SIGINT
SIGNAL INTELLIGENCE FROM SPACE

Listening Electronically

OVERHEAD SIGINT HISTORY

SIGINT satellite programs began in 1960 have been only recently declassified, recognizing the enduring contributions to the preservation of U.S. security and securing of peace in the Cold War.

These electronic signal collection satellites enabled us to understand USSR's ability to track U.S. satellites, ABM radar and anti air installations. This space SIGINT Story reveals efforts to maximize use of space assets. In some instances, both imagery and signals collections capabilities were integrated into early missions.

This presentation provides insight into efforts to maximize all potential orbits for national reconnaissance collection efforts to understand the value of satellite collection programs. SIGINT satellites worked in a cohesive manner to assemble a comprehensive understanding of the intent and capability of U.S. adversaries as possible.

SIGINT OBJECTIVES

SIGINT (Signals Intelligence) is the collection of electronic emissions from communications, radars, and weapons systems provide a vital window for our national defense against foreign adversaries' capabilities, actions, and intentions.

COMINT (**Communications Intelligence)** (usually encrypted) signals which may involve cryptanalysis (to decipher the messages). Traffic analysis determines who is signaling to whom and in what quantity part of the integrate information.

ELINT (**Electronic Intelligence)** collection involved detecting and location electronic emissions from radar & communication systems to support defining the Electronic Order of Battle (EOB).

FISINT– (Foreign Instrumentation Signals Intelligence) monitors data signals during weapon systems tests to support development of US adversaries' capability.

The National Reconnaissance Office (NRO) directed the development & operation of SIGINT satellite programs providing data to the National Security Agency (NSA), for processing to protect our troops, support allies, fight terrorism, combat international crime and narcotics, support diplomatic negotiations, and advance other important national strategic objectives.

SAFSP SIGINT PROGRAMS

SAFSP developed, launched and operated Low Earth Orbit (LEO) SIGINT satellites beginning in the 1960s through the early 1990s that were primarily focused on USSR electronic emanating targets. In the 1970s, SAFSP focused on SIGINT satellites that collected a broader frequency range and had longer mission life. This focus culminated in the late 1980s and early 1990s with advanced missions that were characterized with more sensitivity and improved redundancy resulting in much longer mission life.

Many early SIGINT missions relied on other programs to reach their operational orbit. The primary programs that enabled these SIGINT missions to be successful were the Agena and HEXAGON programs. The Agena provided an excellent platform to mount SIGINT collection payloads, and the HEXAGON Program enable both fixed pallet SIGINT payloads and sub-satellites payloads.

SAFSP was also responsible for development, launch and operation of several other SIGINT systems which remain classified today.

PROGRAM IDENTIFICATION REFERENCES

The diverse SIGINT programs were distinguished by different expressions depending on the organization's security access (need to know) and function.

- Support organizations without reason to know mission objectives referred to them by program number like the AFSCN Inter Range Operation Number (IRON)
- Operational units referred to them by SI/TK mission number. A 7XXX series number may refer to several different specific programs.
- The System Program Office developing technical details of specific satellites assigned classified names for those had an absolute need to know. Those program names were not disclosed to the public at that time.

References to satellites in this presentation will take one of these forms depending on the source from which the information was derived. Unlike IMINT programs, dozens of different SIGINT programs were developed to cover the wide range of collection objective requirements & designs.

DECLASSIFIED SIGINT SYSTEMS

Several SIGINT satellite programs were designed & developed to collect a wide range of signal emissions. This presentation distinguishes those missions common design characteristics and used a representative program as an example. Satellite programs were categorized by launch profile or common collection objectives.

SIGINT payloads were flown on dedicated satellites but also rode piggyback as a supplementary sensor on host satellites or initially launched into space mated to host platforms then were ejected into a different orbit.

Sensor design & data collection depended on the electronic spectrum and waveform of the various emitters.

SATELLITE MISSION PROFILES

SIGINT sensors were orbited on several different classes/types of satellite platforms. These following general terms will be used.

- SFO/PALLET – Secondary flight objective (SFO) sensors or bolt-on pallet subassembly were integrated on satellites with a different primary mission. Some were complementary like IMINT others had non-intelligence related functions.

- SUB-SATELLITE – Smaller satellites were launched mated to a host satellite, then deployed into a different orbit to conduct their specific mission

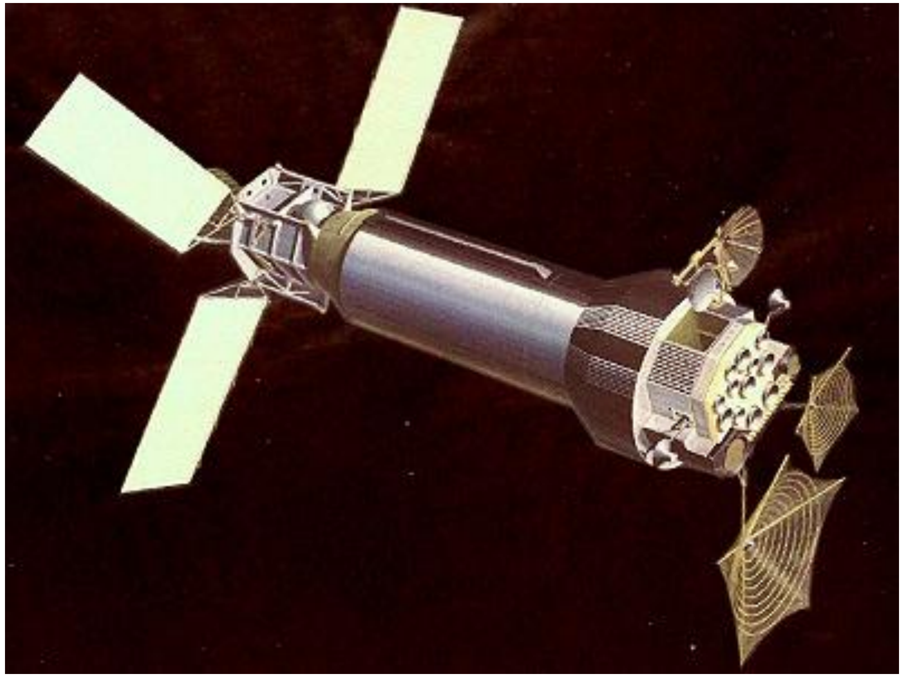
- DEDICATED LAUNCH – Other SIGINT satellites were launched on rockets dedicated for their mission.

EARLY SIGINT OVERHEAD COLLECTION

- Several mission series developed from the Agena aft-rack black boxes which recorded radar skin tracking attempts and intercepted Soviet BMEW (Ballistic Missile Early Warniong) and other SIGINT emitters.
- Program/missions derived from these early missions include:
  - Mission 70XX/78XX – Skin tracking/attack verification packages
  - Mission 71XX/72XX – AGENA-Based SIGINT collection payloads, HEXAGON pallet collection payloads & Experimental SIGINT satellites
  - Mission 73XX – The spin stabilized P-11 & P368 series.
- Early designs were driven by requirements to search for the Soviet TALL KING and HEN HOUSE radar emitters beginning in August 1960 with a total of 23 AFTRACK payloads being flown.

MISSION 7100 SATELLITES

The THRESHER program is a radar location system for SIGINT and electronic order of battle collection. It was deployed on a series of satellites, including the Strawman missions. THRESHER was designed to collect and process radar signals, providing information about enemy radar locations and capabilities focusing on intercepting and analyzing signals from the Soviet SA-5 anti-aircraft missile system. The Strawman missions were a series of reconnaissance satellite launches that carried the THRESHER payload.



PROJECT AFTRACK SIGINT (AGENA) MISSIONS

MISSION #	[AFTRACK] PROJECT & PAYLOAD	MISSION TYPE	YEAR	#DAYS
N/A	SOCTOP 1	X	1960	1
N/A	TAKI 1	ELINT	1961	2
N/A	WILD BILL	ELINT	1961	2
N/A	TEXAS PINT	COMINT	1961	2
N/A	TOPSOC 1	ELINT	1961	5
N/A	TOPSOC 2	ELINT	1961	4
N/A	TOPSOC 3	ELINT	1961	2
N/A	TOPSOC 4	ELINT	1961	2
N/A	GRAPE JUICE 1	COMINT	1961	1
7201	PLYMOUTH ROCK 1	ELINT	1962	5
7202	WILD BILL 2	ELINT	1962	3
7203	VINO 1	COMINT	1962	3
7204	TAKI 3	ELINT	1962	5
N/A	WILD BILL 2	COMINY	1962	(2-ORBITS)
N/A	GRAPE JUICE 2	COMINT	1962	6
N/A	TAKA 2	X	1962	7
N/A	NEW JERSEY 1	COMINT	1962	5
N/A	GRAPE JUICE 3	X	1962	5
7205	NEW JERSEY 2	COMINT	1963	6
7206	VINO2	COMINT	1963	FAILED
7207	WILD BILL 3	ELINT	1963	13
7208	PLYMOUTH ROCK 2	ELINT	1963	12
7215	LONG JOHN 1	COMINT	1964	20
7216	WILD BILL 4	ELINT	1963	35
7218	LONG JOHN 1	ELINT	1963	20
7219	LONG JOHN 2	ELINT	1963	15
7210	HAYLOFT	ELINT	1964	19
7215	OPPOR-KNOCKITY	X	1964	53
7222	LONG JOHN 3	ELINT	1964	23
7223	NEW HAMPSHIRE	ELINT	CNX	0
7224	LONG JOHN 4	X	1964	13
7225	SQUARE TWENTY	COMINT	1965	20
7231	DONKEY	COMINT	1967	180
7223	NEW HAMPSHIRE	X	CANCEL	0

KEY ACCOMPLISHMENTS – AGENA-BASED PAYLOADS

- First scanning superheterodyne receiver and on-orbit radar signal digital processing providing signal measurements and location information (1961)
- First wideband magnetic tape recorder on-orbit (1964) providing a technical ELINT capability
  - First wideband pre-detected radar signal recorded (1965) providing unprecedented details of USSR ABM systems
  - Intercepted many new & unique radar signals
  - First very accurate geolocation for SAMs in Vietnam and provided near real time to US commanders (1968)
  - Auxiliary payloads in 1968-1971 collected more detailed ABM and SAM radar data, such as CW capability and measured power

LORRI
(PALLET MISSIONS)

LORRI was an ELINT pallet sensor suite that hitchhiked/attached to a HEXAGON satellite to monitor electronic signals in the 26-42 GHz band. It was controlled via the host’s command system which downloaded the collected data to the ground stations.

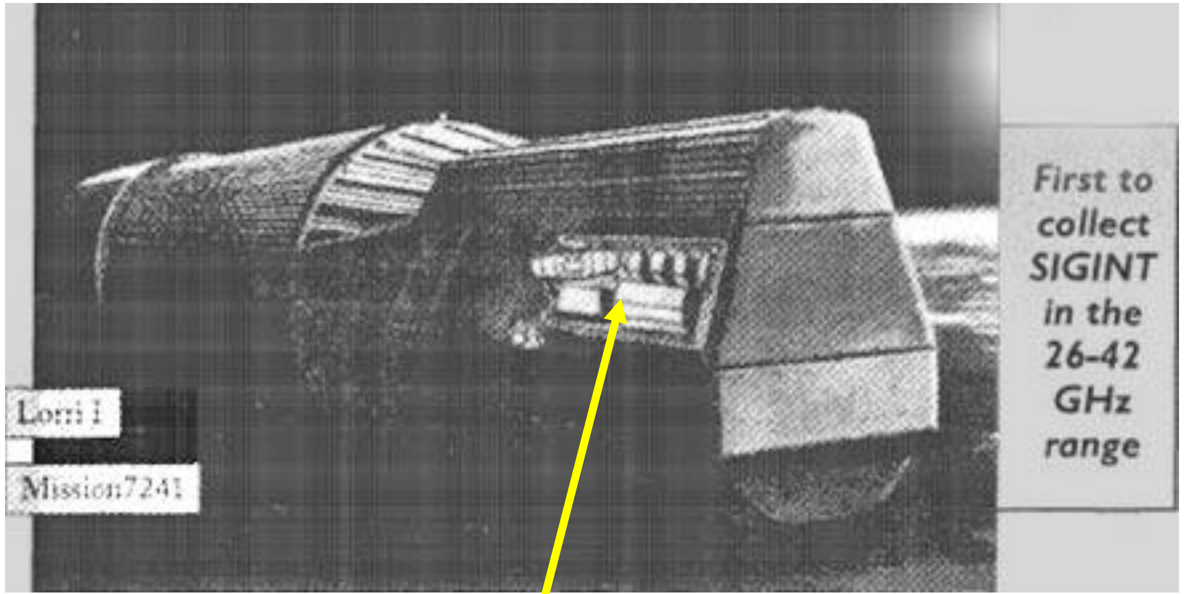
LORRI supplemented intelligence collection in another spectral band with the added advantage of correlating those collections to the imagery taken on the host platform.

This simple “bolt on box” concept provided a simple integration interface option to a diverse satellite system.

LORRI II was lost when the last HEXAGON launch failed.

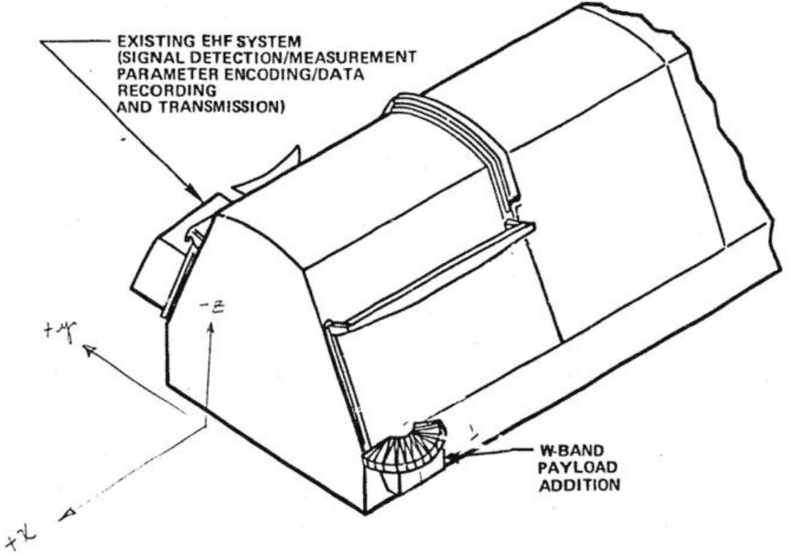
LORRI

MISSION 7200 PALLET PAYLOAD ON HEXAGON

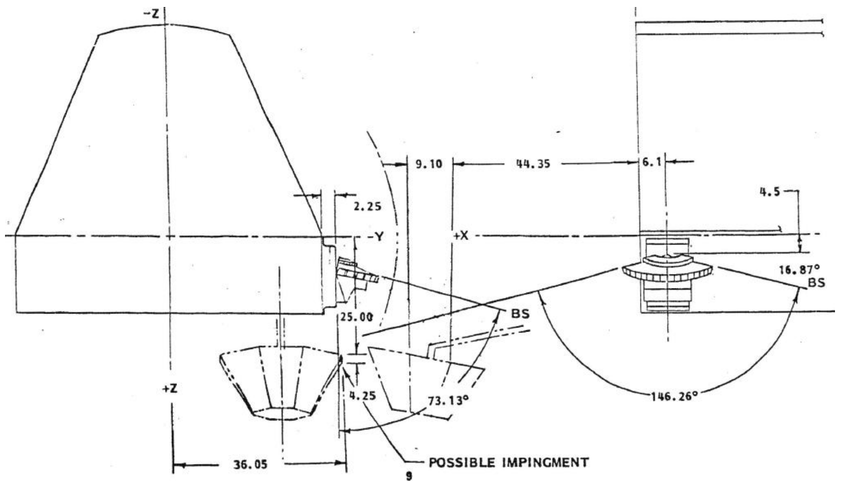


LORRI PALLET

PALLET PLACEMENT ON HEXAGON



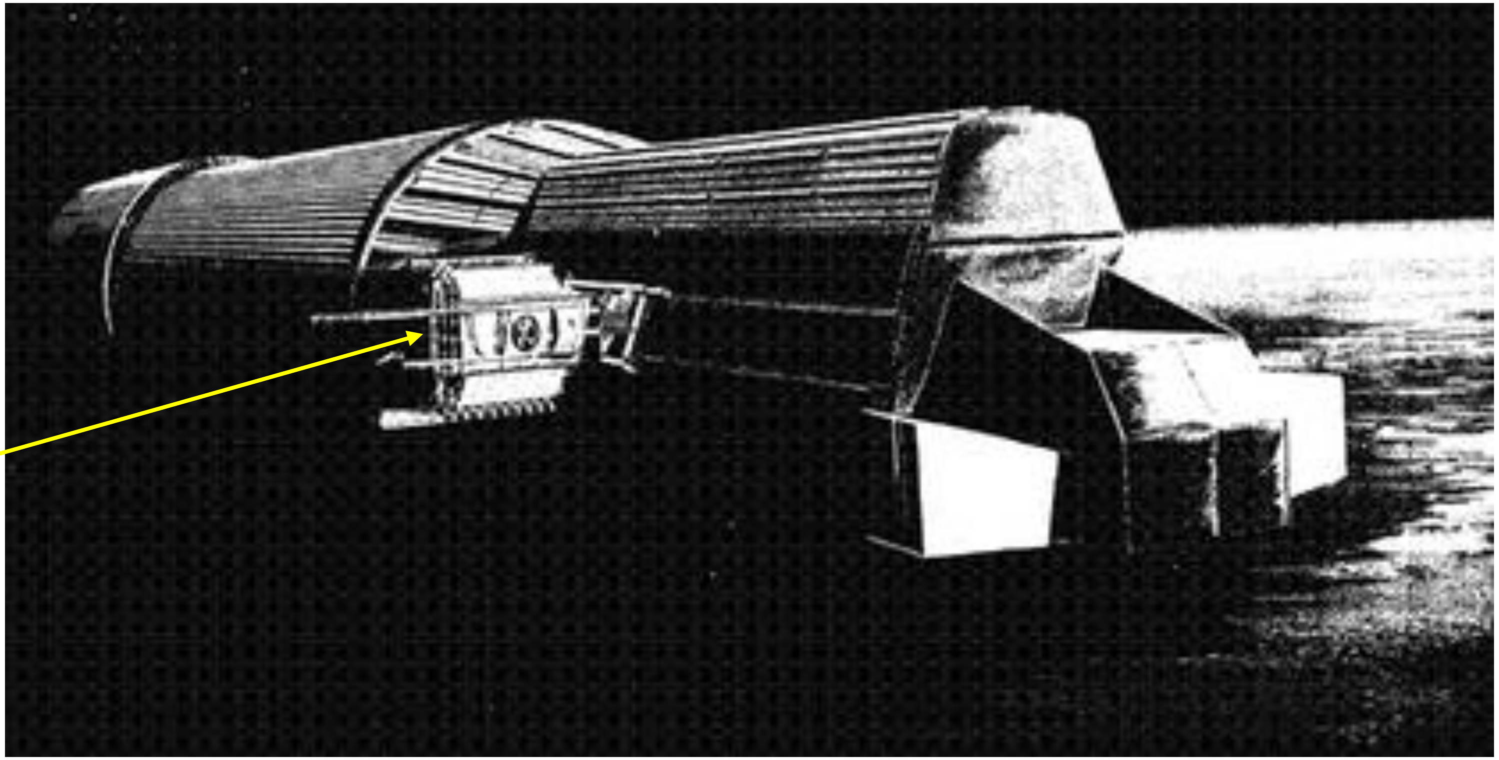
ANTENNA DEPLOYMENT



MISSION 7300

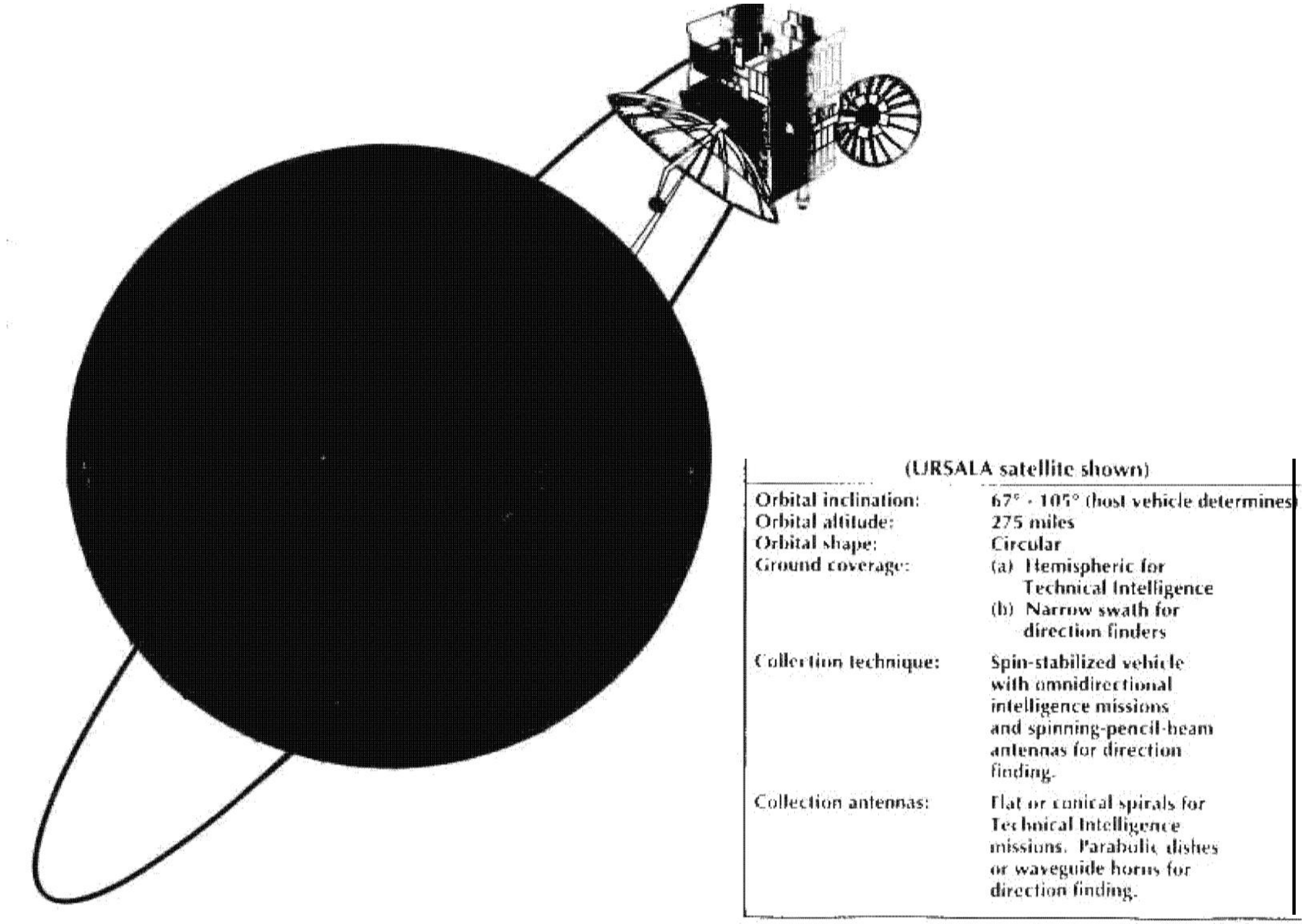
SUB SATELLITES

7300 satellites were launched riding on a host satellite. Once in orbit they separated from their host satellite and assumed an independent orbit and mission.



SUB SAT PRIOR
TO SEPARATION

SUB SATELLITE ORBIT AFTER SEPARATION

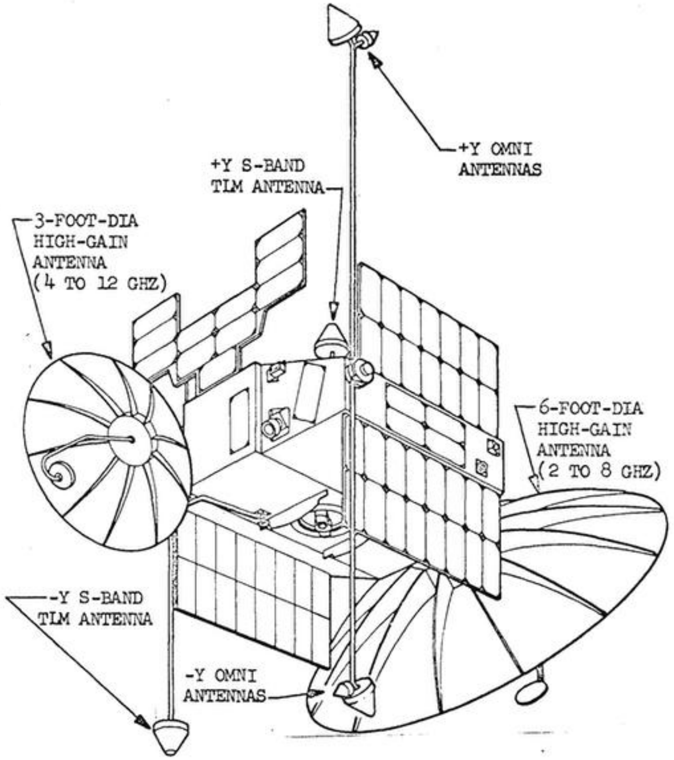


(URSALA satellite shown)

Orbital inclination:	67° - 105° (host vehicle determines
Orbital altitude:	275 miles
Orbital shape:	Circular
Ground coverage:	(a) Hemispheric for Technical Intelligence (b) Narrow swath for direction finders
Collection technique:	Spin-stabilized vehicle with omnidirectional intelligence missions and spinning-pencil-beam antennas for direction finding.
Collection antennas:	Flat or conical spirals for Technical Intelligence missions. Parabolic dishes or waveguide horns for direction finding.

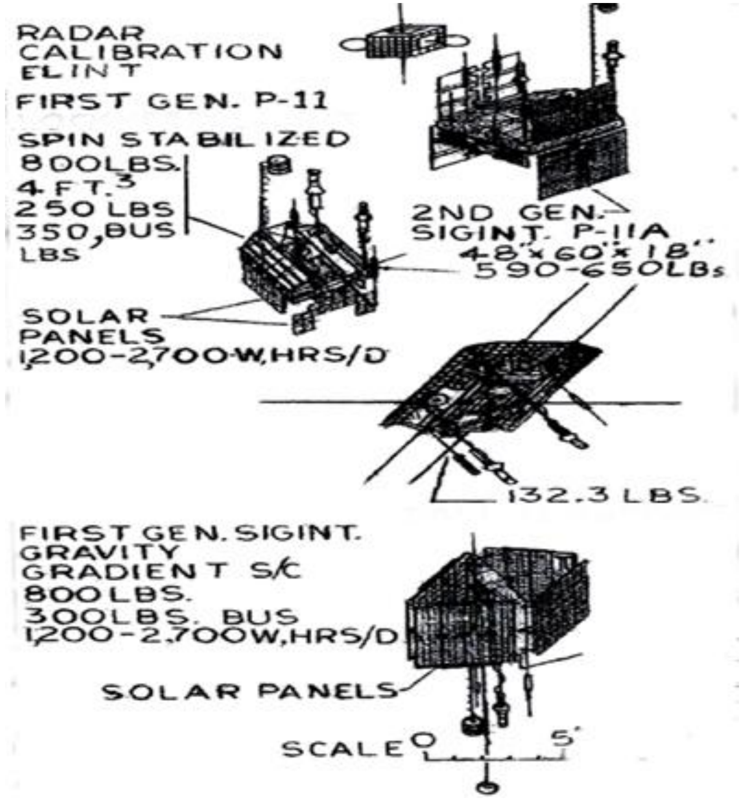
URSALA/RAQUEL

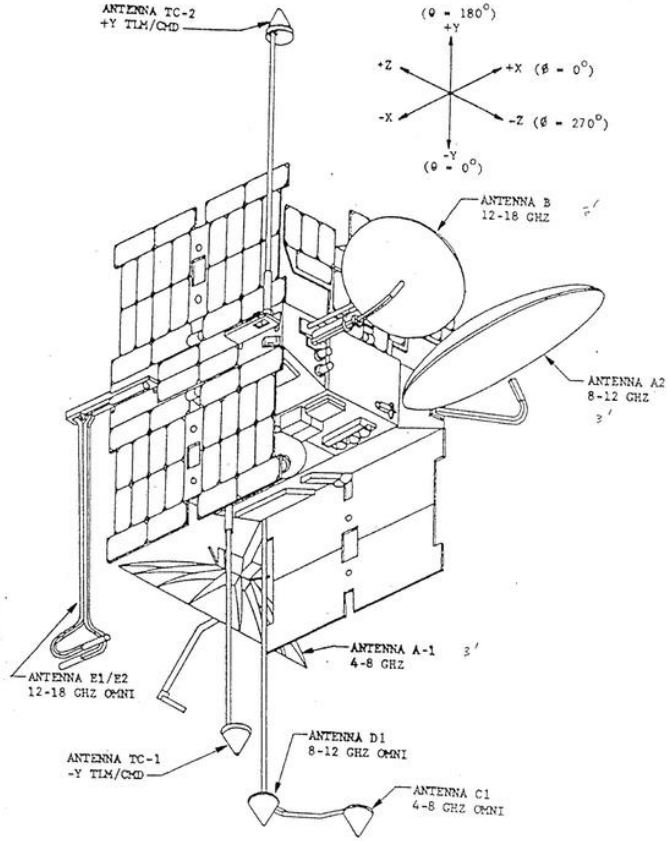
SUB SATELLITES



URSALA

P-11 Standard Bus Satellites





RAQUEL

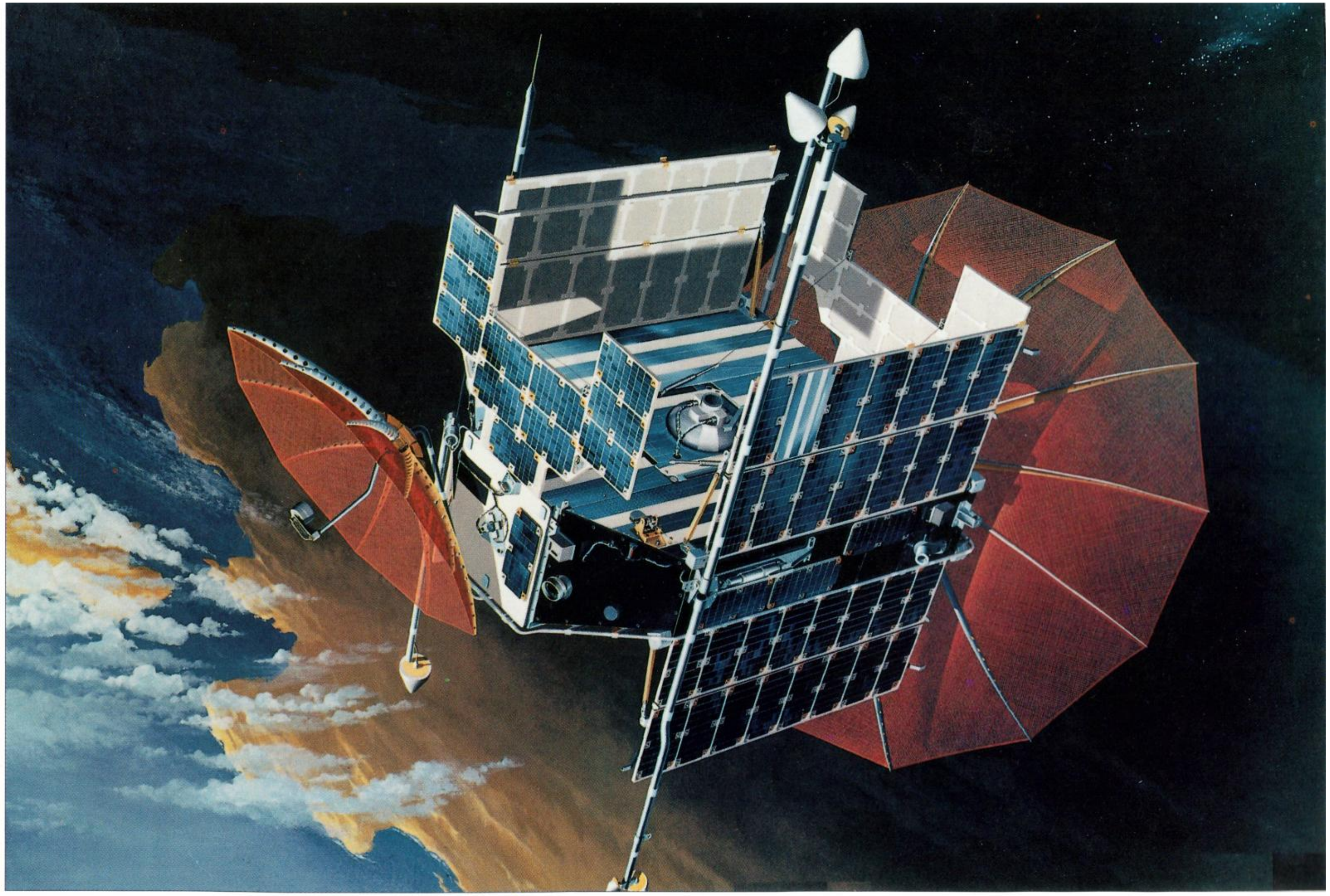
URSALA & RAQUEL SERIES

- In the middle of the Vietnam War, around 1969 several urgent search requirements surfaced for threats in the more conventional warfare area, centering around missile systems. There was no search capability from space for Ku band emitters in the 12 to 18 GHz range. These requirements resulted in the creation of two collection concepts: URSALA and RAQUEL
- Two Stanford studies resulted in a single concept which became known as the RAQUEL vehicle. Antenna mounting angles were optimized to maximize the intercept time on relatively short slant range targets with the spinning pencil beam rather than mapping horizon-to-horizon like a wide area search system.
- The other requirement for collection of double-agile radars was addressed with the first wideband mono pulse AOA (Angle of Arrival) concept with sidelobe inhibit perform onboard. This concept was named URSALA.
- With these two vehicles, the program names were changed to female movie stars rather than acronyms or related to mission objectives as an edict resulting from security concerns.

URSALA SYSTEM FEATURES

- URSALA design was conceived in the 1960s to support sidelobe search in the 2 to 12 GHz bands.
- The mission used both a six-foot flex rib dish and a three-foot parabolic reflector with a new monopulse feed for direction of arrival measurement capability resulting in improved geolocation accuracy.
- URSALA I & II were equipped with OMNI antennas to support a sidelobe inhibit function. These antennas were bore sighted in the direction of the DF (Direction Finding) antennas to enhance the sidelobe inhibit performance.

URSALA

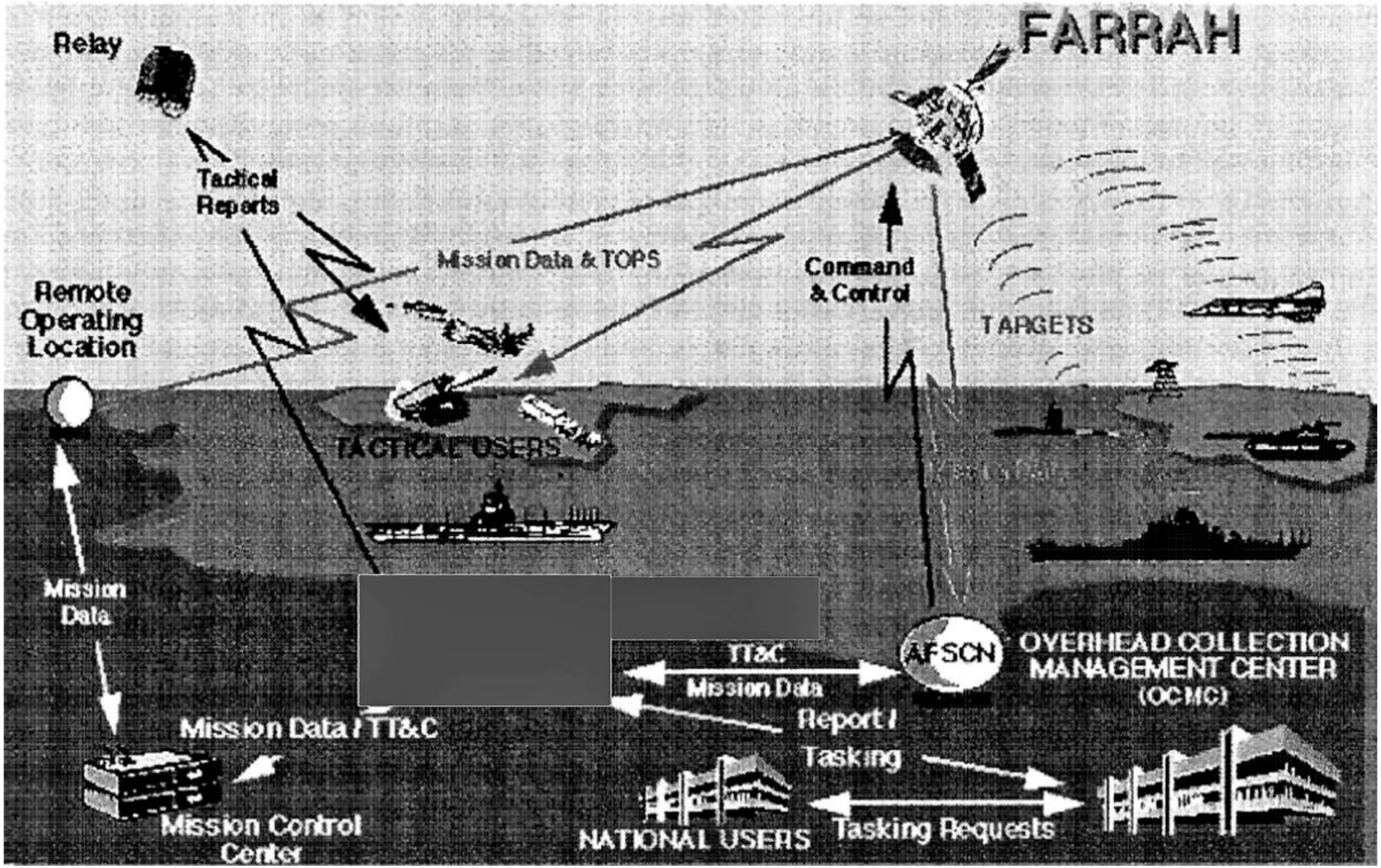


URSALA spinning-pencil-beam P-11 spacecraft

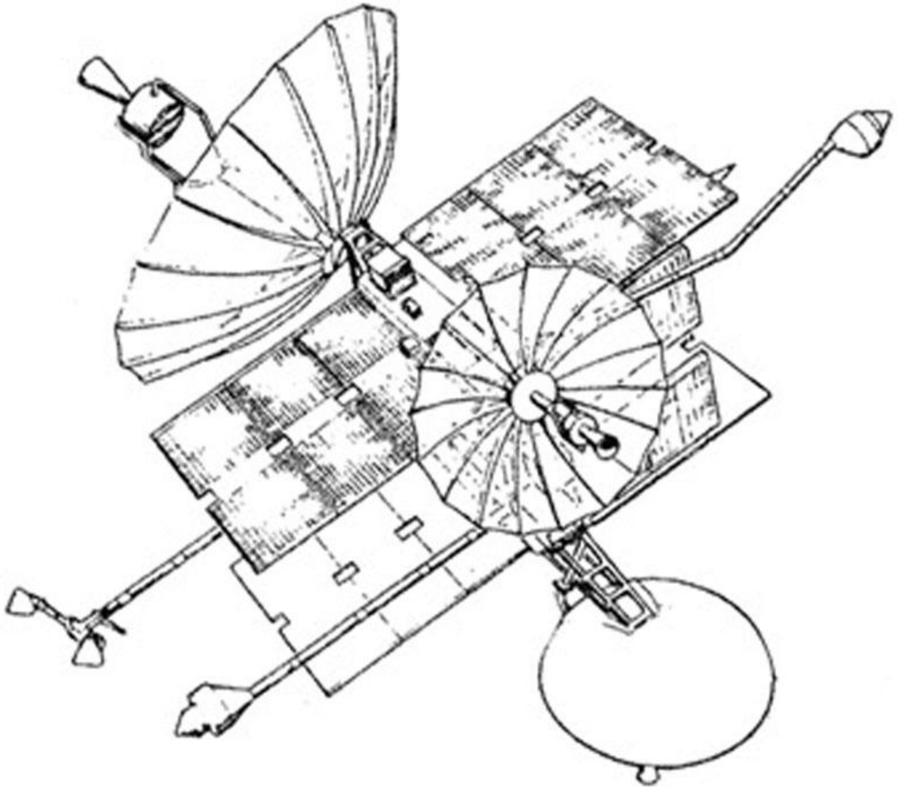
RAQUEL SYSTEM FEATURES

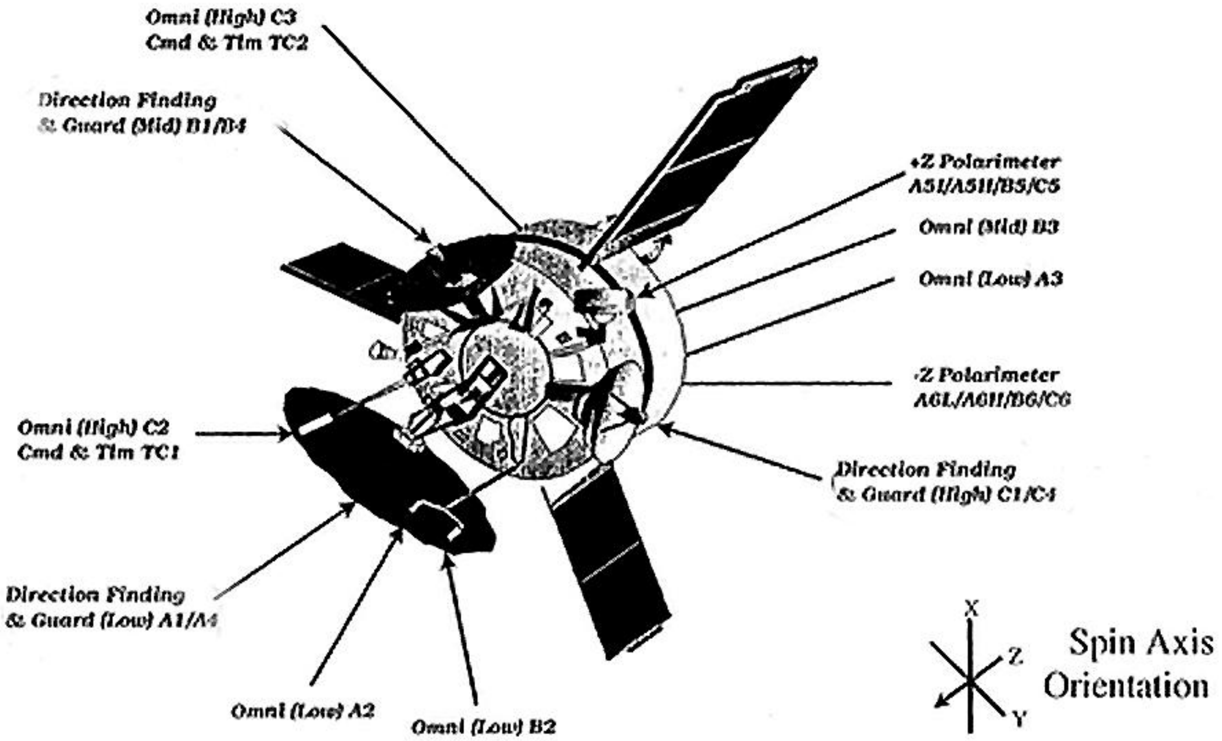
- RAQUEL mission was main beam technical intelligence (MBTI) and search of the J-band, 12-18 GHz region.
- MBTI mission from space can only be provided by a highly inclined low-orbiting satellite.
- Design emphasis was placed on OMNI or low-gain antenna collection of main beam of emitters near the horizon and pencil beam collection of J-band emitters at close slant range at mid latitudes.
- OMNI antennas were oriented with their boresights along the spin axis to reduce spin modulation at the expense of sidelobe inhibit performance
- Dish antennas of the pencil beams were mounted at an angle to emphasize radar collection at the mid latitude regions of the Soviet Union.
- Technical intelligence receiver with 750 KHz pre-detection copy capability was added enabling tuning to main beam intercept frequencies provided by the OMNI collection subsystem.

FARRAH SYSTEM ARCHITECTURE



FARRAH SATELLITES





FARRAH SYSTEM MISSION OBJECTIVES

The FARRAH collection system can collect, process, analyze, & report signals from pulse & CW emitters in the 2 to 18 GHz frequency range to satisfy the following primary mission objectives:

1. General Search (GS) – Search for new or unusual signals from new or modified weapons systems over a wide ranges of frequency and broad geographic areas.

2. Technical Intelligence (TI) – Determine the operational characteristics & performance capabilities of foreign weapons systems at specific frequencies and locations.

3. General Surveillance/Electronic Order of Battle (EOB) – Monitor the operational status & deployment of emitters associated with weapons systems over wide ranges of frequency & broad geographical areas.

4. Directed Surveillance (DS) – Monitor the operational status & deployment of emitters associated with weapon systems involved in tactical operations at specific frequencies & locations & provide time critical reporting (TCR) in specific crisis situations.

FARRAH SIGNAL INTERCEPT CONCEPT

The Mission 7300 FARRAH spacecraft was developed to maximize combined geographic & frequency (geofrequency) coverage. This provides (like URSALA & RAQUEL) a 2 GHz instantaneous bandwidth switch in frequency in synchronism with each antenna as it begins scan of the earth to provide either segmented or contiguous coverage of up to 14 GHz of the spectrum (usually 10 GHz). The highly inclined low-altitude earth orbits give Mission 7300 satellite access to virtually every point on the earth at least once a day, & most areas several times each day. Each satellite searches for emitters operating over any 10 or 14 GHz segment of the 2 to 18 GHz frequency spectrum & maps their location over many millions of square miles during each day of operation.

The FARRAH satellites had the same two intercept modes developed with RAQUEL & URSELA: sidelobe & main beam intercepts. High-gain dish antennas scan the earth horizon-to-horizon with sufficient sensitivity to intercept sidelobe radiation from most radar & signals from a variety of communication systems. The probability of intercept is relatively independent of the emitter pointing direction. Sidelobe collection occurs when the satellite intercept antenna points toward an emitter operating in the receiver collection band, as illustrated in Fig 13.

Omnidirectional intercept antennas on the satellite provide a lower sensitivity over the entire area to the horizon. These OMNI search antenna intercept primarily main beams & strong sidelobes. Main beam collection occurs, for example, when the satellite passes through the beam patterns of a horizon search radar. As the spacecraft rises above the horizon & the radar beam points (or scans) in the direction of the satellite, power & frequency profiles of the radar are recorded. In this manner, signal parameters beam scan characteristics and radiated power levels are measures for technical analysis of foreign weapon systems capabilities & vulnerability to jamming.

FARRAH INTERCEPT GEOMETRY

Low power, highly directive signals such as microwave communication transmissions generally require the satellite to pass through the target emitter beam for detection to occur. Mission 7300 low altitude non-repetitive ground tracks orbits offer numerous intercept opportunities against such difficult targets as periscopic microwave relay towers, for which a portion of the communication antenna beam "spills over" the tower reflector plate & points vertically up from the earth. Figure 14.

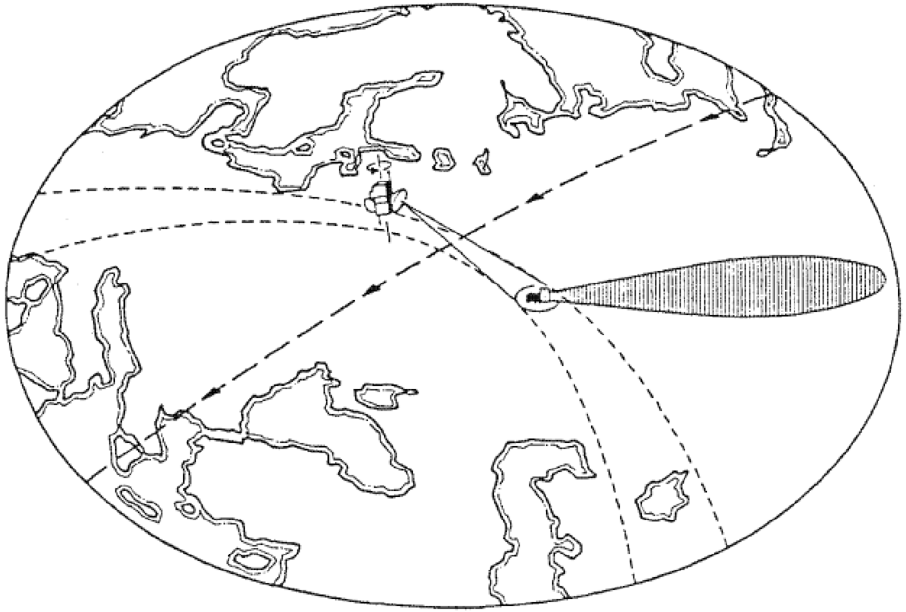


Figure 13. FARRAH Intercept of Emitter Sidelobes

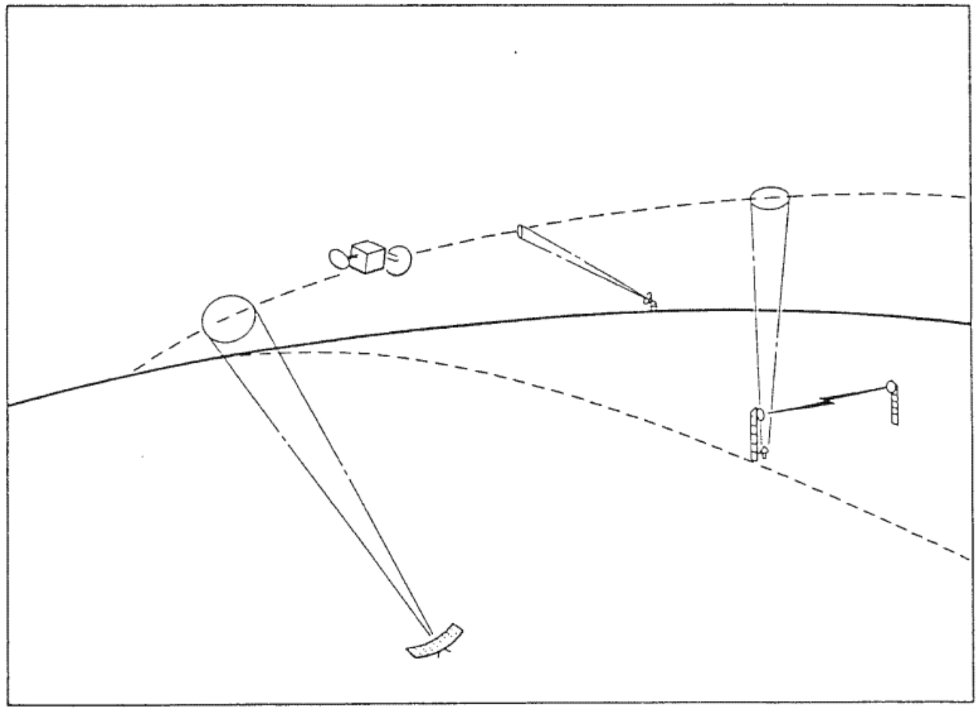


Figure 14. FARRAH Intercept of Communication Links

FARRAH SPIN SCANNING

Receivers are of three types: a pulse receiver, which intercepts & extracts parameters from pulsed signals; continuous wave (CW) receiver, which makes measurements on non-pulsed or very high-rate signals; and the Technical Intelligence (TI) receiver, which can either record a snapshot of up to 10 MHz pre-detection signal bandwidth directly (rather than measuring signal parameters onboard) or perform a spectral analysis of a 13 MHz segment of the spectrum. The FARRAH I/II spacecraft have three recorders for redundant storage of digital intercept data from pulsed & CW receivers, & compressed bandwidth analog or spectrum analysis data from the TI receiver. Recorders are commanded to replay data through the downlink to a network of remote ground stations. Electrical power is provided by solar cell arrays., with batteries providing power during periods when the satellite is eclipsed by the earth. The satellite is spin stabilized with the spin axis parallel to the spin axis of the earth & fine control of the spin axis is maintained by a magnetic attitude control system. Small solid rockets mounted on the periphery of the vehicle spin the satellite after launch. A magnetic spin rate control system maintains a constant spin rate.

Spin stabilization serves also as the mechanism for moving the intercept swath across the earth, scanning the high gain antenna beam across the earth from horizon-to-horizon as the spacecraft moves along its trajectory. The high-gain antenna’s footprint moves across the earth, intercepts signals from emitters within the intercept swath, as in Figure 14. The next sweep of the antenna beam overlaps the first to give continuous coverage of the surface from the rotational motion of the antenna and the orbital motion of the satellite until virtually the entire earth is mapped during the period of one day.

FARRAH COLLECTION GEOMETRY

FARRAH ground coverage and antenna agility are indicated in these diagrams.

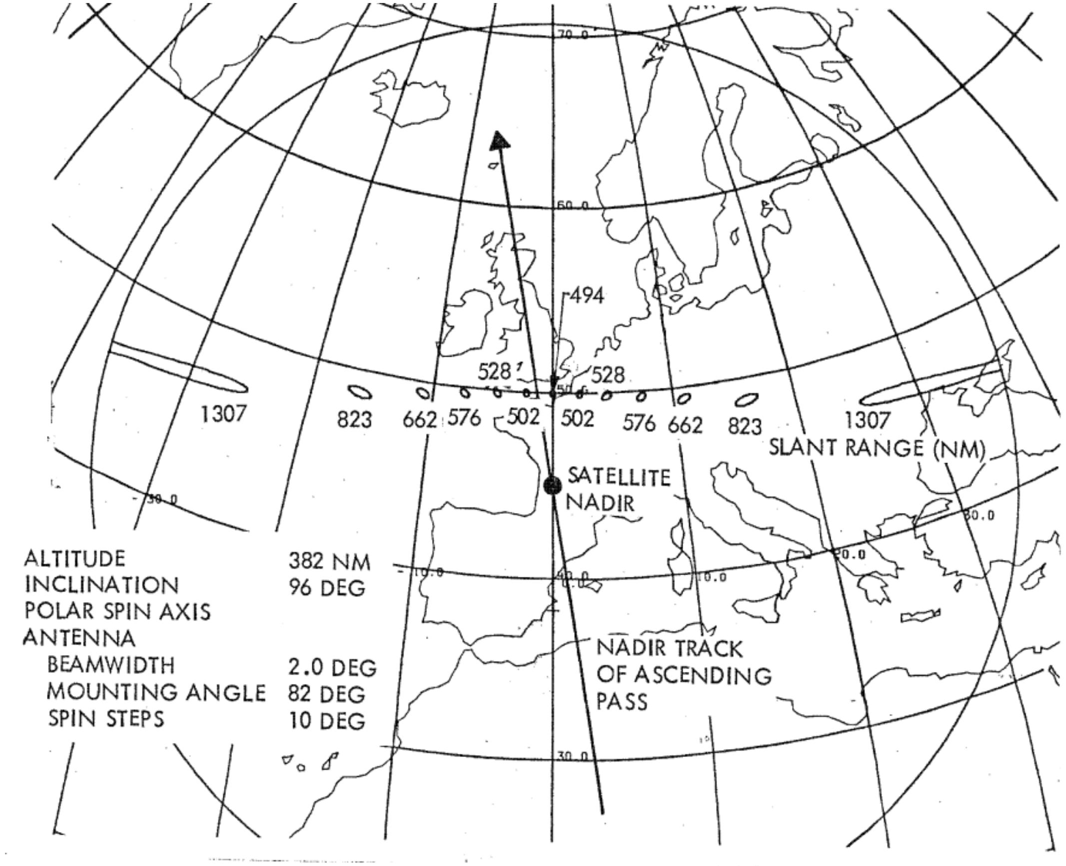
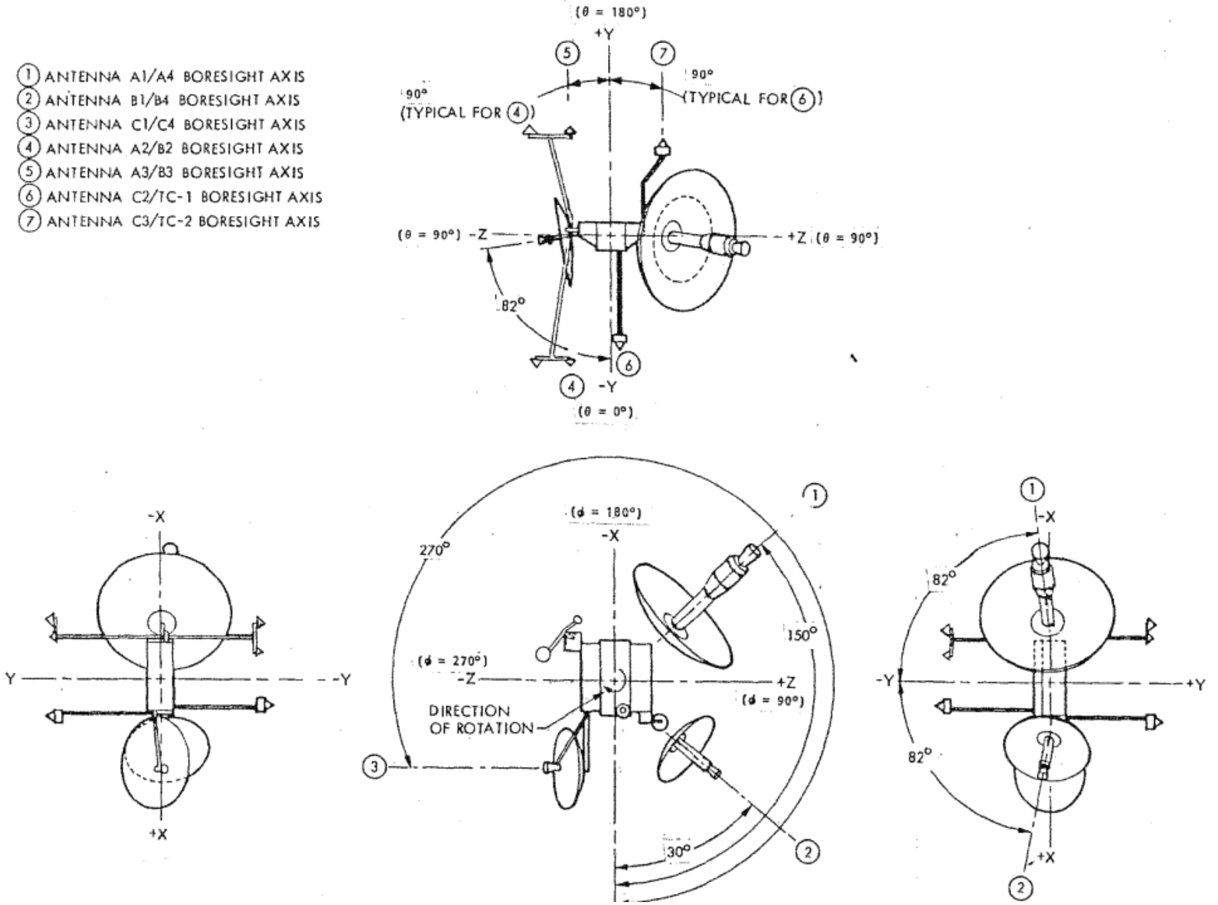
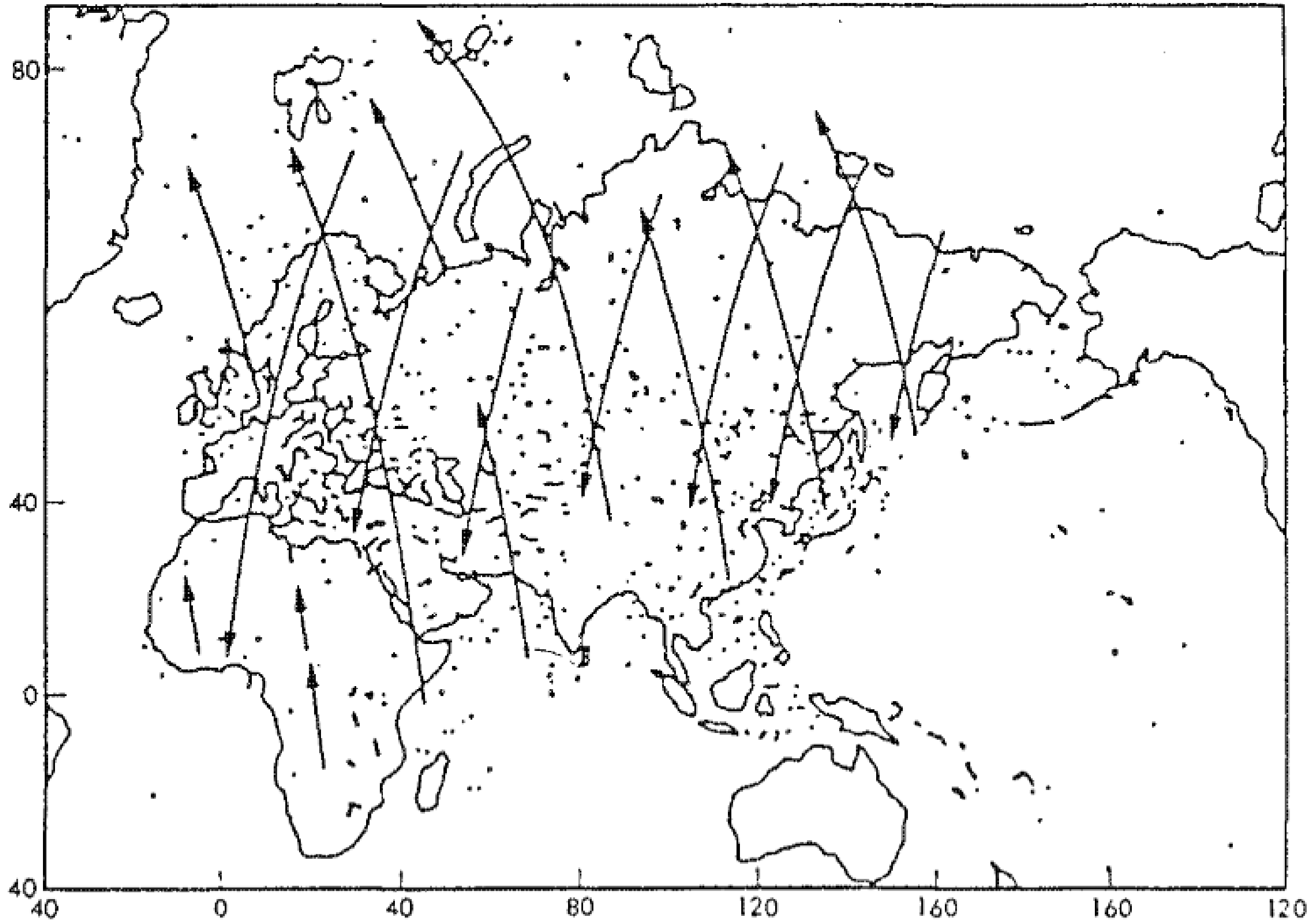


Fig. 3-11 Ground Coverage of High-Gain Antenna



FARRAH ORBITAL GROUND TRACE

SIGINT signal collections took place both on ascending and descending passes doubling the access of IMINT sensors that required daylight. (Figure 18)



FARRAH RECEIVERS

The TCF CW subsystem uses a pair (direct and image) of 8 MHz multipole filters centered 60 MHz to either side of an LO which is swept in a linear sawtooth motion

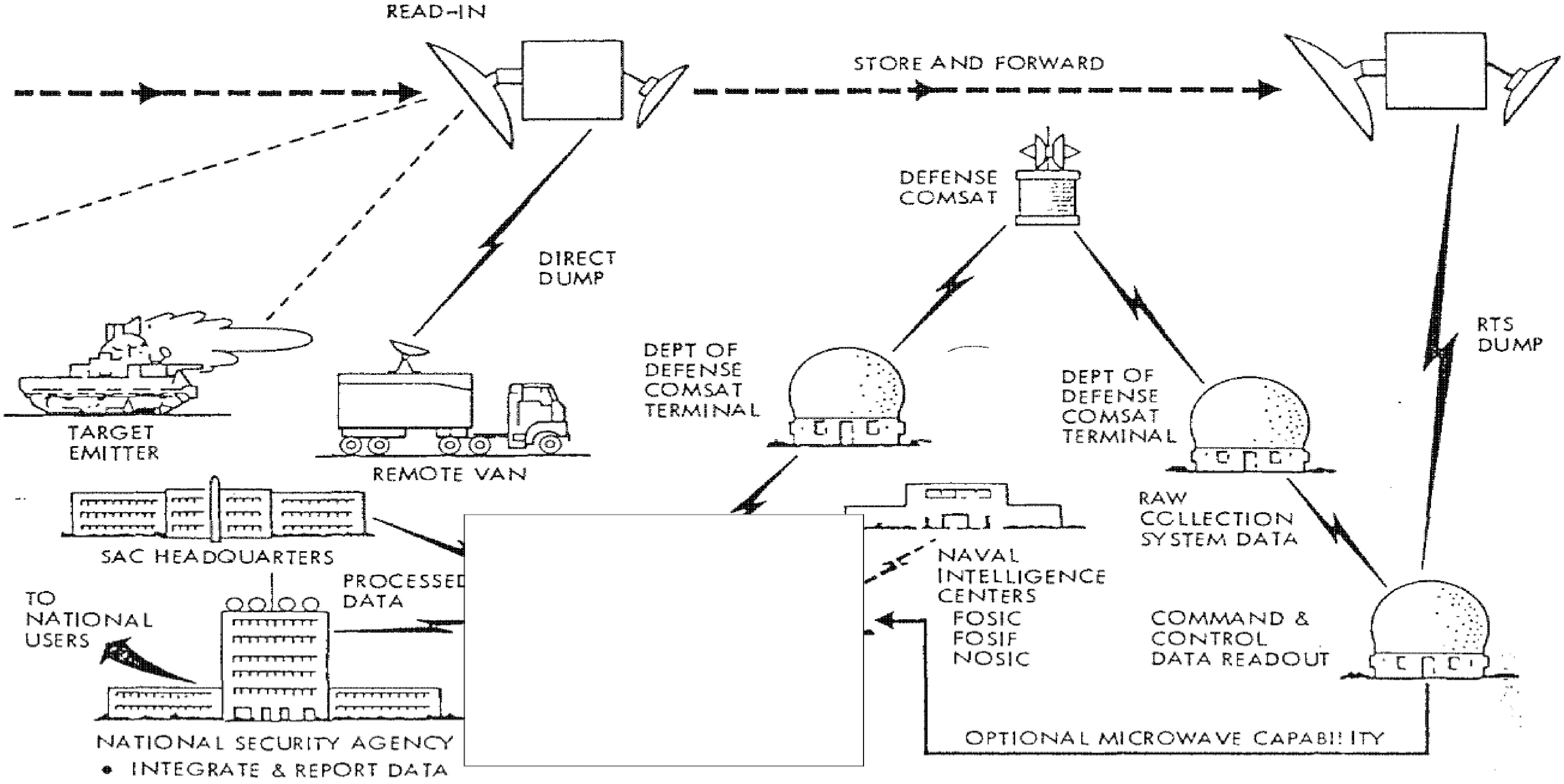
- back and forth across the 2 GHz IF passband at a rate of 4/3 MHz per microsecond.

The resultant output of the 8 MHz filters is a pair of 6 µsec pulses with 8 MHz chirp in opposite directions spaced 90 µsec apart with a PRF repeat interval of about 3.3 msec (300 pps) and an average PRF of 600 pps. The direct and image swept filter channels are separately processed through square law detectors and 0.125 MHz single pole video low pass filters. Each sweep must produce a direct and image response which exceed both threshold and the inhibit margin to be digitized as a pencil beam CW intercept. There is a further command able criterion that the detected PW must exceed 4 µsec as an additional guard against pulse digitization by the CW subsystem. The measured CW parameters are the monopulse parameters, signal amplitude, and time of arrival (from which RF is derived).

Except for the monopulse features, the omni antenna receivers and measured parameters are the same as for the pencil beam intercept. An amplitude comparison is made to pick the strongest of the two omni pattern intercepts for parameter digitization. The omni-RF settings can be commanded independently of the pencil beam settings .

The TI receiver includes a multimode superheterodyne receiver, a 0. 75 MHz pre-D recording capability, and a bandwidth compression capability which allows the recording of a short sample of wideband (10 MHz) pre-detected data.

DATA LINKS FOR THE FARRAH SYSTEM



MISSION 7300 OPERATIONS

- M7300 SIGINT emitter collection data was downlinked to the ground using the Air Force Satellite Control Facility then relayed to the M7300 ground processing center where the data was processed into reportable intelligence.
- This processing center was a joint SAFSP/NSA facility which included senior management, mission planners, space operators, data processing specialists, engineers and SIGINT analysts.
- M7300 tasking was relatively insensitive to geographic priorities because antenna pointing does not have to be decided on a priority basis.
- Daily tasking plan was converted to a series of satellite commands which were transmitted to AFSCN Remote Tracking Stations (RTSs) for transmission to the satellite when they came into view.
- Typical intercept segments for one day's operation of a FARRAH satellite is shown in Figure 18. Solid lines indicate the portion of the orbit trace over which the payload is activated.
- Signals intercepted are either transponded directly to an RTS or recorded and stored on board until spacecraft passes in view of an RTS.
- Intercepts were sorted by geographic areas into time-critical and non-time critical areas, with time-critical data analyzed and reported initially within three hours of intercept which was improved later to 10 minutes. Non-time critical intercepts were processed on a routine basis and reported with 24 hours.
- Both time-critical and routine reports were transmitted directly to Strategic Air Command (SAC), National Security Agency (NSA) and the Defense intelligence Agency (DIA)

DIRECT TACTICAL SUPPORT

- Due to lack of timely receipt of SIGINT information for Army & Air Force tactical users, SAFSP received funding for development of a series of mobile processing vans.
- Experiments were conducted using URSALA III with a prototype van called RTIP which demonstrated feasibility of direct downlink and OBPS (on-board processing) operations.
- RTIP consisted of two vans: a mobile antenna van and a processing van.
- After proving RTIP feasibility, a series of mobile processing vans, ITEP (Interim Tactical ELINT Processor) were developed and deployed in 1979.
- ITEP vans designed to work with URSALA and RAQUEL spacecraft, were also compatible with the FARRAH due to similarity in downlink structure and processing format.
- Later, the Air Force began referring to their vans as the TEP vans. The Army ITEP vans became known as the Electronic Process and Dissemination System (EPDS) and were widely deployed worldwide.

MISSION 7300 SIGINT CONTRIBUTION

Mission 7300 was a major contributor to meeting the following US intelligence guidance.

1. Provide Sin-Soviet general search, EOB and event coverage
2. Monitor crises and wars worldwide
3. Provide worldwide general search and EOB
4. Provide direct support to tactical forces (EPDS vans)
5. Provide moving target geolocation (especially aircraft)
6. Process and report variable parameter radar intercepts

Half of the total US overhead technical ELINT production was generated by the FARRAH system.

MISSION 7300 SIGINT LAUNCHES

MISSION	LAUNCH DATE	NAME	FREQUENCY (MHz)	TARGET SIGNALS	LIFE (MONTHS)
7301	10/29/63	PUNDIT I	61, 66, 71, 76		18
7302	12/21/63	PUNDIT II	61, 66, 71, 76		23
7304	7/6/64	NOAHS ARK	1,500-2,500	ABM RADAR SEARCH	23
7303	10/8/64	PUNDIT III	61, 66, 71, 76		0
7305	10/23/64	STEP-13	60-70		4
7306	10/23/64	PLYMOUTH ROCK	500- 1,000	ABM SEARCH	4
7309	4//28/65	PUNDIT-IV	61, 66, 71, 76		21
7307	6/25/65	FANION-I	4,800-5,200		22
7308	6/25/65	TRIPOS-I	4,800-8,000	GENERAL RADAR SEARCH	22
7312	8/3/65	MAGNUM	155-165	HEN HOUSE TI	21
7310	5/14/66	LEIGE	170-175	TALL KING DF/TI	0
7311	5/14/66	PLICAT	156-163	HEN HOUSE DF/TI	0
7314	8/16/66	SAMPAN-I	2,000-4,000	GENERAL SEARCH DF	14
7315	8/16/66	SOUSEA-I	8,000-12,000	RADAR GS/DF	14
7317	9/16/66	FANION-II	4,800-5,200		4
7318	9/16/66	TRIPOS-II	4,000-8,000	RADAR GS/DF	4
7319	5/9/67	FANION-III	4,800-5,200		3
7316	5/9/67	SLEWTO	156-163	HEN HOUSE TI	3
7320	6/16/67	SAVANT-I	61-250	TEST RANGE TLM COPY	16
7321	11/2/67	FAÇADE	100-2,2000	ABM RADAR SEARCH	3
7324	1/24/68	TIVOLI-I	100-2,4000	ABM RADAR TI	15
7322	3/14/68	LAMPAN-I	1,000-2,000	ABM GS/DF	12
7323	3/14/68	SAMPAN-II	2,000-4,000	ABM GS/DF	12
7326	6/20/68	TRIPOS-III	4,000-8,000	ABM GS/DF	19
7327	6/20/68	SOUSEA-II	8,000-12,000	ABM GS/DF	19
7325	9/18/68	VAMPAN-I	100-1,000	ABM GS/DF	12
7330	3/19/69	TIVOLI-II	100-2,2000	ABM TI	19
7328	5/1/69	LAMPAN-II	1,000-2,000	ABM GS/DF	9
7329	5/1/69	SAMPAN-III	2,000-4,000	ABM GS/DF	9
7336	9/22/69	SAVANT-II	61-250	TEST RANGE TLM COPY	20
7313	9/30/69	WESTON	60-70/390-420		11
7331	3/4/70	TIVOLI-III	100-2,200	ABM TI	20
7332	5/20/70	TRIPOS-IV	4,000-8,000	P&CW GS/EOB	22
7333	5/20/70	SOUSEA-III	8,000-12,000	P&CW GS/EOB	22
7334	11/18/71	TOPHAT-I	470-1,000	COMINT MAPPER	45

MISSION	LAUNCH DATE	NAME	FREQUENCY (GHz)	TARGET SIGNALS	LIFE (MONTHS)
7337	9/10/71	ARROYO	1.2-2.1/3.4/3.9	LOS TOWER MAPPING	1
7339	1/20/72	MABELI	0.156-2.5	ABM MAINBEAM TI	88
7338	7/7/72	URSALA-I	2-12	P&CW GS/EOB	70
7342	11/10/73	URSALA-II	2-12	P&CW GS/EOB	61
7340	4/10/74	TOPHAT-II	0.47-1	COMINT MAPPER	72
7341	10/29/74	RAQUEL-I	4-18	P&CW GS/TI	63
7343	7/8/76	URSALA-III	2-12	P&CW GS/EOB	133
7345	3/16/78	RAQUEL-IA	4-18	P&CW GS/TI	113
7344	3/16/79	URSALA-IV	2-12	P&CW GS/EOB	35
7346	5/11/82	FARRAH-I	2-18	P&CW GS/EOB/TI	100+
7347	6/18/84	FARRAH-II	2-18	P&CW GS/EOB/TI	75+

Signal Target Abbreviations:

P&CW – Pulse & Continuous Wave
GS – General Search
EOB – Electronic Order of Battle
TI – Technical Intelligence
DF – Direction Finding

FARRAH SYSTEM FUTURE

- With the launch of the last HEXAGON satellite, SAFSP proposed that FARRAH be transitioned to a new launch system, such as the Shuttle or an expendable launch vehicles (ELV).
- SAFSP was directed to begin development of a follow-on FARRAH system but due to the shuttle failure, the program transitioned to fly on the Titan II.
- This program remains classified, but had similar capabilities as FARRAH I & II with improved sensitivity, redundancy, payload electronics packaging and mission duration

LEO EXPERIMENTAL SIGINT SATELLITES

GLORIA I & II

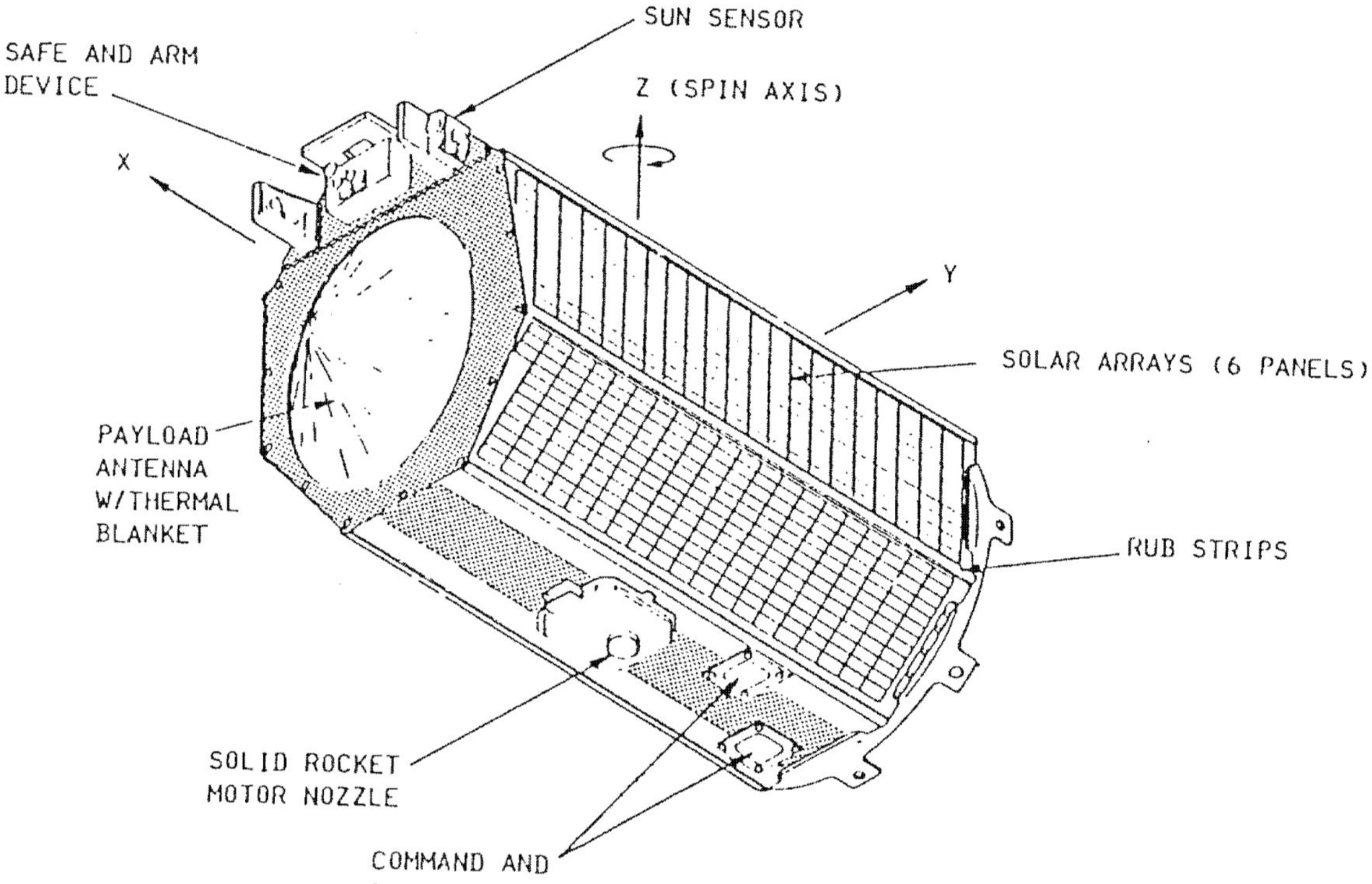
CARRIE

GLORIA I & II

PEGASUS (ALV) LAUNCH

- GLORIA I was conceived as a search mission to collect signals in the 18 to 26 GHz (SHF) band. However, due to the loss of the LORRI II mission, the collection window was raised to 30 to 38 GHz (EHF).
- Unlike LORRI I, GLORIA I implemented a channelized receiver that covered the entire 8 GHz band instantaneously.
- GLORIA I was a spin stabilized satellite with a one-foot parabolic antenna with a 64-channel 250-MHz channelized receiver which was four times the collection bandwidth and twice the instantons RF coverage of the LORRI system at a small fraction of the cost.
- GLORIA I experienced a radiation induced problem to the solid-state memory but still performed the mission and intercepted a larger number of signals than the LORRI mission. Collection highlights included various battlefield radars, nine new unidentified signals and the EHF signals associated with an undisclosed system.
- GLORIA II is like GLORIA I with the major exception of the different band of operation, 18-26 GHz. In addition, the memory, command decoder and mass memory controller were upgraded to overcome the first flight deficiencies.

GLORIA I & II Space Vehicle

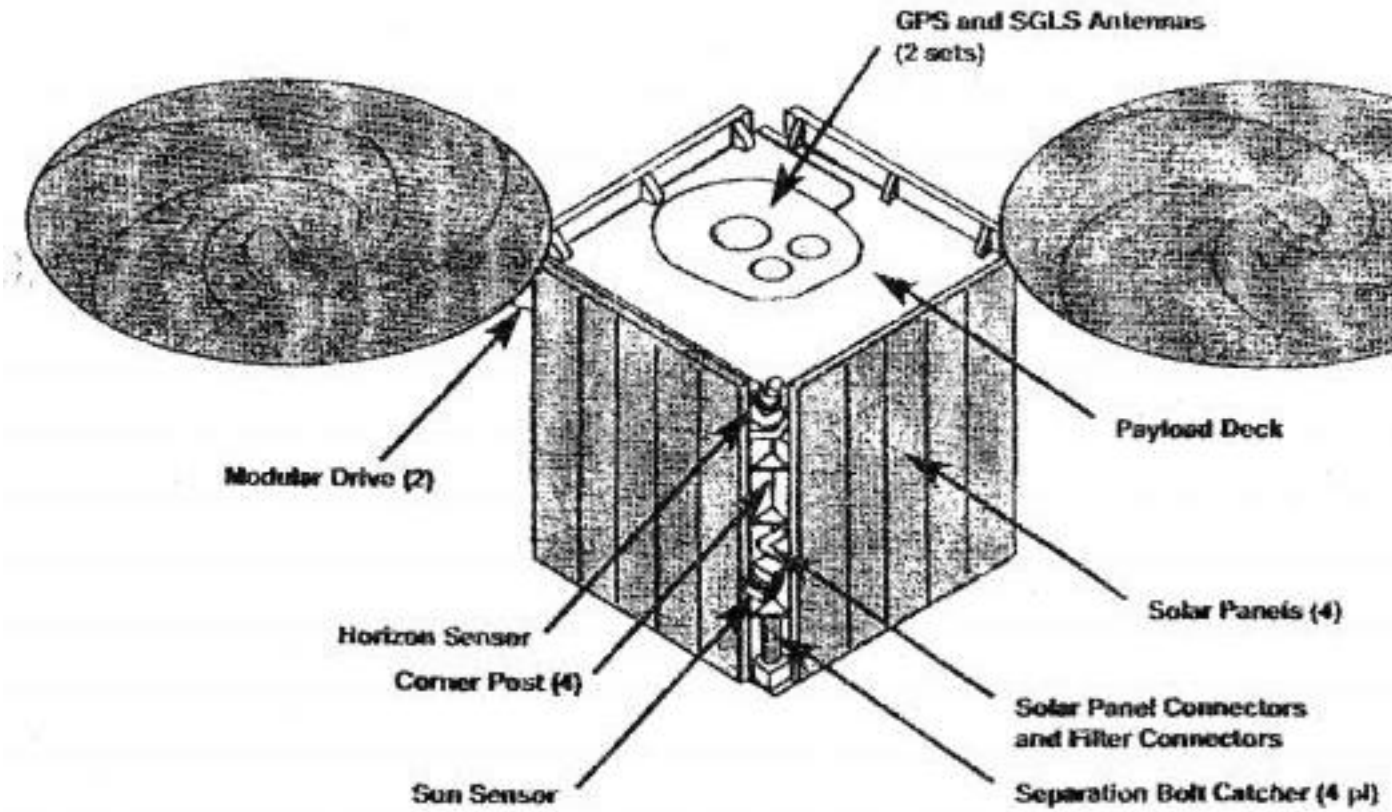


CARRIE

(COMINT AND RAPID REPORTING INTERFEROMETRY EXPERIMENT)

- Mission 7245 (CARRIE) is one of several experimental SIGINT systems which are designed to provide force enhancement data to operational warfighters and theater commanders. The CARRIE mission is to demonstrate how new (experimental) capabilities and techniques will improve space system support to military forces, deployed in theater, who are the primary users of CARRIE mission data.
- Mission 7245 was launched directly into orbit by the DARPA (Defense Advanced Research Projects Agency) developed TAURUS ELV on March 13, 1994.
- The spacecraft was in a retrograde orbit inclined at 105 degrees and at an altitude of 290 nautical miles. The period is approximately 96 minutes. The spacecraft’s orbit lifetime is estimated at 10 years.
- The CARRIE mission is intended to demonstrate improved space system support to military users in the field. As such, the CARRIE system is designed to respond to military commands and theater commanders in a timely manner.
- The CARRIE spacecraft collected COMINT signals in the 100 MHz to 850 MHz range. The collected data was transmitted to an EPDS van in real-time if the Area of Interest (AOI) is within the EPDS acquisition circle. If the AOI is outside the EPDS acquisition circle, the data is stored onboard until CARRIE is within the circle.

CARRIE SPACECRAFT

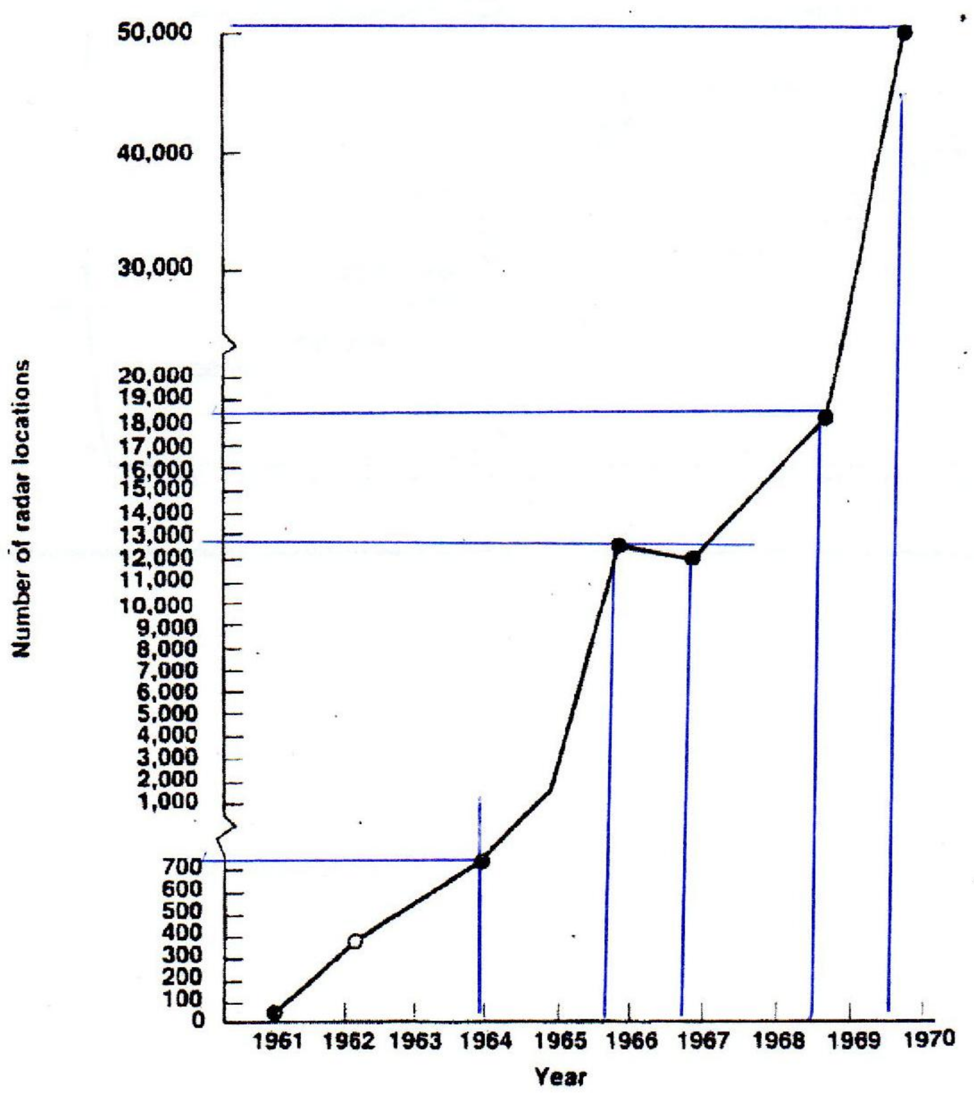


ELINT FROM SPACE

Collecting ELINT data from satellite platforms has both improved the area of coverage and depth of surveillance into denied areas.

Both the number of platform options and the variety of mission profiles increased our ability to develop a comprehensive electronic order of battle to support our national defense.

Number of radar locations produced per year.



CONCLUSION

SAFSP developed and operated a variety of Low Earth Orbiting (LEO) SIGINT satellites that collected critical data during the Cold War over the Soviet Union and other hostile areas. The analysis of this data was important to formulating our defense strategy.

In aggregate these numerous and diverse SIGINT missions enabled the US to formulate the enemy's electronic order of battle.

The accomplishment are more significant considering that they were conducted in the early years while we were also defining how to conduct operations in space.