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SEA SURVEILLANCE BY SATELLITE

The possibility of doing Sea Surveillance by Satellite is extremely attractive because of the wide areas of coverage possible and the security from detection afforded by such a vehicle. Moreover, previous experience and recent studies indicate that such a capability would be technically and operationally feasible. One early possibility might be to utilize the existing ELINT Satellites for such a mission to demonstrate the feasibility of such a program. A brief assessment of each of the existing systems of the available series follows:

FANION Series to date have consisted of "C" Band receivers (4.9 to 5.15 KMC) in a satellite which spins in such a way that two beams positioned at right angles determine the location of an emitter relative to the center of the satellites orbital path. While these systems cover a rather wide swath on the surface of the earth (1400 miles by 100 miles for an altitude of 275 miles), the narrowness of the swath indicates that their dwell time on any one point on the earth's surface is only 24 seconds. This is so short that any type of intermittent operation would reduce the probability of intercepting the signal to such a low figure as to be unusable for sea surveillance. The intermittent data stream resulting from the spinning antenna would make signal recognition extremely difficult.

In addition FANION would not be a good candidate for Sea Surveillance because it is in a band not presently occupied by Soviet

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or Chicom shipborne radars. Also its limited swath lengths inhibit it for Sea Surveillance.

TRIPOS is essentially an "S" Band (4 to 8 KMC) FANION. Comments on FANION apply to it also. It again is not in a frequency region where Soviets of naval interest operate.

SAMPAN is again a spinning satellite. It operates in a choice of bands between 2 to 4 KMC (2.0 to 2.6 KMC; 2.6 to 3.2 KMC; 3.2 to 4 KMC). While it covers "S" Band where many Soviet radars operate, all the limitations of the spinning satellite apply, and it would therefore not be a good vehicle for Sea Surveillance.

SOUSEA. This system again is a "spinner," and though it covers 8 to 12 KMC in two bands (8-8.9 KMC and 9.7 to 12 KMC) and covers frequencies used by Soviet radars, it suffers from the same basic limitations of spinning satellites.

SETTER is another concept in satellites covering "S" Band (2960.5 to 3215.5 MC) in 2.56 steps of 1.5 MC, stepping through the band in 7.8 to 100 milliseconds per step depending on the presence or absence of a signal in the passband. This system flies at 275 NM altitude and gives a ground swath of 120 by 350 NM, which represents a time on target of only 30 seconds. The system is capable of producing a location fix on only 3 pulses, yet because it looks downward on a radar it does not see the main beam of the radar, thereby denying one of the most potent

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factors in signal recognition

While SETTER covers "S" Band where Soviet Shipborne radars operate, its application to the problem would be difficult because of the inability to automatically sort the "threat" signals. Also its limited swath width makes its scan of the ocean areas too slow for rapid survillance.

MULTI-GROUP is another concept of satellites using downward-looking antennas and the comparison of antenna beam patterns to determine the location relative to the orbital path. The original system covered 125 MC to 2100 MC in four bands (125 to 260 MC; 260 to 530 MC; 530 to 1060 MC; and 1060 to 2100 MC). Each of the four bands is scanned in succession, requiring 4 seconds per band or 16 second total scanning time. At the 275 NM altitude its coverage is a 150 NM circle on the surface of the earth. Combined with the probability of intercept this gives a "look time" at any point on the earth of 1/5 second. Because of the very limited "look time" and the fact that it does not look at the main beam of the radar, thus eliminating that recognition parameter, it does not appear as a very good candidate for Sea Surveillance.

STRAW-MAM is a further refinement of MULTI-GROUP covering 125 to 3300 MC in two systems: THRESHER, covering 125 to 1800 MC in four scanning bands and REAPER, covering 1800 to 3000 MC in two bands. All the previously stated characteristics of MULTI-GROUP apply, as do the conclusions of unsuitability of this satellite for Sea Surveillance.

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POPPY is the Navy's satellite in the national effort. Six launches have employed this concept, resulting in increased complexity and frequency coverage. The present system and the one to be launched in about October this year consist launched simultaneously. Each satellite has a group of eight RF frequency bands covering from 125 to 9500 MC which are selectable in groups of four per satellite. The satellites operate at 500 NM altitude and look completely to the horizon, giving a 3750-mile swath width. This results in a "look time" of up to 15 minutes for any apot on the earth. Since this system is primarily interested in looking at the main beam of the radars, it operates at somewhat less sensitivity than other systems and provides essentially two looks at each target (one as it approaches and a second as it leaves). Because of the lower requirement for sensitivity less power is needed; a simple solar cell battery system gives a life of up to two years an orbit compared to 30 to 60 days for other systems.

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Data readout for POPPY is not stored and dumped as in other systems but instead is read out continuously in real time from the satellites by U.S. ground sites located around the periphery of the Soviet Union. The data is recorded and processed at the ground stations. Some of these same stations could be used to read out the data if the POPPY satellites were to be tasked for Sea Surveillance. would form part of such a system. By adding a station at

To simplify operations only those bands utilized by Soviet ships would be activated in the Satellite. To further simplify the operation at the ground station, signal recognizers for only the selected Soviet ship or other target) radar characteristics would be employed, thus limiting data collection to maritime targets of interest. This would insure maximum attention to targets of interest and reduction of data to be processed to a minimum.

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RECOMMENDATIONS

1. While systems optimized for Sea Surveillance could (and should) be built, a good test could be obtained utilizing existing POPPY satellites and collection stations in a limited effort to demonstrate technical feasibility.

2. By tasking the National Reconnaissance Office (NRO) with a Navy requirement for demonstrating the ability to do Sea Surveillance with satellites such a test demonstration could be arranged.

3. If desired, the Navy could install an additional temporary collection station or two to enhance the coverage in the ocean areas for the demonstration to conclusively prove the merit of the plan.

4. Following the analysis of the data collected the Navy could proceed to plan, design, and build an optimum system for Sea Surveillance and implement it as a national program through the NRO.

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