THE U. S. SIGNAL INTELLIGENCE SATELLITE ENTERPRISE

A HISTORY

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Chapter One: Unearthing Ears

(U) Satellite eavesdropping was born over a decade into the Cold War. It could have come earlier, had its two requisites, space systems and signals intelligence, been organized differently. It would surely have come later, had the Soviet Union not scared Americans with *Sputnik*. Had it not come at all, world affairs would have been even more dangerous----threats more mysterious, responses less confident.

Business As Usual

[redacted] During the 1950s, eavesdropping programs were numerous, vigorous, and productive, but they did not embody an integrated rationale on the national level. To discern Soviet intentions and capabilities, Presidents Truman and Eisenhower had the United States listen to Soviet electronic signals, using ground stations, ships, submarines, airplanes, balloons, tunnels, [redacted] (as well as conventional spy and counterintelligence operations using close-in wiretaps and audio surveillance). Individual service elements, the umbrella Armed Forces Signals Agency, the National Security Agency, and the CIA all fielded programs to intercept Soviet emanations---communications, radar, and telemetry. Some of these operations concerned electronic intelligence (elint), by which characterization of a brief radar signal, for example, might warn of incoming aircraft or suggest the strength of air defenses. Others aimed at communications intelligence (comint); the volume of radio traffic, for example; 25X1

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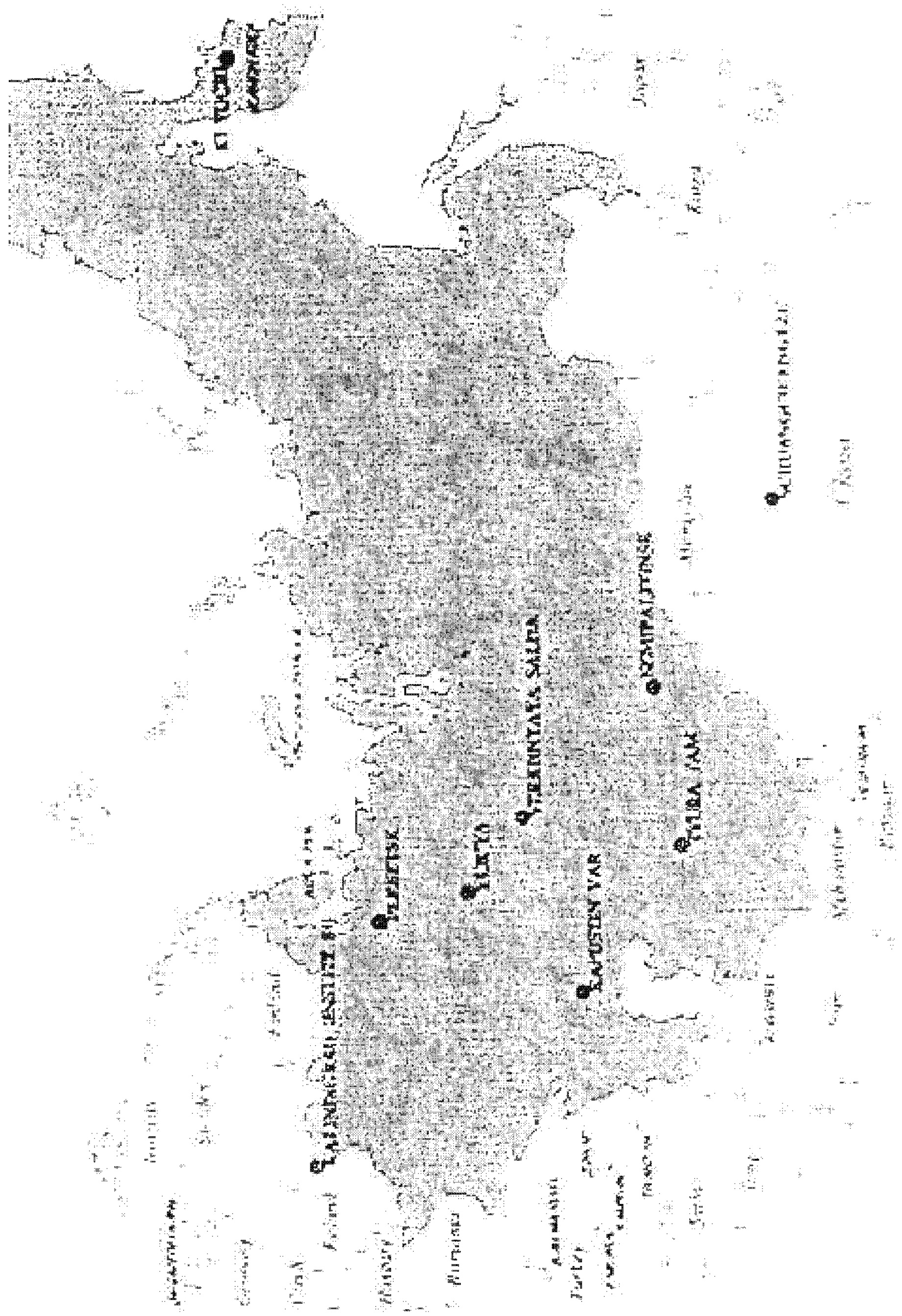
might be enough to warn about enemy efforts to organize, prepare, or move, and decrypted messages might reveal plans, intent, capability, and perceptions.

~~(S//BYE)~~ These programs were generally organized by customer rather than technology or provider—they were "market driven," and often the organizations responsible for collection and analysis were owned by the customer. Such linkages served tactical operations quite well. They made it difficult, however, efficiently to allocate resources and distribute information for broader strategic questions, and customers that were not organized to pull or receive information from this congeries would not reliably get it.* And the congeries proved nearly impervious to change. Beginning with the Korean war it seemed that the eavesdropping world spent the 1950s undergoing unending reviews producing unending recommendations for change, to which in practice it seemed unendingly deaf.[1] Over time, formal authority became vested more and more in organizations charged with broader national missions, but actual capabilities tended to stay where they were. Thus NSA concentrated on communications signals (comint), while military service elements emphasized finding known radars (operational elint). Later in the decade, as Soviet missile programs developed, telint—the telemetry

* The decentralized system also complicated arrangements for sharing intelligence with other countries. Johnson recounts [redacted]'s experience in wanting "to exchange elint with the United States, but the Americans had no focal point for elint. Instead, [redacted] had to establish separate relationships with the American Air Force and Navy. 25X1
The [redacted] frequently complained that there were too many elint players on the American side, so in 1957 CIA undertook to coordinate all U.S. elint relations with [redacted] NSA was as yet not part of the elint picture." Johnson, *American Cryptology*, p. 96, ~~TS//TK~~.

from foreign development testing, sometimes called foreign instrumentation signals, or FIS-- became important and seemed to share some characteristics of both elint and comint. The CIA conducted the principal work on it. (After a few years, "sigint," or signals intelligence, became the accepted rubric for data obtained by intercepting electronic signals of all types, while "elint" most often referred to radar signals exclusively, and this, still the contemporary, usage will be adopted throughout this history.)



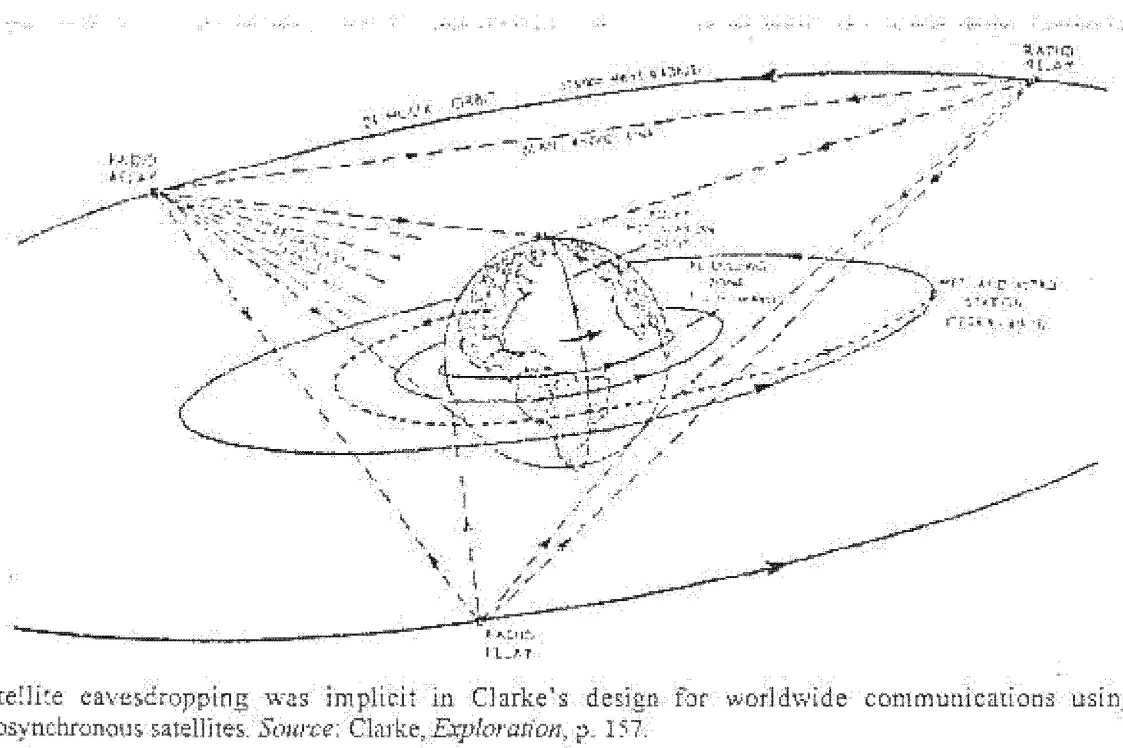
Strategic threat and SIGINT response

Figure 1.1 Strategic Threats.

Source: Johnson, *American Cryptology*, p. 173

(U) Space systems were also needed for satellite eavesdropping, and for most of the 1950s U.S. space programs were at best desultory. The United States and the Soviet Union had both put captured Nazi rocket scientists to work immediately following World War II. Werhner von Braun's programs for the U.S. Army got the United States into space in 1949, but by then defense budgets provided little room for discretionary research and development. The Air Force asserted that space was a logical extension of the atmosphere and demanded organizational primacy in space programs; having gained its point, it thereafter gave budget priority to air-breathing bombers and cruise missiles, investing in ballistic missile technologies only after an outside commission persuaded President Eisenhower to do so.

Figure 1.2 Clarke's Design



Satellite eavesdropping was implicit in Clarke's design for worldwide communications using geosynchronous satellites. *Source:* Clarke, *Exploration*, p. 157.

(U) Even then, attention focused on the missile, rather than the use of space. Reconnaissance satellites had been thought about for years; the Army gave Douglas Aircraft Corporation a contract for conceptual analysis and design work in 1946, and analytic work continued there, at the new Rand Corporation, and, under Navy auspices, at the Jet Propulsion Laboratory. Development contracts, however, were not issued until 1955, when the Air Force selected Lockheed (teamed with Eastman Kodak) over the Glenn L. Martin Company and the Radio Corporation of America to build an "Advanced Reconnaissance System," designated WS [Weapon System] 117L.[7] This program aimed to develop a family of orbital reconnaissance systems; plans in 1956 envisioned a seven-phased program during which 97 satellites would be built, including three types of ferret elint collectors, an infrared sensor, and three kinds of photographic sensors for a total estimated cost of $600 million. Launching would begin late in 1960 with an early photo read-out satellite and conclude in 1963 with a large sigint ferret.[8] The program was assigned to then-Maj. Gen. Bernard A. Schriever's Western Development Division (Ballistic Missile Division), which used the streamlined "Gillette" procedures (special authorities, named for the razor company, to cut through red tape) to speed development of intercontinental ballistic missiles and other space systems. In assigning the work to Schriever, however, the intent was less to speed work on satellites and more to ensure that work on satellites would not hinder progress in ballistic missile development. At the same time, progress with ballistic missiles was itself to be achieved in measured steps. Responding in February 1956 to charges that the United States was far behind the Soviet Union in guided missiles, Eisenhower said that a "war waged with atomic missiles" would not be war "in any recognizable sense, because war is a contest, and you finally get to a point [with missiles] where you are talking merely about race suicide, and nothing else." "Under those circumstances," noted his biographer, Stephen Ambrose, "he was damned if he was going to speed up spending on ICBMs."[4]

(U) The Pentagon's leaders saw little wrong and much to praise in a slow approach to military satellites. Secretary of Defense Charles Wilson disparaged the promise of space systems overall, and money that was not spent on space could be used in other programs that were building real weapons.* The slow approach also fully suited the determination of Air Force Secretary (promoted to deputy secretary of defense in April) Donald Quarles to ensure that the United States' first satellite would be a civil scientific one, being built by the Navy for launch during the 18-month International Geophysical Year scheduled to begin in July 1957. In 1957 Quarles cut funding for WS-117L and ordered the work on it to go slower. Yet a Rand report in 1954 had insisted that "the earliest possible completion and use of an efficient satellite reconnaissance vehicle is of vital strategic interest to the United States, [and] . . . must be considered and planned on a high policy level."[5] Soon after, in February 1955, Killian's Technological Capabilities Panel had concluded that "intelligence applications warrant an immediate program leading to very small artificial satellites in orbits around the earth" and "the new prestige

* Concerning the possibility that the Soviet Union might beat the United States in putting a satellite in orbit, the *New York Times* quoted Secretary of Defense Charles E. Wilson as saying: "I wouldn't care if they did." (17 December 1954). His boss referred to military research and development as "the money we spend yearly without putting a single weapon in our arsenal." Eisenhower, quoted in *Aviation Week*, 14 October 1957.

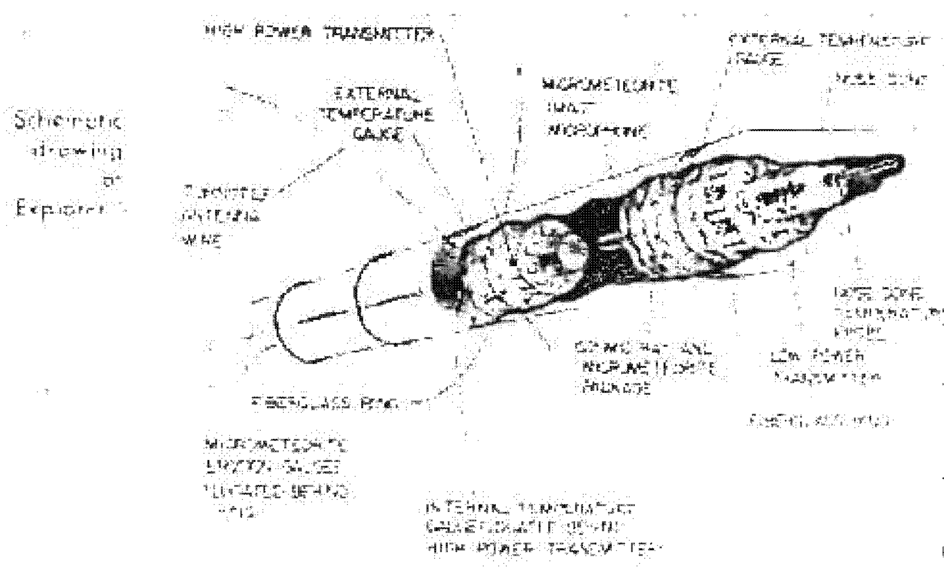
that the world will accord to the nation first to launch an artificial earth satellite would better go to the U.S. than to the USSR."[26] And in 1955 the National Security Council had determined that "considerable prestige and psychological benefits will accrue to the nation which first is successful in launching a satellite. The inference of such a demonstration of advanced technology and its unmistakable relationship to intercontinental ballistic missile technology might have important repercussions on the political determination of free world countries to resist Communist threats, especially if the USSR were to be the first to establish a satellite."[27]

Sputnik's Spur

(U) Events proved these warnings true. In October 1957 the intelligence community, and President Eisenhower, discovered that the United States had lost the race to space when the Soviet Union announced, a day after the fact, that it had launched *Sputnik*. Eisenhower strove to encourage nonchalance, but public and congressional opinion demanded dramatic changes in public education, scientific research, and governmental organization. The administration appeared to have been unaware of Soviet developments. In the ensuing flurry of recrimination, officials with the Army space work in Huntsville publicly claimed they could have launched a satellite a year earlier. Eisenhower asked Quarles if that were true. "Quarles replied that it was worse than true, that Redstone probably could have accomplished the task two years earlier. Well, the President commented wryly, when the congressmen find out about this 'they are bound to ask why this action was not taken.'"[28]

(U) Huntsville soon made good on its boast. Determined to repair the American image, Eisenhower announced that the U.S. would launch a satellite of its own within a few months. The first attempt, a Navy/JPL Discoverer, failed. The second, an Army Jupiter C, succeeded on 31 January 1958, placing in orbit the first "Explorer," (Figure 1.3) a small satellite built by the Naval Research Laboratory for Vanguard and modified by the Jet Propulsion Laboratory to become the rocket's fourth stage.

Figure 1.3 Explorer I



Schematic view of Explorer I, free world's first satellite, launched 2248 EST on 31 January 1958. *Source:* Medaris, *Countdown.*

~~(S//BYE)~~ Over the next twelve months, the Defense Department tried twelve more launches; two-thirds of them failed. Most were publicly identified as Discoverer scientific missions, which hid the covert CIA-directed Corona photographic reconnaissance satellite. That program had been created as an alternative (some thought interim) path to getting photographs from orbit quicker than the Air Force's WS-117L.

~~(S//BYE)~~ The more ambitious WS-117L program was organized by subsystem, which included sensor payloads for both photographic and electronic intelligence missions.* Consistent with the primary mission of attack warning, it gave priority to work on "direct read-out systems," methods for transmitting the collected data to ground stations, for both the photo and intercept data. It also gave priority, as broadly agreed by military and intelligence leaders, to photography. The ferret systems would not be launched until the higher priority photography systems were ready, and the photo systems were far more complicated. A camera would take pictures that were to be recorded on film, which would be developed on board the satellite and then pulled in front of a line scanner, the output of which was then transmitted to the ground station. Each step posed significant engineering challenges. To develop the film on board the satellite, engineers designed a system that would press the film against webs of material that had been soaked with developing and fixing chemicals. To scan the photograph, the developed film had to be pulled at precisely the right speed in front of a scanner operating on precisely the right dimensions so that the right amount of data were ready at the right times for transmission to the ground. These constraints effectively limited the resolution of the scanned images.

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* The project was organized by subsystems: A was airframe; B, propulsion; C, power; D, guidance; E, photography; F, elint; G, infrared; H, ground/space communications; I, data processing.

(~~S/BYE~~) But transmission was the real Achilles heel of the "direct readout" approach: the technology of the day supported only very low data rates. This limitation meant first that there would be a huge imbalance between the size of the area the satellite photographed and the size of the area that analysts would get to see. Perry estimated that it would take three hours to transmit the scanned images from a single photographic pass;[9] considering that each ground station could receive fully useful data for only eight minutes while the satellite was in view, which typically happened five times each day, it became clear that the limitation on transmission rates would also force expenses for building, maintaining, and staffing a large number of ground stations.

(~~S/BYE~~) Noting the complexity of the WS-117L approach and particularly the need for data transmission rates far beyond anything yet accomplished, White House advisors and the Rand Corporation in late 1957 urged that satellite photographs could be obtained more quickly by flying a camera in an Agena upper stage and using a special re-entry capsule to return the undeveloped film to the ground. The Central Intelligence Agency backed that approach and soon took charge of managing it, using a small Air Force group in Los Angeles to conduct the actual development work at Lockheed.[10] The project became known as Corona, and the Discoverer program was invented as a public, "scientific research" fig leaf for the classified reconnaissance effort.* By Perry's

* "Until September 1958, the Corona project was to be concealed in the 1st phase of the WS-117L Military Reconnaissance Program. . . . To secure acceptance of an explanation of the Corona firings which denies any connection with reconnaissance or with other similar sensitive military activities, it is necessary to describe the entire Thor-

calculations, each ground station in the WS-117L system could acquire "62 individual frames representing 16,740 square miles of target area each day," while "an early Corona system could scan 1.5 *million* square miles each day."[11]

~~(S//BYE)~~ Photography was the top priority for the newly urgent reconnaissance satellite programs, driven by worry about Soviet ballistic missiles and the military importance of finding their bases. Through 1960, as one intelligence historian noted, "the existence of a real Soviet intercontinental missile capability was generally accepted, as was Soviet willingness to resort to nuclear attack."[12] Corona was exclusively a photographic system, and WS-117L was predominantly so; it included plans for "ferret" satellites for electronic intercepts, but they had much lower priority. In either case, an intercept sensor would not be flown until a photographic system had been developed: for Corona, it could only be an add-on package attached to the Agena upper stage; for WS-117L, it was part of the design for the first satellite, an E1/F1 demonstration.

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boosted series of flights as an activity entirely separate from the WS-117L program. To accomplish this, ARPA has issued a directive separating the WS-117L program into two (2) distinct series, one identified as Discovery (Corona Thor Boost) and the other as Sentry (117L Atlas Boost). Discovery will be identified as a practical space platform for the conduct of experiments aimed toward the development of improved military systems." "Corona Cover Plan," pp. 1-2.

Figure 1.4 Ferret Sensors

FERRET SENSORS CAPABILITY

F-1	F2	F3
RECOGNITION OF CONVENTIONAL GROUND, NAVAL & AIRBORNE RADAR SIGNALS	RECOGNITION OF KNOWN AND SUSPECTED SIGNALS	"FINE" LOOKS AT SIGNALS DISCOVERED BY GENERAL COVERAGE SYSTEM
LOCATION WITHIN 150 N.M. CIRCLE	IMPROVED LOCATION ACCURACY	"LOOKS" AT GIVEN SIGNALS FROM HORIZON-TO-HORIZON
FREQUENCY COVERAGE OF S AND X BAND	FREQUENCY COVERAGE FROM 50 TO 18,000 MC/S	FREQUENCY COVERAGE SAME AS GENERAL COVERAGE SYSTEM
ONETIME COVERAGE OF 60% -70% OF SOVIET BLOC	COVERAGE OF ENTIRE SOVIET BLOC EVERY FIVE DAYS	WIDE BAND WIDTH (6 MC/S) RECORDING OF ALL SIGNALS
1ST FLIGHT SEPT.60 - 3 FLTS. (IN COMBINATION WITH E-1)	1ST FLT JUNE 61 2 FLTS	1ST FLIGHT WILL BE SCHEDULED

Source: "SAMOS: National Satellite Reconnaissance System" briefing.

~~(S//BYE)~~ The Navy, meanwhile, had taken a different approach. Though it shared the collective commitment to photography of missile bases as the top priority, and indeed had other concerns at the top of its list, the Naval Research Laboratory had designed a small satellite that would intercept radar signals and transpond them on demand to ground stations, where they could be recorded and the tapes flown back to the United States for analysis. Planned in response to operational needs for electronics countermeasures, the naval laboratory proposed the concept for funding within Navy channels in late 1957. Development continued under authorization from the new post-*Sputnik* organization created in early 1958 to manage all defense space projects, the Advanced Research Projects Agency, and after predictable bureaucratic wrangles and a few name changes it was built and launched as the Galactic Radiation Background

(GRAB) satellite.* Carried as a secondary payload on a Thor Able Star launch of the first Transit navigation satellite, GRAB reached orbit on 22 June 1960, and became the first functioning U.S. reconnaissance satellite.[13]

Figure 1.5 GRAB

Source: Potts, p. ii.

~~(S//BYE)~~ By then, satellite reconnaissance had become even more urgent. Less than two months earlier, Soviet air defense forces had shot down the U-2 flown by Major Gary Powers. Eisenhower prohibited any further U-2 flights over the USSR, and there was no other way to obtain high-resolution photographs of Soviet territory. A week after the GRAB success, the CIA-Corona team tried for the twelfth time to obtain satellite photography, and scored another failure as the Agena A second stage went unstable. Two days later, on 1 July, a Soviet fighter aircraft shot down an American RB-47H that was flying above the Arctic Circle and conducting electronic reconnaissance from the Soviet periphery. Finally, on 10 August 1960 the CIA-Corona team launched *Corona 13* and succeeded in putting an Agena into orbit and recovering its reentry capsule from the water.

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* The project was earlier known as Tattletale and was controlled by a security system called Canes. A small scientific payload was included to provide a public rationale for the mission; it was called Galactic Radiation Environment Background (GREB). A few years later the name Solar Radiation (Solrad) was also applied to GRAB retroactively. See Potts, *GRAB & Poppy*.

(~~S//BYE~~) That mission, often reported as the first success of the high-priority photoreconnaissance program, ironically provided only electronic intelligence. In an effort to determine the cause of previous failures, the satellite had been equipped with flight instrumentation but no film or camera. Bolted to the back of the Agena, however, was a small package called Soctop, a secondary payload, that coincidentally had become ready in time for this mission.* It was there because Harold Willis, an electronics engineer working for the Central Intelligence Agency, had become aware of the Corona program in 1959, owing to concern within the intelligence community that the Corona might be vulnerable to Soviet measures to exploit the Agena's S-band beacon that was essential for tracking and commanding it. Detecting and diagnosing this threat required electronic intercept satellites of the kind that the WS-117L ferrets would eventually provide, but they would not be ready in time for Corona. Willis, after discussions with people involved with the ferret work, concluded that a small sensor attached to the back of the Agena could detect possible Soviet electronic efforts to track or interfere with the satellite. The sensor's design was apparently suggested by Eugene Fubini, then at Airborne Instruments Laboratory (AIL), Minneola, Long Island, NY. It included a small receiver covering the band in which the Agena beacon operated (2.5- to 3.2 Mhz), a simple telemetry encoder, and a pair of antennas, one for receiving signals and one to transmit the data to ground stations (there was no data recorder).

* "Originally called Special Component Test Package but for euphemism two O's were added, thus SOCTOP," Busher and Chaid, p. 23.

[redacted] Soctop worked properly and seemed at first to show that Soviet radars did in fact track the Corona and did so in an alarmingly extensive pattern,[14] but upon further analysis the tracking proved to be that of U.S. ground station radars. Analytic embarrassment aside, Soctop demonstrated that so-called "vulnerability" sensors did work, despite Wilson's conviction that radiofrequency signals could not be intercepted in space. It was followed by a long series of "Aftrack" sensors carried on the Agena's aft face. The next Corona mission, *Discoverer 14*, launched on 18 August, yielded the first satellite photography; it also carried a Soctop.

[redacted] Last to be ready for launch was the product that had been started earliest, the first WS-117L satellite. It was slower because its organization was too ambitious, its technology too demanding, and its managers too distracted by non-essential infrastructure. Most of all, it was slower because it was a high-visibility Air Force program that got swept up in the post-*Sputnik* reorganization frenzy. In defense organizations there is a powerful urge to measure value in terms of control of process rather than products and effects, a bias that makes centralization seem desirable in itself regardless of its effects on efficiency or quality. Eisenhower, immersed for decades in the Army's unslakeable thirst for organizational pyramids, reacted to his *Sputnik* surprise in part by demanding that defense space programs be put under a single manager. He created that manager, the Advanced Research Projects Agency (ARPA), early in 1958, and it took effective control of various ongoing programs at different times throughout the year. Corona, a CIA program, was not seriously affected (ARPA supplied it with boosters, through the Air Force).

(S/BYE) In the Olympic skating competition between the WS-117L and the Corona programs, ARPA became the corrupt French judge. It handicapped the Air Force program by adding a management layer that was inexperienced in Pentagon practices and that brought neither important technical expertise nor political clout. The new director, Roy W. Johnson, proved difficult to work with, less concerned with programs and more with asserting his own authority.* ARPA renamed the WS-177L program twice, and even that simple exercise went wrong. In June 1958 it first replaced "WS-117L" with "Sentry," to reflect the defensive attack warning mission and to remove the "weapons" connotation. Later, when satellite reconnaissance programs were being made covert, ARPA wanted a name that would provide no indication of the satellite's mission, and on 6 August 1959 chose "Samos," the name of an Aegean island. But the trade press soon interpreted it to be an acronym for "space and missile observation system." Others in cleared circles claimed it stood for "same old Sentry."

(S/BYE) Worst of all, ARPA soon proved simply incompetent to manage major weapon acquisition programs. The commander of the Air Research and Development Command, Lt. Gen. Bernard Schriever, finally complained to the Air Force chief of staff on 15 September 1959 about ARPA's frequent changes on budget decisions:

* The Navy program also fell into ARPA's clutches, but the effects on it were mitigated by its relatively small budget (as of 1960, $1.1 million, spread over three years, according to Potts, p. 69), and its coherent defense by its parent service. The Air Force program's much larger budget (through 1960, between $353.2 and $360.2 million, according to Perry, *Samos*, p. 87) attracted far more attention, and the service was not uniformly supportive of space programs.

"Establishment of a logical plan and execution of that plan in terms of procurement, scheduling, production, test and operation of Samos has been rendered essentially impossible."[14] By then, difficulties with ARPA and its imperious director had provoked widespread discontent, and on 18 September Secretary of Defense McElroy stripped the space programs away from the agency and remanded them to the newly created post of director of defense research and engineering (DDR&E). Over the following weeks he assigned Samos and other programs to the Air Force, a communications satellite to the Army, and a navigation satellite and the continuing elint satellite work to the Navy.

[redacted] By then, after many a false start, the first Samos was ready for launch. It was to test and demonstrate several aspects of design and technology, including both a film-readout system (E-1) and a ferret intercept system (F-1). The photographic component included a strip camera with a six-inch focal length that could photograph a swath 87 nm wide and yield pictures with resolution of 100 feet, expected to be adequate to see airfields, harbor facilities and shipping, industrial complexes, and identify locations where missile sites might be under construction.[15] The ferret sensor covered the X and S frequency bands and promised data that would allow recognition of conventional radar signals and the location of emitters to within a 150-nm circle. The elint from Samos was expected to be significant for military operations, as shown by the central role assigned to SAC for processing the data (Table 1.1). The ferret system was mounted in front of the camera lens, and both subsystems would operate during the first part of the mission, the camera looking earthward through a hole cut in the ferret's S-band horn antenna. Later in the mission small pyrotechnics would blow the antenna away to provide a larger field of view for the camera, Samos was to be launched from Vandenberg Air Force Base in California into a polar orbit by an Atlas Agena on 11 October 1960, but the mission failed. Because of an embarrassing oversight in launch preparations, the Agena A second stage could not be stabilized and it did not attain orbit.[7]

Table 1.1
Operating Concept—ELINT Data

F-1 ELINT DATA

1. The F-1 data will be received on magnetic tape from the tracking stations at Kaena Point, Hawaii, and Vandenberg AFB. The data will be transported by military or civilian courier to the Satellite Test Annex, Sunnyvale, California, using air transport.

2. The F-1 data on magnetic tape will be in 3-level serial format, and will be played through the F-1 Ground Data Conversion Equipment, which will format the data in IBM 727 Computer format. This output will then be fed into the CDC 1604 computer, along with the ephemeris and calibration data. The resultant output will be in a scaled, merged and calibrated magnetic tape in an IBM 727 format.

3. At this point, the tape contains intercept information and geographic position for each intercept. The tape, together with an operational summary of the magnetic tape, will be furnished to the 544th Reconnaissance Technical Group, Offutt AFB, Nebraska, and to the National Security Agency at Ft. Meade, Maryland. The Chief of Naval Operations will receive the operational flight summary and data print-out only.

4. Preliminary analysis of the F-1 data will be accomplished by the 544th RTG, using their IBM 704 computer and programs prepared by a Samos contractor. The output of this process will be made available to user agencies upon request.

F-2 ELINT DATA

The F-2 data will be received at the Satellite Test Annex, Sunnyvale, California, in a format suitable for direct input into the CDC 1604 Computer. The computer will merge each intercept with its geographic location, and will otherwise calibrate and scale the data, indicate invalid intercepts and attach a confidence factor to each group of data. The magnetic tape output will be printed-out in tabular form. As in the case of the F-1, the tape, print-out, and flight operational summary will be furnished to a designated user agency for further analysis and exploitation.

Source: "Samos Development Plan, Appendix I."

~~(S//BYE)~~ The Eisenhower administration thus left office in January 1961 having obtained very little electronic intelligence about the Soviet Union from space, despite the urgency with which it had been emphasized at least seven years earlier. The president himself seems to have been seized by the need for warning against surprise attack and to have appreciated the potential importance of satellite reconnaissance in helping to do so. His views, however, apparently were not shared by key subordinates like Wilson, who was "notoriously antisatellite,"[38] and Quarles, who impeded work toward a military satellite in favor of a scientific one and failed to deliver either on time.

[redacted]) Still, the legacy was not completely impoverished, however slow and inefficient had been its making. The intercept processing and analysis world was slowly becoming organized on a national scale.[39] A presidentially-directed study headed by William O. Baker and issued in 1957 had set the intelligence community on a path that with NSC Intelligence Directive 6, issued in 1958, brought both comint and elint under NSA's direction, although with the latter the agency could at best encourage common procedures and technical rules. A study headed by Deputy Secretary of Defense Reuben Robertson, also issued in 1957, led to consolidating all cryptologic budgeting---services, CIA, and NSA—in a single Consolidated Cryptologic Program under the director of NSA. And at the end of 1960, the report of a committee chaired by the CIA's Lyman Kirkpatrick encouraged steps to make comint more broadly useable.

Figure 1.6

Source: Johnson, *American Cryptology*, p. 256.

Figure 1.7

Source: Johnson, *American Cryptology*, p. 263.

[redacted] Nor had progress in space systems been negligible. There were satellite reconnaissance photographs, important particularly because they did not support the early fearful estimates that the Soviet Union possessed hundreds of ballistic missiles and bombers with intercontinental ranges. There was a missile warning system and a navigation system under development. And work was underway on communications satellites.

[redacted] And there was a second Samos E-1/F-1 ready for launch. On 31 January 1961, a few days after the inauguration of President John F. Kennedy, it reached orbit, and the ferret subsystem began working on the eighth revolution. Intended for test and calibration purposes only, the system operated only for a short time and only over the continental United States, relaying data on 69 intercepts of west coast radars, but it was enough to demonstrate that the design worked. The photographic subsystem also worked, producing images with a resolution of about 100 feet. The planned second part of the mission, however, did not work: during the 21st orbit, ground controllers sent commands to fire the pyrotechnic squibs to separate the ferret antenna, after which they never again were able to communicate with the satellite.[30]

Organizing for Reconnaissance

[redacted] The new Kennedy administration also could profit from the organizational experience of the CIA and Defense Department space programs, and it kept in place the principal leaders of each—Richard Bissell in the CIA and Joseph Charyk in defense. In the Corona program some questions of programmatic control occasionally arose, but the program was proving ever more successful and providing photographs of millions of square miles of otherwise inaccessible Soviet territory. Still, some people working in the Air Force programs continued to think that Corona was strictly an interim measure, because only a read-out system could provide a timely warning of attack.

Figure 1.8

Source. Johnson, *American Cryptology*, p. 377.

[redacted] Their view was doomed by two facts about Samos. First, it was pursuing a mission that had been overtaken by events. By 1960 the primary national security motivation for developing satellites was no longer attack warning but strategic reconnaissance, a change that brought shifts within the Air Force in organizational roles as well as management priorities. The Strategic Air Command (SAC) was demoted from being a partner in operating Samos to being a user of its data, which in turn would be provided from other organizations.*

(S//BYE) Second, national security leaders came to believe that the Air Force was not managing the Samos program effectively, even after ARPA had been taken out of the picture in late 1959. Undoubtedly working in close cooperation with Charyk, the National Security Council convened presidential review of the troubled program in August 1960, after which it directed the Air Force to manage the Samos work using a special office reporting directly to the secretary (which meant, as a practical matter, the undersecretary). Charyk had succeeded in wresting control of the nation's principal satellite reconnaissance program away from principal development and operating elements of the uniformed Air Force. Within a few weeks he named Brig. Gen. Robert E. Greer to be Director, Samos Project (office designator SAF/SP), and Charyk also created a secretarial-level Office of Missile and Satellite Systems to provide him with direct staff support.[21] With Greer's new position, the Air Force Research and Development Command had to surrender its Samos responsibilities.

* "It was clear [at the end of 1959] that the Strategic Air Command saw Samos as an attack warning device that might make some contributions to general and technical intelligence, while higher authorities in the Pentagon, had the view that Samos was an intelligence system with a limited capacity for attack warning." Perry, *Samos* IIA, p. 156.

Figure 1.9 NSC Directive

NATIONAL SECURITY COUNCIL DIRECTIVE

1 SEPTEMBER 1960

REORIENT PROGRAM TO HIGHEST PRIORITY FOR RECOVERABLE, HIGH RESOLUTION, CONVERGENT STEREO PHOTOGRAPHY

- LAND RECOVERY AS SOON AS POSSIBLE
- COMPETENCE TO IDENTIFY WITH CERTAIN MISSILE SITES BOTH IN CONSTRUCTION AND AFTER COMPLETION
- COMPETENCE TO STUDY STATE OF READINESS, TYPE OF ACTIVITY AND TYPE OF MISSILE

REDUCE ELECTRONIC READ-OUT EFFORT TO LOWER PRIORITY-SUBSTANTIALLY CUT BACK GROUND-BASED ELECTRONIC READ-OUT SYSTEM

CONTINUE FERRET (ELECTRONIC) PROGRAM WITH PRIORITY LOWER THAN PHOTOGRAPHY

PROGRAM TO BE MANAGED WITH DIRECT LINE OF COMMAND-SECRETARY OF DEFENSE TO SECRETARY OF THE AIR FORCE TO GENERAL OFFICER IN OPERATIONAL CHARGE OF PROGRAM

Source: "SAMOS: National Satellite Reconnaissance System" briefing.

(~~S//BYE~~) The NSC review also set new management priorities for Samos' development. It led to canceling work on ground processing systems for the read-out approach, elements of the program that had been designed to make it responsive to operational commanders. Instead, the Samos program was now to emphasize work on film return systems, while research on electronic read-out systems was to continue with lower priority.[22] The read-out system was by then meeting no operational requirements, and many observers, including Greer, doubted that it ever would have.* Its technology

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* Greer later wrote "Anatomy of Readout" (November 1962), in which "he concluded that the best obtainable readout system would require about 700 seconds to

was outmoded, many costly puzzles remained unsolved, and the satellite needed to be launched by an Atlas, instead of the less expensive Thor.[23] In fact the satellite launched on 31 January 1961 was the only film read-out system ever flown.*

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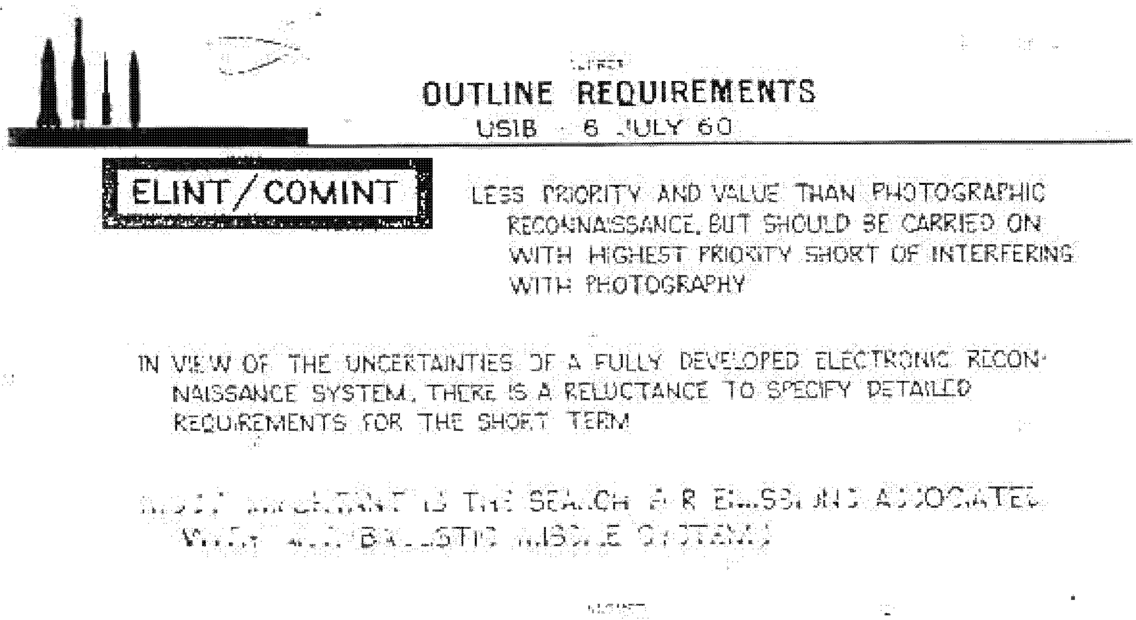
transmit the information it could acquire in one second. Any readout satellite would need 40 days of reliable operation to equal the gross product of available recovery systems that could photograph 100 targets a day for three days in orbit and which could make all of its photographs available for examination within three days of recovery. . . . Apart from obvious disparity in resolution potential which made recovery so attractive, an operationally useful readout satellite would also have to overcome Colonel King's basic objections that current technology could not provide for long-term untended reliability on orbit, for inexpensive ground stations, and for considerable improvements in data transmission." Perry, *Samos*, pp. 185-186.

* Charyk canceled further launches of the E-1/F-1 configuration on the grounds that the technology had already been demonstrated. He agreed to let an E-2 be launched in September, but the rocket exploded on the launch pad. Charyk then ordered the remaining E-2 into storage, and on 6 October King ordered a halt to all readout work (Perry, *Samos*, pp. 172-173). In 1966-67, the National Aeronautics and Space Administration used a modified E-1 subsystem as a lunar mapper, and, despite the doubts of King and others, the system worked (Perry, *Samos*, p. 173; Hall, "Samos to the Moon").

Figure 1.10 USIB Requirements



Source: "SAMOS: National Satellite Reconnaissance System" briefing.

(U) Such revisions in the space program seem rather bold to have been ordered by an administration at the end of its life. Some no doubt expected that Vice President Richard Nixon would win the presidential election; he had been involved in the planning for what became NASA and in other space activities, and he might be expected to continue the course that the Eisenhower people laid out. He and his opponent, Senator John F. Kennedy, had stayed close in the polls all year, with never more than seven percentage points difference, and his numbers in July had been slightly better than Kennedy's. From a bureaucratic perspective, the NSC's actions greatly strengthened the power of a politically appointed civilian over the uniformed service organizations, and it might be expected that an incoming administration of either party might appreciate that fact. Then, too, there was a prevailing cultural sense at the time that important matters of science and technology serving national security interests would be left in the hands of eminent boffins even if executive branch politics were to change.*

(S//BYE) In any case, there seemed to be no foot-dragging in implementing the NSC's recommendations. The NSC's actions assigned the ferret intercept payloads a "lower priority than that assigned to photography," but at least they could proceed unhobbled by the photographic system's problems.† In December 1960 Charyk directed them to be launched by the Thor-Agena system that Corona used rather than the more expensive Atlas Agena system used by Samos. That decision, together with other housekeeping considerations, led Greer in April 1961 to collocate the ferret work (now called Project 102) with the Corona activities. Now both types of satellite would include the secondary intercept payloads of the "Aftrack" program. The original Soctop payloads aimed only at detecting Soviet tracking of the satellite, but by mid-1961 the aft rack was

* That is in fact what happened. Herbert York, outgoing director of defense research and engineering, wrote that "new Secretary of Defense Robert S. McNamara invited all five of the research and development officials at the Presidential-appointee level to stay on . . . . In addition, all of my senior staff stayed on and two of them were promoted . . . . Much the same thing happened in 1961 in the case of the White House science apparatus." York, *Race to Oblivion*, chapter 8, "The McNamara Era." "The belief that scientific advisers constitute an 'apolitical elite' to serve the presidency gained wide acceptance during the years immediately following Sputnik. Nowhere was this ideology more vividly embodied than in the scientific advisory mechanisms which proliferated around Presidents Dwight D. Eisenhower and John F. Kennedy and in the Executive Office of the President." Katz, p. 43.

† Initially these would be known as Project 102 satellites. When the Samos project office was established at the Los Angeles Air Force Station in August 1960, work on read-out systems was conducted under Program I and that on return systems under Program II. Work on read-out photographic systems comprised Project 101 under Program I; work on ferret intercept systems was Project 102 under Program I.

holding systems that could also search for particular signals and record them for later analysis.[24] The Discoverer 25 mission * in June, for example, carried the first " Taki" payload, named for its target, the Soviet air defense ("Tall King") radars, and the first satellite-borne electronic intelligence tape recorder. The next Discoverer, launched in July, carried the first "Wild Bill" payload, tuned to search for radars ("Hen House") thought to be associated with possible Soviet anti-ballistic missile systems. At the end of August, Discoverer 29 carried "Texas Pint," the first effort to intercept communications transmissions from space. In September, Discoverer 30 carried a "Topsoc" payload, an effort to determine the frequencies of radars of interest (including "Hen House") using a scanning receiver and a recorder. That particular effort proved unsuccessful, but the Hen House frequency soon became known in other ways and Aftrack payloads named "Long John" were built to analyze that signal in detail.

~~(S//BYE)~~ And so it went, as engineers and analysts pursued Soviet radar signals with a rolling series of experiments made possible by the simplicity of the Aftrack design and the frequent opportunities for flight. In December, for example, Discoverer 36 carried a "Grapejuice" payload, an effort to intercept and analyze a Soviet tactical communication system called "[redacted]" Neither it, nor Grapejuice II (April 1962) nor Grapejuice III (September 1962) yielded the desired information, and so a refined version, "Vino," was flown in December 1962 and February 1963, with better but still limited success. 25X1

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* Specific launches are identified here as Discoverer, rather than Corona, missions, because that is how they are listed in most unclassified historical manifests.

Finally, in August 1964, good technical and organizational intelligence was derived from data collected by "Opporknockity."* The first several Aftrack missions are summarized in Table 1.2.

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* Busher and Chaid (pp. 11-13) report that "Wild Bill" was named for either Lockheed's Bill Harris or SEL's Bill Rambo; "Texas Pint" because the payload was too small to be a fifth or a quart; "Long John" for John Grigsby of ATI, which built the payload. "Grapejuice" was named because the project engineer was Conrad Welch; "Vino" was a stronger version of Grapejuice; and "Opporknockity" was chosen because "when opportunity knocks, opporknockity tunes."

Table 1.2
Early AFTRACK Payloads

Name	Launch Vehicle	Date	Frequency (MHz)	Life	Remarks
SOCTOP I	Thor-Agena A (Discoverer 13)	10 August 1960	2500-3250	1 day	Vulnerability
SOCTOP II	Thor-Agena A (Discoverer 15)	13 September 1960	300-900 2500-3200	1 day	Vulnerability
SOCTOP II	Thor-Agena B (Discoverer 16)	26 October 1960	300-900 2500-3200	0	Failure; vulnerability
SOCTOP III	Thor-Agena B (Discoverer 17)	12 November 1960	1000-9000	2 days	Vulnerability
SOCTOP V	Thor-Agena B (Discoverer 22)	30 March 1961	100-1000	0	Failure; vulnerability
SOCTOP IV	Thor-Agena B (Discoverer 24)	8 June 1961	1000-6000	0	Failure; vulnerability
TAKI I	Thor-Agena B (Discoverer 25)	16 June 1961	160-6000 (3 bands)	2 days	First recorder used. ABM radar; vulnerability
WILDBILL I	Thor-Agena B (Discoverer 26)	7 July 1961	40-130	0	ABM radar
TAKI	Thor-Agena B (Discoverer 28)	3 August 1961	160-175	0	No orbit. ABM search; vulnerability
Texas Pint I	Thor-Agena B (Discoverer 29)	30 August 1961	100-150	2 days	AM/FM environment, [redacted] signal
TOPSOC I	Thor-Agena B (Discoverer 30)	12 September 1961	400-1600 (2 bands)	5 days	ABM/GS
TOPSOC II	Thor-Agena B (Discoverer 31)	17 September 1961	400-1600 (2 bands)	4 days	ABM/GS
TOPSOC III	Thor-Agena B (Discoverer 32)	13 October 1961	400-1600 (2 bands)	2 days	ABM/GS
TOPSOC IV	Thor-Agena B (Discoverer 34)	5 November 1961	400-1600 (2 bands)	2 days	ABM/GS
GRAPEJUICE I	Thor-Agena B (Discoverer 36)	12 December 1961	[redacted]	1 day	[redacted]
SOCTOP	Atlas-Agena B	22 December 1961	100-1000	7 months	Vulnerability

25X1

Source: Busher and Chaid, Appendix A, TS//BYE

~~(S//BYE)~~ The Aftrack payloads flew in orbits designed for Corona, the primary payload, and their weight and operations on the satellite were carefully limited to prevent any interference with the photographic mission. For the ferret program, intercept was the primary mission; those dedicated satellites could carry more powerful payloads and use orbits more likely to encounter signals of interest. The first ones to follow the E-1/F-1 satellite were designed to intercept known signals associated with particular types of radars and help locate them (to produce an understanding of the Soviet "electronic order of battle").* Advances in solid state electronics allowed these systems to be more powerful, more complex, and lighter than the original F-1. The first was launched on 21 February 1962; six more reached orbit during the next three years. Starting with the third, launched 29 June 1963, they carried secondary payloads themselves. First was "Plymouth Rock," an Aftrack subsystem to locate Soviet S-band tracking radars and that had first flown the previous fall on Discoverer Agena. All the following 698BK satellites carried "Bird Dog 1" (reportedly named for its pointing ability), or its successors, an interferometer-type system targeted against an improved version of the Soviet air defense radar that shot down Powers' U-2. The Bird Dog data yielded some locations with an accuracy of five to ten miles (circular error probable).

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* These payloads were designated "698BK," identified by sequential roman numerals; the first two were produced under Project 102, which was then renamed Program 698BK. They were 698BK-II and - III, however, because the E-1/F-1 satellite launched 31 January 1961 was redesignated 698BK I, post facto. Furthermore, the payload launch in mid-1965 was from a new Program 770 and was designated "698BK/770." One can therefore count a total of six, or seven, or eight "698BK" satellites.

 [redacted]

Table 1.3 Ferret Payloads				
Program	**Payload**	**Date Launched**	**Primary (P) Secondary (S)**	**Vehicle/comment**
WS-117L	Samos I	November 1960	P	Atlas/Agena Launch Failure
WS-117L	Samos II/ 698BK I	31 January 1961	P	Atlas Agena
Project 102	698BK II	21 February 1962	P	Thor/Agena B
Project 102	698BK III	29 June 1962	P	Thor/Agena B
Program 698BK	698BK IV	16 January 1963	P	Thor/Agena D
Program 698BK	698BK V Plymouth Rock	29 June 1963	P S	TAT/Agena D* (*Thrust Augmented Thor)
Program 698BK	698BK VI Bird Dog I	27 February 1964	P S	TAT/Agena D
Program 698BK	698BK VII Bird Dog I	2 July 1964	P S	TAT/Agena D
Program 698BK	698BK VIII Bird Dog II	3 November 1964	P S	TAT/Agena D
Program 770	698BK/770 Bird Dog III	16 July 1965	P S	TAT/Agenda D

Source: Busher and Chaid, p. 10.

[redacted] Unlike satellite photography, this information was directly useful for immediate operational as well as intelligence purposes, and the Bird Dog data went directly to both the National Security Agency and the Strategic Air Command. The struggles of the 1950s over which organizations were to collect and analyze which signals for which purposes had been further moderated formally in 1961 with revision of NSC Intelligence Directive 6. In practice, particular needs called for special arrangements, such as the September 1962 agreement whereby SAC did some intercept processing under NSA guidance. New arrangements then had to be made and improved over time before operational force commanders could feel confident that an organization beyond their control would in fact provide intelligence that met their needs.

[redacted]

[redacted] Organizational relationships had been difficult for national security space activities in general; in addition to the differences between operational and intelligence needs were matters of expertise, experience, development philosophy, management and money. The Air Force had asserted primacy in space matters, but the Army was first to get there and first to orbit a satellite. The Navy was first with an intercept satellite, and the CIA delivered the first satellite photographs. The National Security Agency asserted primacy in sigint collection and analysis, but in many cases its sovereignty over service cryptologic elements was entirely formal, and it seemed to give communications intelligence undue emphasis over electronic intelligence and telemetry. The CIA seemed determined to continue its own intercept and analysis programs regardless of NSA's dictates. Eisenhower had wanted the reconnaissance satellite programs to be under the charge of a single intelligence organization. What he got was mismanagement by ARPA, a new Pentagon bureaucracy (the office of defense research and engineering, created to replace the assistant secretary for research and development and to take charge of ARPA and other programs), and a separate program run by the CIA.

[redacted] By the time the Kennedy administration took office, most of the reconnaissance satellite projects were being managed by the Air Force, and leadership of space reconnaissance programs in the Defense Department rested principally with Undersecretary Charyk. As the Eisenhower team in defense was leaving it gave Charyk another boost. On his last full day in office, the deputy secretary of defense designated the secretary of the Air Force to head up defense reconnaissance satellite programs and directed him to report on them directly to the deputy secretary of defense. It also directed that work on intercept payloads be coordinated with NSA. The new deputy secretary of defense, Roswell Gilpatrick, preferred to give overall approval of defense space programs to the director of defense research and engineering, but he assigned the research, development, test, and evaluation for all approved projects to the Air Force; the new Secretary of Defense, Robert S. McNamara, approved that arrangement on 6 March 1961.

Figure 1.11

Robert McNamara, secretary of defense under Kennedy and Johnson

Source: Johnson, *American Cryptology*, p. 291.

(U) The Navy preferred not to lose its satellite development to the Air Force undersecretary, and soon its program managers secured an appointment with McNamara to tell him about their work. McNamara reportedly said that he had not been aware of it and that he liked what he heard.[25] Defense General Counsel Cyrus Vance then began revising the earlier directive to allow the Army and Navy to develop satellites particularly suited to their needs, but the Bay of Pigs invasion soon displaced such activities. Work on the second GRAB was nearly complete, in any event, and on 29 June 1961 it was launched as a piggyback on Transit IV-A by a Thor Able Star launcher (together with Injun, a scientific research satellite of University of Iowa's Professor James Van Allen, making this launch the first with three satellites).

[redacted] By then the issue of organizing space reconnaissance had moved beyond the Defense Department to include the CIA, manager of the Corona program. The CIA's deputy director for plans, Richard Bissell, was responsible for

Corona and by several accounts worked comfortably with Charyk. During July the two devised plans for centralizing the management of all national reconnaissance space programs.[26] They first proposed that CIA (Bissell) be in charge, an arrangement that Eisenhower had wanted but never got from his own administration. McNamara agreed immediately, but DCI Allen Dulles objected that having a CIA officer giving orders to Pentagon people was "bad practice."[27] In September McNamara proposed essentially the same arrangement but with joint management, and the acting DCI, Gen. Charles P. Cabell, USAF, agreed on 6 September 1961, creating a National Reconnaissance Program including "all satellite and overflight reconnaissance projects whether overt or covert," to be managed by a covert National Reconnaissance Office directed jointly by CIA and the Defense Department.

~~(TS//Special Handling)~~ Special national security activities were reviewed for the White House by the NSC's Special Group,* and that committee quickly objected that the nation's satellite reconnaissance programs were too important to be entrusted to joint management. Both Charyk and Bissell seemed quite willing to have the other be in charge, but each was opposed by others, and the satellite programs de facto continued under joint management until Bissell left the CIA in March 1962. His replacement, Herbert "Pete" Scoville, did not establish the same working relationship with Charyk, and two months later the new DCI, John McCone, and Deputy Secretary of Defense Roswell Gilpatrick signed a revised agreement that put Charyk in charge of the NRO.[28] Less than two years earlier, the Air Force Research and Development Command, the Army, the Navy, and the CIA all had their own satellite reconnaissance programs. As of May 1962, they all answered to the undersecretary of the Air Force. In turn, he was to ensure that plans for the national reconnaissance program would "encompass maximum utilization of the technical and operational resources of the DOD, the Army, Navy, Air Force, NSA and the CIA to support all collection programs, including but not limited to, electronic signal and

Figure 1.12

John McCone

Source: Johnson, *American Cryptology*, p. 324.

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* This group was the successor to the 5412 committee, created by NSC 5412 in 1954 with approval oversight of CIA special activities; later called the "303 Committee" (for the number of the room where it met in the Old Executive Office Building). Its core membership included the secretaries of state and defense, the CIA director, the national security advisor, and the chairman of the joint chiefs.

photographic collection programs."[29] Charyk later organized the development programs of the NRO constituents as Program A (Air Force), Program B (CIA), and Program C (Navy). Aerial reconnaissance was conducted under Program D.

A National Reconnaissance Program

~~(S/BYE)~~ These organizational evolutions imposed no appreciable delay on the engineering and development underway in ongoing sigint satellite programs. By 1962 there was a sharpened need for more extensive coverage in frequency and geography. CIA analysts, looking at U-2 and Corona photographs together with signals collected by TAKI-1 and the GRAB launched in June 1961, thought that the Soviet Union might be developing an anti-ballistic missile capability that could threaten the U.S. Polaris, Jupiter, Thor, and Atlas programs.[30] They called for more detailed collection with better geolocation. The Aftrack, and ferret programs accordingly continued apace; the first Project 102 ferret was launched on 21 February 1962. In addition to continuing evolution of the GRAB satellites, the Navy also proposed to develop "Dyno," two small satellites

[redacted] 25X1

~~(S/BYE)~~ Thus at first the organizational changes, from ARPA to Air Force to NRO, appeared to have little material effect beyond office designators and paper flows—issues

* Potts notes that in some subsequent correspondence the name Dyno was applied retroactively to the first two GRAB satellites. Potts, p. 124.

that caused blood to flow at headquarters but that barely rippled out to operations in the field. That situation deteriorated quickly. Once Bissell left, the bureaucratic wrangling became constant and affected programmatic approvals and budgets, and eventually actual capabilities. The Defense Department and the CIA differed fundamentally over the right approach to managing national reconnaissance. Each felt imbued with a critical national responsibility in the matter, and neither was willing to acquiesce when it felt strongly, no matter what might appear to have been agreed on some earlier piece of paper.

[redacted] Charyk came to believe that the NRO charter signed in May 1962 had become unworkable, because the CIA and the Defense Department held increasingly divergent views of how it was to operate. "Is it," he wrote in a farewell paper, "to be an operating agency, with actual and effective management responsibility for a single national program [his view], or is it to be a coordinating office responsible for liaison and coordination between related projects which are the management responsibility of different Agencies and Services [which he saw to be CIA's view]?"[33] McCone agreed to a new charter, signed 13 March 1963, that made clear that the NRO was to be an operating agency and not a coordinating function.

[redacted] Conceived as physic, the new charter soon proved toxic. It seems unlikely that the DCI understood the agreement to mean the end of the CIA's role in national reconnaissance, but it soon appeared that such was the intent of the new director, Brockway McMillan, who strove from the first to circumscribe and marginalize the CIA's role. McMillan insisted that the deputy director, a CIA nominee, needed no office n the NRO suite and accorded him the merest trickle of program information; put overflight operations under Pentagon control; diminished CIA's control over Corona; and complained mightily withal that CIA personnel persisted in taking orders from their superiors instead of from him.

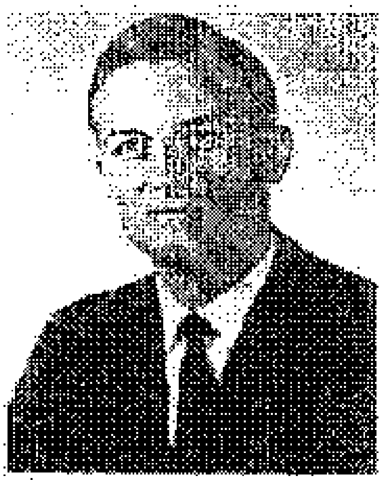
Figure 1.13

Brockway McMillan

Source: Bradburn, *SIGINT Satellite Story*, p. 171.

[redacted] In his efforts to secure what he insisted were his proper authorities, McMillan soon started to use program approvals and budgets as leverage. Those who recognized his preeminence, particularly the military leaders of Programs A, C, and D, found it relatively easy to get funding approved. Not so, those who differed with him, and no one differed with him more than Albert D. "Bud" Wheelon, McCone's choice to replace Scoville on 5 August 1963 as deputy director for science and technology (replacing the earlier directorate for research). A few days earlier McCone had declaimed to his senior staff about the need to get CIA back into satellite reconnaissance in a serious way. Wheelon seemed likely to do the job. McMillan's clashes with him became legendary, and even thirty years later McMillan could only speak of

Figure 1.14



Albert "Bud" Wheelon

Source: Bradburn, *SIGINT Satellite Story*, p. 169.

Wheelon apoplectically, sputtering ad hominem insults.[32] Even while doing so, however, McMillan was forced to apologize for allowing his own petulance to delay work on CIA-designed sigint satellite that the country needed urgently.

[redacted] The idea had taken root in the Office of Elint (designator OEL, established 30 July 1962), part of Wheelon's new organization. While the Aftrack payloads and ferret and Navy satellites were continually improving, as low-orbiting satellites they could not collect signals from any particular emitter for more than a few minutes. [redacted] 25X1

[redacted] 25X1

25X1

25X1

[redacted] 25X1

[redacted] and by the end of the summer a replacement for McMillan had been recruited. Alexander Flax, serving as assistant secretary of the air force for research and development, would be the next director of the NRO.

(S//BYE) Flax was moving into a situation that was politically very difficult, although he could also benefit from the reaction to McMillan's outré conduct. Leaders in defense, intelligence, the White House, and Congress wanted a speedy return to professional comportment and programmatic cooperation. They had created yet another charter for the NRO (the fourth in as many years); this one recognized that an effective NRO would have to be supported by both the CIA and the Defense Department, and that both had responsibilities and capabilities in national reconnaissance in space. It also provided for oversight by an Executive Committee, consisting of the DCI, the deputy secretary of defense, and the president's science advisor. It probably also helped Flax that the principal combatants had moved on (McCone had returned to private life in April, McMillan returned to Bell Laboratories, and Wheelon was soon to become director of the Hughes advanced laboratories in Malibu).

(S//BYE) The NRO's situation was also difficult programmatically. [redacted]

25X1

[redacted]

military forces (as the low-orbiting systems were), were questions still far from being answered. The one certain expectation was that budgeting problems were on the way. The new systems would be far more expensive than any [redacted] if only because of development and launch costs. Perhaps other missions whose products had become of marginal importance could be canceled, or perhaps some existing and new missions could be combined efficiently, or perhaps the proposed new systems could be designed more frugally. In any event, incremental budgetary add-ons would not meet the need. The National Reconnaissance Program would have to be considered as a whole, with an integral rationale explaining the contribution of each component system. 25X1

(U) Flax would have to create an architecture.

Notes

[1] During Eisenhower's first term, for example, the National Security Agency and other signals intelligence organizations were reviewed in 1953 by the Robertson committee, in 1954-55 by the Clark panel of the Hoover commission, also in 1954-55 by the Killian board (Scientific Advisory Committee), and in 1956 by William H. Jackson. Johnson, *American Cryptology*, pp. 227-232.

[2] Bell Laboratories declined to propose. "General Background—WS-117L," p. 2. Welzenbach notes the three bidders but makes no reference to Bell. Welzenbach, *The Central Intelligence Agency*, chapter I, pp. 1-5—1-6.

[3] Welzenbach, p. 1-7.

[4] Ambrose, *Eisenhower: Soldier and President*, p. 411.

[5] Rand Corporation, *Project Feed Back*, p.149.

[6] Technological Capabilities Panel, "Report," pp. 152 and 147.

[7] National Security Council 5520, "Draft Statement of Policy on U.S. Scientific Satellite Program."

[8] Welzenbach, p. 1-24, cites Ambrose, *Eisenhower* p. 428.

[9] Perry, *Samos*, pp. 14-15.

[10] The transition involved the apparent cancellation of film-return plans in order to mask the relationship with work on WS-117L. Further details are in Perry, *Samos*, and R. Cargill Hall, "Postwar Strategic Reconnaissance and the Genesis of Corona."

[11] Perry, *Samos*, p. 15; emphasis in original.

[12] Perry, *Volume IIA—Samos*, p. 57.

[13] Collins, *SIGINT in the Central Intelligence Agency*, reported erroneously that the first ELINT satellite was TRANSIT. Many of the satellite-related portions of his study are incorrect or misleading.

[14] Johnson's account on this subject is inexplicably incorrect. He states that the SOCTOP payload was recovered by Navy frogmen with the Corona re-entry capsule and that it intercepted Soviet radar signals (*American Cryptology II*, p. 404). The account in Bradburn (*SIGINT Satellite Story*, pp. 123-125), which Johnson references at several

points, is quite different and consistent with that offered here. The Bradburn account is itself inconsistent regarding dates; it states that Harold Willis worked for CIA's Office of ELINT (OEL) in 1959 (p. 120), but the office was not established until 30 July 1963; and the Bradburn account reports that Willis obtained approval for the Aftrack work from Bissell in November 1959 (p. 121), but later suggests that the project got underway only a few months later, in early 1960 (pp. 124-125).

[15] Schriever to White, letter, 15 September 1959.

[16] Information in this paragraph draws from "SAMOS: National Satellite Reconnaissance System."

[17] "The satellite umbilical connection failed to release at launch and the hefty push of the Atlas booster tore away the nitrogen fill line—complete with couplings to the Agena—when the hoses reached their physical stretch limits. Although the Atlas operated perfectly and the separation of the Agena from the first-stage booster occurred as programmed, nitrogen had been boiling freely through the entire boost period and the tanks were for practical purposes empty. Attitude stablilization depended on gas stabilization—and there was no gas. The Agena's engines ignited while the vehicle was improperly aligned for injection into orbit—and the flight was over. Investigation revealed that test base personnel had failed to install a half-inch assembly that should have joined the umbilical to the quick-disconnect fittings and that the nitrogen hoses were shorter than the lanyards which were supposed to pull away the quick-disconnect fittings. It was a design oversight that Dr. Charyk [Undersecretary of the Air Force], for one, considered to be an incredible blunder. He was not alone." Perry, *Samos* IIA, pp. 162-153, TS//BYE.

[18] "Another development [in October 1957] that gave heart to those involved in WS-117L was the appointment of Neil McElroy as Defense Secretary to succeed Charles E. Wilson, who was notoriously antisatellite." Welzenbach, p. 1-14.

[19] Information in this paragraph follows Johnson, *American Cryptology I*, pp. 253-265.

[20] Bradburn, p. 81; Busher and Chaid, p.6; Perry, *Samos* IIA, pp. 166-167.

[21] Greer's appointment was published in Secretary of the Air Force Order No. 116.1, 31 August 1960; the office was established by Order No. 115.1, same date. "Organization and Functions of the Office of Missile and Satellite Systems."

[22] Lay, "Reconnaissance Satellite Program."

[23] "The Air Force Samos program was ill considered, undisciplined, and poorly managed. It would have, at best, floundered into success at a much later date." McMillan, "Possible NRO/CIA Issues."

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[24] Information about Aftrack payloads is drawn from Busher and Chaid, pp.12ff.

[25] Ronald Potts, pp. 99-100.

[26] Charyk, "Management of National Reconnaissance Program (TS)."

[27] Welzenbach, p. VII-12.

[28] "Agreement Between Secretary of Defense and the Director of Central Intelligence."

[29] "Agreement," paragraph 2(4).

[30] Ronald Potts, pp. 115ff.

[31] Charyk, "A Summary Review of the National Reconnaissance Office."

[32] McMillan, taped inteview, HOF.

[redacted] 25X1

Chapter 2: Discovery to Design

[redacted] By the summer of 1965, the NRO was like a bad horror movie's spastic zombie. It was alive: it had satellites in orbit delivering imagery and signals intelligence. But the organization was at war within itself, placing in jeopardy the prospects for new systems to meet future needs.[1] Its second director, Brockway McMillan, had selectively interpreted its charter to support his campaign to drive the CIA out of overhead reconnaissance. He was being replaced, but the damage ran deep. The CIA and Air Force programs, instead of cooperating in competitive synergy, fought in rancorous division, and the Navy program had been delayed and denied funds. Programmatically there was little to show for these pains. Satellite reconnaissance was costing and promising much but had contributed nothing to help national leaders facing international crises in Berlin, Cuba, and elsewhere. There was nothing new in orbit. The systems in operation (Corona, Gambit, and Poppy) were born before 1962; engineering enhancements helped improve their performance incrementally, but significant innovation was retarded, primarily by McMillan's insistence on personally controlling technical decisions, contract awards, and disbursements. Program A abandoned its "sparkling success" with imaging radar almost before the film was developed,[2] and Program B's initiative in designing a [redacted] ollector ran into McMillan's vehement opposition. 25X1

[redacted] The Johnson administration opted for an overhaul rather than a burial. The White House science advisors, Defense Secretary McNamara, and new director of central

CL BY: [redacted]
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intelligence, Admiral Raborn, signed a new charter—the third in three years—for the National Reconnaissance Program in August 1965. It offered protections for the CIA's role and made the NRO director accountable to an executive committee ("ExCom") comprising the DCI, the President's science advisor, and the deputy secretary of defense (the NRO director was a nonvoting member). They asked Alexander Flax, who had extensive experience in aeronautical research and development in industry, to be the new director.* A former chief scientist of the air force, Flax had succeeded McMillan as assistant secretary of the air force for research and development when McMillan went to the NRO.

Figure 2.1

Alexander H. Flax

Source: Bradburn, *SIGINT Satellite Story*, p. 172.

~~(S//BYE)~~ Informed opinion thought Flax doomed. He was talented, experienced, and focused on solving problems, but failure seemed certain: the NRO's authorities were too weak; its record, too spotty; the intelligence organizations, too intrusive; the programs' cultures, too different; the personal resentments, too strong.[3] A former NRO historian, himself no fan of the CIA, described Flax as confronted "not only by the tasks Charyk had left undone, but also by the considerable difficulties created by McMillan's disastrously unsuccessful efforts to carry through Charyk's plan."[4] Flax understood the situation quite well, heard the national security leaders affirm that they wanted the NRO and the new charter to work,

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* Flax would not get the title of "undersecretary," a position that had already been promised to Townsend Hoopes, and as assistant secretary for R&D he only had authority over research funds. As director of the NRO he needed a full range of budget, personnel, and other authorities, which were arranged using special delegations from Secretary of the Air Force Harold Brown. Once McMillan left, incidentally, he never returned, not for a visit, briefing, or old-boys' luncheon, for a quarter century. "Nobody wanted him back," Flax said (interview, 5 March 2003).

and decided to give the job a try. He would be helped by James Reber, a long-time CIA officer with wide and friendly acquaintanceship in the intelligence community. Unlike the first two NRO directors, Flax insisted on making Reber a true deputy, fully in the NRO's chain of command.

A Collection of Signals

[redacted] National priorities for satellite reconnaissance had from the outset been on photography. Flax estimated that when he became director on 1 October 1965, less than five percent of the NRO budget was spent on signals collection. The five percent funded the Navy program, which did nothing but sigint, and Program A's scant handful of people working on Aftrack elint and vulnerability sensors. Hence all the space-based signals collectors were sensors in low earth orbits, and all were flown primarily to gain elint, observations of electromagnetic signals that were not communications or telemetry.[5] Elint includes, for example, signals from beacons, transponders, jammers, missile guidance, some data links, altimeters, navigation signals, and friend-or-foe identification. Nearly all the space-based elint in 1965 was concerned with Soviet radars. With measurements of the radar signals, analysts could estimate the capabilities of the radars—how well they could detect, locate, and track different kinds of targets—and so determine their weaknesses.

[redacted] For several reasons, the elint mission required lots of sensors, particularly when they operated in low earth orbits. Obtaining the needed measurements involved discovering the signals, characterizing them, and preserving them for analysis. Discovery is a question of the probability of intercepting a signal, and for most practical purposes there is a resource context as well --probability of intercept within thirty days using three satellites, for example.* This number can be dauntingly low, because it requires, in a simple instance, that several independent events occur at the same time: the radar must be actively transmitting; the elint receiver must be actively listening; the elint receiver is tuned to the radar's transmit frequency; the elint antenna is pointed toward the radar; and the radar antenna is pointed toward the elint site. In some cases where search processes are more periodic than random, the probability of intercept may be zero.

~~(S//BYE)~~ The chance of discovery could be improved in several ways, such as searching with broadband receivers and antennas and receiving sidelobes as well as main beams, but doing so can interfere with the second element of intercept, characterization. Typically analysts need the signal to be characterized is in terms of power, antenna [redacted] carrier (frequency, [redacted] [redacted]nd carrier modulation (continuous wave, pulse, pulse interval, [redacted] Because any particular intercept from a low-orbiting satellite can usually provide only a quick observation of the radar operating at a particular moment, a large number of intercepts, often several thousand, may be needed to provide a reliable basis for statistically estimating the radar's true capabilities. Moreover, making these measurements requires in the first place the ability to separate the signal from the rest of the environment and, for most purposes, identify the specific emitter. Conversely, analysts might need to search for the signals of a radar they had identified in

25X1

* "The interception problem of concern here is determining the probability that an intercept system is available and actively listening in the proper frequency band and at the proper bearing angle at the same time that the radar signal can be received. It is not the same as the detection probability, which is a function of the signal level available and the threshold setting at the intercept receiver." Wiley, *Intercept*, p. 39.

photography. Occasionally the association between signals and radars could be made by using a [redacted] More often, though, the association depended on using signal paths to estimate the location of the emitter [redacted] 25X1 25X1 25X1

~~(S//BYE)~~ By 1965 the NRO had learned a great deal about conducting elint from satellites in low earth orbits. Their relative cheapness, short lifetimes, and frequent launches had allowed both sensors and spacecraft to improve rapidly. The Navy program, for example, had in June 1960 launched the nation's first sigint satellite, GRAB, a small low orbiter that transponded signals intercepted in a narrow frequency range and allowed locating the intercepted emitter within an area no smaller than 400 by 8000 miles. Four and a half years later, now constituted as the NRO's Program C, the Navy program was flying [redacted] four Poppy satellites that were launched on a single Thor Agena D on 9 March 1965.[6] The satellites now provided more information about more signals [redacted] had already located Tall King early warning radars within [redacted][8] The United States Intelligence Board had defined the accuracies needed for each general mission (Table 2.1) 25X1 25X1

* Coverage did not include a 500 Mhz gap from 6250 Mhz. Ronald Potts, p. 171.

Table 2.1 Geolocation Accuracies Needed for Missions	
Mission	**Accuracy Needed**
General search	[redacted] pulsed emitters) (continuous wave emitters)
Electronic order of battle	needed) desired)
Directed search (ABM/AES)	

The satellites were also becoming more capable collection platforms. One was equipped with a 3-axis stabilization system (which failed), and the lifetimes were longer (Table 2.2).

Table 2.2 Early Navy/Program C Launches				
Name	**Mission**	**Launch Date**	**Coverage Bands (Ghz)**	**Lifetime**
GRAB 1	Elint	22 June 1960	[redacted]	3 months
GRAB	Elint	30 November 1960		0
GRAB 2	Elint	29 June 1961	2 (.55-.62, .81-.92)	14 months
GRAB	Elint	24 January 1962	2 (.165-.185, 2.6-3.25)	0
GRAB	Elint	26 April 1962	2 (.165-.185, 2.6-3.25)	0
Poppy 1	[redacted]	13 December 1962	[redacted]	
Poppy 2		15 June 1963		
Poppy 3		11 January 1964		
Poppy 4		9 March 1965		

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25X1

Source: Ronald Potts, pp. 369-370.

In addition, special-purpose experiments were conducted using secondary "piggyback" satellites, such as the Agena front-rack payload, Hayloft, in January 1964.

~~(S/BYE)~~ Program A was also flying more capable signals collectors. Some were new Aftrack sensors, the intercept equipment flown on the back of Agena upper stages. "Opporknockity" and "Square 20"* intercepted Soviet communications signals and collected data that showed promise for intercepting [redacted] communications from satellites.[9] [redacted]

25X1

Table 2.3
Event Sequence for P-11 Launch from Agena

1. The shear panel timer on the Agena vehicle rack is activated by the launch vehicle ascent timer.
2. The launcher release pin pullers are activated by the shear panel timer, and power is supplied to the erection motor.
3. The launch mechanism is slowly extended and locked with the spacecraft in the launch position—its spin axis approximately 13 degrees away from the launch vehicle longitudinal axis.
4. The P-11 vehicle release pin pullers are activated by the shear panel timer and the P-11 vehicle is ejected by means of a soft spring system.
5. The accumulator module of the P-11 primary timer is started at separation of the P-11 vehicle from the shear panel launch mechanism.
6. Activation of the solid propellant spin system in the P-11 vehicle, spin stabilizes the vehicle and imparts an additional separation velocity increment.
7. First rocket firing initiates acceleration of the P-11 vehicle to its prescribed transfer orbit.
8. Second rocket firing initiates acceleration of the P-11 vehicle to its final prescribed orbit.
9. Solar arrays and sensors are deployed.

Source: NRO report to PFIAB, 1 July-31 December

* Named for the [redacted] that was its target.

25X1

These were P-11 subsatellites, built by Lockheed and managed by Program A's [redacted] as Program 989. They could be configured for four different intercept missions: telemetry, Soviet ABM radars, communications, and military radars.

Table 2.4
Early P-989 Missions

Mission #	Name	Date	Frequency (Mhz)	Life	Remarks
7301	Pundit I	29 October 1963	[redacted]	19 months	VHF missile telemetry
7302	Pundit II	21 December 1963		3 months	VHF missile telemetry
7304	Noah's Ark	6 July 1964		135 days	TI on Soviet ABM
7303	Pundit III	8 October 1964		0	VHF missile telemetry
7305	Step 13	23 October 1964		123 days	GS for ABM
7306	Plymouth Rock III	23 October 1964		138 days	Elint, GS
7309	Pundit IV	28 April 1965		21 months	Telemetry
7307	Fanion I	25 June 1965		21 months	EOB; locat[redacted]
7308	Tripos I	25 June 1965		22 months	Search and location on C-band
7312	Magnum	3 August 1965		21 months	ABM/Hen House
7310	Leige	14 May 1966		0	Tall King radars
7311	Plicat	14 May 1966		0	Pre-detection

Source: Busher and Chaid, Appendix A, TS//BYE

25X1

Most of the Agenas used for Corona missions also carried vulnerability monitoring sensors—"Stopper," used during 1963-64, and "BIT," used 1964-66. Both were produced by the Electronic Defense Laboratory of Sylvania Electric Products Incorporated. The BIT sensors were intended primarily to detect tracking by Soviet "Hen House" radars (BIT detected [redacted] and BIT II detected [redacted] in addition).[10]

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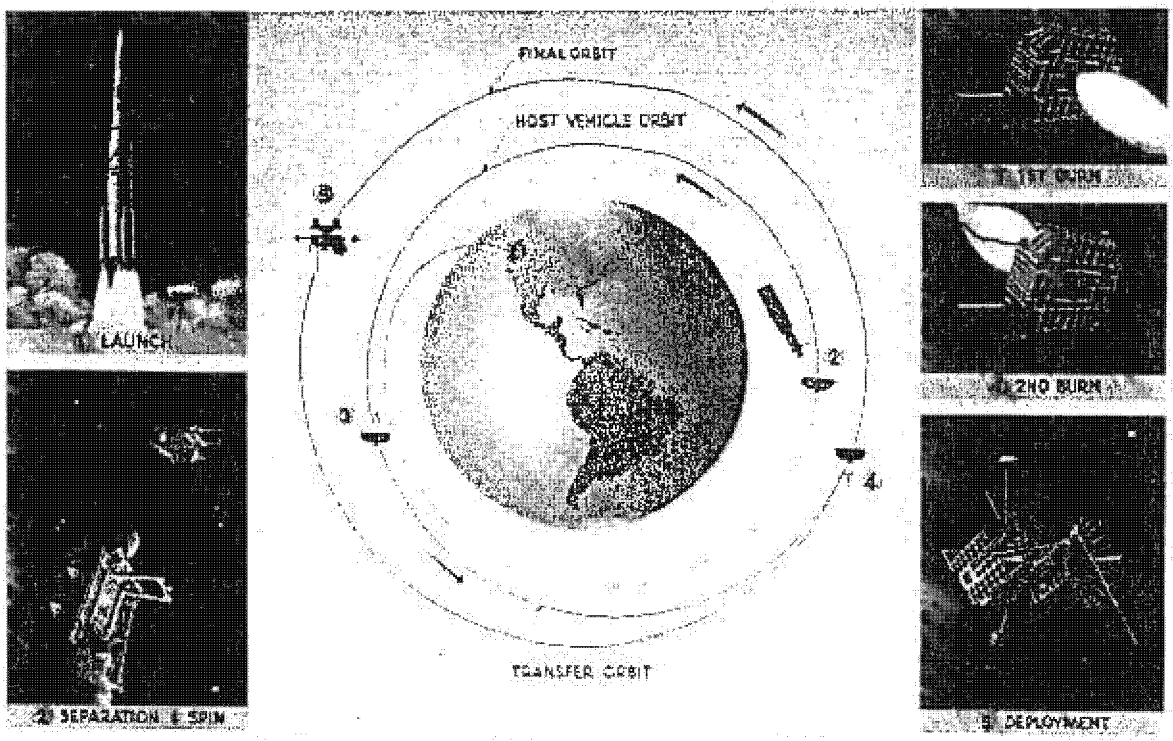
Figure 2.2 Project 989 sequence of launch events



Source: Bradburn, *SIGINT Satellite Story*, p. 138

(S//BYE) The Samos signals collector (the "F" payloads) had become Project 102, and then 698BK with its transfer to the NRO, and then Program 770 in 1965 when the Byeman security system was established.* The satellites' useful lives were foreshortened by vehicle problems (attitude control, batteries, and the like); none of the first eight BK flights lasted longer than 12 days, but finally in 1965 one operated for 51 days. By then Program A was embarked on a new system, Multigroup, designed for longer lifetimes

* The designations were changed by DNRO order on 21 November 1963, "essentially to change payload procurement from overt to covert. The overtly identified 698BK project will be terminated with the launch of FTV #2356 in Oct 64, and a new overt identifier of Project 770 was chosen as a cover for the covert sigint effort. First launch under Project 770 was to be FTV #2701 in Feb 65." Potts and [redacted] 25X1 "Chronology 2," citing Program A's *Quarterly Report*, 31 May 1964.

and more extensive and flexible collection. The first was launched on 28 December 1966 and lasted seven months, providing new information about the Hen House and Hen House II signals.

[redacted] Altogether these efforts were serving a small but growing interest in signals collection by satellites, largely for strategic purposes—mapping Soviet radars of different types, for SAC and for estimating military capabilities. The Program C and Program A activities could collaborate by cueing each other to locations and activities of interest and by sharing information about engineering designs.[11] They were not yet well suited for tactical support: latency was too high (2-3 months between time of collection and receipt of analytic product), geolocation not precise, and security procedures too restrictive. Nor were they providing the information analysts wanted about developments on Soviet test ranges, particularly anti-ballistic missile (ABM) systems.

ABM Imperative

[redacted] By the mid-1960s the United States had come to rest its hopes for strategic deterrence on the triad of Minuteman and Polaris missiles and B-52 bombers. Satellites had collected lots of information to help locate and defeat Soviet air defense radars, but only strategic missiles could provide what would later be known as "prompt hard target kill." A Soviet ABM system might substantially reduce the weight of an American missile attack, particularly if it were a predictably ragged retaliatory strike, a situation that might lead Soviet leaders, under the pressures of an unknown crisis, to launch a nuclear attack preemptively against American targets. The United States might then try to preserve its deterrent power by proliferating missiles to show that Soviet defenses would be overwhelmed, but doing so would probably bring on reciprocal efforts to ensure strategic adequacy—an arms race—which would itself undermine deterrence.

[redacted] Questions about a Soviet missile defense program had been growing for years. Was it exploratory research and development or actual production? Worse, was it actually being deployed, disguised as a new air defense system? And if it was deployed, would it actually work, or just as important for purposes of deterrence, would Soviet leaders believe it would work? By the end of 1965 American intelligence agencies disagreed over the nature of a system of missiles and radars then being deployed in the northwestern USSR. Most, including the CIA, believed it was a long-range air defense system. The military intelligence agencies generally disagreed. The heads of the Defense Intelligence Agency and the Air Force and Army intelligence services believed that it was more likely to be an ABM system, and the head of Navy intelligence and the director of the National Security Agency, thought it was simply too early to reach a conclusion.[12] All the intelligence agencies, however, agreed that the Soviet Union was building an ABM system to protect Moscow, that it would be ready not later than 1968, and that by 1975 the Soviet Union could deploy ABM defenses for "20 to 30 areas containing a quarter of the Soviet population and more than half of Soviet industry"[13] (percentages that mirrored public statements by Defense Secretary McNamara concerning the amount of "assured destruction" he thought necessary for effective deterrence).

[redacted] President Lyndon B. Johnson thought the intelligence estimate exaggerated Soviet capabilities, and the estimate did state clearly that "we do not yet know the performance characteristics of [the Moscow ABM system], or how it will function."[14] Without clear answers the administration faced tough challenges to its defense program, which had capped expenditures on strategic weaponry and increased spending for conventional forces. Uncertainty about Soviet defenses was bringing pressure to increase funding for American strategic missiles and bombers, which would sharply increase defense spending (expenditures on conventional forces could not be cut back because the Vietnam war was escalating) and jeopardize President Johnson's domestic programs for building a "Great Society."

[redacted] 25X1

[redacted] These developments came just as the third NRO charter was being agreed and before Flax had officially replaced McMillan. Deputy Secretary Vance had promised to decide whether to support the program by 3 September, but he remained silent, and so did Program B. McMillan's impending departure was by then widely known, as was the selection of Flax to replace him. In addition, new procedures were being established to manage the satellite reconnaissance program, the result of the McMillan's bureaucratic wars, in which he and Fubini had just months earlier denigrated [redacted] expense and value. The new NRO charter might require significant changes in the [redacted] 25X1 it anticipated that Program B would normally be responsible only for sensors and Program A for the spacecraft.* Such a division of labor was very much what Secretary McNamara desired, and the new director of central intelligence, Admiral Raborn, believed that Vance and Air Force Secretary Harold Brown were trying to change McNamara's views, at least for the [redacted] By the end of the month Vance agreed to let the selected contractors proceed on a sustaining basis, pending independent reviews of the sensors and spacecraft, a definitive management plan, and a cost-effectiveness study. Raborn countered by suggesting that the President's Science Advisory Committee (PSAC) conduct the technical review, but on 6 October, five days after he officially took office, the new NRO director, Alexander Flax, got ExCom approval to take on all three tasks.[18]

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* This provision, of course, did not mean that only Program B would be responsible for sensor development. "Assignment of responsibility for engineering development of sensor subsystems will be made to either the CIA or DOD components .... The engineering development of all other subsystems, including spacecraft, reentry vehicles, boosters and booster interface subsystems shall in general be assigned to an Air Force component .... To optimize the primary objective of systems development, design requirement of the sensors will be given priority in their integration within the spacecraft and reentry vehicles." "Agreement for Reorganization," [D(d)].

~~(S//BYE)~~ How should the program be managed? Flax told the NRO staff director, Brig. Gen. James T. Stewart, USAF; SAF-SP staff member Colonel Paul Heran, USAF; and John McMahon, CIA-OSP, to work together to provide him with recommendations.[19] Would the system be able to collect valuable information? Flax followed Vance's lead and called on James Fletcher to chair a group of outside experts* to assess the expected risks and performance of the [redacted] Were there more cost-effective options available? For that question, he created a "cost effectiveness task group," charged with making "a comparison of the trade-offs of all proposed [redacted] with existing or planned systems which have parallel capabilities, including cost comparisons."[21] Meanwhile, the program essentially was delayed for a year; on 23 November 1965 the ExCom reprogrammed its funds while these reviews were underway.[22]

~~(S//BYE)~~ Flax also asked advice from the National Security Agency (NSA), at least partly in the hope of building better working relationships, although [redacted] was a politically charged subject. NSA's leaders had long quarreled over telemetry with CIA, whose analysts believed NSA paid too little attention to the topic. Still, Lt. Gen. Pat Carter, John McCone's former deputy at CIA and now NSA's director, replied to Flax that [redacted] He

25X1

* Flax created an "Independent Task Group" chaired by James Fletcher, University of Utah; members were Gerald Dinneen, Lincoln Laboratories; Richard Garwin, International Business Machines; Frank Lehan, Space General Corporation; Donald Ling, Bell Telephone Laboratories; William Rambo, Stanford Electronic Laboratories; and Leonard Scheingold, Sylvania Electronic Systems, Inc. The previous year, at Wheelon's request, Garwin and Rambo had reviewed plans for [redacted] and endorsed the program enthusiastically. (Kleyla, *Office of Special Projects*, p. 196.)

25X1

doubted that the Program B plan was the best approach, however, and strongly urged that Flax not agree to the [redacted] He concluded by raising a chronic complaint of NSA's leaders: "it would be useful to me if you would indicate the role you feel NSA should play in further defining the payload characteristics of the space vehicle design."[24] In general, the NSA leaders seemed for some time to have believed that their role as national sigint managers had not been accorded enough weight in NRO planning (although they worked closely with Program C on the Poppy elint system). 25X1

(S//BYE) The management team's report gave early promise that the NRO might finally be concentrating on serving the nation's needs instead of personal animosities. After briefly reviewing five popular permutations of management authority and relationships between Programs A and B, the team recommended that CIA be in charge of the satellite and Program A in charge of launching it.* Flax objected that the report provided him with only a recommendation, not alternatives,[25] and the management team thereupon rewrote it to explicate further the alternatives it had rejected, but not to change the final recommendation.†

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* These assignments matched tasks with capabilities. CIA had expertise with the sensor, and the task group found "extreme difficulty of adequately defining interface between spacecraft and sensor functions." The group also shared a "conviction that one authority and one contractor should be responsible for design integrity and the translation of design to hardware." Stewart, et al., "Task Group Report," pp. 20-21.

† The rewritten report spent considerable effort relating alternative management structures to various recommendations that might be made by the technical merit team, such as redesign or further feasibility studies. At the time of the management team rewriting exercise, Stewart reported that "Flax fully expected the [technical merit] Panel would not recommend a full go-ahead;" McMahon knew differently, but kept the secret and went along with the management rewrite. McMahon, "Meetings of the [redacted] Management Task Group." 25X1

[redacted] The fundamental question was whether the project was worthwhile. Fletcher's panel was slow in reporting but strong in its support of [redacted] The panel determined that the satellite was quite likely to collect [redacted] There appeared to be no insurmountable technical problems; the project was well managed; and sound engineering judgements were being made. At the same time, the panel warned that [redacted] was likely to cost more and, in some respects, do less than expected. Some ancillary developments would improve its geolocation capability, which was likely to be poor, and there needed to be considerable improvement in ground processing to handle the large volume of information [redacted] would provide. [redacted]

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[redacted] By mid-March 1966 Flax had formulated his views and got support for them at a meeting with the PSAC on the 22nd. He presented them to the ExCom on 26 April, saying that [redacted] should be limited to collecting the [redacted] that was its primary objective. Removing the antennas and receivers intended for other frequencies would simplify the spacecraft, reduce the risk of development problems, and make the program cheaper. He requested revised program plans from CIA, adopted the management structure recommended by the task force, and provisionally endorsed the [redacted] pending further studies on downlink security and encryption.[22] The ExCom agreed, and four months later, with those studies in hand, together with revised cost and schedule information, it authorized CIA to proceed with the reduced [redacted]

[redacted] The second program of the NRO that could directly address the Soviet ABM questions concern had been started when McMillan and Fubini tried to replace [redacted] with a non-NRO Air Force program. The precise nature of the program they envisioned is not clear; at various times they talked about other defense needs for geosynchronous satellites, including weather, communications, and nuclear detection, and McMillan even suggested occasionally that the elint mission could be performed by a [redacted] In any event, on 5 November 1964, half a year after he had been briefed on CIA's research, McMillan told Wheelon that the Air Force was undertaking studies of [redacted] 25X1 Wheelon and others in CIA protested McMillan's intention to share sensitive data from the [redacted] with Air Force and other Defense Department elements outside the NRO and Byeman security system,[10] and on that point McMillan and Fubini appear to have retreated, although they never specifically said so. Over the next several months Program B heard repeatedly from industry leaders and others that Fubini, McMillan, and officers in Program A were talking about awarding contracts for an Air Force [redacted] program.

[redacted] Talk of a new program proved premature, but studies were underway and by the end of summer 1965, discussions among engineers from Program A, NSA, and Lockheed led to a concept for intercepting [redacted] at the Soviet [redacted]

[redacted] 25X1

[redacted] A third approach to collecting information about Soviet ABM programs was still at a conceptual proposal stage, [redacted] 25X1

[redacted] 25X1

[redacted] Money had, in fact, become a major concern. In his initial letter to Carter, Flax noted that "unfortunately, the funds required to undertake the overall satellite sigint program exceed by a sizable margin the total amount contained in the President's budget."[35] At that time [redacted] 25X1 was still in a "delay" status; once it started again, funding problems would be even worse.

[redacted] Yet the sigint satellites were being pressed to do more. Sigint had been only a secondary interest from the start of the reconnaissance satellite program, and for several years it provided little help to tactical military operations. Now defense leaders were demanding more, particularly as military operations in Vietnam increased. Harold Brown, secretary of the air force, wrote to McNamara that in the photo satellite program, satellites were launched in response to requirements, vehicles were standardized and advanced versions were being developed, and results were reported within a few days of recovering the film. For the sigint program, in contrast, "reporting, on the whole, averages 2-3 months after interception of data, and launches frequently seem to be based on R&D factors and/or the space available on a photo satellite to carry a sigint sub-satellite."[26] He went on to note that the sigint satellite program had met neither collection nor processing and reporting needs, and urged McNamara to support a forthcoming NRO proposal to give sigint higher priority.[27]

[redacted] Others were less eager, fearing dislocation in anticipated budget allocations. Planned expenditures for sigint tripled as a component of the NRP in Flax's first year as director, jumping from less than five percent to more than fifteen percent of the budget. At the end of 1966 Flax presented his recommended program for FY1968 to the ExCom, [redacted] than provided in the most recent defense program decision (the Defense Secretary's guidance for how funds would be distributed over the five-year defense plan).[28] Warned well in advance that the NRP would be asking for a large increase, other agencies had already begun calling for studies and reviews of alternatives and priorities. Collection of these signals might be important, but what might it displace? Was enough being done to tap the "second order potentials" [redacted] and Bird Watcher III?[29] And could not enough of the important information be collected from other, non-satellite platforms (Table 2.5)?

25X1

Table 2.5
Signals collection without satellites

Type	Examples	Comment
Reflections		Needs prior knowledge of frequency due to clutter. Higher sensitivity problems.
	Moon bounce	
	Objects	
	Arecibo	
	Multiplate	
Seaborne		
	Seven technical research ships (*Liberty*, *Victory* class)	
	Three smaller ships	
	Small installations	
	Waterboy—three nuclear submarines	
Aircraft		
	RB-47, Box Top	Operate in Baltic Sea.
	C-97, Creek Rose	[redacted]
	EA-3B, Chaingate	
	RB-47, Box Top	Barents Sea
	EC-121M, Chaingate	
	U-2	Also limited capability.
	SR-71	
	RC-135, Briarpatch	
	RC-135, Wanda Belle	
Miscellaneous		
	Stationary balloons	Difficult, shifting platform.
	Elint on Manned Orbiting Laboratory	Future not clear.
	Over-the-horizon systems	[redacted]

Source: Davis, briefing.

25X1

~~(S//BYE)~~ Indeed, studying the value of satellite sigint had become somewhat of a cottage industry by 1965. In January the U.S. Intelligence Board's Committee on Overhead Requirements set out to devise a common measure for electronics, communications, and telemetry signal collectors.[20] At the end of April, with Admiral William Raborn in office as the new director of central intelligence, the overhead requirements committee created a special "cost-effectiveness task force" to review and evaluate the reconnaissance satellites. This effort extended through 1966. Meanwhile, McNamara's assistant secretary for systems analysis, Alan Enthoven, wanted to have his staff study the cost effectiveness of overhead reconnaissance.[41] Charles Schultz, head of the Bureau of the Budget, pressed for a "target-oriented program structure" to relate resources to requirements for national intelligence programs.[42] Richard Helms, director of central intelligence, posed "20 questions" as a way "to help us substantially in assessing the value and improving the efficiency of [sigint] activities."[43]

(S//BYE) The thirst for outside studies and reviews and reports and commissions on space-based sigint was not quickly slaked, but the swarm of activities was not likely to redirect the programs significantly, particularly when substantive intelligence needs were at stake. "The president is fed up with the people telling him all these fables about the Soviet ABM program," Don Hornig, Johnson's science advisor, told NRO director Flax. "He's getting harassed by members of his own party saying they are getting way ahead of us, etc."[44] The president wanted to put an end to this carping and needed solid evidence, which could only be obtained from satellites [redacted] 25X1

(S//BYE) The U.S. Intelligence Board promptly revised its sigint priorities and put Soviet radar signals associated with ABM development at the top of the list.[45] Helms then wrote to Vance that "it is essential that every effort be made to meet this requirement within the next twelve months," and urged NRO funding to develop an improvement program and an expanded launch schedule of P-11/P-13 satellites.[46] The President's

Scientific Advisory Committee wondered why existing elint satellites were not collecting the ABM signals, and at its meeting on 6 December heard a CIA representative speculate that Soviet operators turned off the radars when US satellites were in view.[37] In fact, Poppy was collecting the signals (as was the Moon Bounce activity), and analysis by [redacted] sensors on the Multigroup satellites would not be able to collect more than one successive pulse, [redacted] The science committee also wondered what near-term measures could be taken, and on 7 December Flax described ways to improve collection using Multigroup and P-989 satellites. Within another few days, Program C had developed options for giving future Poppy satellites more ABM collection capability as well.[39] On 16 December the ExCom approved the proposed adjustments in coverage and operations.

25X1

[redacted] Such quick responses could help address immediate problems, but they were made possible only because they were episodic excursions from more fundamental, longer-term programs. And the president wanted a satellite system dedicated to the Soviet ABM problem. But the disproportionate cost required for a dedicated system that would collect relatively few useful signals was troubling to Flax. Certainly the president's concern could not be ignored, but perhaps it did not require the use of the dedicated satellite system that he had demanded. "There was no question in what you did to implement [the White House direction]," he said, "but on the other hand it seemed like a tremendous expenditure of resources considering that we would be seeing useful signals a very small fraction of the time. We had to persuade him to modify that view. We would fulfill the requirement but in another way so that the system could perform other functions—they were not dedicated."[50]

(S//BYE) What was needed, Flax understood, was a strategic plan for overhead sigint, and a thrash of contending bureaucratic interests would not produce it. He needed a coherent reconnaissance program, one that showed clearly how the collection of future space-based sigint sensors would help meet the future principal intelligence collection needs—in brief, he needed an architecture. At the same time, a plan generated solely within the NRO could be suspected of being self-serving and would not be very influential, while reports prepared by outsiders too often seemed technically and programmatically naïve. Flax therefore created a committee, including experts from NSA, CIA, and DIA, to review and make recommendations concerning options for future sigint satellite programs.[51] As chair he selected Harry Davis, a specialist in communications and electronics who was deputy to Flax in his "white world" position as assistant secretary of the air force for research and development.*

Figure 2.3

Harry Davis
Source: Bradburn, *SIGINT Satellite Story*, p. 226.

A Sigint Satellite Architecture

(S//BYE) The Davis committee began work on 4 January 1967, charged with recommending a strategy for the NRP to meet the demand for information about Soviet

* Members were Harry Davis, appointed as a special assistant to Flax; John Cromach, NSA; Thomas Haig, SAF-SS; Harold Willis, CIA; Thomas Legett, DIA; Harry Lorenzen, NRL; Charles Willis, SAF-SS; and [redacted] SAF-SP. 25X1

ABM capabilities.* It was to provide technical assessments of alternative approaches and recommend future programs, including schedules and budgets. To search for information about signals from Soviet ABM programs required scanning broad ranges of frequencies, power outputs, and geographic areas, for long periods or even continuously. The means of conducting the search would be constrained by the cluttered electromagnetic environment, the speed and cost with which the current state of the art could deliver needed capabilities, possible intentional avoidance, and orbital mechanics.[52]

Figure 2.4 Davis Committee

TOP SECRET

NRO Action Memorandum #10 directed the committee to:

1. Provide a technical assessment of the alternative approaches considered, and the potential results which could be achieved.

2. Recommend a program to be pursued in addition to the near term program currently being implemented.

3. Provide a schedule for the program accomplishment.

4. Provide a budgetary cost estimate of the recommended program.

Committee Membership:

Mr. Harry Davis, NRO
Dr. John Cromach, NSA
Col. Thomas Haig, SAF-SS
Mr. Harold Willis, CIA
L/Cdr Thomas Legett, DIA
Mr. Harry Lorenzen, NRL
Mr. Charles Willis, SAF-SS
[redacted] SAF-SP 25X1

TOP SECRET

Handle via BYEMAN
control system

Source: Davis et al., briefing, p. 1.

* At the time, the commonly used reference was "ABM/AES," anti-ballistic missile/anti-earth satellite. Later the "AES" usage became replaced by "ASAT." This study adopts the recent usage, with the understanding that much of the work on ABM capabilities could apply to ASAT capabilities against satellites in low earth orbits.

[redacted]

ABMs. For immediate measures, the committee recommended making ABM collection the priority for all sigint systems; extending the frequency coverage of the BIT vulnerability sensors and flying more of them; building and flying Poppy satellites with a full [redacted] improving ground processing to provide real-time data sort by location; and flying five new low-altitude P-11 satellites specifically targeted for ABM intelligence. 25X1

[redacted] In addition to satellites there were elint collectors on ships, submarines, airplanes, balloons, and other platforms, including the planned Manned Orbiting Laboratory. Soviet signals could also be collected as they bounced off the moon, space debris, balloons, and test vehicles. Submarines in the Gulf of Finland might be able to [redacted] otherwise, for the ABM problem, little could be expected from these collateral methods. More could be done if they shared a common time referent, with differences of less than a second.

[redacted] 25X1

Figure 2.5 Davis Committee Recommendations

[redacted]

RECOMMENDATIONS

Pursue following program

	FY-67	FY-68	FY-69
Additional [illegible]	1.00	2.50	1.00
[illegible] additions	.25	.50	.25
Supporting R&D	.62	1.25	1.75

[redacted] 25X1

Continue balloon work; run system performance tests; investigate satellite readout of clandestine transmitters; pursue certain corollary programs.

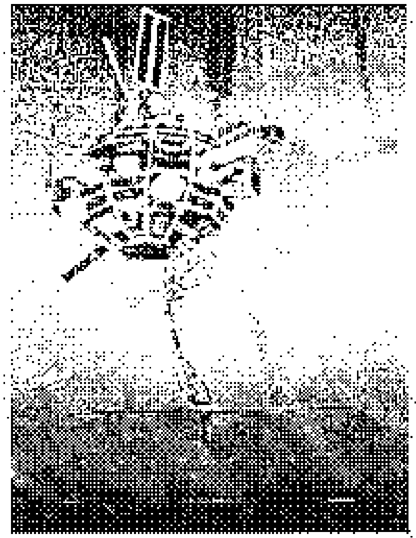
[redacted]

Handle via SYEMAN
control system

Source: Davis et al., briefing, p. 44

([redacted]) The NRO moved quickly to implement these near-term measures. On 10 April 1967 Flax reported progress on each one.[54] The next Poppy satellites, due to be launched within a few weeks, had been modified to provide [redacted] More timely analysis of interesting signals was also expected once improvements were made to equipment at the Poppy ground station at [redacted] The following Poppy mission was changed to launch earlier than planned; to fly four satellites instead of two, cover a broader frequency range, and to provide more accurate signal characterization. A P-11 satellite, "Façade," was being modified to collect signals from 350 MHz to 2200 MHz and was scheduled for launch in September. Two further P-11s were being reconfigured and four more were on contract. All were intended for the ABM mission, all scheduled for launch before the end of 1968. There were plans to fly more BIT boxes, the small recorder-receiver units designed to detect Soviet radar tracking of US photoreconnaissance satellites, and they were redesigned to cover a broader frequency range.[55] Program A had also devised a way to sustain longer observation of [redacted] by flying a modified P-770 Multigroup satellite at a higher orbit, although a crash program to do so would be costly and face high technical risks. Finally, plans were underway to coordinate collection against [redacted] with submarines in the Baltic, and to use U.S. radars to test future elint payloads. 25X1

Figure 2.6 Poppy [redacted]



Source: Potts, p. 342.

25X1

25X1

Approved for Release: 2017/08/16 C05099702

[redacted]

[redacted] 25X1

Figure 2.7 [redacted]

Col David D. Bradburn

Source: Bradburn, *SIGINT* [redacted] *Satellite Story*, p. 201.

[redacted]

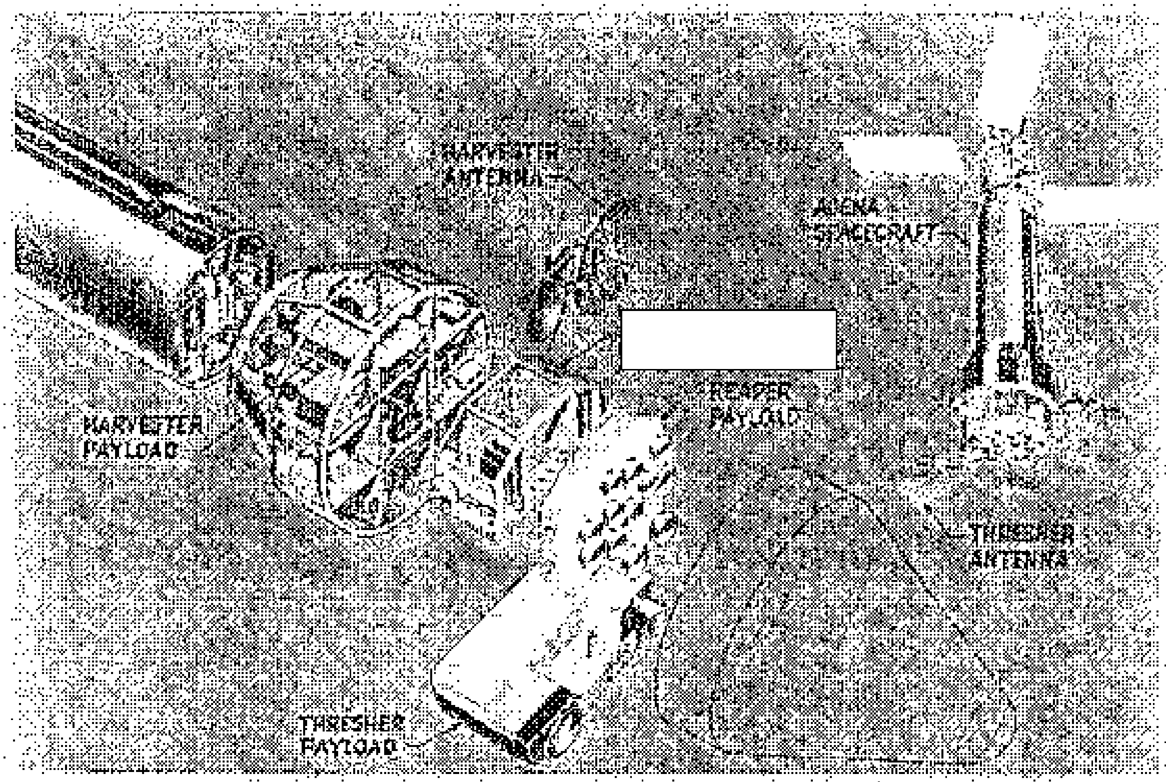
[redacted]

25X1

[redacted]

[redacted] One low-orbiter program effectively had been canceled already: there were no more Aftrack payloads, in part because Corona was phasing out and also because the sigint packages could be added to larger independent sigint satellites and so enjoy longer lifetimes and orbits of greater interest. They migrated to Multigroup, the latest satellite design from Program 770. It was a collection of receivers on a stabilized Agena, designed primarily for identifying and locating known radar signals ("electronic order of battle" collection) but intrinsically capable of conducting some general search and directed coverage.[30] Three were launched (24 December 1966, 24 July 1967, and 17 January 1968) and operated from six to 14 months in orbit. A separate payload called "Setter" covered S-band frequencies and provided accurate radar positions by means of an on-board computer that sorted pulses by location using an interferometer antenna. The second Multigroup included "Donkey," an add-on payload to map [redacted] 25X1 communications links and do a limited amount of communications intercept. Multigroup gave way to the more capable Strawman series; one of the core sensors, "Thresher," could geolocate emitters within 15 nm, and another, Reaper, the successor to Setter, could do so within 5 nm. Four Strawman satellites were launched (one each year during 1968-71) and each operated for several months in orbit. Despite these successes, P-770 could offer few substantial advantage [redacted] and so this line of elint collectors, which traced a lineage back to the Samos Ferrets, also ended.

Figure 2.8 Strawman payload vehicle

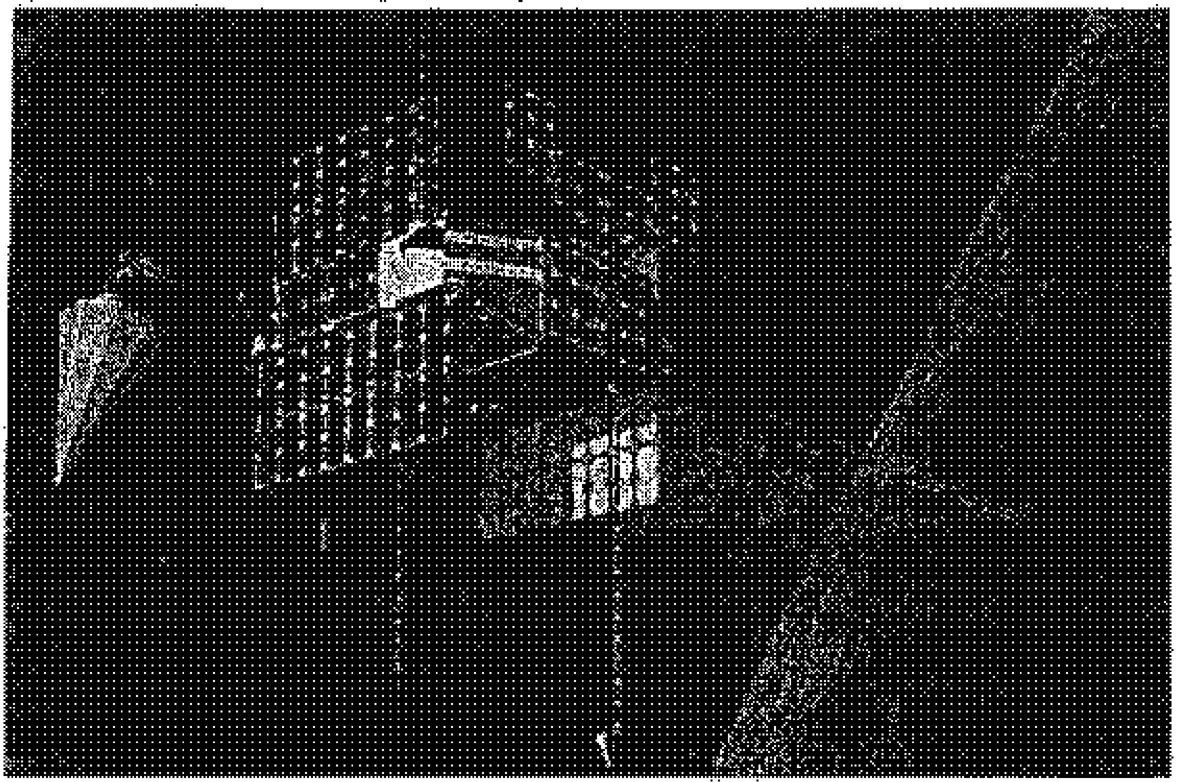


Source: Bradburn, *SIGINT Satellite Story* p. 102

25X1

[redacted] Two other programs seemed less likely to disappear. Program A had several P-11 satellites on order from Lockheed; they provided most of the low orbiter collection aimed directly at the Soviet ABM program (the six missions Flax specified in December 1967). "Slewto" (9 May 1967), "Tivoli I" (24 January 1968), and "Tivoli II" (19 March 1969) primarily served to collect technical intelligence. "Façade" (2 November 1967), "Lampan I/ Sampan II" (14 March 1968), and "Vampan I" (18 September 1968) had payloads primarily intended for search. Several others primarily served communications intelligence or general search missions. Some in Program A anticipated that it would be difficult to give up the flexible and inexpensive P-11s, whatever the merits of the future elliptical system.

Figure 2.9 Tivoli technical intelligence P-11 spacecraft



Source: Bradburn, *SIGINT Satellite Story*, p. 147

[redacted] Poppy was another program that was not likely to die quietly. It was contributing strongly to the ABM mission; as the Davis committee had noted, however, the better answer to that problem was found through higher orbits. But in recent years a new problem was beginning to emerge, and it was one that Poppy or a derivative could address: ocean surveillance. The Navy was concerned by recent growth in Soviet naval forces and expansion of their areas of operation; it appeared that the Soviet navy was aspiring to a global, blue-water capability. McNamara dismissed these concerns, citing the lack of extended support facilities, but his arguments did not persuade the admirals. In 1967 they began asking Poppy ground stations to look for maritime radars (on a not-to-interfere basis), conducted a substantial review of the service's involvement in space activities, and created a flag-level director of space programs in the office of the chief of naval operations.

Better Than New

[redacted] Enabled by advances in spacecraft and sensor engineering and propelled by the warrant of the president's concern over Soviet ABM developments, Flax forged an assemblage of space-based sensors into a sigint satellite architecture in less than two years. It was, he pointed out, an organic evolution rather than a blueprint: "As soon as we said we could go to high orbit, people started coming up with these various capabilities that were possible. . . . So we had to come up with some rationale for what we were going to do and who was going to do it. So rather than being motivated by the intellectual satisfaction of creating an architecture, we were forced to create an architecture."[567] As such, it reflected continuing pressures of ongoing operations as well as the potentials of proposed new developments.

[redacted] Some of those continuing pressures were flare-ups of the inescapable bureaucratic wrangles over issues of process and prerogative. Flax recognized that McMillan's wars had for a time vaccinated the NRO from renewed conflict between its CIA and Air Force components. He himself took care to build community support for his program, talking through issues with John S. Foster and Cyrus Vance in defense, ensuring good treatment for CIA interests and sensitivities, including NSA as a partner in system planning and ground station operations. Flax put a stop to CIA's work toward its own launch system, restructured the emerging Hexagon program to include both Programs A and B, and terminated Program A's low orbit sigint work—decisions like these, coming from someone less credible and skillful, might well have reignited internecine warfare. In fact, Flax succeeded in keeping everything within the NRO community. He turned to outside review only once, when he asked Fletcher to evaluate [redacted] potential, which he did in the hope of soothing nerves that had long ago rubbed raw. Moreover, Flax was helped throughout by the mediating influence of his popular deputy, Jim Reber. 25X1

[redacted] In fact there appears to have been only one instance during Flax's tenure in which issues connected with satellite reconnaissance spilled outside the ExCom and intelligence community. It began in 1967, by which time space-based sigint operations had been growing substantially; in that year the intelligence community revised its requirements structure, creating separate sigint and imint committees in place of the earlier Committee on Overhead Reconnaissance. The operations were also becoming very expensive: there were new satellites to buy as well as the systems for ground processing, analysis, and distribution to make them useful in meeting the new demands for ABM intercepts and support to military operations. Opposition was sure to arise, as it did at mid-year. At NSA, Director Carter had created a new organization to focus on sigint activities, following a review of sigint operations and plans for handling the large amounts of data that would be collected by the new NRO satellites. The programmatic result was a sharp increase in estimated costs, which took the Bureau of the Budget by surprise. Its director, Charles Schultze, promptly fired a memorandum to the White House calling for an extensive review of sigint activities. DCI Helms protested that Schultze's arguments were not well founded, but he agreed that "doubts about the adequacy of the present structure and controls are strengthened by the mounting costs of the sigint effort over the past years; which are best illustrated by the current request by NSA for an additional amount for FY69 which exceeds by at least [redacted] the amount authorized for FY68."[68] According to a CIA history, Robert McNamara, Clark Clifford, and other senior administration officials collaborated in shaping an approach to reviewing NSA's role in sigint that would have Helms be in charge of the study with backing from the Defense Department.[69] President Johnson agreed with this approach, and six weeks later, Helms signed terms of reference for a group from outside government, charging it to conduct a wide-ranging "objective appraisal of all significant management, policy and operational aspects of the sigint activities of the US government. The purpose of the appraisal is to make these sigint activities as responsive as possible to national needs at minimum necessary cost."[70] Helms chose Frederick M. Eaton, a lawyer with the New York firm Sherman & Sterling, to chair the group, and General Lauris Norstad, Eugene Fubini, and Ambassador Livingston T. Merchant as members. 25X1

[redacted] Eaton convened the first committee meeting on 5 September 1967 but soon started to work independently of the other members and the staff, which had been seconded from various intelligence and defense offices. Using a single staff writer, who was enjoined from talking with others, he prepared several draft recommendations and circulated them in May 1968. His suggestions were roundly criticized, not only by NSA, which had objected at the outset to the committee's terms of reference, but also by reviewers in the Defense Department, CIA, and the NRO. The final report, which included at least some consultation with other committee members, was sent to Helms on 16 August 1968. One of Eaton's recommendations in May was the creation of a "National Intelligence Resources Board" to provide long-range planning, and such an organization soon came into being, but it is not clear whether the new board was created in response to Eaton's recommendation or whether Eaton simply recommended something that he had learned was already in work. Otherwise, despite the salience of the effort and the attention it got from top administration officials, Eaton's work had no effect on sigint operations, and budgets for space-based sigint systems continued to grow.[72]

[redacted] Perhaps no better evidence could be found to show that the NRO's sigint architecture was now well established. Before Flax arrived, space-based sigint accounted for only about five percent of the NRO's budget and consisted of a collection of ad hoc systems. When he left, it represented nearly a third of the budget and had been structured into a coherent architecture responsive to national needs.

[redacted] And the sigint work was only one part of Flax's triumphs. The renaissance of the NRO by the end of 1968, its strength as an organization, could not have been imagined three years earlier. The success came largely because of Flax, who steadfastly refused to give first place to matters of institutional procedure and bureaucratic prerogative. He would measure success in terms of substantive accomplishments for national security, rather than bureaucratic clout. He brought the same perspective to decisions about programs, evincing a rare ability to see beyond the argumentation surrounding particular proposals, to focus on matters of capability rather than process; to ask whether it was really a good idea. Was it a capability the country would need? The [redacted] for example, in its early days had many critics who argued that it would not be successful in collecting [redacted]. In later years Flax confessed that he too doubted that the system would meet the "requirements" as advertised. But he supported 25X1 going ahead with it, because of the capabilities that were being developed. By the time it reached orbit, he reasoned, the specific targets of interest would probably be different from what they were in 1965, but the capability that [redacted] represented would still be needed. 25X1

(U) He reasoned better than he knew.

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[1] Perry is slightly more positive: "the NRO at the time of McMillan's departure was probably less influential than at any time since its creation . . . ." *Management*, p. 204.

[2] Butterworth, *Quill*.

[3] ADW; and Air Force..?

[4] Perry, *Management*, p. 204.

[5] Discussion of elint and radar analysis is drawn from Wiley, *Electronic Intelligence: The Analysis of Radar Signals*, preface and chs. 1 and 11, Unclassified. Discussion of intercept problems and approaches is from Wiley, *Electronic Intelligence:The Interception of Radar Signals*, chs. 1 (Secret) and 6.

[6] Information in this paragraph about the Navy program is drawn from Ronald Potts, pp. 157-190.

[7] Development of [redacted] is recounted briefly in Busher and Chaid, pp. 17-18. In that study, incidentally, the numbering of the Poppy missions is increased by one; what Potts (and this present study) call Poppy 4 is Poppy 5 to Busher and Chaid. 25X1

[8] Ronald Potts, p. 162.

[9] Busher and Chaid, p. 14.

[10] Busher and Chaid, pp. 23-24.

[11] "Probabilities of detection for Program A's elint satellite systems were independent of radar scanning characteristics but highly dependent on the combination of antenna footprint and RF tasking. Often cued by Poppy tip-off, for payload design or tasking and for searching previously recorded data, lower-altitude systems employed individually distinct directional antennas and scanning receivers to detect and measure side-lobe radiation." Potts, p. 170.

[12] National Intelligence Estimate 11-3-65, "Soviet Strategic Air and Missile Defenses," excerpted in Haines and Leggett, *CIA's Analysis of the Soviet Union*, pp. 150-152 (U).

[13] *Soviet Defenses*, p. 151 (U).

[14] *Soviet Defenses*, p. 151 (U).

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[15] Maxey, [redacted]

[16] Lauderdale, "Report of the Contractor Evaluation Team–[redacted]

[17] Kleyla, pp. 200-201. The pertinent parts of the 1965 charter read (D.1.d): "Assignment of responsibility for engineering development of sensors subsystems will be made to either the CIA or DoD components in accordance with the above criteria. The engineering development of all other subsystems, including spacecraft, reentry vehicles, boosters and booster interface subsystems shall in general be assigned to an Air Force component . . . ."

[18] "Dr. Flax stated that he planned the following actions: (a) a technical evaluation by an independent panel . . . . (b) [concerning program management, Flax and] Mr. Vance and Admiral Raborn agreed that, although the references aspect of the Agreement [the most recent NRO charter] was a general guide, each case should be examined on merit . . . . (c) a cost-effectiveness study . . . . The Executive Committee concurred in [these] actions." ExCom Minutes of Meeting held 6 October 1965, pp. 3-4.

[19] Flax, "DNRO Action Memorandum No. 3, Terms of Reference for the Project Management Task Group for the [redacted]

[20] Flax, "DNRO Action Memorandum No. 4, Terms of Reference for an Independent Task Group to Evaluate the [redacted] 25X1

[21] Flax's deputy, drawn by charter from the CIA, James Q. Reber, chaired the group. Members were Max Oldham, CIA-SAS, and Thomas Rogers, DoD/DDR&E. Harry Davis, deputy assistant secretary of the air force for research and development, served as technical advisor; and Roger Thayer, an NSA expert assigned to the NRO staff, served as consultant. Flax, "DNRO Action memorandum No. 5, Terms of Reference for the cost-effectiveness task group of the [redacted]

[22] Kleyla, p. 202.

[23] Carter, "National Reconnaissance Program Satellite Launches," p. 1.

[24] Carter, "National Reconnaissance Program Satellite Launches," p. 4.

[25] Flax would not have been particularly troubled by the deviation from the division of labor between sensor and satellite presumed in the new NRO charter. At a CIA briefing provided him in anticipation of his assuming the directorship, Flax said that "hardware development and production must not be dictated solely by administrative agreements as there must be logic to the interface definition." Sether, "Notes on the briefing of Dr. Flax, Mr. Reber, and Gen. Stewart 9 September 1965," p. 9.

[26] Information in this paragraph is drawn from "[redacted] Technical Task Group—Final Report," attached to Fletcher, "Report of technical task group on [redacted]

[27] Flax, [redacted]

[28] Anonymous, "Activity Report, Office of Special Projects, September 1966," p. 5; Flax, [redacted]" This description, as in several other places

in this manuscript, differs from the account provided in Bradburn et al. They report that the Fletcher task group reported back to Flax on 31 August 1966 and that it "was key to getting ExCom approval. On September 1966, three years after Bud Wheelon read about SynCom II in the New York *Herald Tribune*, the ExCom approved the [redacted] The timing and effect of the Fletcher report is as incorrect as the fairy story about Wheelon and the newspaper article (as already shown in chapter one of the present study). As noted above, the substance of the task force recommendation was known to some (John McMahon among them) as early as December 1965, and the copy of the report in the AARC has a penciled notation that it was typed 22 January 1966. The Bradburn team probably copied the error from anonymous [redacted] p. 3, HOF.

[29] Kleyla, 195.

[30] Kleyla, *Office of Special Projects*, p. 196.

[31] National Reconnaissance Office, "Report to the President's Foreign Intelligence Advisory Board on the National Reconnaissance Program, 1 July to 31 December 1967," p. 7.

[32] Givens, [redacted] Preliminary Results." 25X1

[33] Flax, "NRP Budget for Fiscal Year 1968," p. 4.

[34] Carter, "FY1967 NRO Satellite Sigint Program."

[35] Flax, "FY1967 NRO Satellite Sigint Program."

[36] Brown, "Increased emphasis on the sigint satellite program." According to Potts, in October 1965 "[redacted] Latency averaged three months, from time of intercept to publication." Ronald Potts, *GRAB & Poppy*, p. 176.

[37] Program C and NSA had been working to remedy this deficiency, the "latency" between need and response, in the Poppy program starting in 1963: "Months passed between data collection and NSA's issuance of reports, due to collection at remote sites, analog tape shipment to Fort Meade via bi-weekly courier runs, and the tremendous amount of work performed by NSA for tape handling, analog/digital conversion, location processing, output evaluation and correlation, and hard copy issuance of results." Ronald Potts, *GRAB & Poppy*, p. 149.

[38] "The DNRO Recommended FY1968 Budget for the National Reconnaissance Program," attached to Flax, "NRP Budget for Fiscal Year 1968."

[39] These "second order potentials" were part of the charge to the Fletcher panel that Flax had convened to review the merits of [redacted] Flax, "Action Memorandum No. 4").

[40] Ronald Potts, *GRAB & Poppy*, p. 169.

[41] Flax, "Systems Analysis Studies of the National Reconnaissance Program."

[42] Schultz, letter to Robert S. McNamara, 10 November 1966.

[43] Richard Helms, letter to Robert S. McNamara, 28 October 1966.

[44] Flax, interview, 21 November 2002.

[45] USIB action was dated 17 November 1966. It was contained in USIB-D-41.14/303, according to Bradburn et al., *SIGINT Story*, p. 59.

[46] Helms, letter to Cyrus R. Vance, 21 November 1966.

[47] Ronald Potts, *GRAB & Poppy*, p. 191.

[48] Ronald Potts, *GRAB & Poppy*, p. 195.

[49] Ronald Potts, *GRAB & Poppy*, pp. 191-192.

[50] Flax, interview, 5 March 2003.

[51] Bradburn et al., *SIGINT Story*, p. 59, credit the President's Science Advisory Committee with creation of the ABM/AES Technical Committee (the Davis committee), but identify no source. Documents found to date do not address the subject. The account provided in the present study reflects information provided by Flax in two interviews with the author.

[52] Davis et al., briefing, p. 18.

[53] Davis et al., briefing, p. 32.

[54] Information in this paragraph is drawn from Flax, "ABM/AES Requirement (ExCom Agenda Item)."

[55] In 1967 photoreconnaissance satellites began flying with BIT sensors called OTEX (Orbital Test Experiment), intended to show detection and tracking by various large Soviet radars in several frequency ranges. The KH-4, -7, and -8 satellites used BIT IV and BIT V, and KH-9 used BIT IX. Busher and Chaid, p. 24.

[56] Other advantages included a lesser dynamic range requirement, no continuous programmed pointing, and the possibility of [redacted] which would permit lower frequency coverage, flexibility to survey any area of interest, and sorting of signal from clutter." Davis et al., briefing, p. 33. 25X1

[57] NSA, "Comparison of proposed elint systems," appended to Flax, "Sigint Systems for ABM/AES Collection."

[58] Flax also endorsed the Davis committee's recommendation that an [redacted] pending further studies of OTH radar capabilities. Flax, Sigint Systems for ABM/AES Collection," p. 18.

[59] Flax, Sigint Systems for ABM/AES Collection," p. 18.

[60] *Ruffer History*, p. 23.

[61] A third proposal, from General Electric and Airborne Instruments Laboratory, was considered unsuitable without major design changes. Carter, "Evaluation of ABM/AES System Proposals."

[62] Bradburn, "Resume of ABM Activities in Washington, 4 to 8 September 1967."

[63] Information about contractual developments from 12 September 1967 through 1968 is drawn from *Ruffer History*, pp. 25ff.

[64] This idea was apparently first suggested by DDR&E's Finn Larsen.

[65] National Reconnaissance Office, "Report to the President's Foreign Intelligence Advisory Board on the National Reconnaissance Program, 1 July to 31 December 1968," p. 23.

[66] Information on developments in the low earth orbiting collectors is principally from Busher and Chaid, pp. 1-35

[67] Flax, interview, 5 March 2003.

[68] "This very substantial increase in the intelligence budget," Helms went on, "has not, so far at least, been justified by a showing that there will be a commensurate gain in our intelligence coverage." Helms, letter to Charles L. Schultze, 23 June 1967.

[69] Collins, *Sigint in the CIA*, III, pp. 133-150.

[70] Helms, "Terms of Reference: Special Study Group on the U.S. Signals Intelligence (sigint) Effort."

[71] Collins insists that "although the immediate impact of the Eaton Report was negligible, its longer term catalytic effect was considerable, in that its stepchildren, if not its direct offspring, made their mark on the government intelligence structure. The creation of the 'National Intelligence Resources Board' under the DCI and the establishment of an Assistant for Intelligence under the Assistant Secretary of Defense were stepchildren of the Eaton Report." Collins, *Sigint in the CIA*, III, p. 148.