Army SATCOM programs

by Col. A. R. McCahan

Satellite communications (SATCOM) is a fascinating and dynamic business. There are many organizations and units which have been waiting patiently to receive their new SATCOM equipments. My purpose here is to update the status of Army SATCOM programs with a short description of each program and how it will be used. I will deal only with the tactical side of SATCOM in spite of the blurring of the traditional lines between strategic and tactical systems. The fixed (strategic) aspects of SATCOM, referred to as the Defense Satellite Communications System (DSCS) will be discussed briefly and then only as it pertains to the use of the DSCS satellites.

From my vantage point as the TRADOC Systems Manager (TSM) for Satellite Communications, I have a slightly different view than most others. I have the opportunity to participate in SATCOM systems from the cradle to the grave. Unfortunately, no TSM is with his system from beginning to end, but because there are so many programs within the purview of the TSM, I am able to capture all the phases through the various programs.

The basic ground rule to follow is that SATCOM is simply another transmission system. True, it is the superman of transmission systems in that it can leap mighty oceans in a single bound, but it is a transmission system all the same. Then, you might ask, why isn't SATCOM treated as just another transmission system? And the question is certainly fair. There are two quick answers. First, SATCOM does provide some unique capabilities not available using other means, such as long range, multichannel, bulk encrypted, service. Second, throughout the Joint Arena, SATCOM is handled as a separate system, and if the Army wants full partnership, it must afford SATCOM more than merely passing interest.

The discussion will be divided into three portions which correspond to the frequency bands of interest: UHF (300 MHz - 3 GHz), SHF (3 GHz - 30 GHz), and EHF (30 GHz - 300 GHz).

Two major SATCOM systems operate in the UHF Frequency Band—the Special Communications Systems (SCS) and the Manpack SATCOM System, both of which are single channel systems.

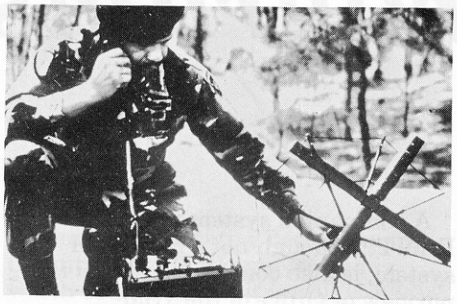
There are two terminal types included in the SCS which make up the Flaming Arrow Net (FAN) and the FAN-P (for Pacific). The AN/GSC-40 is used at various Command Posts in Europe and the Pacific in a dismounted or fixed configuration. It is being put together by Naval Oceanic Systems Center (NOSC) in San Diego, California, and the Air Force is responsible for Tri-Service Training. The AN/MSC-64, carried in an S-280 Shelter on a 2 1/2 ton truck, is a Magnavox terminal which will be located with Special Users throughout Europe and the Pacific. Training for the AN/MSC-64 is a Signal Center responsibility, and that training has been underway for about two years. A variant of the AN/MSC-64, called the Single Channel Command Post (SCCP) terminal, provides a limited mobile capability. This system will be provided with KN-2 cryptographic equipment in the near future when testing has been completed and supply of KN-2s catches up with demand.

AN/MSC-64

A companion system to FAN and FAN-P, although not a SATCOM system, is also considered within the purview of Office of the TSM-SATCOM. The Regency Net (RN), which serves most of the Special Users of FAN and FAN-P, is a High Frequency Radio System. RN also will be fielded with two terminals called the Force Terminal (AN/TRC-179(V1)) and the Team Terminal (AN/GRC-215). That contract was awarded to Magnavox after a rigorous Source Selection in December 1983.

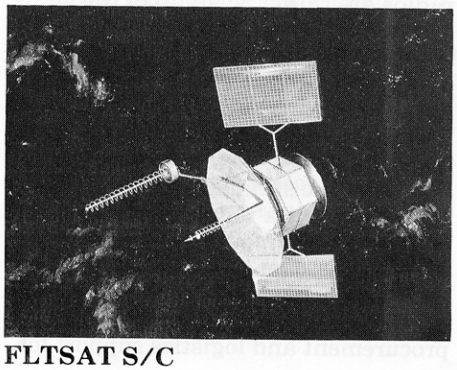
The Manpack SATCOM System is characterized by lightweight, easily carried single channel satellite radios. The Army Standard "A" Radio, the AN/PSC-3, and its companion vehicular mounted AN/VSC-7 are manufactured by Cincinnati Electronics. These sets have undergone the complete testing cycle, are type-classified, and should be released for field issue beginning in the 2FY85 time frame. The AN/PSC-3 was developed to meet an operational need for special operating forces such as Special Forces, Ranger, Long Range Reconnaissance, and certain Engineer units. The AN/PSC-3 demonstrated its value in Grenada. The identified need was for burst communications with a fairly low duty cycle or low rate of use. Other, similar small terminals have been put into service to meet contingency requirements. These non-standard radios are rather wasteful of the scarce space segment because they use a 25 KHz access, but were available at a lower initial cost. The Joint Chiefs of Staff, who control the use of these vital national assets called satellites, have directed 5 KHz access as the standard. The 25 KHz access manpack radios in the field will have to be modified to meet the 5 KHz access requirement. The JCS guidance helps in logistics as well. Since the Army is responsible for procurement and logistics support for

earth terminals (Air Force for airborne terminals, Navy for shipborne), a proper logistics plan can be developed to support these non-standard "A" terminals that were fielded to meet urgent operational needs, less full logistics support.



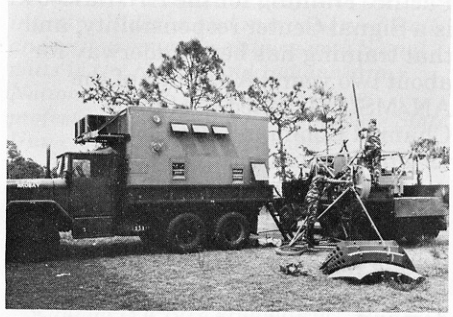
AN/PSC-3

All of the UHF satellite-capable terminals use the Navy's Fleet Satellite Communications (FLTSATCOM) system or the Air Force Satellite Communications (AFSATCOM) system. The FLTSATCOM System has four operational satellites, providing worldwide coverage. Each FLTSAT has nine 25 KHz "channels" available for use although they are normally carrying traffic for the Navy Fleet. Each of those channels has a dedicated transponder, that is, a frequency translator and amplifier for each channel. The AFSAT packages carried on the FLTSAT spacecraft have two transponders—one powers a 500 KHz (wideband) "channel" and the other powers 12 ea 5KHz (narrowband) "channels". Of the 12 channels, 7 have the capability to accept a frequency hopping signal and faithfully reproduce that signal on the downlink from the satellite. In addition to FLTSAT, there are AFSAT packages on non-communications "Host" satellites. These packages have but one transponder since only the 12 ea 5KHz channels are provided. There is also some signal processing or enhancement provided to the 5 KHz channels on the "Host" satellites.



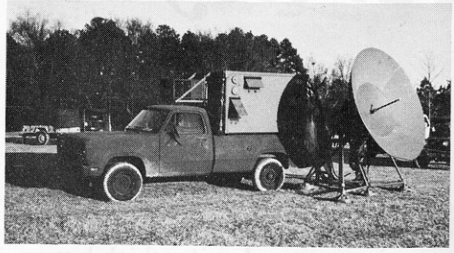
FLTSAT S/C

Now let's turn our attention to the 7 - 8 GHz range (SHF) and discuss the Multi-Channel SATCOM System. A brief history is appropriate. Ever since SATCOM was demonstrated in the late 1960s, planners and developers have been looking at ways to apply those techniques to a threat-laden, maneuver-intensive battlefield. Clearly, the large terminals evolved through research and development programs were not the answer. The need was articulated in a 1971 Qualitative Materiel Requirement (QMR - forerunner to the Required Operational Capability - ROC) for a highly mobile, multichannel equipment which could be quickly set up and operational over the longer distances of the dispersed battlefield. It wasn't until 1979 that the first Low Rate Initial Production (LRIP) Terminals were placed in service. RCA built these LRIPs against the QMR needs, using then easily attainable 48 kbps/channel ATACS multiplexers nomenclatured as TD-660. The TD-660 is capable of 6 or 12 channel operation and had been Army Standard "A" for several years at that time so the training and logistics bases were well established. After a successful demonstration and testing effort, the Army embarked on a full scale production contract with Harris Corporation for 82 AN/TSC-85A and 140 AN/TSC-93A terminals for the US Army users. There are currently a few open action items pertaining to this system; however, the newest schedule shows these terminals to begin initial fielding during 1FY86.



AN/TSC-85A

The AN/TSC-85A and AN/TSC-93A terminals operate in a Hub-Spoke configuration. Each AN/TSC-85A can terminate up to four AN/TSC-93As. The AN/TSC-85A has one uplink and four downlink converters (plus one additional downlink converter for the satellite beacon for tracking and control) while the AN/TSC-93As have one uplink converter and one downlink converter (plus one downlink converter for satellite beacon). The uplink signal from the AN/TSC-85A has the equivalent of four sub-carriers which are "tuned" to by the intended addressee terminal. In turn, the AN/TSC-93A can receive any one of the four sub-carriers and demodulate/demultiplex into individual voice or data slots (VF channels).



AN/TSC-93A

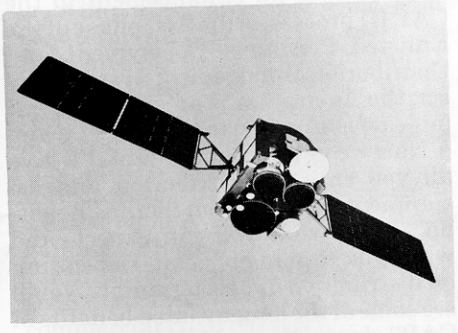
Several initiatives are underway to increase the efficiency of this system and to make it more survivable on the electronic battlefield. First, Low Rate Multiplexers (LRMs) which operate at 16/32 kbps per channel will be installed to replace the inefficient TD-660s. The new LRM is very adaptive and can be operated with any channel density from 1 to 16 so long as the composite signal does not exceed 256 kbps. Since the LRM is adaptive, only as many channels as are required for the particular mission at hand need be provided.

The second initiative associated with increased efficiency concerns the terminal antenna subsystem. The terminals are equipped with eight foot parabolic reflectors for ease of mobility and transportability. The small dish size results in a disadvantaged terminal. To increase the number of links which can be put through an individual satellite, larger antennas are required. A 20 foot Quick Reaction Antenna (QRA) is being procured for use with selected Air Force Terminals. There is applicability for the larger antenna at theater level and potentially at corps level for selected terminals. Requirements for the QRA are being examined.

The Anti-Jam Control Modem (AJCM) provides not only control for the multichannel system but a means for surviving on the electronic battlefield as well. Several years ago, the Army made an architectural decision to have both the network control mechanism and the anti-jam protection provided in the same "box" instead of separating those two functionalities. Further, conscious decisions were made regarding the degree of sophistication that this "box" would have built in as well as

the precise timing needed to make it operate. The more functions the modem could accomplish automatically, the less highly trained the operator and maintainer would have to be. The AJCM does provide network status information automatically as well as a 32 kbps data port for traffic. That data port is serviced by an LRM that adaptively processes the maximum data rate possible under the particular jamming attack being sustained. During non-stressed periods, a 75 baud teletype circuit will be terminated between command posts, superimposed under the clear traffic (non-AJ protected) of 4-6 channels between those command posts.

These SHF multichannel terminals use the Defense Satellite Communications System (DSCS) spacecraft for the space (repeater) segment. There is currently a mix of Phase II and Phase III satellites in the operational constellation. Since Phase III satellites will comprise the majority of the operational constellation by the time the terminals are fielded, this paper will be concerned only with the Phase III satellites. The SHF multichannel terminals will operate in Channel 2 of the Phase III spacecraft. Uplink to the satellite is received by a 61 element, electrically steered, multi-beam antenna (MBA) which is shared by channels 1-4. Channel 2 is 60 MHz wide and is powered by a dedicated 40 watt travelling wave tube amplifier (TWTA), backed up by a spare 40 watt TWTA. The downlink from the satellite is via a Gimbal Dish Antenna (GDA) which is steerable anywhere within the satellite footprint. Unfortunately, not all of the Channel 2 power and bandwidth is available to serve the GMF SHF community since there are other "disadvantaged" users (those with small antennas) also operating in Channel 2 who enjoy higher operational priority.



Phase III S/C

The last frequency band of interest to SATCOM is the relatively untapped EHF band. There are two major programs ongoing at EHF, follow-on DSCS and MILSTAR. Follow-on DSCS is envisioned to use the EHF band, but little active planning is ongoing at this time since there is a potential conflict with MILSTAR. Another factor affecting Follow-on DSCS discussion is the significant capital investment already made in SHF assets, both fixed for Defense Communications System (DCS) and NATO use, and tactical for GMF tactical use. There is little doubt that the DSCS will eventually transition to EHF; only the time line is unclear.

MILSTAR, on the other hand, is an ongoing program. The Single Channel Objective Tactical Terminal (SCOTT) is the Army's entry in that horserace. MILSTAR is to provide highly survivable connectivity for critical strategic and tactical users. SCOTT will provide four input/output ports (75 baud to 2.4 kbps ea) capable of terminating all standard Army user equipment such as the Advanced Narrowband Digital Voice Terminal (ANDVT), the Single Subscriber Terminal (SST), and the Tactical Facsimile (TACFAX). The system will provide assured connectivity through all threat conditions and thus meet communication needs existent for some time. The input/output devices will all be user operated. SCOTT will normally be installed in an S-250 shelter mounted on a CUCV or HMMWV but will be capable of being dismounted into a Command Post established in a tent or building. The antenna can be located up to 200 feet from the terminal mainframe and the four users up to 1500 feet away, thus providing a great deal of flexibility.

MILSTAR (no longer an acronym) cannot be described in detail in an unclassified paper because of its classified nature. Suffice it to say that the authorized Army users will be provided adequate space segment resources to accommodate their needs.

Military use of SATCOM offers significant advantages to the Army users. Its use must be carefully planned and judiciously applied. If used correctly, it can provide service otherwise not available. SATCOM is a true combat multiplier.

Col. McCahan served as the TRADOC System Manager-Satellite Communications from 1 Aug 83 to 31 Oct 84. Before that he was the Terrestrial System Manager for Military Satellite Communications at the Organization of the Joint Chiefs of Staff. His present assignment is TRADOC System Manager-Mobile Subscriber Equipment, United States Army Signal Center and Fort Gordon, Fort Gordon, GA.