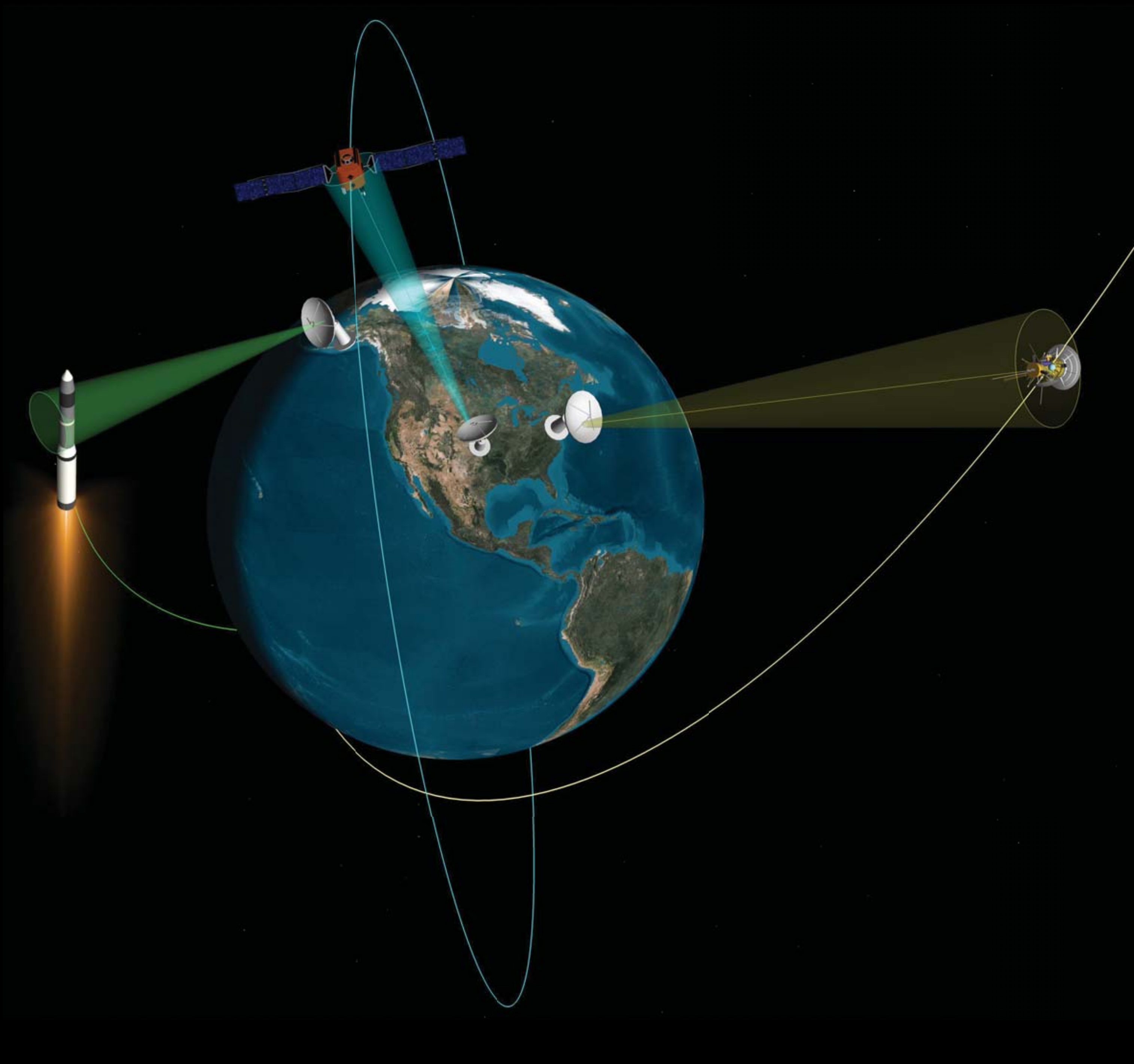
Center for Cryptologic History

Telemetry Intelligence (TELINT) During the Cold War



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National Security Agency

9800 Savage Road, Suite 6886

Fort George G. Meade, MD 20755

Cover: Graphic by Savan Becker

Telemetry Intelligence (TELINT) During the Cold War

Richard L. Bernard

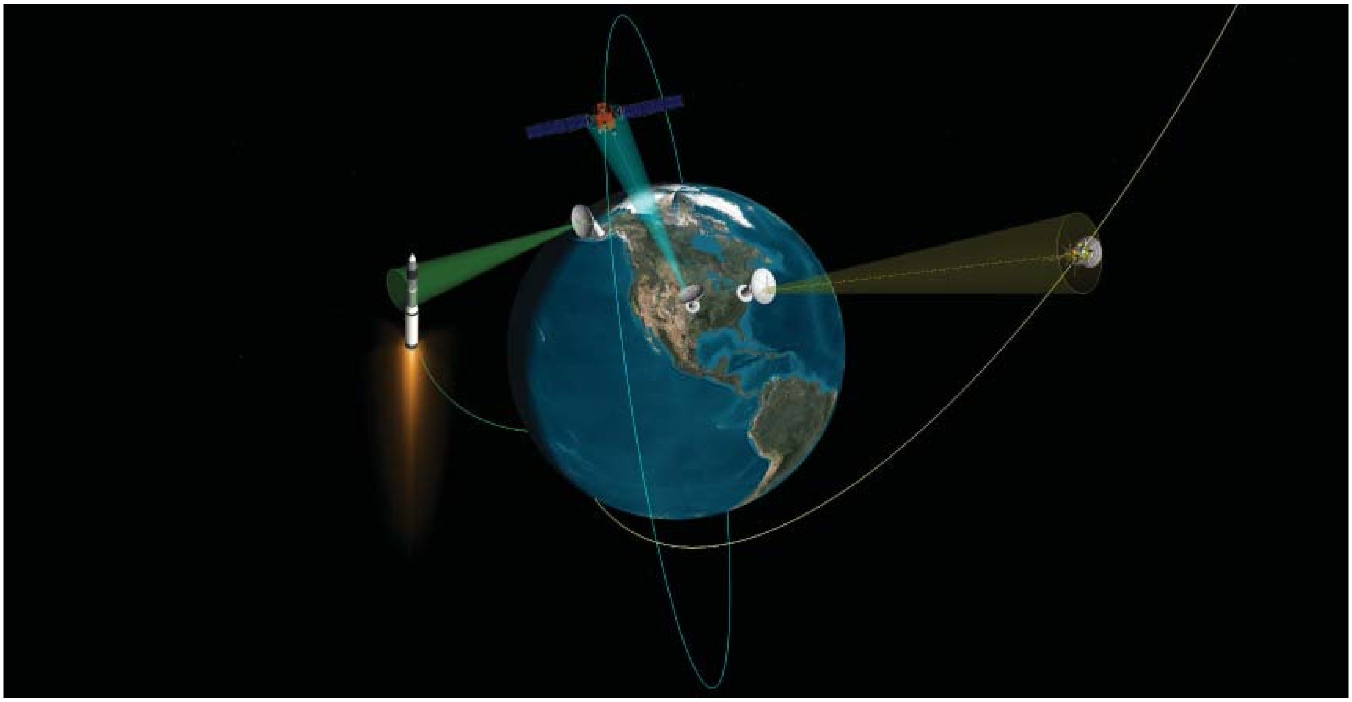
National Security Agency
Center for Cryptologic History
2016

Contents

Preface

This document was developed with a key purpose of providing information for the docents at the Smithsonian Air and Space Museum (in the Space Gallery at the Washington, DC, facility) and the National Cryptologic Museum (NCM) at NSA at Fort Meade, Maryland. The display of one rack of equipment from the HARDBALL telemetry collection system at the ANDERS station and one rack of equipment from RISSMAN are part of the "Intercepting Signals from Space" exhibit at the Smithsonian. The full displays for HARDBALL and RISSMAN are at the NCM facility, along with an EA-3B aircraft.

Most of the information in the sections on pages 6–9 was originally prepared by Mr. James V. Boone and Mr. Edward A. Hart, former NSA technical managers and now retired NSA senior executives.



Telemetry from foreign missiles, satellites, and space probes was often collected from overhead intelligence resources, ground-based locations, airborne platforms, and seaborne intelligence collection platforms. Graphic by Savan Becker

Background and Introduction

Telemetry intelligence (TELINT) (later to be called FISINT) was a critical source of performance information on foreign missiles and space vehicles while they were being developed and tested, as well as a source of telemetry from military aircraft during their development. TELINT could also provide much operational information on foreign satellites and space vehicles. The National Security Agency (NSA) became responsible for U.S. TELINT under a Department of Defense (DoD) directive in 1959 as part of NSA's electronic intelligence (ELINT) responsibilities. TELINT prior to 1959 was being conducted by all of the DoD military departments.

All during the Cold War years, NSA continued to sponsor or participate with the DoD military departments and the National Reconnaissance Office (NRO) to develop sophisticated signal collection equipment that could collect and process foreign telemetry signals and keep pace with the ever-changing technology of those signals.

As described later in this brochure, the HARDBALL telemetry data collection system was one of the major systems developed and installed for operational use in the late 1960s. This system design was optimized and located on Shemya Island, Alaska, to collect data from Soviet intercontinental ballistic missiles (ICBMs) that impacted in the Soviet Kamchatka peninsula test range impact area. HARDBALL could also collect data from Soviet military satellites that sent data to Soviet telemetry receiving locations in the far eastern land area of the Soviet Union.

Context of the Early Cold War Missile and Space Intelligence

World War II was brought to a formal end just as an increasing variety of new technologies was evolving into an entirely new class of weapon systems. The American development and use of the atomic bomb, delivered by a conventional aircraft, is the most prominent example; however, Germany had effectively used guided cruise missiles (the V-1 series) and intermediate-range ballistic missiles (the V-2 series) in significant numbers. Fortunately for the Allies, Germany had only conventional high-explosive warheads on its missiles. Neither the Soviet Union nor the United States paused in their weapon system developments during the Cold War. Winston Churchill summarized the world situation in his now-famous speech given at Westminster College in Fulton, MO, on 5 March 1946. He titled his speech "The Sinews of Peace," although today it is usually called "The Iron Curtain Speech." Only about six months after the formal conclusion of World War II, it was clear that the Soviet Union had a very serious agenda of world domination. In a portion of that speech, Churchill put it this way:

> I do not believe that Soviet Russia desires war. What they desire is the fruits of war and the indefinite expansion of their power and doctrines. But what we have to consider here today while time remains, is the permanent prevention of war and the establishment of conditions of freedom and democracy as rapidly as possible in all countries. Our difficulties and dangers will not be removed by closing our eyes to them. They will not be removed by mere waiting to see what happens; nor will they be removed by a policy of appeasement....

Just a bit later, he said:

> From what I have seen of our Russian friends and allies during the war, I am convinced that there is nothing for which they have less respect than weakness, especially military weakness. For that reason the old doctrine of balance of power is unsound. We cannot afford, if we can help it, to work on narrow margins, offering temptations to a trial of strength.[1]

His observations became a new strategic doctrine, to avoid narrow margins of power, which was soon implemented.

The tension was real, not imagined, and the pace of advanced weapon systems development increased. Thomas Reed, secretary of the U.S. Air Force at that time, has written a book on weapons[2] that provides his personal view of the Cold War and the associated arms race. It contains information about the atomic and hydrogen bomb developments, ICBM developments, and related intelligence systems and activities.

On the weapons delivery side of the weapons development activity:

- The Soviet Union successfully tested its first ICBM, the R-7, on 21 August 1957. [3]
- The Soviet Union launched the world's first artificial satellite, Sputnik, on 4 October 1957 using a modified R-7 as the booster.
- The United States successfully conducted its first full-range (5,500 nautical miles) ICBM test, with the series B ATLAS, on 28 November 1958.[4]

Post-World War II Analytic Challenges for Intelligence Analysts

New technologies and applications always present both challenges and opportunities to the weapon system developers and to those in the intelligence community who must determine, from the outside, not only general developments, but also detailed technical information. Our intelligence community had many new challenges.

U.S. Cold War missile systems intelligence analysts faced an array of questions:

- What type of propulsion systems are being used?
- What is their power?
- What is their fuel composition?
- How reliable are the boosters?
- How much weight can they lift?
- What is the range capability?
- What types of guidance systems are used?
- How accurate are they?
- What are possible flight profiles?
- How do the re-entry systems work?
- What seem to be the developmental problems?
- What is the pace of the development program?

Furthermore, as each general question was answered, there was a natural continuing drive for increasing the accuracy of the answers. Then, as the weapons were deployed, operational readiness and the detailed functionality of the command and control systems became essential intelligence targets.

Sometimes it was not easy to even determine the location or timing of a test flight. The huge landmass of the Soviet Union presented challenges. There were many test ranges and impact areas. Most of these key areas were inaccessible to our existing intelligence systems. As a result, many new collection and sensor systems were developed and operated. There were many types of both platforms and sensors, including radar, infrared, optical, and, of course, TELINT. Military units from all services were involved, as were all segments of the intelligence community and many of our allies.

No single "technical" (e.g., TELINT, ELINT) sensor system could provide the data required to answer the wide variety of important questions that were being asked. True weapon system performance could be determined only by using a variety of data types in a highly interactive and coordinated manner. A variety of analysis teams were created and worked effectively. Of course, there was also some competition, but that usually provoked a great deal of creativity since the working analysts knew that they were doing important work. As is usually the case, talented and creative people are the key to success in any complex endeavor.

Technical Problems Presented by Telemetry Signals Information

Many very basic problems were presented to those faced with using telemetry as an information source. Consider the following simplified list:

- The signal itself must be reliably identified as containing telemetry data as opposed to some other set of data.
- A reliable connection must be made between an individual signal and a specific weapons test.
- Since a wide variety of test measurements are often conducted on a given missile/weapon test, some determination must be made about the goals of the test.
- Most telemetry signals are multichannel, and the assignment of individual data elements to a specific system test measurement must be made accurately.
- None of the above is generally useful unless the nature of the original instrumentation measurement is understood and the coding schemes are determined.

Now consider what would happen if sources of Soviet missile/space telemetry were to be lost to the U.S. The Cold War made it clear that signals intelligence (SIGINT) challenges are provoked by a wide variety of issues; some are technical, some political, but they all have an important time dynamic. This is one of the features that required continual technical attention from a talented and well-equipped workforce.

The areas of telemetry signals collection, analysis, and reporting all evolved over time. It was not a smooth evolutionary process because of the nature of the problem and had little to do with formal organization of the community. Those who had information or talents did work together. This was partly because of the professionally challenging nature of the problem, but perhaps largely because they all had a personal understanding of the importance of the topic.

From a technical point of view, the collection and analytic challenges were also not smoothly distributed in time because they were associated with a development process that was truly state of the art. Progress in such programs has never been smooth or predictable simply because the programs are, by their very nature, experimental. Thus, the results are unknown to all parties in the early stages of the development process.

U.S.–Soviet Strategic Arms Limitations Treaties

A major milestone was reached in May 1972 when President Nixon and General Secretary Brezhnev signed a document officially called "Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics on Certain Measures with Respect to the Limitations of Strategic Offensive Arms." This soon became known as SALT I and entered into force in October 1972.[5]

Article V (of VIII) of this interim SALT agreement stated in part:

> Each party undertakes not to use deliberate concealment measures which impede verification by national technical means of compliance with the provision of this Interim Agreement. This obligation shall not require changes in current construction, assembly, conversion, or overhaul practices. [6]

As is often the case with such diplomatic language, it was not exactly clear what some of the terms really meant. In particular, the term "national technical means" was probably intentionally left to the imagination. The interim agreement was accompanied by a number of "agreed statements, common understandings, and unilateral statements…" regarding the basic topic. Discussions continued under Presidents Ford and Carter, and in June 1979, President Carter and General Secretary Brezhnev signed the SALT II agreement (with minor word changes to make it clear that the telemetric information segment was a part of the treaty) and then added a "Second Common Understanding" which reads as follows:

> Each party is free to use various methods of transmitting telemetric information during testing, including its encryption, except that, in accordance with the provisions of paragraph 3 of Article XV of the Treaty, neither Party shall engage in deliberate denial of telemetric information, such as through the use of telemetry encryption, whenever such denial impedes verification of compliance with the provisions of the Treaty. [7]

In 1991 as the Cold War ended, the U.S. and the USSR entered into a new "Strategic Arms Reduction Treaty," abbreviated START. It was implemented on July 31, 1991. This treaty included an agreed "Telemetry Protocol" that called for the exchange of very specific telemetric data on certain ICBM and submarine-launched ballistic missile (SLBM) tests conducted by each party.[8] The data was to be exchanged on magnetic tapes that contained all of the telemetric data broadcast during the designated flight test. The treaty also contained limitations on the use of telemetry encryption.

Directions for NSA to Manage DoD ELINT and TELINT

Starting in 1954, a number of presidential-level committees recommended that all ELINT be brought under NSA's purview. Both the Mark Clark subcommittee of the Hoover Commission in 1954 and the William O. Baker committee in 1957 made such a recommendation. Strongly backed by President Eisenhower, the Baker committee efforts culminated in the issuance of National Security Council Intelligence Directive (NSCID) No. 6, "Communications Intelligence and Electronics Intelligence," in early 1958.

NSCID No. 6 gave NSA many ELINT/TELINT powers. Within DoD it was implemented in early 1959 by an updated 1955 DoD Directive S-3115.2 and focused DoD top management review within the office of the Deputy Director for Research and Engineering (DDR&E)—soon to be headed by Dr. Eugene Fubini, a staunch supporter of ELINT. With certain exceptions, the directive gave NSA "operational and technical control" of all DoD ELINT/TELINT activities. Foreign telemetry at that time was considered part of ELINT. The directive made it quite clear that the Joint Chiefs of Staff, component commanders, and the military departments and services were to fully support these NSA-managed ELINT activities.[9]

NSA headquarters, Fort George G. Meade, MD, in the 1970s

Soviet R-7 ICBM booster for the SL-4 space launch vehicle

The 1960s were a period of extensive development of ballistic missiles by the Soviet Union, particularly medium range (MRBM) and ICBM weapons. Many of the Soviet test ranges were within the borders of the Soviet Union, which often made advance knowledge of the tests and collection of test data very difficult. Fortunately, the Soviet ICBM test range impact area was on the Kamchatka peninsula and provided for limited access by U.S. collection assets. The Soviet SL-4 space launch booster pictured above was initially developed during the 1960s as the R-7 ICBM.

The SL-4 remains in use today as a Russian space launch vehicle, and the photo shows the launch of a Russian-manned mission to the International Space Station, where the U.S. and Russia now have a cooperative venture.

TELINT Planning, Operations, and Management at NSA

Many TELINT signal collection and telemetry signal processing systems were built and deployed during the 1960s by NSA or sponsored by NSA. A ring of sophisticated TELINT systems was developed and deployed to gather information on the missile development and space activities of the Soviet Union. At the same time, the DoD military departments modified various aircraft and ships to be able to collect missile telemetry. It was often necessary to position and use these telemetry collection platforms during many types of Soviet missile tests.

The Defense Special Missile and Astronautics Center (DEF/SMAC)

One of the major technical and managerial problems that made collection of Soviet missile and space technical data difficult was how to alert all intelligence sensors of impending missile test events. In 1964, to better orchestrate the various U.S.-sponsored intelligence collection sensor systems, DoD formed the Defense Special Missile and Astronautics Center (DEF/SMAC), a joint NSA and Defense Intelligence Agency (DIA) center. DEF/SMAC served at the forefront of U.S. missile and space intelligence and defense. The center coordinated the collection of intelligence information on foreign missiles and satellites from the ground, sea, and in aerospace based on intelligence requirements, and then analyzed the initial collection results and provided reporting based on the information.

DEF/SMAC was an "all-source" operations and intelligence center that served as the focal point for real-time mission operations, analysis, and reporting of foreign missile and space events. It provided time-sensitive alerts, initial-event assessments, and mission support to national agencies, national command authorities, DoD combat commands, and field-deployed data sensor platforms and stations. Below is the DEF/SMAC logo from that time. The DEF/SMAC acronym was later changed to DEFSMAC and the full title changed to the Defense Special Missile and Aerospace Center. [10]

DEF/SMAC logo from the early 1970s

National Telemetry Processing Center

One of the first actions taken in response to the DoD ELINT directive in March 1959 was to incorporate the National Technical Processing Center (NTPC) at Nebraska Avenue in Washington, DC, into the NSA organization as the "Non-communications Signals Analysis and Processing Division." NTPC had been established in 1955 and by 1959 employed about 100 people, who primarily worked electronic intelligence (ELINT) signals and foreign radar signals.

The NTPC also processed, or managed the processing of, foreign telemetry signals obtained from missiles, satellites, and space probes while being developed or placed into operation. This data was collected from a large variety of collection facilities and platforms.

The NTPC processed Soviet telemetry signal data until the end of the Cold War. The word *Technical* in the organization name was changed to *Telemetry* when that became the major type of signal processed by the NTPC.

National Telemetry Processing Center logo

Telemetry Analysis and Reporting

Once the telemetry tapes were processed, the signal analysis phase began. Signals associated with Soviet individual missiles or satellites were analyzed. In the case of missile data, the analysis contributed to the determination of flight characteristics described on page 7 of this document, for example, "What is the range capability for that particular missile test?" NSA had a major role in missile signal analysis and in managing the U.S. intelligence community analytic activities. Once the analysis phase was completed, then reports were prepared and distributed to the U.S. intelligence community, particularly the DoD intelligence agencies, and to the Army, Navy, and Air Force Intelligence Centers.

Collection and Processing Development and Examples

By the early 1970s NSA had completed, or sponsored, a network of ground-based foreign telemetry collection facilities and worked with the DoD military departments and services to develop aircraft and shipborne TELINT signal collection facilities. In 1971 elements of the NSA Research and Development (R&D) organization and other NSA SIGINT operational elements were merged to form the Electronic Intelligence and Systems Management Group. This group provided an institutional base for NSA to manage TELINT and the development of new collection and processing systems for TELINT efforts. TELINT attained its DoD formal status as a separate "INT" in 1971 with the publication of the revised DoD Directive 5100.20, which gave NSA its updated charter at NSA. TELINT activities were managed by the Advanced Weapons and Space Systems Office.

Examples of collection and processing equipment are displayed in an exhibit at NSA's National Cryptologic Museum at Fort George G. Meade, Maryland. The overview description of the exhibit reads as follows:

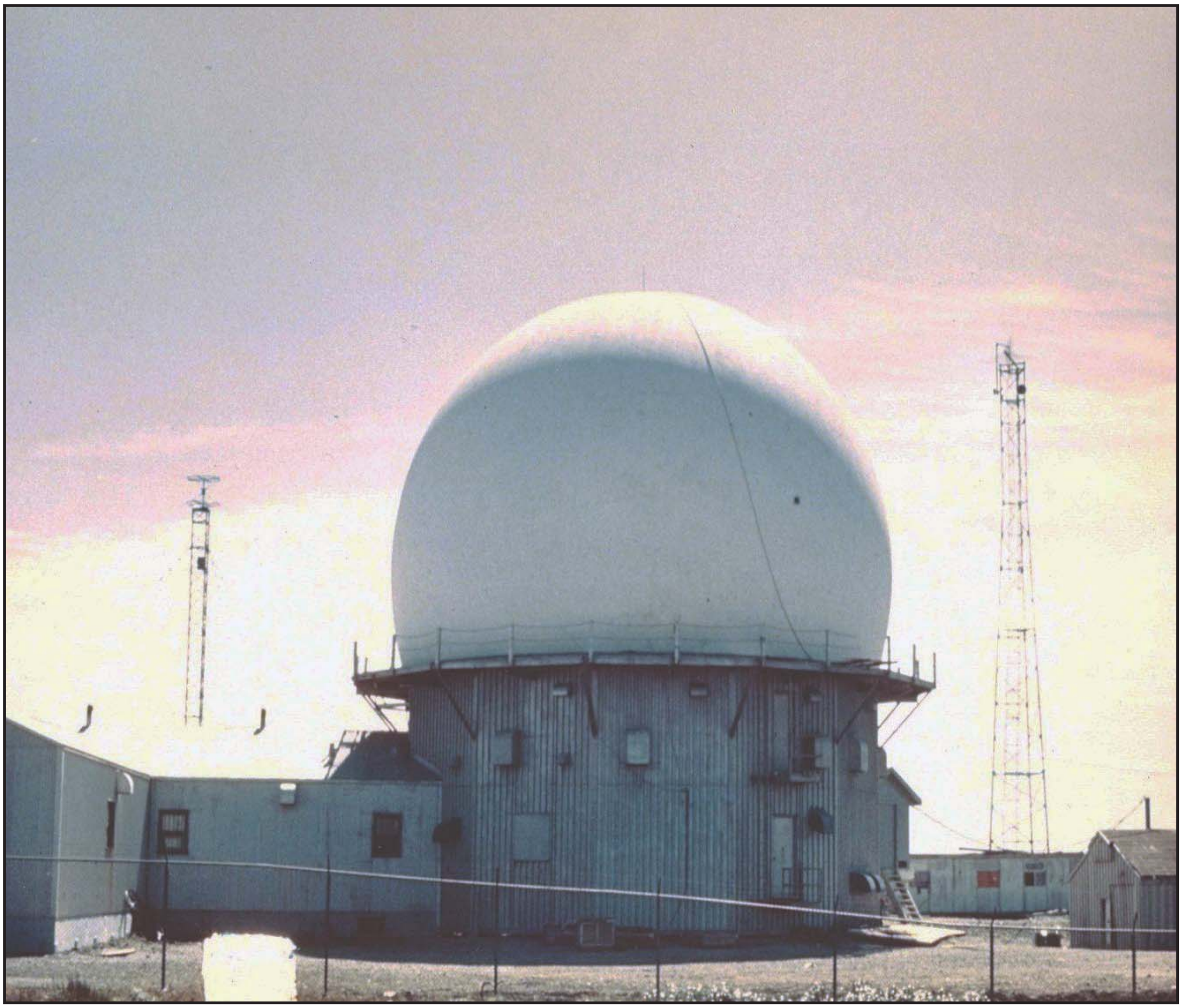
> Telemetry literally means remote measuring. Something is measured and the data is received at a distant location. This can be the strength of an earthquake, the temperature on Mars, or the speed of a launched missile.
>
> Telemetry from missiles includes speed, location, engine status, tracking, and other data. Telemetry from satellites may include similar information as well as imagery used in reconnaissance. Understanding the adversaries' telemetry signals provides crucial information about their weapons systems' capabilities. NSA's involvement in Foreign Instrumentation Signals Intelligence (FISINT) began in 1959. Throughout the Cold War, it grew and improved, pushing computer development and improving warfighters' countermeasures.
>
> As the Cold War progressed, foreign countries began intense efforts to develop a broad range of weapons systems. As these systems went from research and development to operational status, each step required extensive testing. Designers carefully monitored their systems through telemetry. This same telemetry could sometimes be obtained and processed by the United States as well. The desire to closely monitor an adversary's weapons development led the United States to a commitment to collect, process, and analyze the foreign telemetry signals.
>
> Adversaries' telemetry data can be collected from a variety of platforms. In WWII, converted bombers flew over the Aleutian Islands to electronically map the Japanese radars on the islands. EA-3B Navy aircraft not only worked against Soviet-built SA-2 missiles in Vietnam, they also helped target Iraqi antiaircraft missiles in the First Gulf War. In the 1960s, the GRAB and POPPY satellites collected Electronic Intelligence (ELINT) from Soviet air defense radar signals providing their locations and capabilities. By the 1970s, NSA had a network of ground-based foreign telemetry collection facilities gathering information on missile development and space activities of the Soviet Union.

The National Cryptologic Museum's HARDBALL and RISSMAN telemetry exhibit

The photograph above shows the NCM display on the ground-based telemetry collection facility called ANDERS located on Shemya Island, Alaska, and some of the included telemetry collection equipment called HARDBALL. It also shows part of the RISSMAN signal preprocessing equipment display.

Telemetry Data Collection System (HARDBALL)

Typically, four large "horn" antennas, protected from the weather by a radome, received foreign telemetry signals from the roof of a two-story collection facility. The antennas collected telemetry from foreign satellites and sometimes from missiles within the HARDBALL "view area." On-site analysts also used the signal to automatically follow or track the satellite or missile as it passed within view of the station. Shown below is a photograph of the ANDERS station (now closed) where HARDBALL was located on Shemya Island, Alaska. The HARDBALL system was designed and built by Sylvania Electronics Systems Western Division, now part of General Dynamics Mission Systems, under contract to NSA in 1965-66, and installed at ANDERS in 1967.



ANDERS Telemetry Collection Facility on Shemya Island, Alaska

The second floor of the collection facility held most of the HARDBALL telemetry collection equipment. Racks of equipment received, displayed, and converted several signals before they were recorded on magnetic tape and forwarded to NSA for processing.

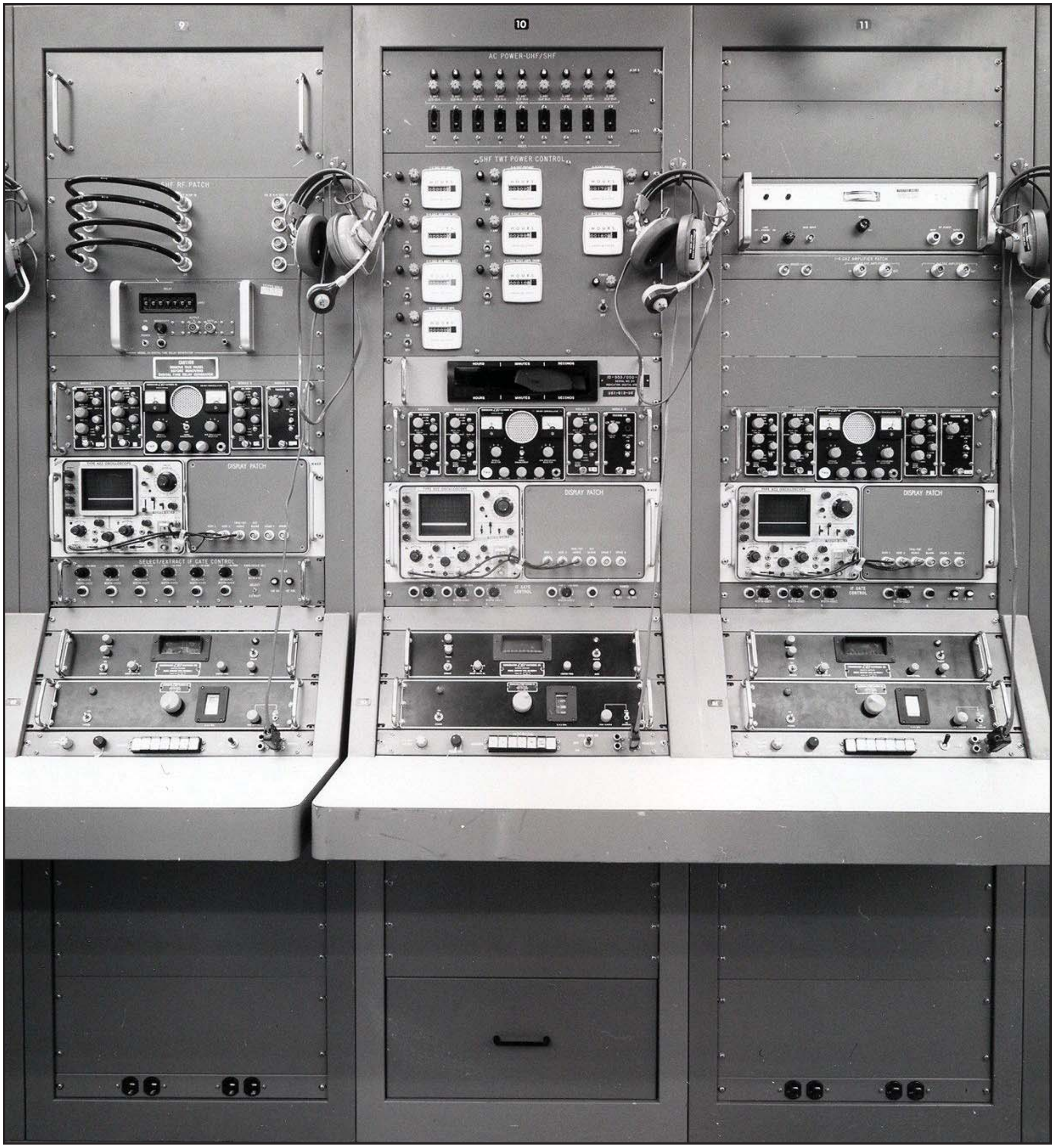
The HARDBALL system at the ANDERS location primarily contained:

- Antennas to initially receive the signals from satellites and missiles in view of ANDERS. These signals contained data on the satellite's purpose or missile's performance, such as reconnaissance photographs or rocket trajectory.
- Receivers to manipulate the signals and properly format the signals so that human operators could use oscilloscopes to graphically display the signals. This allowed the operator to make sure the equipment was adjusted properly to ensure that the signal could be processed correctly.
- Equipment which further converted the signals and then combined several foreign telemetry signals into data streams, which were then recorded on magnetic tape at the facility or at a processing facility at another location
- Equipment to initially analyze and report the results of the telemetry received

The overall facility for the HARDBALL system was the DoD ANDERS station. An informal logo used by the station is shown here.

DoD ANDERS Station logo

The photograph below shows three “racks” of telemetry signals collection equipment typical for such a ground site collection facility. Each rack of equipment could receive one signal and convert it to be recorded on magnetic tape for further signal processing and analysis, either at the site location or at other processing facilities.



Signal collection equipment racks for three operator “positions”

The photograph below is a view of one rack of equipment holding signal receiver equipment and signal manipulation ("demodulation") equipment.

Demodulators: Changed the signals from the receivers into a form that was suitable for recording on magnetic tape. The tapes would then be played back on RISSMAN in the NTPC

Displays: Operators used oscilloscopes to graphically display the signals. This allowed operators to make sure the equipment was adjusted properly, ensuring the signal could be processed correctly.

Receivers: Picked up telemetry from satellites and missiles. These signals contained data on the satellite's purpose or missile's performance, such as reconnaissance photographs or missile trajectory.

One signal collection "position" rack of equipment including the operator console and displays

During the Cold War period many technology advances were made in TELINT collection and analysis equipment. These advances increased capabilities via more reliable configurations and used less electrical power. As the state of the art of foreign electronic equipment advanced, signals receivers had to keep pace. NSA also continued to modernize and expand the TELINT signals processing and analysis equipment at selected data collection locations and at NSA facilities.

Telemetry Data Processing and Analysis (RISSMAN)

Special-purpose telemetry processing equipment configurations, often computer-based, were also developed and operated by NSA in the National Telemetry Processing Center (NTPC). Different types of equipment sets were needed to process and analyze different forms of telemetry used by different telemetry transmission equipment.

The telemetry signals were collected by various collection platforms. Magnetic tape recordings of the collected data signals were then sent to NTPC for processing. These measurements were then sent on computer tape to various analysis centers which identified the function of the various transducers and developed performance estimates. The resulting information was used to formulate defense policy and guide treaty negotiations.

RISSMAN was one of the computer systems specially designed for this work using custom hardware. For a decade, from the early 1980s through the end of the Cold War, RISSMAN processed these tapes daily, often around the clock.

Prior to RISSMAN was TELLMAN, the Agency's first telemetry processor to make extensive use of a general purpose computer. RISSMAN processed a wider variety of signals with higher system reliability and lower maintenance costs. RISSMAN's custom-designed chassis for the front-end of the signal processing is shown on the rack on the left in the NCM exhibit. RISSMAN used three Intel 8086 microcomputers to perform real-time process control. Not shown are the Digital VAX-11 computers that provided data "demultiplexing," data file storage, and user-interface. RISSMAN also provided local area network (LAN) access within the NTPC, digital tape generation, and quality-control plotting services.

RISSMAN telemetry signal preprocessing equipment and description at the National Cryptologic Museum

The knowledge gained from foreign telemetry collection and analysis, as well as other ELINT signals, provided information for the United States to design electronic countermeasures. Equipment such as radar warning systems and jamming equipment were designed and helped protect those in harm's way. Decision and policy makers also used the data gained from these signals to formulate defense policy and guide treaty negotiations.

Above is a photograph of the RISSMAN equipment display.

The RISSMAN telemetry preprocessing system was designed and constructed by NSA engineers and technicians.

Smithsonian Air and Space Museum TELINT Exhibit

The National Air and Space Museum in downtown Washington, DC, has had a "Missile Gallery" exhibit for many years. After the Cold War, it began to include Soviet (and now Russian) artifacts. The initial emphasis was on the manned flight programs of both the United States and Russia in the "Race to the Moon" display several years ago. Other displays included the joint Apollo-Soyuz effort and continuing joint efforts on the International Space Station.

When the U.S. National Reconnaissance Office declassified several of the U.S. photographic reconnaissance satellite programs, it loaned the museum several spacecraft components, particularly on the first major photographic CORONA program. NSA provided a replica of the early GRAB ELINT spacecraft. The U.S. Navy provided information on U.S.-collected ELINT from satellites; it covered the Soviet defense radars that detected any bomber threat to the Soviet Union. The CORONA and GRAB spacecraft have been included in the "Spying from Space" display. The display overview graphic states:

> Satellite reconnaissance programs are cloaked in secrecy. Only since the 1990s has the public learned about just a few of them. The United States began developing satellites in the late 1950s to augment the aircraft, ships, and ground stations it had used for reconnaissance since World War II. Satellites have important advantages over these other platforms. They provide greater coverage and are much less vulnerable to attack. The United States conducts reconnaissance to acquire imagery intelligence and signals intelligence. Along with other sources of intelligence, reconnaissance provides civilian and military leaders with timely and accurate information on political, military and economic developments around the world. It also assists the military in its operations.

The Smithsonian requested that Cold War SIGINT information collected by the United States be added to the "Secret Eyes in Space" display. It was agreed that NSA would loan the museum the HARDBALL single rack of equipment and one rack from the RISSMAN three-rack assembly, along with pertinent information. These items and associated information were added to the Air and Space Museum exhibit in 2014.

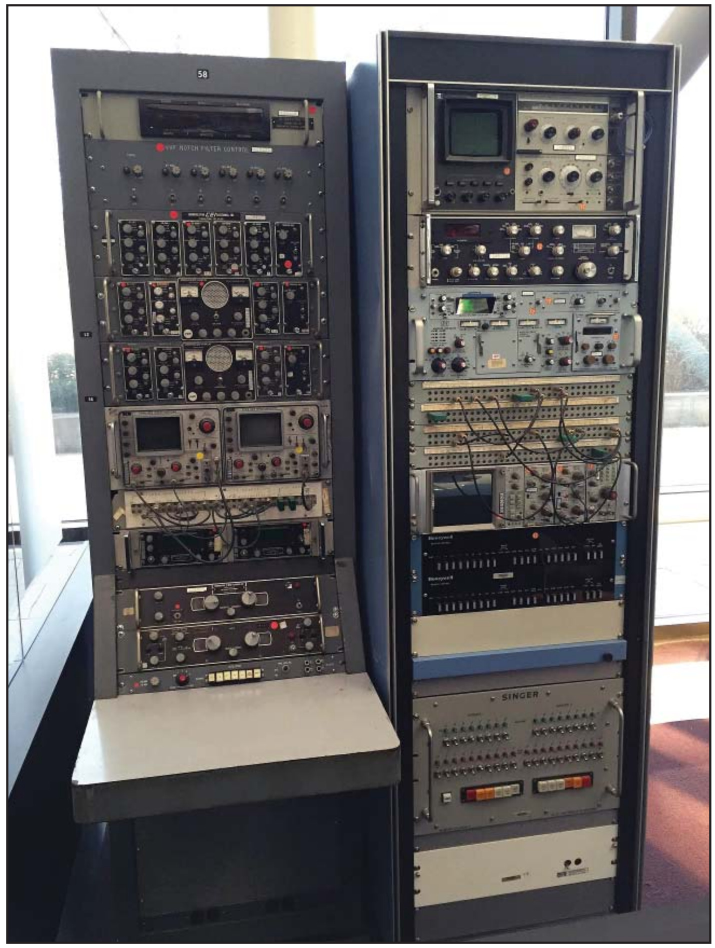
The introductory panel text that describes the HARDBALL/RISSMAN area is shown below:

Verifying Arms Control Treaties

The United States and the USSR signed the Strategic Arms Limitation Treaty (SALT I) in 1972 and the follow-on SALT II in 1979. These were the first agreements between the superpowers limiting their strategic nuclear weapons systems, including intercontinental ballistic missiles (ICBMs).

The treaties permitted both nations to use "National Technical Means"—satellites and other platforms conducting imagery and signals intelligence—to verify compliance. Ground stations in countries bordering the Soviet Union were critical to this effort. Equipment with the Ground Station intercept receivers, like the one displayed here, and other hardware, collected telemetry sent from the Soviet ICBMs to their ground controllers during flight tests. The magnetic tapes with the data were brought to the United States for analysis to ensure that the missiles did not exceed the treaty limits. . . .

The United States and Russia have signed additional treaties beginning in the 1980s that have further reduced their strategic nuclear weapons arsenals. National Technical Means remain a key instrument for verification.



HARDBALL and RISSMAN equipment racks

A photograph of the NSA equipment in the National Air and Space Museum display appears above.

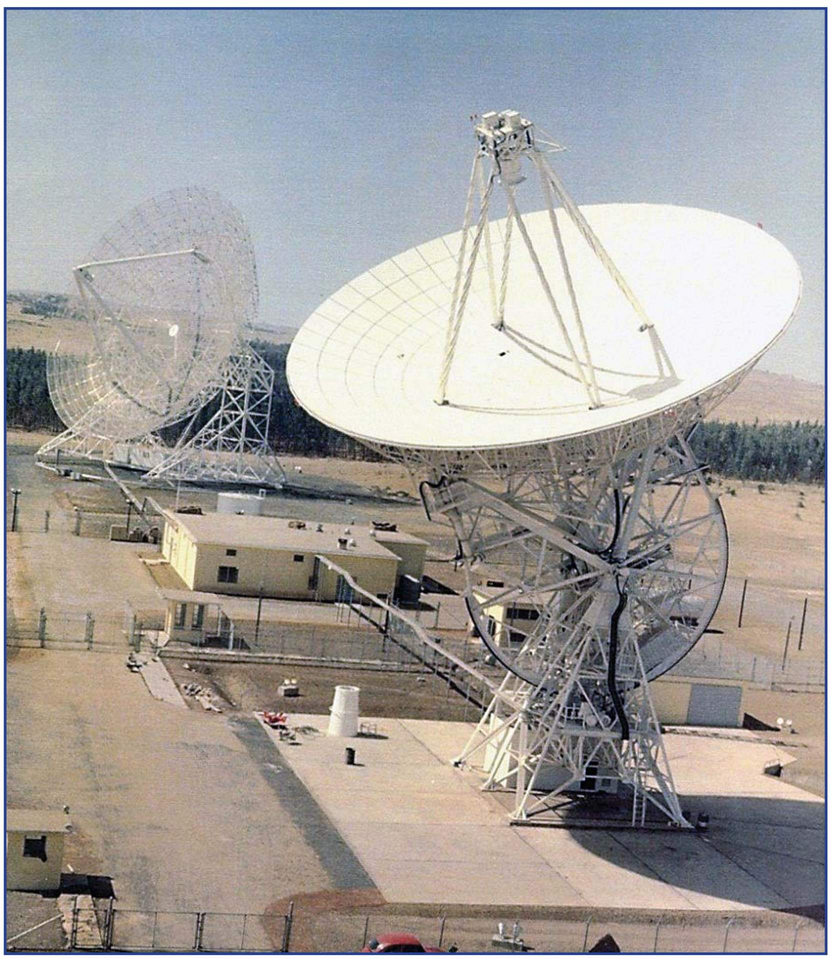
A photograph of the STONEHOUSE antennas and operations building, as shown on the following page, is included in an adjacent Smithsonian display.

Specialized Telemetry Signal Data Collection Assets

An adversary's telemetry data could be collected from a variety of platforms. The U.S. Army, Navy, and Air Force employed shipborne and airborne collection platforms to gather data from foreign missile tests. NSA also sponsored a network of ground-based telemetry collection facilities that gathered information on the missile development and space activities of adversaries.

STONEHOUSE Deep Space Data Telemetry Collection Facility

The photo below is of the now-closed STONEHOUSE deep space TELINT facility that was located in Asmara, in Eritrea province, Ethiopia. This location had telemetry access to the Soviet command station for Soviet deep space objects and allowed reception of the command responses and telemetry from the probes. The antenna shown on the right is an 85-foot reflector, and the one on the left is a 150-foot diameter antenna. These large antennas were needed to receive the very weak telemetry signals from Soviet space probes that were as far away as the Moon, Mars, and Venus. Radiation, Inc., now part of Harris Electronic Systems Division, designed, constructed, and installed the STONEHOUSE system under contract to NSA in the early 1960s. The facility closed in 1975.



STONEHOUSE antennas and operations building

Shipborne Data Collection—ARIS Ships and USNS *Observation Island*

The USNS *General Hoyt S. Vandenberg* (AGM-10) and the USNS *General H.H. Arnold* (AGM-9) were U.S. Atlantic range instrumentation ships (ARIS) that were modified for intelligence data collection. These major mobile technical intelligence collection platforms provided radar signature data and collected telemetry data from Soviet ICBMs that impacted on the Kamchatka peninsula or in the Pacific Ocean when they were tested to their full range. The modified ARIS ships deployed on Pacific Ocean intelligence missions several times per year when Soviet ICBM tests were anticipated. The ships operated during the 1960s and 1970s. The *Vandenberg* was retired and now serves as an artificial reef off Key West, Florida.

Starting in 1973, DoD began development of a multisensor collection ship to monitor Soviet strategic missile testing. It was designated the USNS *Observation Island*. The primary mission equipment was a sophisticated precision missile-tracking radar designated COBRA JUDY that was developed by Raytheon Corporation under a USAF contract. The ship became operational in 1982 and was retired from mission duties in 2014.

USNS *General H.H. Arnold*

EA-3B signals intelligence and optical airborne platform

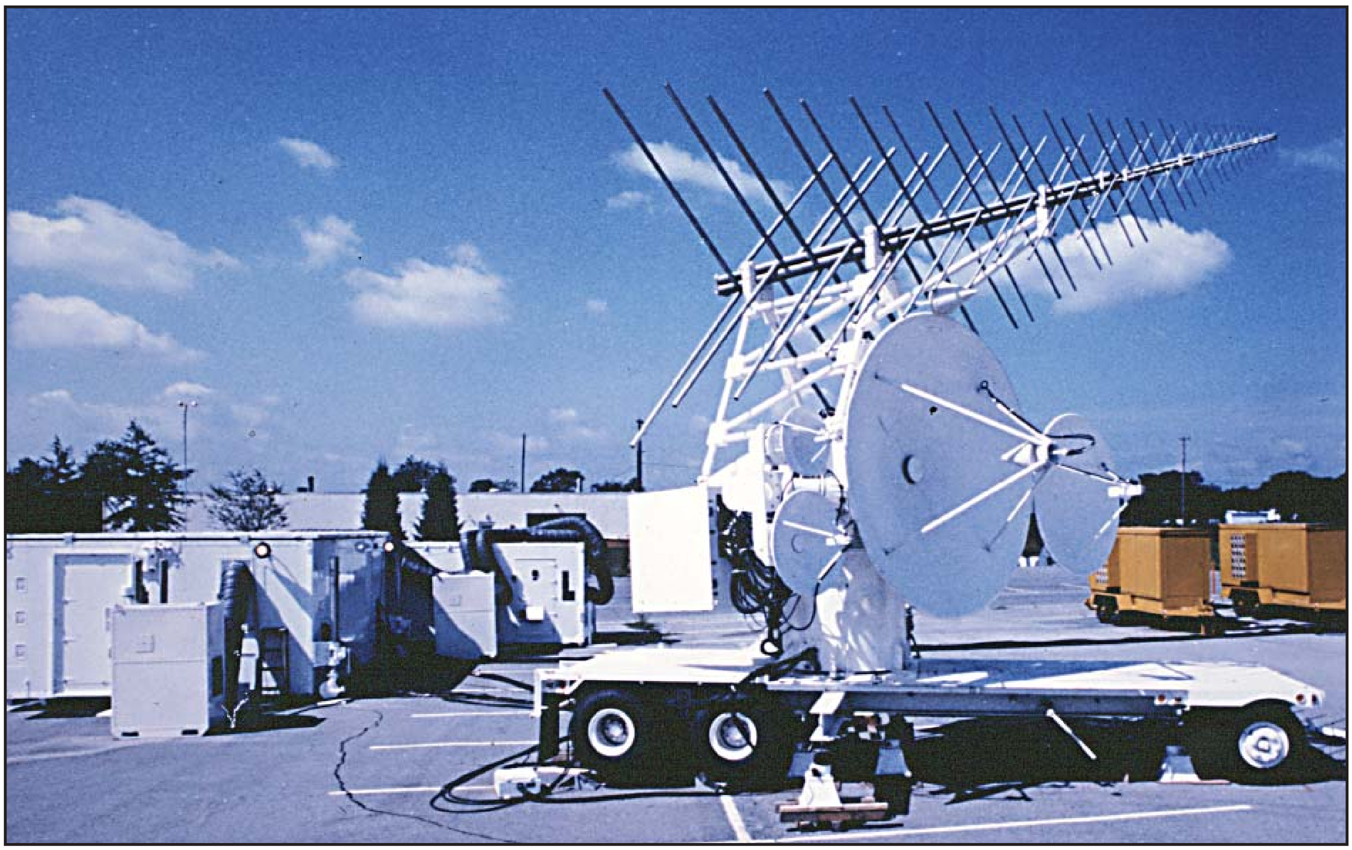
Airborne Telemetry and Optical Collection—EA-3B (SEABRINE)

The EA-3B was an unarmed, electronic support measures (ESM)/reconnaissance variant of the A3D carrier-based bomber. Twenty-four of the variants were built and four were modified for technical collection of optical, radar, and telemetry information. SEABRINE operations started in 1961 and were targeted against Soviet missiles impacting on the Kamchatka peninsula. EA-3B aircraft were based on Shemya Island, Alaska. The SEABRINE aircraft were flown by U.S. Navy personnel, while the telemetry collection equipment was operated by U.S. Army Security Agency personnel since at that time the U.S. Army had the DoD overall responsibility for intelligence on foreign ground-to-ground missiles. The project was a very successful joint Army-Navy effort. The project's short title for this configuration was SEABRINE. The aircraft modification for the SEABRINE equipment system was performed in the early 1960s by Sylvania Systems–Electronic Defense Laboratories, which also provided system maintenance at the operating locations.

An EA-3B aircraft is on display at the NSA National Cryptologic Museum at Fort George G. Meade, Maryland.

Transportable Ground-Based Telemetry Collection (LEFTOUT)

During the Cold War, the land-based AN/MSQ-90V telemetry collection system was available for air transport to locations around the Pacific Ocean. It was operated and maintained by the U.S. Army Security Agency (USASA) during the 1970s and early 1980s. Other smaller, limited-capability, transportable telemetry collection equipment systems were also used during the Cold War for special collection opportunities. The system project name was LEFTOUT, and the system was developed by E-Systems in Greenville, Texas, now part of L-3 Communications Holdings.



LEFTOUT transportable telemetry collection system

Observations and Conclusions

Only a few months after the end of World War II it was clear that the free world needed to be concerned about the spread of communism, and that the activities of the Soviet Union might be used to forcefully gain its political and geographic objectives. Winston Churchill summarized the world situation in his so-called "Iron Curtain Speech" in 1946.

The Soviet Union had already started, and continued, development of nuclear weapons as well as missile and space systems. The Soviets tested their first ICBM in 1957. Starting in 1958, NSA technical and management initiatives and expertise made significant intelligence gains for the United States and its allies from TELINT information. The information provided critical data on foreign missiles and space vehicles that were a threat to the United States, including vital intelligence information for use by U.S. missile and satellite system designers and system operating personnel.

The U.S. had also started political actions to limit the world-wide use of possible weapons of mass destruction. In 1972 the United States formalized an agreement with the Soviet Union on strategic arms limitations called SALT I. SALT I contained wording that allowed each party to use "national technical means" to verify aspects of SALT I and stated that neither party would interfere with the technical means of the other party. In 1979 the SALT II agreement contained the "Second Common Understanding," which stated:

> Each party is free to use various methods of transmitting telemetric information during testing, including its encryption, except that, in accordance with the provisions of paragraph 3 of Article XV of the Treaty, neither Party shall engage in deliberate denial of telemetric information, such as through the use of telemetry encryption, whenever such denial impedes verification of compliance with the provisions of the Treaty.

These provisions attested to the value of the information gained by both parties through the use of TELINT from each other's missile and space developments. NSA sponsored an aggressive program to collect, process, analyze, and report on Soviet Union telemetry for use by U.S. policy makers and technical managers.

The information presented in the National Cryptologic Museum displays, including the HARDBALL and RISSMAN equipment, attempts to portray some of the system developments sponsored by NSA to accurately and thoroughly monitor Soviet achievements in the missile field.

Acronyms and Project Names

ANDERS – The now-closed station on Shemya Island, Alaska, that housed the HARDBALL telemetry collection equipment

COBRA JUDY – Project name for the precision radar on the USNS *Observation Island* that monitored Soviet strategic missile testing

DEF/SMAC – The Defense Special Missile and Astronautics Center; responsible for DIA and NSA collection coordination and early reporting on all DoD intelligence collection and early processing activities on foreign missile and space activities. The name was changed to Defense Special Missile and Aerospace Center, and the acronym became DEFSMAC in 2002.

ELINT – Electronic intelligence; a category of electronic signals that includes TELINT

FISINT – Foreign instrumentation signals intelligence; the current acronym for TELINT

HARDBALL – The project name for the equipment system that collected Soviet telemetry from missiles and satellites that could be viewed from the Shemya, Alaska, location

NSA – National Security Agency; responsible for DoD ELINT/TELINT/FISINT since 1959

NTPC – National Technical Processing Center; the name used by NSA to describe the ELINT and TELINT signal processing laboratory at NSA

R-7 – Soviet ICBM that was developed in the 1960s and was the booster for the Soviet SL-4

RISSMAN – A project name for telemetry processing equipment at the NTPC

SL-4 – Soviet space launch booster based on the R-7 ICBM

SALT – Strategic Arms Limitations Treaty; SALT I was implemented in 1972 and SALT II was implemented in 1979

START – The Strategic Arms Reduction Treaty, signed on July 31, 1991

STONEHOUSE – The facility, now closed, that collected telemetry from Soviet deep space probes from a U.S. Army base at Asmara, Ethiopia

TELINT – Telemetry intelligence; defined as an NSA management responsibility in the 1959 Department of Defense Directive that was updated in 1971

TELLMAN – The equipment that was replaced by RISSMAN in the early 1980s

References

1. Churchill's speech is contained in many references and is surely worth reading completely. One of the easiest ways to find sources on his speech is: http://history1900s.about.com/library/weekly/aao082400a.html.
2. Thomas C. Reed, *At the Abyss: An Insider's History of the Cold War*, New York: Random House/Ballantine Books, 2004.
3. Robert Godwin, editor, *Rocket and Space Corporation Energia: The Legacy of S.P. Korolev*, English edition, Burlington, Ontario, Canada: Apogee Books, 2001. This is an English edition of a Russian publication that covers, with photographs and illustrations, the early missiles and space activities of one of the major contributors to the Soviet Union's efforts in these areas. It is also a reference for Soviet R-7 flights and "Sputnik" data and booster types.
4. See "Key dates in ICBM history" at http://afspc.af.mil/library.
5. A detailed narrative of the U.S./USSR process of developing SALT I can be found at http://www.state.gov/t/isn/5191.htm.
6. Full text of the SALT I Interim Agreement can be found at http://www.state.gov/t/isn/4795.htm.
7. Full text of the SALT II treaty can be found at http://www.state.gov/t/isn/5195.htm.
8. "The Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms" (START) was signed in Moscow on July 31, 1991. It can be found at http://www. state.gov/t/avc/trty/146007.htm.
9. Richard L. Bernard, "Electronic Intelligence (ELINT) at NSA," Center for Cryptologic History, National Security Agency, 2009.
10. Richard L. Bernard, "In the Forefront of Foreign Missile and Space Intelligence: History of the Defense Special Missile and Aerospace Center (DEFSMAC), 1960-2010," Center for Cryptologic History, National Security Agency, 2012.

Author's Biography

Richard L. Bernard is a consultant and volunteer in the Center for Cryptologic History (CCH) at the National Security Agency (NSA). He is a retired NSA Senior Executive with over forty years of SIGINT experience. He joined NSA as a USAF 2d Lt. in 1953 and was assigned to the Office of Machine Processing at Arlington Hall Station. He became an NSA civilian in 1954 and served in a succession of engineering and engineering management positions involving TELINT throughout his career, including Deputy Chief of the Line-of-Sight Systems Group in the Research and Engineering Organization and Director of the Defense Special Missile and Astronautics Center (DEFSMAC) in the early 1980s. (The name was changed to Defense Special Missile and Aerospace Center in 2002.)

Mr. Bernard was one of the first set of NSA personnel in 1959 assigned to address NSA's new ELINT/TELINT responsibilities. He was an active participant in working with the DoD military departments, CIA, and foreign partners on TELINT matters. As Director of DEFSMAC from 1980 to 1983, he was active in using TELINT to fulfill the Center's mission. He retired from NSA in 1985 to work in private industry. In 1996 he became a consultant to CCH. He has completed several documents on the history of ELINT and TELINT, the latter now designated foreign instrumentation signals intelligence (FISINT).

Mr. Bernard has an electrical engineering degree from the University of Cincinnati and a Master of Engineering Administration degree from George Washington University. He also completed the Federal Executive Institute Executive Management Program. Mr. Bernard was a 1982 charter member of the NSA Senior Cryptologic Executive Service. He received the NSA Meritorious Civilian Service Award in 1983 for his achievements as DEFSMAC Director.

Mr. Bernard has been a consultant and volunteer for CCH since his retirement from private industry in 1996. He has held the honorary title of DEFSMAC Historian since 1997. He is also a member of the National Cryptologic Museum Foundation and assists in preparing and obtaining information for current and future museum exhibits.

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