot supply and repair support was continued throughout the fiscal year.

Eleven of 13 AN/URC-61 subsystems were returned to Magnavox for upgrade and modification. The two remaining subsystems are at the SATCOM Agency. All printed circuit boards, oscillators, power supplies, drawers and mainframes not affected by modifications were repaired as necessary and brought to the 001 (EN916) baseline configuration under the normal repair contract for fiscal year 1971. Depot supply support for the AN/URC-61 has been limited to that required by the repair facility.

DSCS

The Navy returned four AN/URC-61X subsystems to Magnavox. The same procedure applied to the AN/URC-61 subsystems is being applied to the AN/URC-61X.

Support for the Interim Contingency Communications Subsystem (ICCSS), two units of which were constructed in-house, was developed, coordinated and programmed for the Lexington depot.

In its continuing vigorous research and development program, SATCOM Agency devised a new cooling scheme for cooling an 8 kilowatt, high-power klystron, similar to one used in the AN/TSC-54 terminal. The design goal was to dissipate 30 kilowatts of DC power which is surpassed by 700 watts. The benefit derived from this achievement is the eventual elimination of the less reliable liquid cooling system.

Another significant development was a 77 gigahertz long-life millimeter wave klystron oscillator to be used as a pump source in a low-noise, uncooled parametric amplifier. A rugged, air-cooled tube was operated for more than 2,000 hours with no deterioration in specified performance.

SATCOM Agency initiated and conducted a series of logistics orientation conferences with the contractor, Philco-Ford, and representatives of DCA, Army, Navy and Air Force to insure proper logistic support planning for the Phase II heavy and medium satellite communications terminals. All necessary procurements of long-lead spares were approved and the schedule and arrangements completed for tri-service representation at a series of provisioning conferences to be held in fiscal year 1972.

DSCS

SATCOM Agency satisfied Army Materiel Command Integrated Logistics Support (ILS) requirements as applicable to the Agency, initiating a specialized ILS concept tailored specifically for the Defense Satellite Communications System. These requirements made up a specific task under PROMAP-70 which was completed in December 1970.

The Agency sought and obtained DCA approval for the multimillion-dollar, three-year contractual effort to provide a variety of ILS documentation and specialized technical services. SATCOM Agency prepared the Statement of Work and allied procurement data for initiation of the contract in early fiscal year 1972. As a result, a major procurement action is in progress for documentation. This will include earth terminal complex level support documentation and logistic support system analysis.

The Agency developed data items for the heavy and medium terminals and communications subsystems and human factors engineering.

TACTICAL SATELLITE COMMUNICATIONS (TACSATCOM) PROGRAM

On 1 July 1970, the Tactical Satellite Communications (TACSATCOM) program officially completed the R&D phase and entered an Interim Operational Capability (IOC) period as set forth by the Secretary of Defense in 1966. The IOC period for TACSATCOM is intended to provide maximum utilization for the unique and versatile tactical satellite terminals and to obtain field experience for follow-on efforts.

The first major field exercise in which the TACSATCOM terminals were deployed was in the late summer of 1970 when a tactical satellite communications team and equipment from the SATCOM Agency was airlifted from Fort Riley, Kansas, to Germany to participate in the North Atlantic Treaty Organization training exercise Reforger II. The team was among more than 11,000 U. S.-based troops taking part in the exercise.

Deployed with the team were two teampack terminals, two jeep-mounted terminals and a terminal installed in a shelter on a 1 1/4-ton vehicle. A five-man team and a shelter-mounted terminal remained at Fort Riley.

The team in Germany provided communications between field headquarters and 1st Division headquarters at Fort Riley, as well as between field headquarters and subordinate elements participating in the exercise.

Following the Reforger II exercise, the terminals and team remained in Europe and conducted a number of demonstrations intended to bring this new communications technique to the attention of commanders and communications personnel.

TACSATCOM

In August 1970, a milestone was marked in the history of tactical satellite communications when a teampack terminal was airdropped for the first time by members of the 50th Signal Battalion (Airborne Corps) at Fort Bragg, North Carolina.

Carrying the equipment, the paratroopers leaped from an aircraft at 1,500 feet, landing in a simulated combat area. Thirteen minutes from the time the jumpers left the aircraft, the first signal was beamed skyward to a satellite designated TACSAT I. The signal then was relayed by satellite to a ground station at SATCOM headquarters.

In September of 1970, tactical satellite communications equipment was used for the first time in support of a presidential trip. The occasion was President Nixon's visit to Yugoslavia when the SATCOM Agency was tasked to back up the White House Communications Agency's TACSAT terminal.

The AN/TRC-157 1 1/4 ton shelter with teletype and voice capability that had been designated for emergency-contingency missions by the Joint Chiefs of Staff, was airlifted to Yugoslavia from Andrews Air Force Base on 21 September 1970. The terminal was accompanied by a four-man SATCOM Agency team.

On 22 September, the terminal was set up with the voice circuit extended to the White House Communications Agency switchboard in Zagreb. Although teletype was available, it was not extended.

TACSATCOM

Another major achievement in the art of tactical satellite communications was recorded in January 1971 with the microwave radio linkup of two aircraft in flight--one over Lakehurst, N. J., the other over Australia.

The two-way voice contact was between an Army helicopter over Lakehurst Naval Air Station, and an Air Force EC-135 aircraft near Sydney. The SHF hookup was effected through the TACSAT 1 satellite. The linkup demonstrated the ability of a satellite relay to extend to thousands of miles the normal 50-mile range of reliable microwave communications.

The feat was made possible by a unique antenna system for helicopters developed under a joint program of the Army and Air Force. A high-gain tracking antenna, under a protective cover, is mounted atop the rotor of the helicopter to obtain a path to the satellite unobstructed by the rotating blades. Electronic equipment is mounted in a console inside the helicopter and only one operator is required.

The SATCOM Agency has been engaged in testing the feasibility of the helicopter antenna and equipment to meet a need for dependable, long distance communications.

A SATCOM Agency team had an impressive role in the Apollo 14 mission as part of a highly coordinated, worldwide communications and tracking system. The team was commended by Major General Louis C. Wilson, Jr., Commander of the Space and Missile Test Center (SAMTEC) at Vandenberg Air Force Base, California, for their effort which "contributed immeasurably in the successful voice relay from the astronauts via the Apollo Range Instrumentation Aircraft."

TACSATCOM

Exercise Freedom Vault, a readiness test conducted by the 82d Airborne Division in the Republic of Korea, saw a SATCOM Agency tactical satellite communications team airlifted to Korea to establish communications between elements of the 82d in the field and division headquarters in Fort Bragg, North Carolina.

The force was flown in aircraft of the Air Force Military Airlift Command to a sparsely populated location well south of the Korean Demilitarized zone, where it was airdropped into the designated exercise area.

SATCOM Agency committed to the exercise two ultrahigh frequency team pack terminals and a terminal mounted on a 1/4-ton vehicle. Two Agency soldiers with a 1/4-ton vehicle-mounted terminal at Fort Lewis, Washington, also took part in the exercise.

In a further demonstration of the versatility of tactical satellite communications, terminals manned by SATCOM Agency military personnel played a part in an Army training exercise in Alaska. With a team pack terminal airlifted to an offshore island where a company of the 75th Rangers was airdropped, and a terminal on a 1/4-ton vehicle at Fort Richardson, communications were established between the rangers and headquarters on the mainland.

In a very real sense 1971 marks a new era in tactical satellite communications. The Army has completed major studies into the terminal parameters and cost effectiveness of the TACSATCOM Program.

TACSATCOM

As a result of these studies and approval at Army staff level of the coordinated TACSATCOM Qualitative Materiel Requirement, SATCOM Agency has developed complete specifications and launched the operational system for implementation in the 1975 time frame. Within guidelines set forth in the Development Concept Paper, it is envisioned that standardized 1 1/4-ton shelter terminals will begin to be fielded in calendar year 1976, with gradual buildup of quantities of these and the remaining terminal types reaching a peak in the 1980 time frame. The multichannel terminals will be designed to operate with the Phase II DSCP satellites as well as with other defense satellites which will evolve from the Department of Defense program.

Commanders and communications personnel who have been exposed to tactical satellite communications have reacted favorably and generally have concurred in the feeling that the potential of TACSATCOM is enormous.

SATCOM Agency is the Army's field agent in the North Atlantic Treaty Organization (NATO) research and development program in tactical satellite communications. The participants are Belgium, Canada, Federal Republic of Germany, Italy, The Netherlands, Norway, the United Kingdom, the United States and the Technical Centre of Supreme Headquarters, Allied Powers Europe. The NATO TACSATCOM program continued the use of the Lincoln Experimental Satellite (LES-6). Emphasis was on the development of airborne and miniaturized, transportable terminals. Terminals of participating nations have taken part in various NATO exercises with notable success. It is anticipated that this program will continue, at least through the next fiscal year.

TACSATCOM

SATCOM Agency is investigating Communications in Motion, a project to demonstrate tactical communications via satellite from a moving Army vehicle. A 1 1/4 ton vehicle terminal type antenna was gyrostabilized and mounted on an M37B 3/4 ton field vehicle under a fiberglass shelter (radome). The radome reduces the servo power to 5 watts per axis by eliminating wind forces.

The front end of this terminal uses two cascaded tunnel diodes as super-high frequency amplifiers. A dual channel rotary joint for transmitting and receiving SHF frequencies permits free rotation about the azimuth axis.

For the first half of the fiscal year, supply and maintenance support for the SHF TACSATCOM AN/TRR-30, AN/TSC-79, AN/MSC-57, AN/TSC-BD and AN/ASC-14 was provided by Radio Corporation of America, Camden, the contractor depot. In December 1970, logistical support for SHF TACSATCOM was transferred from the contractor depot to Lexington-Blue Grass Army Depot, Lexington, Kentucky. The transfer of assets began 21 December and was completed 30 December. The Lexington depot began the full support to field terminals on 4 January 1971. All depot supply and maintenance support for SHF TACSATCOM now is provided by the Lexington depot.

Collins Radio Corporation, Cedar Rapids, Iowa, the contractor depot, continued logistical support for UHF TACSATCOM AN/TRR-32, AN/TRC-156, AN/MSC-58, AN/TRC-157 and AN/ARC-146. Support of UHF TACSATCOM is administered by Oklahoma City Air Material Area, U. S. Air Force.

DEFENSE NAVIGATION SATELLITE SYSTEM

A revised "Development Plan for the Army Portion of the Defense Navigation Satellite System (DNSS)" was issued 19 February 1971. The plan describes the program and activities to be carried out during the Army's Concept Formulation Phase (CFP) for the joint-service DNSS.

A Qualitative Materiel Approach (QMA) for "Positioning, Navigation and Survey by Means of Navigation Satellites" was prepared and forwarded to Army Materiel Command on 14 September 1970. This QMA discusses the feasibility of navigation satellites meeting Army positioning, navigation and survey requirements. It recommends a technical approach to exploit this technique to satisfy several operational capability objectives and qualitative materiel development objectives. U. S. Army Combat Development Command concurred in the QMA and recommended DNSS for the second generation system.

In February 1971 a final report was rendered by Cornell Aeronautical Laboratory on the result of a study indicating that DNSS can improve operational capabilities by providing three-dimensional position fixes quickly. This can be done under all weather conditions and is relatively independent of terrain obstacles and enemy actions. The study was conducted under a contract awarded 27 June 1970.

The Air Force has a contract with Grumman Aerospace Corporation for a field demonstration of its proposed 621B NAVSAT system to be conducted at White Sands Missile Range starting the end of calendar year 1971. This demonstration will use a four-channel receiver for high performance aircraft.

SATCOM Agency has funded a task with Grumman, through the Air Force, to plan and propose additional field tests of a single-channel receiver, which is

typical of the ones the Army will employ in helicopters and ground vehicles. Contingent upon availability of funds, plans call for these Army tests to be added to the Air Force program.

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As the Army's agency for engineering satellite communications systems, SATCOM is constantly advancing the design of terminals for use in strategic and tactical military networks. New concepts and techniques are being evolved through an intensive program of research and development as the SATCOM Agency moves toward its goal of providing instant, flexible, reliable communications for the Armed Forces of the United States wherever they may be deployed.