US OVERHEAD SIGINT MISSIONS

Background

The US overhead SIGINT program started with the June 1960 launch of a USN 42 pound radar main beam intercept system along with Transit 2A followed in August 1960 by a USAF ABM radar monitoring package on Discoverer 13. By the mid 60's the USN program had evolved into the POPPY [redacted] program, the ABM radar monitoring (vulnerability) boxes were a standard feature on US photoreconnaissance missions, the earth oriented angle of pulse arrival measurement STRAWMAN missions had become the major US program, and the spin stabilized P-989 spacecraft had become the platform for SIGINT experiments in space. Growing concern with the inability of the low altitude program to provide sufficient access time for appreciable COMINT copy or for the monitoring of on-going Soviet ABM tests at Sary Shagan in central Asia resulted in the approval in the [redacted]

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By the mid 70's, demonstrated capabilities and changing priorities resulted in the redefinition of the SIGINT missions as follows:

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The primary P-989 mission has been broad area search/EOB above 2GHz (using a spinning pencil beam technique).

The USN POPPY system evolved into [redacted] with a primary mission [redacted] 25X1

[redacted]

monitoring boxes on HEXAGON missions.

A HEXAGON pallet (bolt-on) payload is under development to provide a 26-42 GHz SIGINT search function.

Current Overhead SIGINT Systems

The current operational and approved US overhead SIGINT programs are:

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PROGRAM-989

In the early 60's, LMSC developed a spin stabilized spacecraft, designated P-11, and a launcher to mount it on photoreconnaissance systems as a source of cheap rides into orbit. The system rapidly became an [redacted] project and has since been used to launch 32 SIGINT spacecraft. The current launcher is mounted on the side of the HEXAGON spacecraft and the [redacted] program designation is P-989. The launcher springs the spacecraft off to the side of the HEXAGON orbit where spin rockets are fired followed by boost rockets to achieve a higher circular orbit where solar arrays and antennas are deployed. Current systems weigh 600 pounds, have a 20 watt power system and dual storage batteries (up to 4 hours per day collection at 100 watt power drain), stowed dimensions of 3 x 3 x 2 feet, magnetically controlled (N-S) spin axis and 55 RPM spin rate, three 6 minute dual track tape recorders which are often operated at 4/1 slowdown for data collection (48 minutes to fill two, the third is a spare), and commandable timers for collection and spin vector control. The systems have a several hour per year orbit plane regression rate relative to the sun synchronous HEXAGON orbit. Command and data return are supported by the VAFB (California), New Hampshire, Hawaii, and Guam SCF stations with COMSAT (VAFB microwave) data return to the [redacted] The systems currently being used are: 25X1

MABELI - Launched January 1972, nearly dead, used for ABM radar main beam parameter measurements; ERP to 0.5 dB, polarization to 20°, dimensions and scan.

URSALA-I - Launched July 1972, nearly dead, and
URSALA-II - Launched November 1973, nearly dead, 2-12 GHz area search/EOB, 50 watt ERP CW mapper.

TOPHAT-II - Launched April 1974, still healthy, 0.45-1 GHz troposcatter map (10 nmi) and copy, spinning interferometer technique, encrypted downlinks.

RAQUEL - Launched October 1974, fair health, 4-18 GHz search, CW predetection record (failed subsystem), spinning pencil beam technique, [redacted] accuracy. 25X1

URSALA-III - Launched July 1976, healthy, 2-12 GHz search/ EOB, [redacted] accuracy, 2000 locations/day spinning pencil beam antennas with monopulse beam split. 25X1

URSALA preserves only the RF and location of CW intercepts. RAQUEL provides spectral analysis and 0.75 MHz predetection recordings to classify the signals, [redacted] Until URSALA-III (340 nmi) the orbits were 275 nmi circular. The above accuracies are average 95 percent confidence values over a 1000 nmi swath.

A second RAQUEL is scheduled to launch in March 1978, and a fourth URSALA (with encrypted downlinks and an in-field transpond capability to a processing van) in March 1979. The program cost has averaged $30 M/yr in recent years. Additional approved systems under P-989 management are FARRAH, a $20 M 900 pound combination and extension of URSALA and RAQUEL, and LORRI, a $10 M 26-42 GHz search system. FARRAH will cover 14 GHz per collection (vs 8 GHz for URSALA and 2 GHz for RAQUEL) in the 2-18 GHz range with horizon sensor switching (like URSALA) between 6 foot, 3 foot, and 3 foot pencil beam antennas each spin. A 2-to-1 improvement over URSALA in [redacted] 25X1 25X1
In addition to 0.75 MHz predetection recording (like RAQUEL), threshold circuits will trigger bursts A/D conversion of pulses in a 13 MHz bandwidth with D/A conversion at a 17-to-1 slowdown to 0.75 MHz. A minicomputer is included for on-board geopositioning and direct relay of operational ELINT data. The scheduled launch is in March 1981 on HEXAGON. LORRI is scheduled to launch in March 1980 on a HEXAGON bolt-on pallet and will use a 0.5 x 2.5 foot gimballed antenna, horizon looking low gain antennas, and P-989 tape recorders for the 26-42 GHz SIGINT search mission. It will share the HEXAGON command, telemetry, and power systems. A P-989 1.5-10 GHz main beam parameter measurement system (like MABELI) was proposed and disapproved but is still of interest. Alternatives are the rapid reaction use of [redacted] for this purpose.

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HF Experiment

Since 1972 there has been agitation in the US Congress to identify ways to reduce the cost of overseas NSA HF COMINT collection. Under Project DRAWSTRING, NSA partially automated a site on [redacted] 25X1 Congress has been asking since then for a satellite HF collection experiment to determine if a major part of the overseas effort can be shifted to space.

Studies of Soviet HF copy have concluded that a 12 hour elliptical orbit [redacted] can provide the long dwell high elevation angle access desired. 25X1 SP-6 has designed an experiment using an 11 hour elliptical orbit which will walk across the USSR sampling the 2-30 MHz environment over a wide range of elevation angles from each point and transponding the full 28 MHz pre-detection spectrum to the CONUS.

SP-6 and NSA have initiated tests with the Canadian ISIS HF spectrum analysis spacecraft wherein illumination by an HF transmitter at Rome, N.Y., is monitored at the [redacted]. These tests have partially verified the more Optimistic HF propagation models but shed no light on the probable level of man made interference with Soviet signals or the resultant duration or quality of copy of any given signal. The outlook is that a Soviet copy experiment will be funded in the next few years and that the results will be favorable enough to seriously consider a [redacted] 25X1 [redacted] 25X1 not otherwise covered by the approved future program. The estimated cost of the experiment is $30 m. Excellent HF access is provided by the future long dwell ELINT orbits. The addition of the operational HF payloads to these spacecraft is being considered.

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SOVIET OVERHEAD SIGINT MISSIONS

Concurrent with the USN launches of single spacecraft main beam radar intercept systems in the early 60's, the USSR initiated a similar program. [redacted] The USSR program had minor growth from the first generation photoreconnaissance add-on systems to the second generation separate spacecraft systems and was reoriented towards ELINT ocean reconnaissance (EORSAT) with four RF coverage bands (.19-.28/.38-.45/.9-1.4/2.7-3.6 GHz) and stored command data readout to Soviet ships but with no apparent location discrimination other than the horizon visibility circles. In the late 60's this was augmented by the detection radar ocean reconnaissance (RORSAT) system with 5 nmi location capability but with a swath of only a few hundred miles, poor sensitivity (broadside detection of large ships), and severe weather clutter. 25X1

The Soviet third generation (land surveillance) ELINT system uses a gravity gradient stabilized phase interferometer technique with a useful swath of several hundred nautical miles and 5 nmi location accuracy. It is similar to the US REAPER system of the mid 60's. Neither these nor the EORSATS provide precision parameter measurements nor CW intercept data. The usual RF range is .14 to 3.6 GHz in 10 bands, two of which have been omitted on some flights to add 3.6-5 GHz and 5.1-6.9 GHz bands. Tasking is primarily against the US and PRC.

It is postulated that the USSR will upgrade and encrypt their overhead reconnaissance systems during the next decade. The expected upgrade will add an EORSAT 9-9.6 GHz RF coverage band (most of the USN surface search radars and many of the newer land based military radars are between 9 and 9.6 GHz) and deploy a wide swath geopositioning system. The postulated geopositioning technique is spinning pencil beam, similar to the current

US low altitude EOB systems, [redacted] It is anticipated that the 25X1
Fleet SATCOM uplink will also be added as an ocean surveillance target signal. It is postulated that the phase interferometer ELINT design will be continued but with an upward extension of the RF range to 9.6 GHz, a location capability for CW signals and aircraft (the A/B command post and AWACS), and a 1 MHz predetection recorder for SIGINT technical analysis. A RORSAT RF reduction from 8.2 to below 2 GHz to reduce weather clutter and a larger aperture with either multiple beams or scan motion to increase the coverage swath are postulated. It is also postulated that the current reactor power supply will be replaced by a solar array design.

Other trends in the Soviet overhead reconnaissance programs are towards more command sites and faster data return (particularly to Moscow). Deployment of a relay satellite (by the mid 80's) is possible. Other possibilities are the use of satellites to read out sonobouys or ground traffic sensors and the jamming of NATO communications by a large antenna system in synchronous orbit or of COMSATS or US SIGINT satellites by small nearly co-located systems. Of lower probability are the deployment of TDOA SIGINT geo-positioning systems (too much data processing) or a very large antenna microwave radiometry system.

Except for command uplink copy, the US overhead program provides almost no access to Soviet space activities. Prior to the appearance of the booster on the launch pad, there is rarely any indication of an upcoming Soviet space launch. On-pad photography is rare and canvas covers have been used to defeat it. The newer Soviet instrumentation signals tend to be at too low a power level for overhead intercept. By contrast, most launches are detected by [redacted] and Over-the-Horizon radars and the orbits are 25X1
routinely determined by the US space track network. The spacecraft external appearance is determined to 0.5 meter resolution by the Alcor radar on Qwajalein which will soon be supplemented by an MIT several centimeter

resolution laser. [redacted] 25X1 25X1 The MIT Haystack radar has been used to image higher altitude satellites (out to 10,000 nmi) to 0.5 meter resolution. Good on-orbit images at greater slant ranges and of the ASAT (not up long enough to obtain accurate orbital elements) have not been obtained.

[redacted] 25X1 25X1 units will remain important and the need for high resolution configuration imaging (the MIT laser) will grow. With good configuration data the capabilities can be reconstructed rather accurately. For nontranspond modes, the tasking would remain largely unknown.