NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY

Know the Earth... Show the Way... Understand the World

The Advent of the National Geospatial-Intelligence Agency

Office of the NGA Historian

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Message from the Director

Intelligence based upon the Earth's physical and man-made attributes—and the art and science of interpreting that information—began to change well before the tragedy of September 11, 2001. By combining America's most advanced imagery and geospatial assets within the National Imagery and Mapping Agency (NIMA) in 1996, our nation created a much-needed critical mass of skills and technologies under a single mission umbrella. As a result, the intelligence community was able to take its geospatial products to a new level. With the creation of NGA in 2003, this area of intelligence took another leap forward, allowing us to integrate multiple sources of information, intelligence and tradecrafts to produce an innovative and sophisticated new discipline that then NGA director James Clapper formally christened as geospatial intelligence, or GEOINT.

The change of name from NIMA to NGA had little to do with semantics and much to do with achieving greater insight into GEOINT. Using this new paradigm, intelligence professionals were better able to exploit and analyze imagery and geospatial information to describe, assess and visually depict physical features and human activity on the Earth. Today, NGA continues to deliver these vital intelligence products in responding to, and anticipating, our nation's most critical national security challenges. GEOINT enables our nation's leaders to make the best policy decisions possible. It also supports our military partners' tactical and operational missions abroad. More than ever, this agency works hard to put GEOINT in the hands of our customers—when, where and how they need it.

From the discovery of atrocities in Kosovo, to support for the cities hosting the Olympics, through the response to Hurricane Katrina, and our work in Haiti and Japan, NGA has provided critical GEOINT support when our nation needed it most. In the White House report reviewing the response to Hurricane Katrina, NGA was specifically commended for our timely response during the crisis. GEOINT offered an early version of the same total picture for responders that the administration later recommended for the entire nation as its plan to address major disasters in the years ahead.

With this modest analysis of its past, NGA uses history to better understand

its present and its future. While firmly rooted in a legacy that extends back to surveyors like the young George Washington and explorers like Meriwether Lewis and William Clark, GEOINT combines extraordinary modern technologies and diverse personal skills to solve today's most difficult and complicated intelligence problems. In fact, NGA helped track down al Qaeda leader Osama bin Ladin and shared insights with the special operations team that successfully stormed his compound in Abbottabad, Pakistan on May 1, 2011.

Challenges continue to face our nation. In September 2011, we complete the consolidation of most of our East Coast activity to a new state-of-the-art campus, which, combined with our facilities in St. Louis, will help further unify and focus our efforts on behalf of America's warfighters and policy makers. NGA will continue to learn from our past GEOINT successes, and we will continue to find innovative ways to better prepare for the challenges that our nation will face in the future.

Letitia A. Long

Letitia A. Long
Director
National Geospatial-Intelligence Agency

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President Clinton speaking to the troops in Bosnia
Photo provided by DoD

PART ONE

The Genesis of GEOINT

Introduction: Something Happened in Dayton

On November 1, 1995, President William Jefferson Clinton called on the warring factions in Bosnia to end the conflict that had cost over three hundred thousand Serb, Croat, and Muslim lives since 1991. He invited their representatives to come to Wright-Patterson Air Force Base in Dayton, Ohio to negotiate an end to the ethnic discord.

In Dayton the U.S. delegation relied on a technical team led by the Defense Mapping Agency (DMA) and the U.S. Army Topographic Engineering Center. These agencies drew together a support team of over fifty individuals who digitally mapped the disputed Balkans areas in near-real-time to assist the diplomats in their deliberations. The digital renderings included up-to-date terrain visualization with cultural and economic data relating to potential boundaries.

Using automated cartography, computer-assisted map tailoring, and spatial statistical analysis, the team regularly furnished fresh maps reflecting territorial dispositions that had been negotiated less than thirty minutes earlier. The digital technique guaranteed accuracy, consistency, and reliability.

The power and flexibility of the technology and the technicians gave the political decision makers the confidence needed to reach agreement. Three-dimensional visual imagery of the disputed areas permitted cartographers to walk negotiators through disputed terrain, giving them a vivid and virtual experience of the space. In at least one instance, this three-dimensional experience proved crucial in persuading Yugoslav President Slobodan Milosevic to compromise on a disputed area.

These hard-working cartographers and analysts collectively contributed to the Dayton Peace Accords, leading to a temporary, but significant, suspension of regional violence. In this case, the professional lesson did not go unlearned. Combining people and talent from eight agencies and offices the following year into the National Imagery and Mapping Agency (NIMA) certainly reflected initiatives underway and also spoke to the wisdom of asking those involved in defense imagery and mapping to emulate the Dayton success on a more permanent basis.

Of course the agency's enabling legislation simply brought people together and initially could

do nothing more. For many months after the creation of NIMA, imagery analysis and geospatial information services within the agency remained in separate and culturally distinct worlds. Seeing the potential in integration, a number of senior leaders recommended strongly that the agency actively integrate the talents assembled under the NIMA umbrella. Strong cultural identities on all sides at times made the idea of cartographers and other geospatial specialists regularly emulating the Dayton experience a very difficult and almost unlikely prospect.

Recognizing possibilities in the combination, a number of people stepped forward to bridge the gap. In one case, a DMA veteran and senior cartographer felt that she might be able to help. Having worked for a time in private industry on one of the first automobile navigation system studies, she thought the need to integrate skills and personnel to achieve a goal seemed natural. Working with the NIMA Production Cell at the Washington Navy Yard, she gained approval for a plan to blend the analytical skills applied to imagery with those of the geospatial arts and sciences. In 1999 she began to hire cartographers, geographers, and other geospatial professionals for placement in some of NIMA's imagery analysis offices.

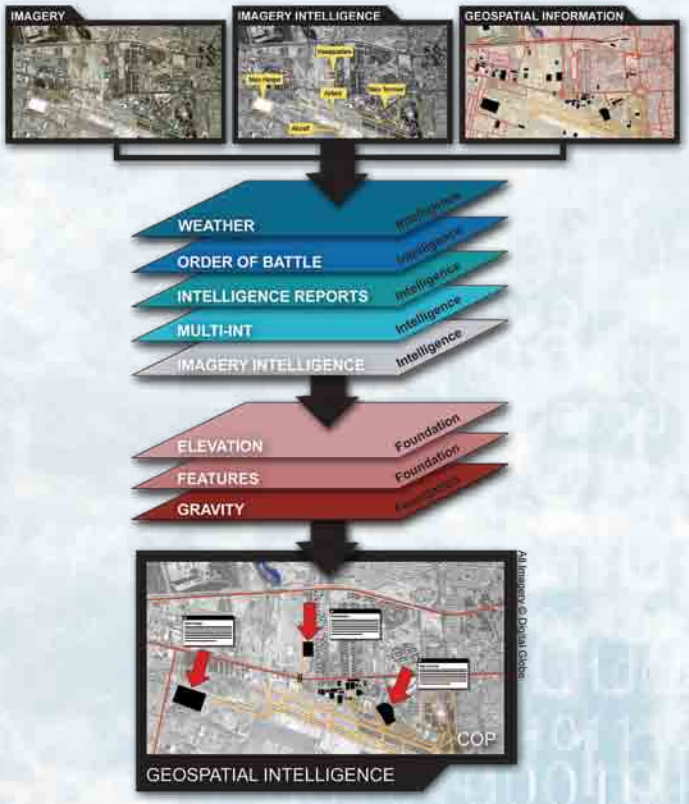
In the process, all concerned began to appreciate more fully the cultural divide between the world of maps and imagery. Speaking with some old hands at the imagery effort, this former DMA veteran received responses to her plan that ranged from "What am I going to do with one of them?" to "We would not recruit from that university." In an exchange with one imagery analyst, she asked, "Where do you get your requirements from?" To that point in time cartographers lived by the routine of a production schedule, discreet well-defined projects each with a neat beginning, middle, and end. Instead of an answer characteristic of her professional world, she learned that the imagery people just knew what to do. In short, they owned their areas of specialty, their tasks, their analysis, and the process of reporting. They thought out loud, collaborated regularly, and directed their own work to serve the mission at hand. The DMA veteran recalled recently, "I was immediately jealous." She wanted that same ownership, the freedom and responsibility it offered, and the same flexibility for people in her own field in collaboration with the imagery world.

The bloody conflict in Chechnya presented the perfect opportunity. Driven for a time by this civil war, NIMA's Eurasia division turned potential into practice. Welcomed by a group willing to experiment, in 2000 those leading the integration initiative asked a Bethesda-based cartographer to join the Eurasia group to merge his talent with their imagery analysis. The newcomer to the Eurasia division had only recently joined NIMA after working at a private industry mapping company, and his colleagues felt that he had "a sense for cartography. He had a sense for displaying information in a thematic context and wove it into a story."

Once augmented by a geospatial professional, the Eurasia group managed to set cultural barriers aside, listened, shared, and proceeded to issue intelligence products that had their customers immediately clamoring for more, frequently describing the output as "phenomenal." As one senior NIMA manager remembered it, Eurasia's new cartographer "was a rock star:" He provided the magic ingredient that brought the effort and the

output to another level. Intellectual insight into a crisis situation expressed in a tight, complementary symphony of image and idea quickly set a new standard for professional achievement. This pioneering group, one among many, arrayed their early products on a display surface at the Washington Navy Yard that quickly became known as the "Wall of Fame." In a visit to NIMA during this period, CIA director George Tenet lingered for a considerable time over the all-source intelligence on the Wall of Fame, with the distinct feeling that the future lay before him. Starting with eight embedded geospatial specialists, within six months those leading the integration initiative had little trouble placing eighteen more in various imagery offices in NIMA.

The success of the Washington Navy Yard Eurasia division eroded cultural barriers and promoted professional integration. Coming together as NIMA created the critical mass of talent and insight, but people willing to trust, to collaborate, and to experiment provided the catalyst. NIMA's customers understood the crisis in Chechnya as never before, through a new lens called geospatial intelligence, or GEOINT. Intelligence had entered a new era.



Geospatial intelligence is the exploitation and analysis of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the Earth.

NSG GEOINT Basic Doctrine 1-0.

Photography from the
NGA Historical Research Center

PART TWO

The New from the Old

New Product, Old Roots

NIMA and its predecessor agencies reflected the historic need of American military and civilian leaders for an appreciation of the physical environment surrounding them. When General George Washington required information on the roads, rivers and fields of the New Jersey, Pennsylvania, and New York countryside, he turned to Robert Erskine an engineer, surveyor and inventor. Erskine was commissioned as Geographer and Surveyor General to the Continental Army on July 27, 1777. He completed over two hundred maps and surveys for General Washington.

In June 1803, President Thomas Jefferson commissioned Captain Meriwether Lewis to explore the new territory gained by the Louisiana Purchase and to record what he saw. After traveling west from St. Louis to the Pacific Ocean, Lewis and his partner, Captain William Clark, brought back maps and information about the activities of American Indian tribes and potential rival European powers—an early combination of mapping and intelligence reporting to meet the needs of the new nation's leaders.

Emerging Technology

The French brothers Jacques Etienne and Joseph Michel Montgolfier successfully launched the first balloon on June 5, 1783, in southern France using three animals as passengers. The first manned flight followed in October. Both British and French military leaders immediately saw the value of being able to view a battlefield beyond their maps into the third dimension.

The United States began exploiting this new opportunity during the Civil War. Thaddeus Lowe and at least six other civilian balloon operators offered their services to the Union Army. First in civilian balloons and later in sturdier military balloons, Lowe repeatedly confirmed the value of this observation technique, providing a demonstration for President Abraham Lincoln himself on June 18, 1861. With an accompanying military telegrapher, Lowe also sent the president an electronic transmission proving the possibility of near-instantaneous reporting. The Army put Lowe to work the following week observing and reporting on Confederate forces operating in northern Virginia.

Seeking a more professional eye for reconnaissance than the occasional civilian balloonist, the Army started sending officers aloft. One was General George Armstrong Custer, who soon recommended night flights in order to better observe enemy encampments. Nighttime campfires made it easier to see the Confederate forces through the trees. As morning mess fires were lit, they clearly signaled the enemy's possible strength and distribution. Frequently, balloon reconnaissance efforts failed for want of the proper technology, inadequate ground support, or the open opposition of many officers, blue and grey. Technological limits, military skepticism, and bureaucracy managed to interrupt the Union Army's use of balloons in June 1863.

After the Civil War the new U.S. Army Signal Corps incorporated a balloonist in its weather forecasting program. The Signal Corps purchased a new balloon and established a balloon detachment at Fort Logan, Colorado. In possession of the Army's sole balloon when the Spanish American War began in April 1898, the Signal Corps deployed to Cuba during the American invasion. The balloonist soon detected a route to bring U.S. forces more rapidly into the battle of San Juan Hill. However, inexperience led the Signal Corps to position the balloon too far forward, where it soon betrayed American positions to the Spanish artillery. Consequently, it made only three ascensions.

These experiences and the potential of the technology led to a continued Signal Corps interest in balloons after the war concluded in August, with several officers giving serious study to aerial observation. This included the use of kites that carried small instruments aloft for military uses and gathering meteorological data. In 1895, an American researcher, William A. Eddy, took the first aerial photographs from a kite in the United States. Two years later, in 1897, Eddy approached the Navy about a system that used kites to see beyond the horizon. Kites remained in use until gradually replaced by an alternative perfected by the Wright Brothers at Kitty Hawk.

As armies realized the advantages of aerial observation, they welcomed any means of obtaining this valuable information. One possibility emerged with the familiar homing pigeon. In 1903 the Germans developed a seventy-gram pigeon camera that took thirty-eight-millimeter negatives automatically every thirty seconds. When the United States entered the Great War in 1917, the army followed suit with a pigeon system that took pictures of the enemy lines.

The new opportunity to combine the airplane with the still image camera gave the armed forces the ability to move, see, and record the Earth in a more systematic manner. The reliability, regularity, and responsiveness of the airplane, as opposed to the pigeon, permitted the data gathered to become reliable and timely intelligence.

Photographer Edward Steichen made the transition from front-line balloon observation to aircraft. He eventually commanded a reconnaissance unit on the Western Front consisting of fifty-five officers and 1,111 enlisted soldiers daily providing General Billy Mitchell's staff with imagery intelligence. Steichen, one of the traditional artists who raised photography to a widely recognized art form just before the war, advised the army on the best way to use the large, aircraft-mounted cameras and significantly improved the results presented to the U.S. Army senior leadership. During the interwar period, Steichen worked for Condé Nast publications and virtually defined fashion photography. After Pearl Harbor,

The demands of World War II made photo intelligence even more essential.

Steichen placed his camera in the service of the U.S. Navy. At the end of his career, this imagery intelligence pioneer became head of the photography department at the Museum of Modern Art in New York City.

Aerial photographs not only enhanced cartographic services but also offered more reliable battle damage assessments based upon images captured before and after bombing runs. Military leaders standardized many techniques, including the use of multiple images to produce three-dimensional effects, enhancing detection further.

The period between the world wars saw great improvements in both aviation and photography. Highly technical equipment was developed to extract maximum value from photographs for mapping purposes. Stereoplotters designed to reconcile differences in scale among photographs and maps became essential to cartographers.

World War II

The demands of World War II made photo intelligence even more essential. Long-range reconnaissance and widespread stereo photo coverage became necessary for the success of strategic planning and combat operations.

Aerial reconnaissance photos provided the Allies with early intelligence on the German wonder weapons, giving the scientific community and strategic planners basic insight into the next generation of airborne firepower. In helping to reveal the nature of German work on the wartime V-1 and V-2 missiles, aerial photography and imagery analysis demonstrated impressive potential for supplying information from denied areas. In this case, imagery intelligence provided an essential part of the total picture for those concerned with national security.

As aerial photography grew in importance with the war effort, three fundamental changes in U.S. military mapping and photo analysis occurred. Necessity spawned a close alliance with our allies. In 1941, American analysts deployed overseas, first to the British Central Interpretation Unit at Medmenham, England, and later throughout the Allied theaters of operation. To accelerate map production, the Army Map Service adopted a division of labor according to geographical feature to accelerate production at its new facility at Brookmont, Maryland. During this period and for the first time, due to wartime shortages, women and African-Americans entered the intelligence workforce as professionals in intelligence career fields.

The Cold War Era

Although World War II ended in victory for the United States and the Allies, anxiety rather than true peace followed. The struggle between communist ideology and the largely democratic and capitalist west now included the deadly threat of nuclear weapons and a constant struggle over the general character of the postwar world, with dangerous flashpoints in Germany, Korea, Greece, and Turkey. As the Soviet Union progressively suppressed democracy in Eastern Europe, British Prime Minister Winston Churchill popularized the image of an iron curtain running from the Baltic Sea in the north to Trieste in the south to symbolize the East-West conflict.

In reaction, President Harry S. Truman sought to contain the Soviet threat with military might, the authority of the atomic bomb, and support to vulnerable regions of the world through the Marshall Plan. The Truman containment policy placed a high premium on intelligence that might betray Soviet intentions. As the Soviets closed Eastern Europe to the west, the

potential of information-gathering techniques that had been developed and used successfully during World War II became increasingly important.

In the summer of 1949 the Soviet Union exploded its first atomic bomb, ending the short-lived American monopoly on atomic weapons. A few months after the Soviet atomic bomb test, the Chinese Communist Party won the country's civil war and took control of the mainland. In this unsettling geopolitical context, North Korea invaded South Korea in June 1950, immediately drawing the Defense Department's maritime charting, aerial reconnaissance, and mapping organizations into the war effort. While the shooting in Korea stopped in 1953, a new Soviet long-range bomber and hydrogen bomb increased cold war anxiety, as did the barely controlled hostility daily on display in a divided Berlin. In this environment, the United States and its allies turned to technology to help them understand events in those areas denied by the Soviet presence. New reconnaissance aircraft and satellites became a principal means for developing insight into the plans and actions of the communist world.

Analysis of aerial imagery increased in importance as a resource for the intelligence community. In 1947 the newly created Central Intelligence Agency (CIA) organized a team to study and interpret aerial photography of Eastern Europe captured during World War II from the archives of the German geodetic service. These captured German materials proved invaluable since maps of the area possessed by the western powers were inexact or nonexistent, and the communist governments denied western observers access.

In the mid-1950s, with the support of President Dwight D. Eisenhower, the CIA inaugurated a program to design and build a high-altitude aircraft equipped with cameras for detailed photographic surveillance. To exploit and interpret aerial photos from the new U-2 aircraft, the CIA formed a separate photographic interpretation division with analysts from the Army, Air Force, and Navy. The new organization, the National Photographic Interpretation Center (NPIC), used data gathered by flights over Communist territory to give the most senior policymakers and strategists authoritative knowledge about Russian capability, giving the lie to the bomber and missile gaps commonly appearing in the media during the 1950s.

Photography from the
NGA Historical Research Center

Vietnam War

Long before the United States formally became militarily engaged in the Vietnam conflict in Southeast Asia, the AMS, the Air Force's St. Louis Aeronautical Chart and Information Center (ACIC), NPIC, and the Navy HydrographicOffice collected data and prepared aeronautical and maritime charts, maps, and analyses for that region.

During a tense summer in 1954, for a moment the United States seriously considered intervention to help the French after their defeat at the hands of the Communist Viet Minh at Dien Bien Phu. AMS provided analyses of the terrain around the cities of Hanoi and Saigon to provide American policymakers with critical intelligence on the challenges of intervention.

Division of the country followed the French defeat in 1954. However, in the late 1950s and into the 1960s, contractors and survey parties provided the AMS with aerial photographs permitting the first complete and accurate maps of Vietnam.

In 1959 President Dwight D. Eisenhower requested U-2 missions over Vietnam and the surrounding region and tasked NPIC with an evaluation of the results. NPIC analysts also visited the region to evaluate the needs generated by the growing conflict between North and South Vietnam. By 1962, NPIC analysts had already conducted bomb-damage assessments, identified possible targets and produced valuable intelligence products.

As demands for targeting information grew, along with American involvement on the side of South Vietnam, ACIC deployed a new database targeting system that enabled attacking American and allied pilots to evade Communist air defenses more effectively and to place their ordnance on target more accurately. Exploiting SR-71 Blackbird aircraft photography, analysts could identify the exact coordinates of newly found targets and send that information back to allied forces for action.

The AMS adapted the land-based, low-frequency Long Range Navigation (LORAN) system to record the location of sensors being dropped from the air to help allied forces interdict North Vietnamese supply and troop movements into South Vietnam. At the same time, AMS provided its traditional mapping support to the Army.

With the beginning of American ground combat in Vietnam, experiences during 1965 and 1966 quickly demonstrated the inadequacy of coastal charts based largely upon World War II data. In particular, the Army's understanding of the river deltas fell far short. Consequently, over the next three years the Naval Oceanographic Office completed comprehensive geodetic, coastal, and harbor surveys of that complex coastline using a series of survey vessels. In addition, during December 1966 the Naval Oceanographic Office established a branch office in Saigon to provide updated maritime charts and publications for use by local fleet and Marine Corps units in their blockade, interdiction, and naval air support actions.

Increasing American military involvement required accurate information about the names of natural and cultural features in Vietnam and adjoining countries for application to maps and charts and for operational purposes. The U.S. Board on Geographic Names, part of the Department of the Interior, provided guidelines for standardizing the names. The AMS survey parties collected names data in the field for topographic maps of Vietnam and other countries, and similar staffs at the Naval Oceanographic Office and ACIC provided names for maritime and aeronautical charts, respectively.

The U-2

Designed by Clarence “Kelly” Johnson in the Lockheed Martin Skunk Works, from the beginning of its operational life on 1 August 1955 this aircraft satisfied a variety of critical requirements set down by the intelligence community. Able to fly at altitudes approaching 70,000 feet, the U-2 employed optics and a camera developed by the Polaroid Corporation that initially provided an image resolution of 2.5 feet from 60,000 feet above a target.

This aircraft first captured international attention when the Soviets shot down pilot Francis Gary Power as he overflew the territory of the Soviet Union on 1 May 1960. The U-2’s utility, however, never came into doubt. On 14 October 1962, a U-2 from the U.S. Air Force 4080th Strategic Reconnaissance Wing photographed Soviet missiles armed with nuclear warheads in Cuba, providing critical evidence for the world community during the Cuban Missile Crisis.

The U-2 still serves on the front line of intelligence gathering in 2011.

Photography from the
NGA Historical Research Center

Cuban Missile Crisis

In late August 1962, NPIC, using data from U-2 flights, identified the installation of Soviet missile sites in Cuba. On October 15, President John F. Kennedy and his civilian and military advisors learned that photos taken the day before revealed the presence of six long, canvas-covered objects initially called "unidentified military equipment." Further analysis branded the objects as Soviet medium-range ballistic missiles. Photographs also revealed missile installations in a significant state of readiness with supporting transporters, command and control quarters, cables, and launch erectors. In the seven weeks since late August, when NPIC analysts made the first photo identification of the surface-to-air missile sites in Cuba, just ninety miles off the coast of Florida, the Soviets had managed to ship and assemble an arsenal of offensive weapons with nuclear capability.

Using irrefutable photographic evidence, and with confidence in the analysis, President Kennedy and his closest advisors developed a strategy that gave the United States the moral high ground and incomparable situational awareness in the ensuing public confrontation with the Soviet Union. In a nationally televised address, the president revealed publicly the existence of Soviet offensive weapons capable of striking deep into the United States. He called for their immediate removal, and he declared a "strict quarantine" on all shipments by air or sea to Cuba. Intense diplomatic exchanges followed, in both official and unofficial channels.

Tensions mounted as Soviet ships steamed toward Cuba in the days immediately after the speech. On October 24, half of the twenty-five Soviet vessels en route to Cuba either turned back or altered course to avoid the U.S. Navy's positions around the island. Meanwhile, President Kennedy and Soviet Premier Nikita Khrushchev exchanged diplomatic notes that resolved the conflict. On October 28, Premier Khrushchev announced that the Soviet Union would withdraw all missiles and related equipment from Cuba in exchange for a pledge from the United States not to invade the island. Only in the 1990s, with the opening of documents related to Soviet policy, did the world learn that the Soviet military in Cuba actually did have nuclear warheads at their disposal on the island and that the commanders in the area had the authority to use them. Not publicized at the time was President Kennedy's agreement to remove similar missiles from Turkey, situated geographically as close to the Soviet Union as Cuba is to the United States.

Aerial surveillance photography had not only revealed the initial buildup of Soviet missiles in Cuba; it also revealed the missiles' state of readiness and, during the quarantine, the nature of cargo carried by Soviet ships. Photographic interpreters clearly established the critical value of their craft.

Complementing the aerial intelligence, below the surface of the Atlantic Ocean, the newly installed east coast arrays of the Navy's sound surveillance system, or SOSUS, not only tracked the surface vessels, but also detected four Soviet diesel, Foxtrot class submarines on their way to establish a submarine base at the northern Cuban port of Mariel. The quarantine forces drove all four boats away from their intended destination, forcing three of them to the surface.

Technologies and Services

After the confrontation over Cuba, many existing agencies and a few newly created began to depend significantly on imagery to provide an essential part of the overall intelligence picture. In 1961, the newly created National Reconnaissance Office (NRO) began to develop reconnaissance satellite programs. The critical nature of its work kept its existence secret and unacknowledged until 1992. Also in 1961, the Secretary of Defense established the Defense Intelligence Agency (DIA), consolidating many of the uniformed services' intelligence activities.

ACIC began incorporating data collected by U-2 flights into its aeronautical charts. With the development of tactical and long-range missiles, ACIC became responsible for missile targeting data.

To improve the capabilities of its personnel, in the late 1950s ACIC began to send its employees to graduate programs in geodesy, mathematics, photogrammetry, and astrophysics. This ACIC program and others like it prepared the military's mapping, charting, and geodesy community for its work in the new space programs and in accurate missile targeting.

Paralleling these developments, satellite imagery began to augment the now-traditional aerial variety. Beginning in early August 1960, the CORONA program provided photographs taken from space. CORONA imagery, especially of the Soviet Union, retrieved from space once a month, satisfied many of the program's customers, such as the precise cartographers at ACIC and the AMS.

As good as CORONA was, the nation's leaders needed timely intelligence, even more efficiently collected and delivered. In response, imagery analysts at NPIC, inundated by an avalanche of new satellite imagery, accelerated reporting on select priority areas. However, the multiplicity of agency administrative structures produced overlapping mandates and responsibilities, regularly creating conflict and inefficiency. Both the intelligence and mapping communities independently used satellite images, developing techniques and missions that frequently led to duplication of work, conflicting priorities, and possibly complementary products generated in isolation. Technical incompatibilities in their respective processing systems also made coordination of work awkward and difficult.

Analysts in the intelligence community wanted imagery that covered a broad sweep of terrain, and they were prepared to use unconventional sensors to get it. For them, speed in processing and analysis took precedence in gathering actionable intelligence. In contrast, AMS personnel, who used imagery data to create maps for the military, required carefully calibrated
mapping cameras that recorded snapshots in which geodetically fixed points appeared as references for exact measurement.
Map makers required cameras that could compensate for image motion, deviation from the vertical, and optical irregularities present in any photographic lens. They prized dimensional stability and absolute accuracy. Both the intelligence community and the mapping community used images of the Earth taken from satellites, but processed the information through a series of very different priorities and cultural assumptions.

As the Vietnam War drew to a close for the United States, Congress looked for ways to consolidate military and intelligence organizations. The Defense Mapping Agency (DMA) emerged in the Department of Defense in 1972 to increase efficiencies and

economies by bringing into one organization the mapping, charting, and geodesy activities of all three major services. This new organization absorbed the Air Force's ACIC operations, the oceanographic and charting services of the U.S. Naval Hydrographic Office, and the AMS.

The new agency faced several challenges, not the least of which was the rapidly growing power of the computer. In the early years of DMA, information in digital form began to supplant analog data. DMA led a major effort in the 1980s to convert its map making to digital format, adapting a variety of new geographic products, procedures, and modernization programs. By the mid-1990s DMA had created a new system for generating maps, the Digital Production System.

The power of the computer vastly expanded both memory capacity and the ability to manipulate data. This ever-increasing capability allowed the smoother consolidation of the analysis and generation of products by a single agency.

The End of the Cold War

In November 1989, the Berlin wall, that premier symbol of the cold war, came crumbling down, and within months, communism collapsed in Eastern Europe, taking the Warsaw Pact and many American defense assumptions with it. A change in the threat would certainly mean changes in priorities, national investment, and a need for an even more flexible intelligence community.

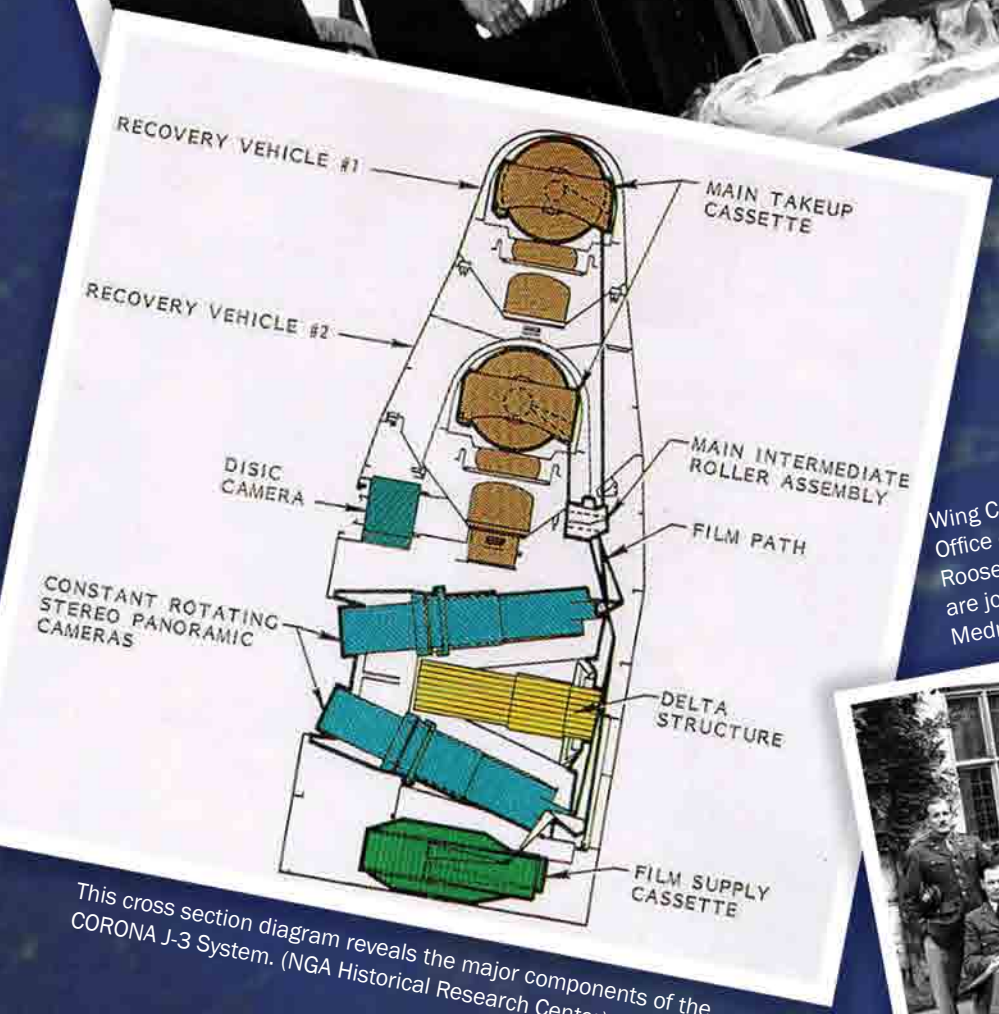
With the reduction of the Soviet military threat, pressure mounted in the United States for a "peace dividend." Analysts began to reassess governmental operations in all fields, intent on streamlining structures and cutting costs. In 1990 the Senate Select Committee on Intelligence and the Senate Armed Services Committee instructed the Secretary of Defense to examine all intelligence activities supervised by the Defense Department and "to the maximum degree possible, consolidate or begin consolidating all disparate or redundant functions, programs, and entities." Within a year, the Assistant Secretary of Defense proposed a plan for restructuring defense intelligence, directing the military services to "consolidate all existing intelligence commands, agencies, and elements into a single intelligence command within each Service." This consolidation of the defense and intelligence communities led to substantial reduction in the number of both civilian and military personnel.

Lessons Drawn from the First Gulf War

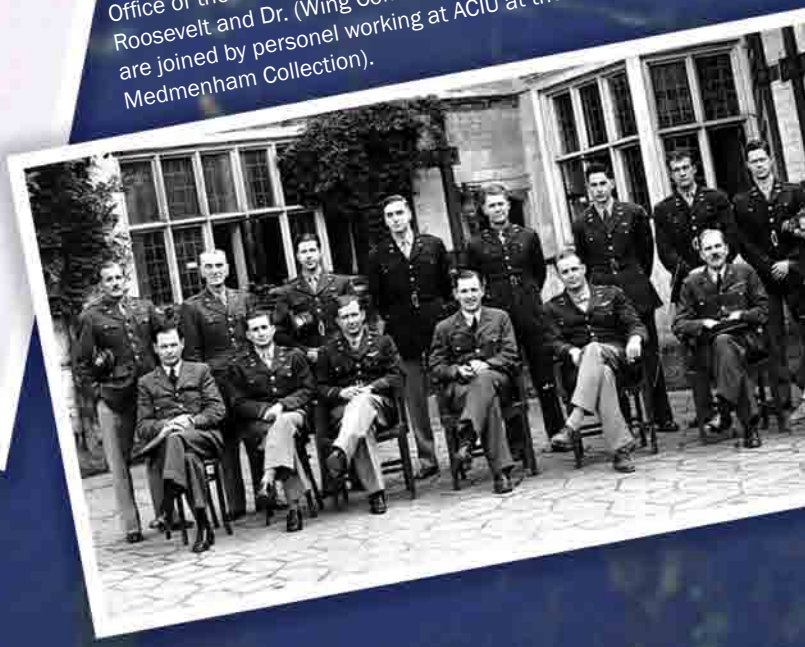
On August 2, 1990, President Saddam Hussein of Iraq sent his army into neighboring Kuwait. International attention shifted to the Near East. The United States responded by dispatching military forces to the area in Operation Desert Shield to protect Saudi Arabia from Iraqi attack. On January 17, 1991, after several months of diplomatic pressure failed to bring an Iraqi withdrawal, an international coalition of military forces led by the United States launched Operation Desert Storm to free Kuwait.

Desert Storm: Troops in protective gear against Chemical weapons.
Photo provided by DoD

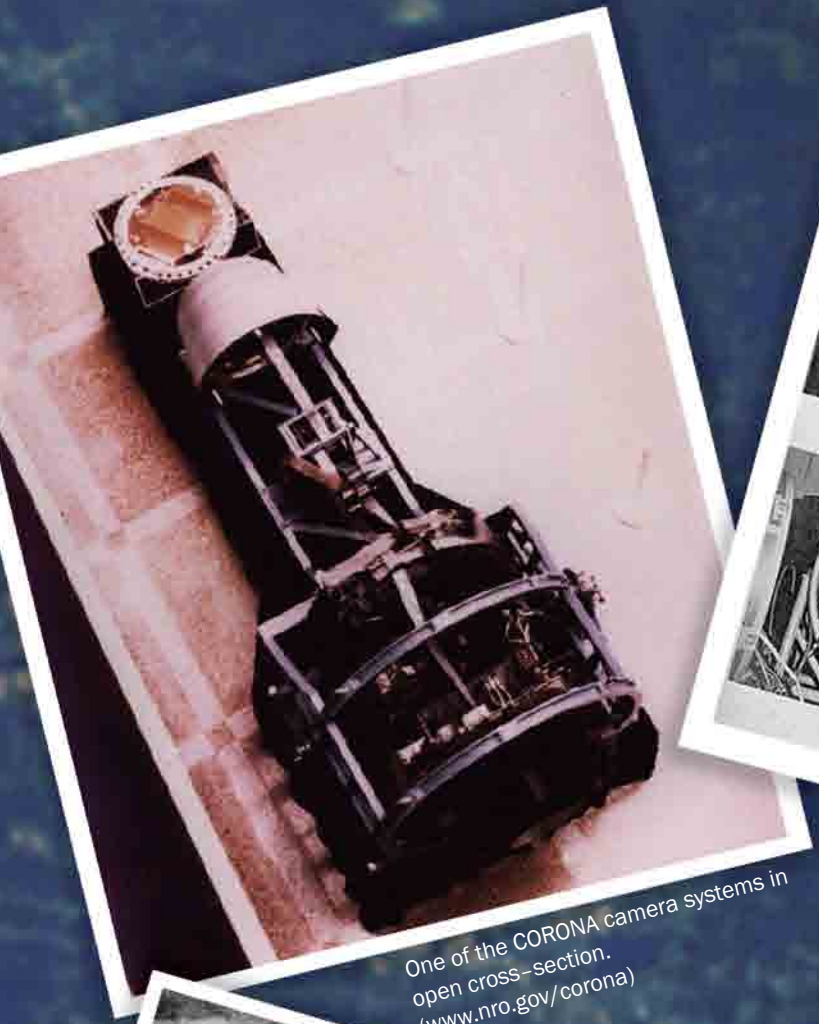
President Dwight Eisenhower examines one of the first CORONA film buckets retrieved from space. A ceremony was held to mark the event in the White House Conference Room, 15 August 1960. (Eisenhower Presidential Library; www.eisenhower.archives.gov/avwebsite)



This cross section diagram reveals the major components of the CORONA J-3 System. (NGA Historical Research Center)



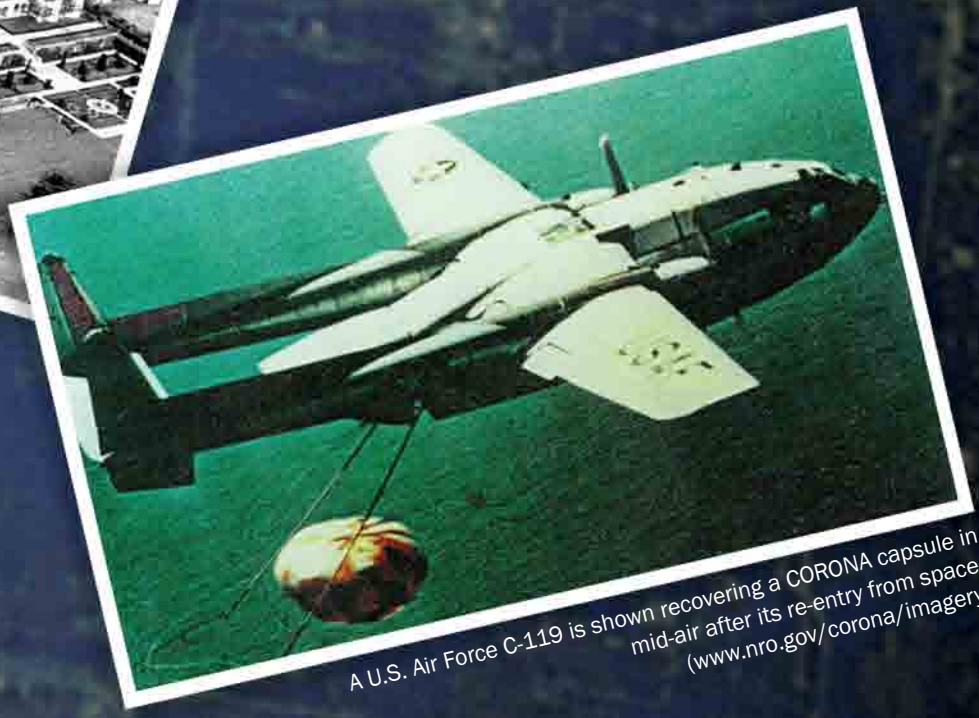
Wing Commander Douglas Kenall, head of the Technical Control Office of the ACIU through WWII (Center seated) on his left is Col Elliot Roosevelt and Dr. (Wing Commander) Hugh Hamshaw – Thomas. they are joined by personel working at ACIU at the time. C.1943. (Courtesy Medmenham Collection).



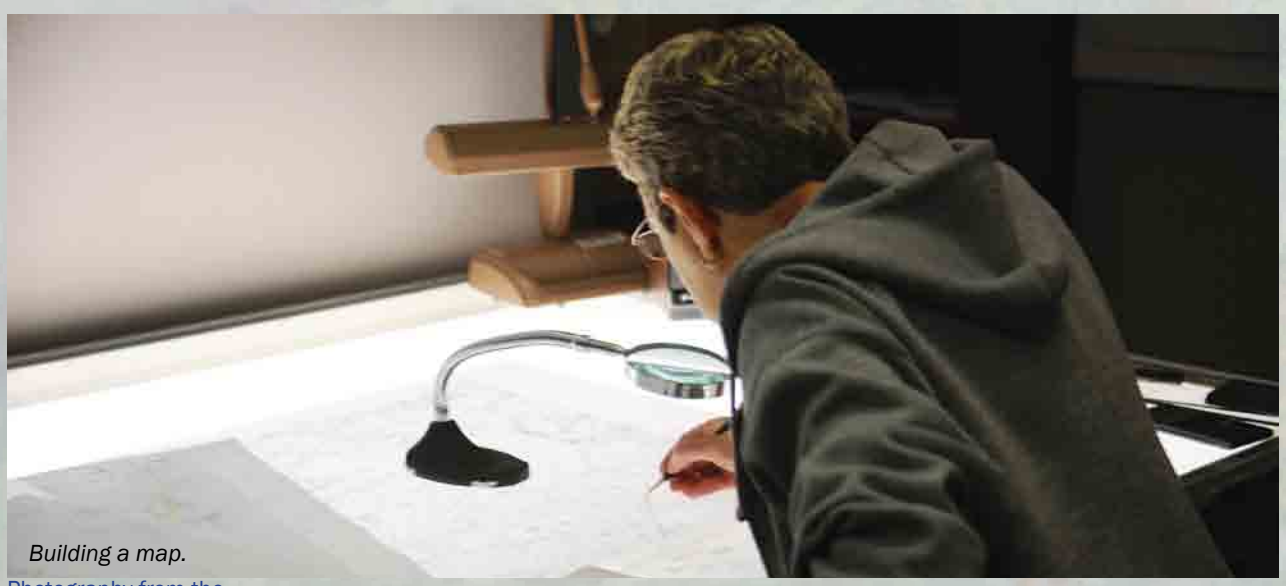
One of the CORONA camera systems in open cross–section.
(www.nro.gov/corona)

The variety of CORONA cameras: Specific cameras addressed specialized missions.
For example: ARGON—developed for mapping missions (KH-5); LANYARD—developed for spotting missions (KH-6).
(NGA Historical Research Center)

Royal Air Force — Medmenham c.1945
(Coutesy Medmenham Collection) .



A U.S. Air Force C-119 is shown recovering a CORONA capsule in mid-air after its re-entry from space.
(www.nro.gov/corona/imagery)



Building a map.

Photography from the
NGA Historical Research Center

DMA provided the military forces in the field with precise positioning and targeting information. It also provided maps to military commanders, producing over 110 million copies as the battle progressed. In addition, NPIC, the Defense Dissemination Program Office, and the DIA all provided imagery or intelligence based upon imagery.

Combat exposed shortcomings in the system as a whole. DMA's mapping and production systems still reflected cold war needs, emphasizing Eastern Europe rather than the Middle East. To meet the immediate military requirements, DMA turned to images of the terrain available commercially through the Landsat program operated by the U.S. Geological Survey and the National Aeronautics and Space Administration (NASA). The Landsat image maps became an integral part of the materiel supplied to theater commanders. Other imagery assisted with precision targeting, intelligence gathering, and many other needs, much of it coming from NPIC.

In spite of such adaptations, the war in the Persian Gulf revealed that the application of imagery data to military needs clearly needed improvement. In the Pentagon and out in the field, DMA products supported the operations staff, whereas NPIC products supported the intelligence staff. The two agencies used similar resources and technologies, but their customers lived in separate cultural worlds.

This cultural separation now seemed counterproductive. Although several agencies collected and analyzed imagery, they used incompatible dissemination systems and had different release restrictions. These differences impeded the timely transfer of imagery-based data to the theater of operations. Military commanders commented that in the heat of battle they often did not receive necessary information when they needed it. In the end, this would not do. The threat had changed along with the probable nature of future war. Those generating imagery analysis and geospatial information would have to change as well.

AIT
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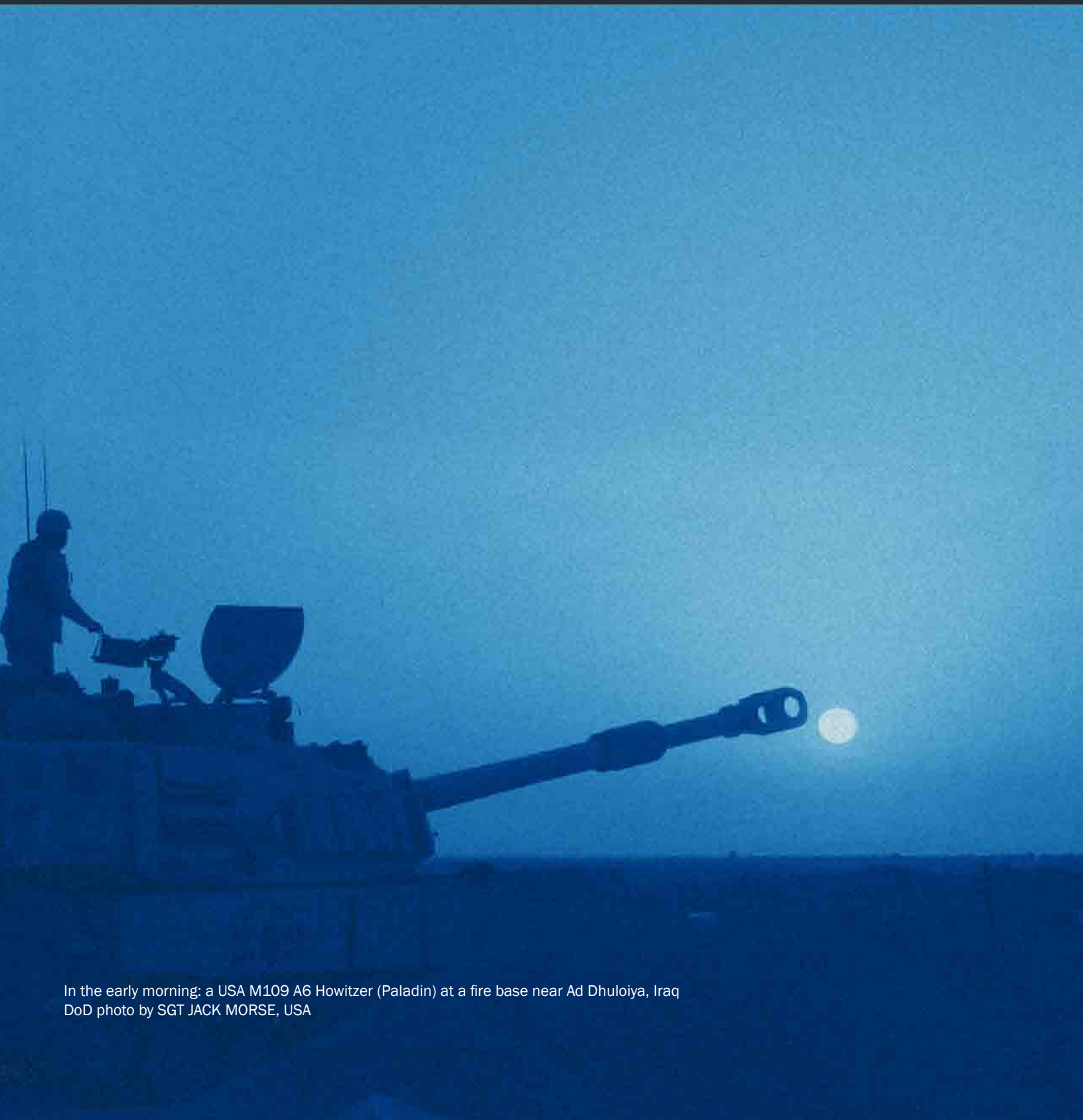
(KUWAIT)



In the early morning: a USA M109 A6 Howitzer (Paladin) at a fire base near Ad Dhuloiya, Iraq
DoD photo by SGT JACK MORSE, USA

PART THREE

NIMA and NGA

To Support the Warfighter: NIMA

On the imagery issue, DIA, the service intelligence chiefs, and the joint command staff intelligence officers of the unified commands had one overriding concern. Any new imagery– and cartography–based organization had to support the warfighter. Any approach to Congress for authorization to unify these services while making them more responsive would have to adopt this position and confirm absolutely the new entity's commitment to national intelligence needs.

On November 27, 1995, Secretary of Defense William Perry, Director of Central Intelligence (DCI) John Deutch, and Chairman of the Joint Chiefs of Staff General John Shalikashvili came forward as principal sponsors and wrote a joint letter to Congress, affirming their mutual commitment to create a new "single agency within the Department of Defense," designated as the National Imagery and Mapping Agency (NIMA). NIMA would "improve the overall effectiveness and efficiency of imagery and mapping support to both national and military customers" [emphasis in the original].

The next day Deutch appointed Rear Adm. Joseph Dantone to implement the plan and named him director designate. To include the new agency in the fiscal 1997 budget, the implementation team had to assemble all the material necessary to support authorizing legislation and present it to the key congressional committees by April 15, 1996.

Dantone's team included representatives of the potential constituent agencies: Leo Hazlewood, former director of NPIC; Dr. Annette Krygiel, director of the Central Imagery Office; W. Douglas Smith, deputy director of DMA, which would bring the largest contingent of employees into the new imagery agency; and Edward Obloy, DMA's General Counsel.

NIMA's funding would come from three different appropriations. It relied on funds for Tactical Intelligence and Related Activities (TIARA) that support military commands, dispensed by the Secretary of Defense, and funds for the National Foreign Intelligence Program (NFIP) used by the DCI to support policy planners in the White House, the Department of State, the National Security Council, and similar national agencies. A third funding line,

created in 1994, came from Joint Military Intelligence Programs that support intelligence assets across service boundaries.

The legislative process for establishing NIMA involved primarily the House Permanent Select Committee on Intelligence (HPSCI) and the Senate Select Committee on Intelligence (SSCI). Actual appropriation of funds, as opposed to fund authorization, would fall to the Armed Services Committees of the two houses of Congress.

The merging of funding lines became an issue in obtaining final approval for the proposed agency. Putting NIMA under both TIARA and NFIP funding raised questions about who controlled the agency. Providing answers would require working with thirteen congressional committees.

To navigate this tangle of interests, the implementation team developed a strategy for winning support both on Capitol Hill and among the stakeholders and users of imagery and mapping products. At its offices in Reston, Virginia, the team conducted a series of NIMA Days in January and February 1996, in which team members offered presentations on "Why NIMA and Why Now?" for committee staffers and Department of Defense representatives. After additional, substantial discussions to ensure this new structure would meet both national and military needs, Congress agreed and approved the establishment of NIMA. The authorization to create NIMA emerged in the Department of Defense authorization bill for fiscal 1997, and on September 23, 1996, President Clinton signed the legislation establishing the new agency.

On October 1, Acting Director Joseph Dantone raised the flag that bore the NIMA seal, and a formal establishment ceremony took place on October 29 on the River Parade Field at the Pentagon. Deputy Secretary of Defense John White hosted the event, with Deutch, Shalikashvili, Dantone, and two hundred guests attending.

With the ceremonial activities completed, the leaders of the new organization faced the formidable task of forging a unified operation from the pieces of the various imagery, mapping, and intelligence agencies that comprised it.

Elements

NIMA emerged from the legislative process as an amalgam of personnel and missions from eight separate organizations, each of which had its own history and corporate culture. NIMA absorbed four of those organizations entirely: NPIC, DMA, the Defense Dissemination Program Office, and the Central Imagery Office.

The oldest of these, NPIC, began in 1953 as an expansion of the CIA's photo-interpretation organization. President Dwight D. Eisenhower officially designated the organization as the National Photographic Interpretation Center in January 1961. For the next 35 years, NPIC furnished the Department of State, the Department of Defense, the military commands, and civil agencies with photo analysis.

The largest organization fully absorbed by NIMA, DMA was itself a 1972 merger of Army, Navy, and Air Force mapping, charting, and geodesy organizations. DMA in turn provided those services to the nation's leaders and to the armed forces. It also supported the Drug Enforcement Agency in counter-drug operations in the western hemisphere and provided cartographic support for humanitarian relief in Africa, the Caribbean, and other crisis points around the globe. In 1990-1991 it supported the troops in Operation Desert Shield and Operation Desert Storm.

For Electronic Dissemination of Imagery

1974
Defense Dissemination Program Office

To Interpret Imagery

1952
Photographic Interpretation Division

1958
Photographic Interpretation Center

1961
National Photographic Interpretation Center

To Manage Imagery

1967
Committee on Imagery Requirements and Exploitation

1992
Central Imagery Office

To Prepare the Military's Maps

Navy 1854
U.S. Naval Observatory and Hydrographic Office

Army 1917
Engineer Reproduction Plant

Army Air Corps 1928
Map Unit

Army Map Service 1942

Army Air Force 1943
Aeronautical Chart Plant
St. Louis

Air Force 1947
Aeronautical Chart and Information Center

Defense Mapping Agency 1972

Through the 1970s and 1980s, DMA expanded its retrieval of geospatial data to include digital imagery. By the early 1990s, DMA had converted its production system to the digital environment.

The Defense Dissemination Program Office, formed in 1974, was the main source of time-critical imagery for warfighters, national intelligence agencies, the scientific community, and the civil sector. Its products supported analysis for intelligence, precision targeting, and other activities that monitored indications and warnings. It provided critical support to Operation Just Cause in Panama in December 1989, Operation Desert Shield and Operation Desert Storm in 1990-1991, and peacekeeping operations in Bosnia in the 1990s.

The Central Imagery Office was the smallest and the most recently formed of the four entities entirely merged into NIMA. Created in 1992 as the focal point of imagery within the Department of Defense, it enhanced image collection, analysis, exploitation, production, and dissemination by developing training standards and a broad architecture for imagery. It also helped formulate guidelines for policy discussions, classification and compartment issues, and imagery sharing.

Four other governmental agencies contributed elements of their operations specializing in image exploitation. From its first days in 1947, the CIA had employed photographic analysis in its intelligence operations. In addition to NPIC, the CIA also surrendered to NIMA management of its foreign imagery-sharing arrangements and an element from its research and development section, part of the agency's Directorate of Science and Technology.

The DIA, created in 1961, provided combat support to the Department of Defense, coordinated and evaluated the intelligence operations of all of the armed services, and supplied timely, objective, and cogent military intelligence to warfighters and policymakers. DIA delivered imagery-derived products to the Secretary of Defense, the combatant commands, subordinate organizations, and other customers. NIMA assumed DIA's imagery analysis element, which exploited multi-sensor imagery from a range of collection platforms.

The NRO, also dating from 1961, managed the U.S. reconnaissance satellite programs and developed technology and space-borne assets that gather intelligence worldwide. It directed research, development, acquisition, and operations for the satellite systems. From the NRO's inception, the U.S. Air Force played a strong role in the agency, in which the CIA also participated. NRO transferred to NIMA twenty imagery-related projects and the personnel working on them.

Finally, the Defense Airborne Reconnaissance Office, created in 1993 as an office of the Department of Defense, addressed all joint military and DoD requirements for intelligence. It developed, acquired, and managed a system of manned and unmanned aerial reconnaissance aircraft, sensors, data links, data relays, and ground stations. With the formation of NIMA, it transferred two areas of responsibility: the development of technology to enhance imagery analysis as well as the exploitation and dissemination elements of the Common Imagery Ground/Surface System (CIGSS).

JPL
ASI

The Early Challenges

Creating a functioning operation from eight constituent organizations, six of which had over twenty years of independent operation, presented a host of problems. The legacy agencies brought with them different personnel systems, electronic office systems, procurement practices, and systems for creating and distributing products to customers.

NIMA's initial organizational structure consisted of three directorates, each headed by a deputy director selected from Dantone's implementation team: Leo A. Hazlewood for Operations, Dr. Annette Krygiel for Systems and Technology, and W. Douglas Smith for Corporate Affairs.

Politics and Money

The fiscal situation compounded the difficulties of achieving synergy in NIMA's early days. When the idea of a consolidated agency for imagery and mapping took life during the confirmation hearings before Congress in 1995, DCI nominee John Deutch asserted that the move would save money. Deutch's emphasis on economy fit the current political imperative to trim defense spending. Before NIMA's formation, personnel reductions descended upon several of the legacy agencies, and it fell to NIMA to execute them. The prospect of reductions in force intensified the stress of physically relocating some personnel and merging disparate practices and cultures.

NIMA's leaders had a directive to hold spending in tight check, and the budget for fiscal 1998 involved cuts. NIMA's deputy director, Leo Hazlewood, acutely felt the adjustments, which significantly affected customer services. The budget reductions accelerated the reductions already mandated in NIMA's civilian workforce and involved even deeper downsizing. NIMA had to consolidate its production facilities and slow plans to modernize its production systems.

The austerity of its situation did not prevent NIMA from setting goals. A master plan developed during the agency's first eighteen months focused on transformation from production of paper maps to the use of detailed geospatial databases. It proposed planning for an Internet-like architecture with digitized geospatial information as its foundation. One of the six working cells established to realize this goal sought to integrate the work of imagery analysts and cartographers to facilitate cooperation and encourage integrated production.

We've got hundreds of cartographers looking at imagery every day. If just twenty percent of those cartographers
find just one item of intelligence interest every year, imagine how much better off NIMA will be. (Video Interview with Jim MacLeay, spring 1997, NGA Historical Research Center.)

NIMA planned to build its new database using commercial off-the-shelf products rather than proprietary software. Off-the-shelf products, flourishing in the new technology environment, offered greater potential for rapid development and interoperability. NIMA also created partnerships with six university-based advanced research projects in imagery, imagery intelligence, and geospatial information. The agency saw long-term, advanced exploration free of specific requirements as an opportunity to revolutionize the way business was done and to move forward to an all-digital environment.

In July 1999, Assistant Secretary of Defense John J. Hamre thanked the NIMA workforce for what had been accomplished during the first three years of NIMA. Specifically, Hamre mentioned the agency's support to military forces conducting operations in Bosnia, Iraq, Afghanistan, Sudan,

Kosovo, and Serbia, while at the same time maintaining a global intelligence watch.

It couldn't have happened without you ... NIMA is at the very core of our ability to fight the kind of wars we have to fight today, with precision and care and great compassion for the people who are the innocents involved in the conflict.

The Assistant Secretary's remarks were a defining moment; his audience had struggled for three long years to make NIMA work as one agency.

As NIMA continued to evolve, a unique technical threat arose. Computer systems might crash as the new century dawned. Y2K, as it became known, placed the agency's work in jeopardy. Programs written with only two digits to designate the year were unable to distinguish between the years 1900 and 2000. The solution involved replacing or reprogramming every computer system used by the government.

NIMA's legacy elements operated with widely differing computer networks that followed different operating and security protocols. As deputy director for operations, Hazlewood launched a campaign to build a common, integrated structure for the agency's information technology systems. In addition to enhanced efficiency, Hazlewood saw full connectivity as a means of lowering operating costs. The effort toward connectivity overlapped with the task of preparing for the end of the millennium.

Under the direction of Tom Earley, as Special Assistant to the Director for this issue, a Y2K Task Force looked at the more than two hundred separate systems within the agency that depended upon computer operations. In all, nineteen needed modifications. Earley's team knew it had succeeded when, from midnight to morning on January 1, 2000, nothing happened to interrupt normal operations.

Significant Accomplishments: Turn of the Century

In spite of early challenges, NIMA managed numerous accomplishments in its formative years. Included among them were:

- The creation of GEOINT.
- The Shuttle Radar Topography Mission (SRTM), a joint project with NASA that closed gaps in worldwide mapping elevation data;
- International cooperative efforts that arbitrated and ended several country border disputes;
- Joint military exercises that both tested and improved interoperability among the military services and NIMA;
- Support following the terrorist attacks on September 11, 2001, which spurred the recognition of GEOINT as an independent intelligence entity; and
- Improved support to the warfighter, including implementation of new tools and venues, such as the Mobile Integrated Geospatial-Intelligence System (MIGS) and the birth of NGA support teams (NSTs) that took GEOINT to the warfighter in Afghanistan, in Iraq, and other locations both overseas and at home.

Shuttle Radar Topography Mission

When Iraq invaded Kuwait in August 1990, the United States did not have current detailed mapping of the Arabian Peninsula and the Fertile Crescent. DMA's digital terrain elevation data (DTED®), its most accurate mapping information, measured elevations only at roughly three-hundred-foot intervals. Large areas of critical terrain remained uncharted.

Operation Desert Shield and Operation Desert Storm succeeded militarily, but they demonstrated to senior U.S. military leaders the need for more detailed mapping data worldwide. The Joint Chiefs of Staff endorsed this view and set the year 2000 as the target date for acquiring the enhanced data. DMA was asked to undertake the project.

The most critical data set, in their opinion at that point in time, was Digital Terrain Elevation Data worldwide, and not the Digital Terrain Elevation Data of the quality that we had been producing for the previous ten to fifteen years, but a quality that was more dense in terms of the number of posts per square kilometer. (Oral history with Thomas A. Hennig, SRTM Program Manager, June 5, 2003, NGA Historical Research Center.)

DMA scientists reviewed several potential methodologies to obtain better measurements of the Earth's surface, including taking measurements from a satellite orbiting the Earth. They settled on an approach using methods of radar interferometry developed by scientists at the Jet Propulsion Laboratory (JPL) in Pasadena, California. Interferometry uses two images of the same area taken simultaneously from two different vantage points. The slight differences between any pair of images allow scientists to determine surface elevation and relief.

JPL proposed that a NASA space shuttle orbit the Earth carrying a device that would take radar readings during repeated, overlapping passes. Radar signals, not dependent upon daylight, can penetrate cloud cover, offering distinct advantages over photography. The passes would allow imaging of the globe between sixty degrees north latitude and about fifty-six degrees south latitude, covering about eighty percent of the Earth's surface and ninety-five percent of its populated areas.

In August 1996, work began on the SRTM, collaboration between DMA, NASA, the German Aerospace Center, and the Italian Space Agency that began just before the creation of NIMA. The JPL provided project management, and the U.S. Geological Survey worked on the use and subsequent storage of the data collected. Nine private sector companies, U.S. and foreign, provided hardware or services during the development and execution of the mission.

Project scientists designed a mast that would deploy in space and extend about two hundred feet outside the shuttle bay. A main antenna inside the shuttle bay transmitted and received radar signals, while a second antenna at the far end of the mast simultaneously received the same signals as they bounced back from the Earth. All of the transmissions were recorded on high-density tapes.

Originally scheduled for September 1999 on the space shuttle *Atlantis*, the mission was postponed by NASA because of bad weather and rescheduled for the shuttle *Endeavour* in early 2000. Launched from the Kennedy Space Center at 12:44 p.m. EST on February 11, Endeavour spent eleven days in flight, returning on February 22. The crew responsible for the operation of the SRTM spent 222.4 hours, almost nine days and eight hours, recording topographic data during repeated orbits 145 miles above the Earth.

After the mission, NASA duplicated the data tapes for the JPL, which processed and released them to NIMA one continent at a time. Over the next two years, the staff at NIMA refined the data, identifying and resolving anomalies and making the information compatible with the agency's standard DTED® protocols. With the completion of all related tasks in 2004, this highly successful mission achieved its goals with

a budget that would have permitted, without SRTM, only about 7.7 percent of the desired results. Furthermore, gathering comparable data by traditional means would have taken at least twenty years. As program manager Thomas Hennig indicated,

From a cost perspective, it's a fourteen-to-one ratio. From a time perspective, it's a four- or five-to-one ratio. From an accuracy perspective, it's at least twice as accurate as the DTED® Level 1. From the density perspective, it's at least nine times more data per cell—they're phenomenal numbers that make it easy to talk about a project like that. (Oral history with Thomas A. Hennig, SRTM Program Manager, 5 June 2003, NGA Historical Research Center.)

The project's managers donated the shuttle arm, itself a marvel of technical sophistication, to the Smithsonian Institution. It currently resides in the Steven F. Udvar-Hazy Center of the National Air and Space Museum near Washington Dulles International Airport in Virginia.

After the better part of a decade, SRTM data continues to yield data for a variety of scientific applications in geology and geophysics, including earthquake research, volcano monitoring, and hydrological modeling. Civilian applications include enhanced approach and ground safety systems for aircraft, better land use planning, and better location of cell phone towers. Military applications include improved flight simulators, missile and weapons guidance systems, battlefield management, and logistical planning.

International Cooperation

To assist in treaty monitoring and resolving national long-standing border disputes, NIMA provided detailed geospatial information and imagery analysis of Latin America and the Near East and continued to monitor conditions in Bosnia and Serbia following the 1995 Dayton Peace Accords. The accords demonstrated convincingly the value of digital map compilation and revision, as well as the utility in diplomatic negotiation of the three-dimensional moving terrain simulations known as "fly-throughs." During the late 1990s, NIMA brought these new capabilities to other regions of global concern, including the decades-old border dispute between Peru and Ecuador. The new agency supplied the products used in negotiations between Peruvian President Albert K. Fujimori and Ecuadorian President Jamil Mauad. That half-century-old conflict came to a conclusion on May 14, 1999, with the ceremonial laying of a boundary stone in a disputed area of the Amazon jungle.

In Bosnia-Herzegovina, NIMA's support of peacekeeping efforts was more effective, although the agency's contribution involved the revelation of atrocities. The Dayton Peace Accords placed a Zone of Separation between the warring factions patrolled and regulated by an international force, allowing limited traffic through a number of checkpoints. In practice, the partitioning did little to help the plight of Muslims in Bosnia and Albanians in Kosovo, both part of a disintegrating Yugoslav state. In fact, the partitioning of Bosnia-Herzegovina mandated by the accords forcibly displaced more than a million civilians.

On November 25, 1998, the North Atlantic Treaty Organization (NATO) ordered Yugoslav President Slobodan Milosevic, who had rejected earlier calls for international action in Kosovo, to stop his ethnic persecution of Albanians in Kosovo or face NATO air strikes. To prepare pilots for these missions, should Milosevic not comply, NIMA produced virtual fly-throughs of the terrain to provide experience with the terrain and local conditions.

Intelligence from NIMA also revealed evdence of ethnic cleansing in the region. In May 1999 the United Nations War Crimes Tribunal indicted Milosevic and four of his associates for crimes against humanity. The indictment produced a change in the political agenda of the Serbian government. Serb troops began to withdraw from Kosovo, and the following month NATO suspended its bombing missions.

During the late 1990s, NIMA also assisted the U.S. Drug Enforcement Agency and its international partners in stemming the production and international transport of illegal drugs, and produced reports monitoring suspected international drug trafficking in both hemispheres. In the same timeframe, NIMA supported humanitarian relief efforts in Rwanda and Uganda with quickly produced Landsat image maps used by U.N. relief workers to deliver aid shipments to the refugee camps.

Support to Military Operations

Prior to the action in Kosovo, NATO's internal command relationships had not been used to plan and conduct sustained combat operations. A lessons learned report presented by Secretary of Defense William Cohen and Chairman of the Joint Chiefs of Staff General Henry Hugh Shelton to the Senate Armed Services Committee on October 14, 1999, stated that mechanisms developed by NATO for delegating target approval authority to military commanders proved flexible in meeting the military requirements of the campaign while preserving the necessary level of political oversight.

NIMA's participation in an annual exercise hosted by the Chairman of the Joint Chiefs of Staff known as the Joint Warrior Interoperability Demonstration (JWID) greatly enhanced these NATO mechanisms. JWID, now known as the Coalition Warrior Interoperability Demonstration, enables U.S. combatant commands and the international community to investigate new and emerging technologies that can be moved into operational use. The demonstration builds a temporary global network over which communications technologies interact to support a scripted scenario. Technologies are evaluated for utility, interoperability, and security. JWID '97, for example, involved forty-five sites and tested communications interoperability among the U.S. military services and its worldwide allies, Australia, Canada, New Zealand, the United Kingdom, and elements of NATO, during a wartime exercise scenario.

September 11, 2001

On September 11, radical Islamic terrorists hijacked four commercial airliners and flew one of them into the Pentagon and two others into the twin towers of the World Trade Center in lower Manhattan. The fourth crashed in Pennsylvania when the passengers resisted and fought against their highjackers. In all some three thousand innocent individuals lost their lives. President George W. Bush declared a global war on terrorism.

Two days later, NIMA welcomed retired Air Force Lt. Gen. James R. Clapper Jr. as its second, and first civilian, director, succeeding Army Lt. Gen. and GEOINT pioneer James C. King. Soon after his arrival, the new director began to promote products that emerged from initiatives like NIMA's work on Chechnya. This ambitious synthesis of source and image emerged during General King's tenure and became known simply as geospatial intelligence, or GEOINT. Among Clapper's newly created list of offices was the Office of Geospatial-Intelligence Management, whose mission was to provide the director, in his role as the GEOINT functional manager, with the plans and policies

to manage GEOINT resources and a new system to be known as the National System for Geospatial Intelligence (NSG). The first task of the new office was to develop and publish a series of formal communications that would comprise the doctrine of GEOINT. The first of these, *Geospatial Intelligence Basic Doctrine*, appeared in July 2004.

The global war on terrorism and the events of September 11 dramatically changed the nature of NIMA's priorities and products. Recognizing that new threats could occur at any time or place, Clapper determined both to make regional analytic overviews more robust and to embed NIMA analysts throughout the combat support and intelligence community networks. His concept of a unifying discipline and doctrine evolved into a new agency name: National Geospatial-Intelligence Agency (NGA). The new name represented the maturation of a new discipline and the increased unification of NIMA's parts.

The report by the House-Senate Intelligence Committee investigating the September 11, 2001 attacks recommended creating a new Director of National Intelligence as the principal intelligence adviser to the president and the statutory intelligence advisor to the National Security Council. This cabinet-level official would coordinate all fifteen components of the intelligence community, a task that previously fell to the director of the CIA. On February 17, 2005, President George W. Bush named John Negroponte, former U.N. Ambassador and U.S. Ambassador to Iraq, to the post. By April, Congress confirmed the Director of National Intelligence, and within months a new National Intelligence Strategy drove NGA operations.

The National Geospatial-Intelligence Agency

NIMA officially became NGA with the November 24, 2003, signing of the fiscal 2004 Defense Authorization Bill. The passage of the Homeland Security Act a year earlier clarified the agency's role in supporting its national customers and helped strengthen NIMA's relationship with other domestic agencies. After September 11, 2001, the agency quickly began to utilize tactics, techniques, procedures, and solutions it had long used overseas, only now applying them to domestic situations with congressional approval. Some of these new tasks included surveying the World Trade Center site as an aid to reconstruction efforts and supporting the counterterrorism activities of the CIA. NGA played a significant role in site examination and response planning for major national and international events, working with domestic and overseas authorities to provide security for the Winter Olympics in Salt Lake City (2002) and Turin (2006) and the summer games in Athens (2004), providing maps and geospatial intelligence for training and security. The same period saw more involvement in newly intensified efforts to protect the president of the United States, the vice president, and other high-ranking officials, and to provide better security for U.S. military and other government facilities.

NGA brought to the table the same capabilities for scene visualization, situation analysis, intelligence data fusion, and contingency planning that it provided military customers. The same technology that enabled flight simulation allowed walk-through or drive-through animations. Analysts brought together information from divergent sources, just as they did in GEOINT support to military customers. One notable example was the discovery in utility-company records of a tunnel running

DoD photo by Master Sgt. Cecilio Ricardo, U.S. Air Force

directly under the site of the World Trade Center Memorial dedication. On the basis of that discovery, New York City police were able to secure the tunnel and eliminate a potential risk of attack. In deployments to support security planners at the national political conventions, NGA added a new imagery source, commercially available terrain data from a radar source, avoiding the limitations of cloud cover. Such high-resolution data has become the standard for other major, non-intelligence activities.

Overseas, the Near East continued as the locus of most terrorist activity, but as the new century approached, many areas in Central and South Asia, the Balkans, and Transcaucasia became even more significant. In 1993, eighteen U.S. soldiers were killed in Mogadishu, Somalia, during an attack that some analysts attributed to Islamic terrorists. Five years later terrorists struck in the region again, bombing American embassies in Nairobi, Kenya, and Dar es Salaam, Tanzania, killing over two hundred people and injuring more than four thousand. In October 2000, terrorists struck the USS *Cole* in Yemen, just off the horn of Africa, taking the lives of seventeen U.S. sailors. All of this took place even before the terrible events of September 11 brought the violence of the Near East to the American homeland. The comforting, if macabre, equation known as mutually assured destruction, which restrained the superpowers during the cold war, no longer applied.

New Tools and New Regions

Along with the challenges and changes that transformed NIMA into NGA came new tools and practices that better defined and applied GEOINT. During Operation Allied Force in Kosovo, NGA recognized the need for a deployable system that could withstand harsh environmental conditions and move with the troops in order to bring more timely, actionable

intelligence directly to the customer. The MIGS became the solution: a mobile, fully self-sustaining suite of communications, life support, and transportation equipment.

MIGS utilizes the High Mobility Multipurpose Wheeled Vehicle (HMMWV or Humvee) and includes a mounted satellite link, integrated power and server control, and internal backup power. As demonstrated during the military operations in the Near East and during cleanup operations after Hurricane Katrina in New Orleans in 2005, it permitted remotely accessible GEOINT exploitation and the ability to reach back to other NGA facilities for support.

Support personnel worked for their operational and tactical customers and built tailored products in support of fluid military operations. These analysts also served as liaisons to incorporate the latest national-level information, continually updating the database. NGA analysts had advantageous, real-time access to the latest tactical information coming from the maneuver units and could provide this knowledge to NGA.

Shortly after September 11, the agency developed systematic ways of using the emerging technology for real-time airborne tracking and targeting. Just prior to the launch of the military action in Afghanistan, NIMA set up new centers at three of its main offices for viewing and exploiting airborne imagery from unmanned aerial vehicles like the Predator and for establishing the precise targeting information these vehicles needed to make accurate strikes. In August 2002, NIMA leadership established the Airborne Analysis Cell in Washington, recognizing airborne imaging platforms as an untapped source of raw intelligence. The cell, constructed in less than four months and completed in December 2002, improved support to U.S. combat forces.

St. Louis became the site of the Targeting Fusion Center, placing geospatial and imagery analysts together in the same spaces, creating a synergy that provided even more complete and accurate answers to forces in the field.

Operation Enduring Freedom

The swift military response to the September 2001 terrorist attacks on New York City and Washington, D.C., christened Operation Enduring Freedom (OEF), began on October 7, and NIMA's new product, GEOINT, followed American forces. OEF's objectives, as articulated by President George W. Bush, included the destruction of terrorist training camps and infrastructure within Afghanistan, the capture of al Qaeda leaders, and the cessation of in-country terrorist activities. In addition to American participation, the coalition included more than sixty-eight nations, with twenty-seven nations having representatives at the headquarters of the U.S. Central Command in Tampa, Florida.

As OEF began, the Taliban controlled more than 80 percent of Afghanistan and seemed poised to overwhelm their domestic opponents. By October 20, U.S. and coalition forces had destroyed virtually all Taliban air defenses, and U.S. Army Special Forces detachments joined with anti-Taliban leaders and coordinated operations on multiple fronts. By mid-December, U.S. Marines had secured Kandahar Airport, and the Taliban capital was in the hands of anti-Taliban forces. Within weeks, the combined international effort reduced the Taliban and al Qaeda to isolated pockets of fighters. Seventy-eight days after the beginning of combat operations on December 22, Army General Tommy Franks arrived in Kabul to attend the inauguration of the Afghan interim government. By mid-March 2002, the coalition removed the Taliban from power in Afghanistan. Assisted by special maps, aeronautical navigation data, and GEOINT products supplied by NIMA, U.S. Transportation Command addressed all force positioning and most logistical needs in theater by air.

With a combination of overwhelming firepower, delivery systems, and ever-more accurate targeting information from NIMA, the ratio of sorties to successful strikes shrank dramatically, from ten aircraft per target during Operation Desert Storm to two targets per aircraft during OEF. U.S. airmen and aircraft, some operating from western Missouri and assisted by both NIMA navigational aids and on-site support, flew the longest combat fighter missions in U.S. history, taking more than fifteen hours, and broke another duration record for surveillance missions at twenty-six hours. The agency also supported extensive use of unmanned aerial vehicles, which permitted around-the-clock surveillance of critical sites, facilities, and troop concentrations.

Directed from Tampa by U.S. Central Command, which provided real-time connectivity to all manner of forces operating seven thousand miles away, the OEF effort drew support from 267 bases. The coalition operated from thirty locations in fifteen countries and regularly over-flew forty-six nations. In every case, the ability to see the battlefield literally and virtually at each location provided unprecedented insight into each mission.

Operation Iraqi Freedom

On March 19, 2003, United States, United Kingdom, and other coalition forces began conducting military operations designed to depose Saddam Hussein and deprive the state of Iraq of any weapons of mass destruction it might possess.

During Operation Iraqi Freedom, imagery from reliable commercial satellites supplemented NGA's own assets to supply the necessary imagery in support of diplomatic initiatives, humanitarian relief, and reconstruction efforts. Commercial imagery aided in defining deployment locations for Patriot missile and air defense batteries, assisted in mission planning for the seizure of Kirkuk in northern Iraq, and helped locate and characterize minefields along the border between Iraq and Iran. It demonstrated that coalition forces did not ignite the Baghdad oil fires and provided context for decisions to strike or pass on select Iraqi industrial targets.

The military and humanitarian efforts in Afghanistan and Iraq occasioned the largest overseas deployment of NGA and NIMA personnel in the history of the agency. To facilitate arrangements for their overseas tours and ensure efficiency, NIMA established the Office of Global Support, initially called the Office of Deployed and Externally Assigned Personnel, in August 2003.

Development of NGA Support Teams: NSTs

Emulating practices employed by other agencies and defense consulting firms, NGA asked some analysts to join deployed customers. The NGA deployments formed part of a concerted effort to extend the NSG into each command headquarters and national government agency. By providing support team experts at each customer site to help interpret and manipulate GEOINT products and services, NGA gave warfighters and the intelligence community a worldwide, first-hand intelligence baseline for their own analytical and operational needs.

Thus, rather than reaching back for expertise from NGA, the operating forces found the GEOINT community projected forward, at their side and available.

Most NST members deployed for ninety-day rotations and received warm testimonials from the field commanders and warfighters whom they served in Afghanistan, Iraq, and other locations. In case after case, their talents helped save lives and resources by supplying vital information in a timely manner.

During Operation Iraqi Freedom, NGA downloaded a major portion of its Iraqi GEOINT database to more than two hundred computer hard drives and delivered them, through the NSTs in theater, to forces throughout the area of operation. An Army warrant officer pointed out that it would have taken him a year to download what NGA provided!

A UH-60 Blackhawk from the 101st Airborne Division (Air Assault), 9th Aviation Battalion, A Company flies over Al Hamdania, Iraq, during Operation Iraqi Freedom June 16, 2003.

U.S. Army photo by Sgt. Michael Bracken

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Banda Aceh, Indonesia (before tsunami)

Humanitarian Efforts

The Space Shuttle Columbia lifted off from Florida on January 16, 2003 for a sixteen day mission to work in the physical, life, and space sciences. It conducted approximately eighty separate experiments. On February 1, during re-entry, it disintegrated over Texas, killing all seven astronauts on board. NIMA analysts, working with NASA and Federal Emergency Management Agency (FEMA) personnel, precisely mapped the likely trajectory of shuttle debris to focus search efforts more precisely, and then refined the model with data from actual recoveries. A team of Remote Replication System personnel from NIMA in St. Louis provided replication and graphic output services for the massive numbers of maps requested by the various debris search teams. The NIMA team aided the recovery of human remains and most of the debris that had not disappeared in space.

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Banda Aceh, Indonesia (after tsunami)

Following the December 26, 2004, undersea earthquake and tsunami in the Indian Ocean, NGA provided imagery products of the affected areas daily to all agencies supporting humanitarian relief activities. These included the U.S. Agency for International Development's Office of Foreign Disaster Assistance (OFDA) and the U.S. Pacific Command (USPACOM), in whose region the tsunami occurred. With these geospatial products, OFDA and PACOM determined priorities for emergency relief efforts and the deployment of life-supporting supplies and personnel. The products showed the scope of the damage caused by the earthquake and resulting tsunami. NGA also assessed the impact on infrastructure, including damage to roads, bridges, ports, and airfields and how that damage affected access to the damaged areas. This assessment assisted the U.S. Transportation Command and others providing assistance.

NGA's Hurricane Assistance

In the fall of 2005, NGA rose to the occasion in providing support for relief efforts during the most destructive hurricane season on record. The agency's director, James R. Clapper, told the Associated Press on May 13, 2006, that the work the agency did after hurricanes Katrina and Rita was the best he had seen from an intelligence agency in his forty-two years in the intelligence business.

This was kind of a direct payback to the taxpayers for the investment made in this agency over the years, even though in its original design it was intended for foreign intelligence purposes.

NGA's assistance to Hurricane Katrina relief efforts began before the first waves hit the Louisiana shore on August 29, 2005. For first responders from those Gulf Coast counties in the hurricane's path, the agency provided scores of graphics for relief agencies and depicting the locations of major airports, hospitals, police and fire stations, emergency operations centers, hazardous materials, highways, and schools. FEMA and other government agencies welcomed information from NGA that was based on imagery from commercial and U.S. government satellites as well as American military airborne platforms.

A White House report issued in March 2006, The Federal Response to Hurricane Katrina: Lessons Learned, documented widespread deficiencies in the federal government's planning and management response to Katrina. Among its 125 recommendations, the report called for creating a national operations center and establishing a national information and knowledge management system to provide a common operating picture for federal incident managers.

During Hurricane Katrina and Hurricane Rita, which struck the Gulf Coast near Houston about a month later, NGA forward-deployed more than two dozen analysts and two MIGS to the affected areas to provide timely, on-site support.

U.S. Navy photo by Larry W. Kachelhofer

Photo Courtesy of Department of the Army

President Obama and his staff watch as
US Navy SEALs close in on Usamah–bin–Ladin
1 May 2011 White House photo by Peter Souza

Now and the Future

The diversity of tradecrafts and the increased technical capability of NGA have enabled this community of practitioners to expand the mix of services and support they can provide to our nation and to those in need around the world. This mix naturally includes direct warfighter support and assistance to valued allies, as well as regular involvement in global humanitarian efforts.

On the humanitarian side, NGA quickly became a valued component in the response to the oil spill crisis in the Gulf of Mexico in 2010 and to the terrible flooding in Pakistan during that same year. Agency focus cells also played a role in the response to the dreadful earthquake in Haiti and the tragic combination of earthquake and tsunami that assaulted Japan in 2011.

However, the warfighter always represents NGA's primary concern. The current drawdown in Iraq, the safe withdrawal of our troops, and the nature of future American support to the Iraqi government regularly draw on NGA assets and talent. The ongoing fight for stability and peace in Afghanistan preoccupies NGA personnel, from those involved in research and development to thwart the production of home-made explosives, to the provision of essential intelligence details about the field of battle, to the significant geospatial and cultural aspects of a land ravaged by war. The power of GEOINT products surged into public view in May 2011 when NGA played a critical role in locating Usamah–bin–Laden and eliminating him as a threat to world peace.

As the functional manager for GEOINT within the intelligence community, NGA has begun to play an ever-increasing role in the way the United States relates to the rest of the world. The new Fort Belvoir home of NGA will house nearly all of the agency's East Coast personnel and the facilities that support them. For the first time in its history, NGA will have an eastern workforce concentrated in a single facility, able to generate an even more effective professional synergy in creating GEOINT, advancing the tradecraft, and satisfying those who depend upon geospatial knowledge.

CONCLUSION

Beyond a Name

Well before the tragedy of 11 September 2001, intelligence that depended upon the Earth's physical attributes, as well as the art and science of interpreting that information, changed quietly but fundamentally. Combining most of the nation's capable imagery and geospatial intelligence assets within NIMA in 1996 went beyond simply addressing problems of efficiency and economy. Rather, NIMA suddenly provided a critical mass of skills and technologies under a single mission umbrella that soon enabled the intelligence community to realize a significant step in the evolution of its craft and product. Creating NGA acknowledged, in name and in practice, the confluence of every possible sort of imagery with geospatial, human, signals, and open source intelligence. This confluence created the innovative, sophisticated, and powerful product General Clapper formally christened GEOINT. The change of name from NIMA to NGA had little to do with semantics. As one experienced analyst put it barely one year before the agency became NGA,

Bringing geospatial information fully into imagery intelligence added a new dimension in terms of analytical content and the visualization of the information. Thus practitoners and policymakers collaborated to bring the discipline to a new stage in its evolution, moving from just imagery intelligence to broader geospatial intelligence.

GEOINT demonstrated its unique ability to illuminate critical situations in ways that permit both intelligent policy decisions and timely action. GEOINT confirmed ethnic cleansing atrocities in Kosovo through the latest in imaging and geospatial technology enhanced by an incomparable knowledge of culture and context. From the cities hosting the Olympics to the disaster in New Orleans, NGA provided timely GEOINT products that allowed American authorities at every level to improve the quality and the timing of their security and emergency response.

Even the 2006 White House report, in reviewing the Katrina disaster response and offering recommendations for improvement, applauded NGA timeliness during the crisis. GEOINT offered a preliminary version of the same total picture for responders that the administration proceeded to recommend for the entire nation as a part of a standard plan to address major disasters.

While firmly rooted in a past that extends back to surveyors like the young George Washington and President Thomas Jefferson's explorers Lewis and Clark, GEOINT has only recently emerged as a new synthesis of extraordinary technologies and valuable personal skills. NGA has the dual responsibility to learn daily from past GEOINT achievements and to practice for the greater good the powerful combination of technology and art it has created.

Photo by Robert Cox

photo of NCE

Photography from the
NGA Historical Research Center

GLOSSARY

ACIC
Aeronautical Chart and Information Center

AMS
U.S. Army Map Service

CIA
Central Intelligence Agency

CIGSS
Common Imagery Ground/Surface System

DCI
Director of Central Intelligence

DIA
Defense Intelligence Agency

DMA
Defense Mapping Agency

DTED®
Digital Terrain Elevation Data

FEMA
Federal Emergency Management Agency

GEOINT
geospatial intelligence

HPSCI
House Permanent Select Committee on Intelligence

JPL
Jet Propulsion Laboratory

JWID
Joint Warrior Interoperability Demonstration

LORAN
Long Range Navigation

MIGS
Mobile Integrated Geospatial Intelligence System

NASA
National Aeronautics and Space Administration

NATO
North Atlantic Treaty Organization

NFIP
National Foreign Intelligence Program

NGA
National Geospatial-Intelligence Agency

NIMA
National Imagery and Mapping Agency

NPIC
National Photographic Interpretation Center

NRO
National Reconnaissance Office

NSG
National System for Geospatial Intelligence

NST
NGA Support Team

OEF
Operation Enduring Freedom

OFDA
Office of Foreign Disaster Assistance

SOSUS
The Navy's sound surveillance system

SRTM
Shuttle Radar Topography Mission

SSCI
Senate Select Committee on Intelligence

TIARA
Tactical Intelligence and Related Activities

U.N.
United Nations

USPACOM
U.S. Pacific Command

Y2K
The year 2000, associated with the problem of computers' ability to roll over to the year 2000, given that 00 could be interpreted as 1900.

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History

The History of the NGA Community

Using geospatial methods, seasoned intelligence professionals exploit and analyze imagery and geospatial information to describe, assess, and visually depict physical features and human activity on the Earth.

Therefore the history of geospatial intelligence includes the history of geography, cartography, aircraft and satellite reconnaissance, physical oceanography, digital imaging, geodesy, weather forecasting, and the analysis of products generated by these arts and sciences as they pertain to the national defense.

Collection

The history program at NGA supplements the records permanently retained by law with additional historical sources rendered in text, imagery, and oral history. These records and artifacts permit historical analysis and the transmission of our heritage.

Analysis

How did we get here? Historical analysis rendered in publications, presentations, and exhibits asks questions of our sources to explain how and why the NGA community works as it does and the significance of GEOINT.

Education and Outreach

History is an incomparable teacher. Through sponsorship, partnerships, and museum activity, the history program seeks to inform teachers and involve students of all ages in the effort to understand NGA's history and its significance to the American experience.

Services

Historical Services

Reference

Records Retention and Recall

Archives

Historical Analysis

Curatorial Consultation

Oral History

Exhibits

Teacher Training

Education Programs

Internships

Guest Speakers

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Museum
NGA-West, St. Louis
314-676-3246

LiDAR shot of the Presidential Palace in Haiti.
LiDAR Image NGA Historical Research Center.

HYDROGRAPHIC/TOPO
DEFENSE MAPPING
HYDROGRAPHIC/TOPO
DEFENSE MAPPING
NATIONAL PHOTOGRAPHIC
DEFENSE MAPP
AEROSPACE
DEFENSE
UNITED S