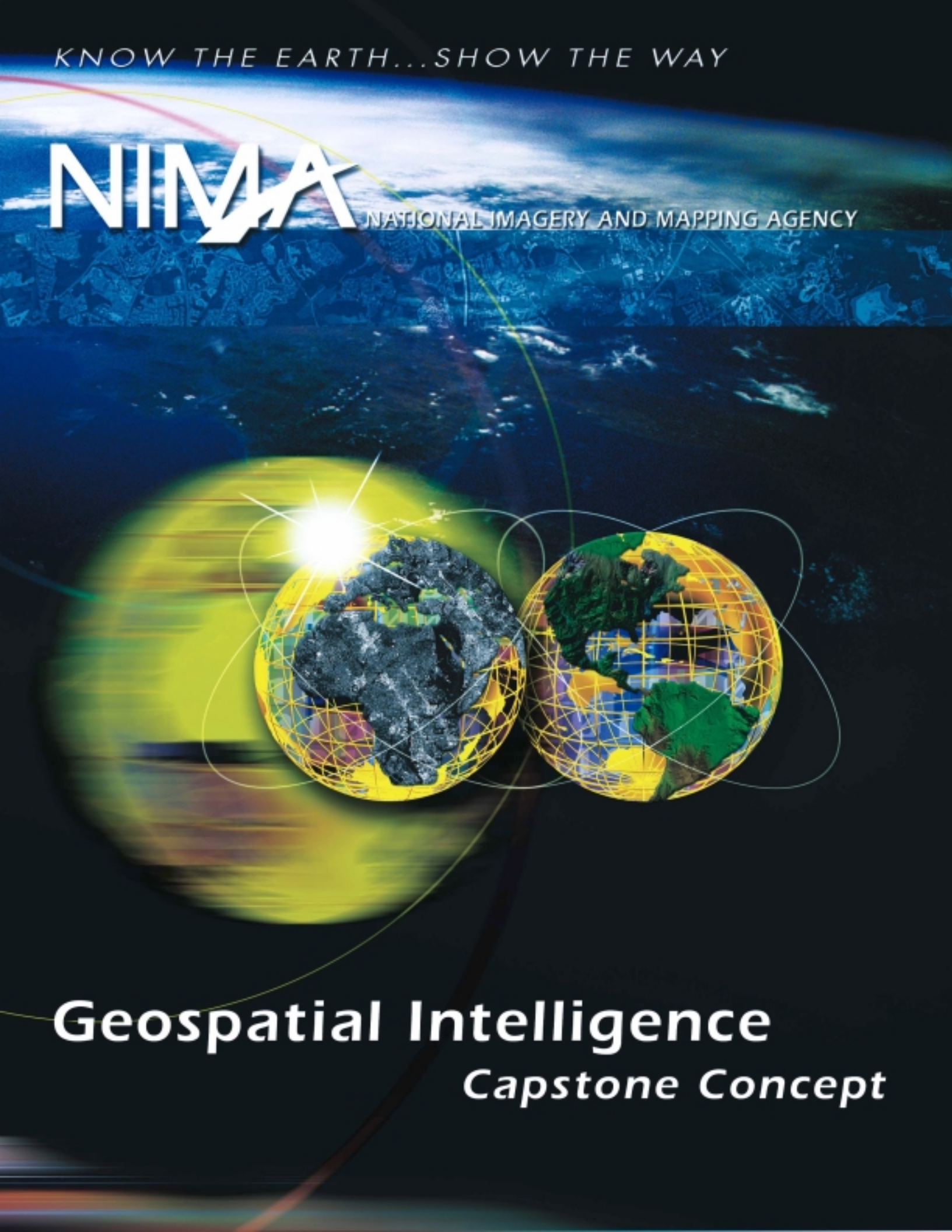
KNOW THE EARTH...SHOW THE WAY

NIMA

NATIONAL IMAGERY AND MAPPING AGENCY



Geospatial Intelligence

Capstone Concept

Geospatial Intelligence

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

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Foreword

Why geospatial intelligence? What defines geospatial intelligence as a discipline? Simply put, geospatial intelligence is about the integration of NIMA's existing imagery and geospatial analysis capabilities for the digital information environment of the twenty-first century. The convergence of our imagery and geospatial tradecrafts and the emergence of our new, integrated discipline of geospatial intelligence represent the fulfillment of the vision of NIMA's founders. By unifying our unique ability to precisely model the environment and to remotely monitor dynamic world events, we are transforming into a powerful new discipline that is truly greater than the sum of its parts.

Our transformation has altered the conceptual framework of our discipline and the way it relates to the larger context of the profession of intelligence. At the same time that technology has enabled the integration of our tradecraft and tools, the world environment has changed dramatically. The September 11 terrorist attacks have caused our nation to rethink our tenets of national security and reevaluate our approach to the collection, analysis, and dissemination of intelligence.

With these changes in our conceptual framework, it is essential that we understand what is changing, what remains the same, and why. As the functional manager for geospatial intelligence, I have launched an effort to develop a formal body of National Geospatial Intelligence Doctrine. This body of doctrine will provide the conceptual link between our national security strategy and the plans and procedures that guide our actions. Our doctrine will reflect a community of shared beliefs, a stable set of truths that, while enduring, remains flexible enough to embrace new concepts.

With *Geospatial Intelligence*, our capstone concept, we take our first step toward a formal doctrine of geospatial intelligence. *Geospatial Intelligence* speaks of our heritage, defines our core values, and provides the intellectual foundation for our ongoing transformation. It outlines our enduring characteristics and our evolving and emerging capabilities.

Although this capstone concept introduces geospatial intelligence as a new term in the intelligence lexicon, our mission remains the same. While our concepts, methods, technology, and terminology evolve, the essential qualities demanded of NIMA remain unchanged—satisfy our customers' geospatial intelligence needs at any moment, for any purpose.

Know the Earth … Show the way!

JAMES R. CLAPPER, JR.
Lieutenant General, USAF (Ret.)
Director

Introduction

*This capstone concept publication introduces the term **geospatial intelligence** to the lexicon of national security. It describes the common framework of shared beliefs as they apply to imagery, imagery intelligence, and geospatial information, hereafter referred to collectively as geospatial intelligence.*

Geospatial Intelligence outlines the capstone concept for the National Imagery and Mapping Agency (NIMA). While this document primarily addresses NIMA, the principles it outlines are generally applicable for geospatial intelligence practitioners throughout the National System for Geospatial Intelligence (NSGI).

This capstone concept describes our highest enduring principles, providing the conceptual link between our national strategy and the plans, procedures, and methods that geospatial intelligence professionals develop and apply in their work every day. It responds to the direction set in the *National Security Strategy*, the *National Strategy for Homeland Security*, the *Quadrennial Defense Review*, *Joint Vision 2020*, and the *Strategic Intent for the U.S. Intelligence Community*. It draws heavily upon the enduring principles we have inherited from joint and service doctrine, the transformational principles described in the NIMA Commission Report, and the lessons we have learned in recent operations from Bosnia and Kosovo to the Global War on Terrorism.

This document:

* describes the nature of a new intelligence discipline;
* explains the radical shifts in the geopolitical landscape and the advancing technologies that are transforming the imagery and geospatial tradecrafts;
* outlines our evolving and emerging processing and remote sensing capabilities, encompassing the entire range of sources from reconnaissance satellites to airborne platforms and commercial providers;
* explains the power of geospatial intelligence as a medium for multi-disciplinary intelligence collaboration and visualization.

This capstone concept begins a dialog about the nature of our evolving discipline. It is the first word on geospatial intelligence, but not the last. While it answers several important questions, many others remain to be answered. *Geospatial Intelligence* builds upon the legacy of established joint and service doctrine, and sets the stage for our development of a formal doctrine of geospatial intelligence for NIMA and the NSGI.

Intelligence—and how we use it—is our first line of defense against terrorists and the threat posed by hostile states. Designed around the priority of gathering enormous information about a massive fixed object—the Soviet Bloc—the intelligence community is coping with the challenge of following a far more complex and elusive set of targets.

National Security Strategy

The end of the Cold War and the dawn of a new era in the global security arena brought about a time of tumultuous change in the U.S. Intelligence Community. The collapse of the Soviet Union and the U.S. military experience in the Gulf War were followed by a virtual explosion of intelligence requirements resulting in the need for a profound transformation of our nation's imagery and geospatial capabilities. The nation responded with an ambitious effort to strengthen these capabilities, uniting the imagery and geospatial communities in 1996 within a new agency, the National Imagery and Mapping Agency (NIMA), and beginning a long process of converging the two fields into a single, integrated discipline—the new discipline of geospatial intelligence.

NIMA Arrives

The establishment of NIMA in 1996 began the process of integrating the Geospatial and Imagery Analysis tradecrafts under a single discipline manager, the Director of NIMA. Over the past six years, the agency has worked to understand the nature and parameters of this new discipline and to test new concepts and develop an integrated architecture for national geospatial intelligence.

The Director of NIMA is the steward of the discipline of geospatial intelligence. He exercises broad authority on behalf of the Director of Central Intelligence (DCI) and the Secretary of Defense to manage imagery and geospatial information production and the tasking of national imagery collection systems, as well as lead the geospatial intelligence community as the functional manager for the National System of Geospatial Intelligence (NSGI). As the guardian of the geospatial intelligence future, he oversees research and development of geospatial intelligence technologies, development of doctrine and future concepts, imagery and geospatial data standards, and training and development of geospatial intelligence professionals throughout the Intelligence Community.

Most who have tried to reconstruct the logic that put the National Photographic Interpretation Center and Defense Mapping Agency together into the National Imagery and Mapping Agency have concluded that it was the potential, profitable convergence of imagery and geospatial processes and products.

Report of the Independent Commission on NIMA

inevitable result of powerful forces of change in our strategic environment. The major catalysts for this change have been a radical shift in the threat environment, the evolving nature of conflict, and the revolutionary technologies of the digital age. Working together, these forces have provided both the impetus and the means for the convergence of the imagery analysis and geospatial tradecrafts into the single, integrated discipline of geospatial intelligence.

Uncertain Threat Environment

Though uncertainty has always characterized the international security arena, the world order that has emerged in the twenty-first century has made knowledge of foreign lands more important and challenging than ever before. Rather than facing a stable, dominant peer competitor, the United States is confronted by regional conflicts, transnational crime, terrorism, drug trafficking, failing states, and a growing number of states and non-state actors with access to weapons of mass destruction. Today, with the emergence of global terrorist networks, our nation confronts an elusive new threat, operating not only in rogue and failing states, but also within our own borders.

Kabul, Afganistan

Superior, timely knowledge of the environment and adversary is the key enabler that gives American government officials and military forces the home field advantage even in distant foreign lands.

This complex environment places high demands upon our nation's imagery and geospatial capabilities. Intelligence targets have multiplied dramatically since the days of the Cold War. It is now more difficult than ever to predict precisely where (and when) American power will next be needed to protect our national interests, and where the Intelligence Community must focus America's eyes and ears to provide the information advantage to decision-makers and warfighters. This demanding environment has driven us to evolve our tradecraft through digital processes and collaborative models to ensure that we have a ready base of global knowledge and can provide responsive, focused support in a crisis.

September 11, 2001

Evolving Nature of Conflict

The technology-enabled shift from attrition warfare to effects-based warfare has dramatically increased the emphasis on—and the demands upon—intelligence in military operations. In *Joint Vision 2010* and *Joint Vision 2020*, the Joint Chiefs of Staff articulated a view of warfare that places unprecedented value on the role of information. The central operational concepts of precision engagement, dominant maneuver, focused logistics, and full-dimensional protection require warfighters to possess an unparalleled degree of information superiority—with comprehensive and detailed knowledge of the battlespace and the adversary.

information age warfare have turned the Cold War model of national intelligence upside down. In the centralized model of the Cold War era, intelligence reports written by tactical units were sifted and analyzed by national agencies for the benefit of national decision makers. In today's more distributed model, the national intelligence collection systems and subject-matter expertise

Geospatial Intelligence is primarily about obtaining knowledge of the physical and cultural aspects of the global security environment and the capabilities and intentions of potential adversaries.

once dedicated to supporting a select group of national decision makers now support a vastly expanded base of theater and tactical users as well. Interoperability has become essential in these distributed worldwide networks of intelligence producers and consumers, where finished intelligence often ends up in the guidance system of a tactical missile.

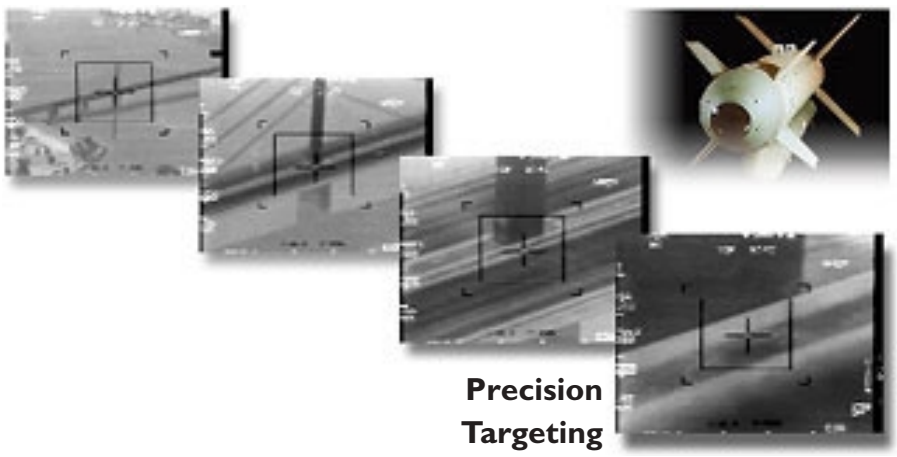
This growing demand for tactical support has been a key factor in the emergence of geospatial intelligence as a new discipline. The rapid pace of the targeting cycle and the massive volume of targets has placed tremendous stress on intelligence production processes. Emerging network-centric concepts of operations, which rely on the ability of friendly forces to detect, changes in the battlespace more quickly than adversary forces, require us to further reduce cycle times. The timeliness required for rapid, precision engagement demands closer integration of the tools and processes of the imagery specialists who detect and characterize targets and the geospatial specialists who characterize and measure the battlespace.

Advancing Technology

The convergence of the imagery and geospatial tradecrafts has been enabled by revolutionary developments in three key technology areas: advanced remote sensing, precision geopositioning, and digital information processing.

These advanced technologies are increasingly allowing data to be moved and manipulated interchangeably between imagery products and maps and charts, blurring the distinctions between the two product categories. Geospatial vector data sets, showing such things as roads and jurisdictional borders, can be superimposed over orthorectified imagery to update outdated maps rapidly. Similarly, digital imagery "chips" may be inset on a digital map to provide additional detail of highly localized events or recent changes. With the advent of Geographic Information Systems (GIS), digital databases, rather than venerable paper maps and charts, are becoming the key medium for recording, organizing, and visualizing geospatially referenced information, whether derived from imagery or other source data. These digital technologies provide the common currency that makes possible the convergence of imagery and geospatial processes and tool sets within the discipline of geospatial intelligence. ❑

The union of three technological achievements: precision geopositioning, advanced imagery and sensor technologies, and low cost ubiquitous digital data processing, has made possible the convergence of geospatial and imagery analysis into the integrated discipline of geospatial intelligence.



Precision Targeting

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

Unifying the strengths of imagery analysis and mapping, charting, and geodesy, geospatial intelligence has emerged as a new discipline, separate and distinct from its predecessors. To understand the nature of this new discipline, it is important to examine its enduring elements. A set of defining characteristics outlines the essential qualities common to both the imagery and the geospatial specialties. An integrated body of tradecraft draws upon each of our specialties to bring capabilities that far surpass what any could accomplish alone. The human analyst, endowed with a unique set of traits, plays a central and timeless role in our trade. Finally, geospatial intelligence can be used for a wide range of applications that are vital to our nation's security.

Defining Characteristics

As a discipline, geospatial intelligence is defined primarily by three qualities: its character as an intelligence discipline, its unique analytic tradecraft, and its fundamental spatial and temporal nature.

An Intelligence Discipline

Geospatial intelligence is first an intelligence discipline, and therefore shares the general qualities and attributes of the broader field of intelligence. It primarily aims to understand the capabilities and intentions of potential adversaries and the physical and cultural aspects of the global security environment. Geospatial intelligence confronts non-cooperative targets that may be trying to conceal their activities from the United States and our allies. Our nation therefore requires the use of clandestine means to collect information about them and sensitive analytical techniques to understand the meaning of this information. Like other intelligence disciplines, geospatial intelligence aims to produce trusted knowledge. It examines new information in the context of our existing knowledge base and information obtained from other sources to arrive upon valid conclusions about the security situation. Geospatial intelligence responds to specific requirements, either to support policy decisions or the planning and execution of military or civil national security operations. Because collection and production assets are limited and time is an important factor, geospatial intelligence must focus on meeting the highest priority needs of national security decision-makers according to finite timetables.

Geospatial intelligence aims to reduce uncertainty, providing a knowledge advantage in time for a decision to be made or an action to be taken to advance or protect national interests.

Geospatial intelligence is an ***analytical discipline***, defined by its analytic tradecraft—the complementary and related skill sets of geospatial specialists and imagery analysts—rather than by a particular source of data. Geospatial intelligence relies upon data from multiple collection sources, including remote sensing, open sources, and human sources. In this respect, it differs from the traditional collection disciplines, which are defined by the skills associated with a single collection source. Its focus is not on its source, but rather on its ultimate product—an integrated, digital, visual picture of the global security situation.

Collection Disciplines	Analytical Disciplines
Imagery Intelligence	**Geospatial Intelligence**
Signals Intelligence	**Cryptology**
Human Intelligence	**Measurement & Signatures Intelligence**
Open Source Intelligence	**Scientific & Technical Intelligence**
Foreign Materiel Acquisition	**General Military Intelligence**
Acoustic Intelligence	**Economic Intelligence**
Radar Intelligence	**Medical Intelligence**
Electro-optical Intelligence	
Nuclear Intelligence	
Unintentional Radiation Intelligence	
Laser Intelligence	
Material Sampling	

Intelligence Disciplines

Fundamental Spatial and Temporal Nature

Geospatial intelligence is also characterized by its fundamental spatial and temporal nature. It is focused primarily on examining tangible, physical things. Geospatial intelligence observes and measures the physical world, drawing conclusions based on the spatial relationships among objects as they change over time. It uses both qualitative and quantitative methods, analyzing geometric attributes like shape, size, dimension, distance, movement, pattern, elevation, and location to characterize geographic areas and reach conclusions about intelligence issues. It is this elemental spatial and temporal nature that unites our constituent tradecrafts and distinguishes geospatial intelligence from all other intelligence fields.

This spatial and temporal aspect makes geospatial intelligence a powerful, visual medium. Information from many sources can be integrated in a spatial framework to reveal spatial relationships not immediately evident. Through visualization, geospatial intelligence permits both rapid, intuitive understanding of the physical environment and evaluation of potential adversary courses of action in the three spatial dimensions and through time.

An Integrated Body of Geospatial Intelligence Tradecraft

Geospatial intelligence unites the complementary strengths of our imagery and geospatial tradecrafts in a powerful, integrated discipline, while at the same time recognizing and preserving the distinctiveness and unique value of each specialty. It is the increased interaction between specialists, not their homogenization, which provides value. This convergence brings a closer integration of the detailed, dynamic information derived from imagery with the geospatial framework and precise modeling techniques of the geospatial specialties.

The convergence of our geospatial and imagery analysis tradecrafts makes possible an integrated understanding of the global security situation. While our geospatial tradecraft provides the environmental context, our imagery tradecraft provides the perishable, dynamic context.

have developed methods of measuring and modeling the physical environment with unprecedented precision. These methods enable the precise geolocation and measurement of objects and features on imagery, helping us to better quantify our characterization of intelligence targets. This ability to precisely quantify knowledge gained from imagery adds tremendous value for geospatial intelligence consumers. It enables us to produce intelligence that is highly actionable, especially in tactical applications such as targeting and navigation, and brings more confidence to policy decisions.

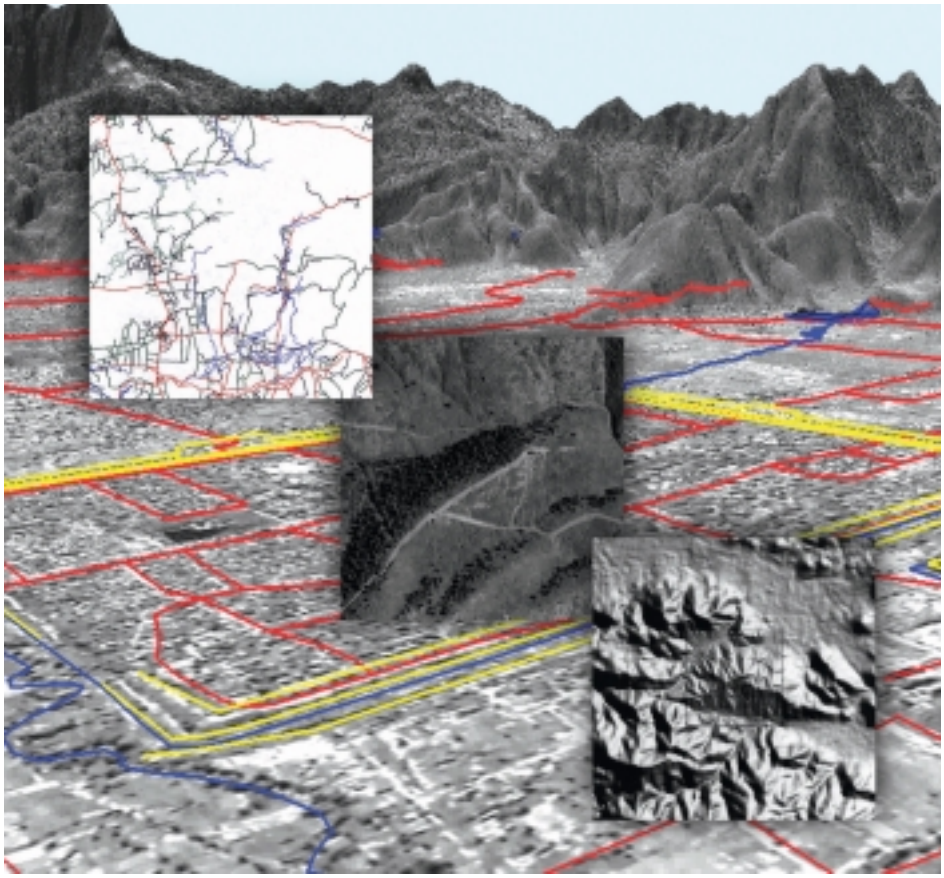
Using Geographic Information Systems (GIS), geospatial specialists bring new analytic tools to bear on many traditional intelligence problems. These tools allow data to be organized and visualized in a geospatial context, enabling a better integration of environmental factors in intelligence problem solving. By allowing a more interactive approach to the analysis of environmental effects and adversary observables, GIS capabilities provide potential to improve the collection, as well as analysis, of intelligence, enabling scarce collection assets to be focused on areas where targets of interest are most likely to be found.

the dynamic, detailed content to our overall picture of the security environment. Imagery analysts detect important world events in near-real time, updating decision-makers on rapidly changing situations with a high degree of confidence and detail. At the same time, imagery serves as an important basis for long-term historical research and trend analysis. Imagery analysis is a powerful means for detecting and measuring changes, whether rapid or gradual, in the global security situation.

Imagery has long been vital as a source for geospatial applications such as mapping, charting, and geodesy as well as intelligence analysis. Since the development of aerial (and later, satellite) photoreconnaissance,

The integration of the imagery and geospatial tradecrafts bring new analytic tools to bear upon many traditional intelligence problems.

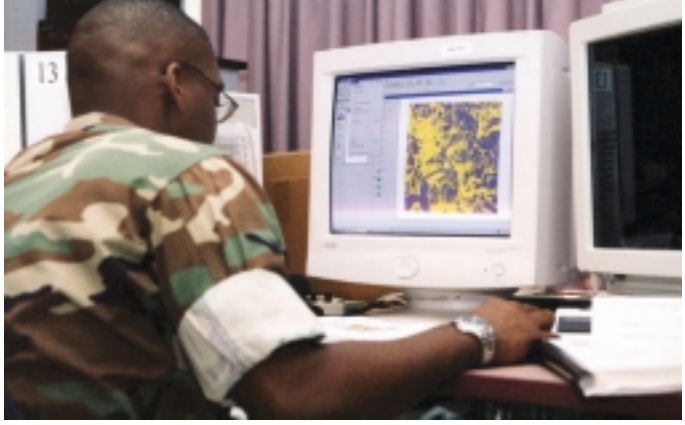
overhead imagery has been unmatched for rapidly recording large amounts of spatial data. Imagery collection management has historically played an important role in the integration of our discipline, balancing the requirements for collecting source data to satisfy both intelligence and geospatial production requirements. Digital imagery has opened new avenues for integrating our tradecrafts, enabling the development of increasingly integrated products, such as imagery maps, three-dimensional fly through scenes, and other tailored geospatial intelligence.



Geospatial Intelligence: An Integrated View

As we progress in the integration of our tools, processes, and products, imagery and geospatial specialists will discover new ways to leverage this body of tradecraft to produce intelligence that is more intuitively understandable, more predictive, and more actionable for national security decision-makers.

Critical thinking is therefore the most essential element of our tradecraft. True analysis goes beyond the mere extraction and repetition of intelligence facts from a collection source. The geospatial intelligence analyst understands methods of acquiring data, evaluating its quality, and systematically examining it in light of existing knowledge to reach a meaningful conclusion about the environment or the adversary. The geospatial intelligence analyst performs three basic functions: an *extraction* function, using specialized skills and knowledge to recognize information of intelligence interest, a *filtering* function, shielding the consumer from information overload, and a *synthesis* function, logically assembling relevant facts that reasonably lead to a significant conclusion.



Conducting Mobility Analysis

The ability to ***communicate*** geospatial intelligence information clearly, quickly, and effectively using multiple media in multiple dimensions is a key skill of the geospatial intelligence analyst. Visualization is our preferred medium for communicating geospatial intelligence. Knowledge is most rapidly absorbed by the minds of our consumers when it transmitted by visual media—whether as a hardcopy map, a digital image, or a three-dimensional simulation. However, mastery of the basic skills of clear writing and effective briefing will always be essential. It is up to the analyst to choose the best available means to objectively and authoritatively communicate the intelligence facts, his or her analytical judgments, and any remaining knowledge gaps.

Geospatial Intelligence Specialties

Aeronautical Analysts
Cartographers
Collection Managers
Geodesists
Geophysicists
Geographers
Geospatial Analysts
Hydrographers
Imagery Analysts
Imagery Performance Officers
Imagery Interpreters
Imagery Scientists
Marine Analysts
Oceanographers
Regional Analysts
Target Analysts
Terrain Anaylsts
Topographic Analysts

The Geospatial Intelligence Analyst

The human analyst is our most important geospatial intelligence asset. While the technologies of our discipline offer valuable tools, vastly improving our ability to produce intelligence, their primary value is in improving the performance of the human analyst.

> *The computer has also had its dramatic impact on analysis . . . But whatever the new wrinkles, the eternal verities remain . . . there is no substitute for the intellectually competent human—the person who was born with the makings of critical sense and who has developed them to their full potential.*
>
> Sherman Kent
> Strategic Intelligence for
> American World Policy 1965

analyst's chief commodity is a set of proven models and methods—a ***tradecraft***—that can be applied to an intelligence problem. It is the tradecraft of geospatial intelligence that allows the analyst to reduce ambiguous or contradictory data to a few useful conclusions that increase the potential for victory on a battlefield or reduce uncertainty in a policy decision. These methods are both quantitative and qualitative, and constitute both the art and science of geospatial intelligence.

1962 Cuban Missile Crisis

Applications of Geospatial Intelligence

Geospatial intelligence provides *unique knowledge not available by other means* that is critical for informed national security decisions. It provides objective, precisely measurable information about the environment and potential adversaries, especially in remote or inaccessible regions.

The applications of geospatial intelligence include the most important functions of our national government. Geospatial intelligence supports the development of national policy, the planning and execution of military operations, the protection of homeland security and other civil operations, and the collaborative efforts of analysts throughout the Intelligence Community. It is an essential tool for national security policy and operations, providing the knowledge basis for decision, planning, and action.

Overlapping Applications of Geospatial Intelligence

Informing Statecraft

Geospatial intelligence provides knowledge national leaders need to make informed decisions on matters of national security and foreign affairs. It plays a central role in identifying strategic threats, providing warnings of war, predicting humanitarian crises, and verifying international treaty compliance. It enables national decision-makers to monitor crisis situations as they develop and measure or forecast the effects of foreign policy decisions. Geospatial intelligence provides information useful in the negotiation of international agreements and in the protection of U.S. diplomatic facilities overseas. Geospatial intelligence increases confidence in policy decisions by reducing uncertainty, risk, and surprise.

Supporting Military Operations

Geospatial intelligence provides the vital knowledge foundation for modern joint warfare, serving as the basis for decision superiority, dominant maneuver, and precision engagement for the joint, interoperable force.

Geospatial intelligence offers the visual picture of the battlespace and the situational understanding that is essential for operational decision making throughout the spectrum of conflict and at all levels of warfare. It is a major source of content for the Common Operational Picture (COP) and the primary means of visualizing it. Geospatial intelligence modeling capabilities are powerful predictive tools for Intelligence Preparation of the Battlespace, giving Joint Force and Component Commanders unparalleled decision superiority.

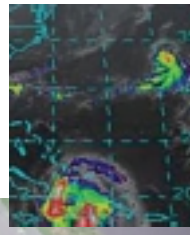
Geospatial intelligence is the critical ingredient that enables dominant maneuver and precision engagement. In conjunction with advanced navigation and targeting systems, it provides U.S. air, land, and naval forces important tactical advantages. Precise knowledge of the battlespace in a common frame of reference enables the synchronization of widely dispersed maneuver forces to achieve a common objective. Geospatial intelligence gives warfighters a critical understanding of an adversary's strategic infrastructure and vulnerabilities, permitting precision strikes against strategic and tactical targets in all weather conditions. When strike missions are complete, geospatial intelligence is the primary means of battle damage assessment, enabling commanders to assess the results and order re-strikes if necessary.

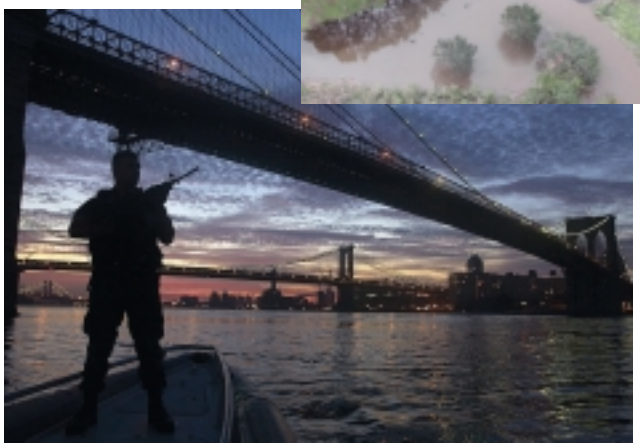
With its common spatial and temporal frame of reference, geospatial intelligence is essential for interoperability in joint and combined warfare.

give every Component Commander and every combatant a shared view of the battlespace. This common picture enables dissimilar forces distributed throughout the area of operations to provide mutual support, massing effects in time and space in unified action to decisively defeat an adversary.

Homeland Security and Civil Support

Geospatial intelligence plays a critical role supporting protection of the homeland and other civil missions. In supporting homeland security, geospatial intelligence is valuable both for reducing the probability of terrorist attacks and for managing the consequences of attacks. Geospatial intelligence can provide the means to conduct detailed assessments to identify vulnerabilities in critical national infrastructure where the probabilities of successful terrorist attack are highest.





Homeland Security and Civil Support

intelligence provides data and products on selected urban areas of interest, land and maritime entry and exit points, identification and assessment of foreign threats, and extent and scope of natural and man-made damage. In cases of terrorist attack or natural disaster, geospatial intelligence can rapidly give federal agencies and first responders a comprehensive and detailed view of the scene, helping them to make the best possible decisions in preparation, response, and recovery actions. Geospatial intelligence also plays an essential role in a wide range including drug interdiction, humanitarian relief and as permitted by law, support to law enforcement.

Intelligence Collaboration

Geospatial intelligence supports Intelligence Community analysts, providing imagery, imagery intelligence, geospatial information, and geospatial intelligence analysis skills and techniques to support the centralized analysis of all-source intelligence. Geospatial intelligence is an important source for scientific and technical intelligence and basic Country Studies and Military Capabilities Studies. It is a major source of economic intelligence information, providing useful insights into foreign agricultural and industrial production. Geospatial intelligence is also used to support the development of Defense Intelligence Assessments and National Intelligence Estimates, which represent the consensus position of the Intelligence Community on matters of critical strategic importance to national policymakers and planners. ❑

NIMA, The Geospatial Intelligence Functional Manager

As functional manager for the National System for Geospatial Intelligence (NSGI), NIMA exercises stewardship of our nation's geospatial intelligence capability from the national to the tactical level. Through this functional management responsibility, NIMA:

- Acts to identify and advocate NSGI community requirements and to manage the nation's geospatial intelligence investments to ensure interoperability and collaboration among our partners and consumers;
- Develops and manages the NSGI technical architecture and guides the community's research and development efforts;
- Promotes common standards for imagery and geospatial information systems and provides training in the tradecraft of geospatial intelligence;
- Develops policy to promote interoperability and protect sensitive geospatial intelligence sources and analytical techniques; and
- Leads the NSGI in the development of doctrine to guide the employment of geospatial intelligence capabilities and of innovative future concepts to ensure we remain the world leader in geospatial intelligence.

The discipline of geospatial intelligence unites a broad range of evolving and emerging data processing and remote sensing capabilities. By bringing together the technical capabilities traditionally associated with imagery intelligence with those more typically used for acquiring and manipulating geodetic, gravimetric, geomagnetic, and hydrographic survey data, we are developing an expanded tool set for solving intelligence problems. Rapidly advancing digital processing capabilities are revolutionizing our ability to respond to the needs of our customers in the emerging network-centric environment, while the incorporation of an expanded range of data sources and sensors is enabling us to provide new dimensions of knowledge to national security decision-makers.

Advanced Data Processing in an All-Digital Environment

The rapid spread of desktop computers with enhanced processing performance and the increasing use of digital sensor technologies have made digital processing ubiquitous throughout the intelligence cycle and at multiple echelons of government. These digital processing capabilities provide the potential for NIMA and the National System for Geospatial Intelligence (NSGI) to dramatically improve interoperability, collapse production timelines, and broaden the accessibility of geospatial intelligence as we develop and deploy new capabilities throughout the NSGI.

Enhanced Analytic Perception

Desktop data processing systems provide powerful automated analytic aids for improving the confidence and sensitivity of geospatial intelligence. Using modern imagery analysis workstations, analysts can electronically manipulate, mensurate, annotate, and enhance images and compare them against on-line libraries of imagery signatures. Automated change detection and other imagery-derived Measurement and Signatures Intelligence (MASINT) capabilities enhance the analyst's perception by detecting minute changes in imagery of intelligence targets that are difficult to detect with the unaided eye. Geographic Information Systems (GIS) offer powerful tools for synthesis, enabling analysts to integrate information about related targets to better understand how they function as elements within national or regional infrastructures.

Future Integrated Analysis

Analytic Assets

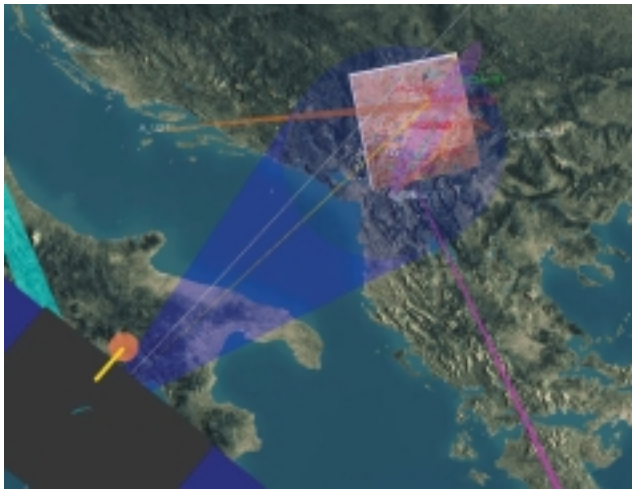
Advanced processing capabilities improve the efficiency of geospatial intelligence operations by automating simple, manual, or repetitive production tasks and allowing human analysts to focus on more complex geospatial intelligence problems. Capabilities such as automated feature extraction, pattern recognition, automated change detection, and automated search and retrieval have proven useful in maximizing the use of valuable human analysts. These advanced capabilities offer great potential to enable the limited analytic assets of NIMA and the NSGI to better manage the enormous volume of data collected by our worldwide intelligence collection system.

Managing Complex Collection Strategies

Networked, distributed data processing and digital visualization capabilities provide new tools for managing complex imagery and multidisciplinary collection strategies. Using advanced tasking and collection management tools to dynamically simulate potential collection scenarios, collection managers can more effectively leverage the expanding range of available data sources, to include emerging remote sensing platforms and sensors as well as the growing capabilities of commercial data providers. Collaborative networks convey information about collection postures and about operations throughout the community of intelligence producers and consumers. These tools are enabling collection managers at all echelons to support analysts through their understanding of evolving and emerging remote sensing capabilities, brokering analyst's collection requirements to the best available sources or collection systems.

Worldwide Collaboration and Value-Adding

Digital data is the common currency of information in the all-digital environment of the twenty-first century. The NSGI digital information infrastructure provides connectivity among NIMA and its collaborative partners and accessibility to geospatial intelligence consumers from the national to the tactical level. Digital geospatial intelligence products can be rapidly shared and manipulated by others in a virtual collaborative environment, with various players adding value by digitally overlaying thematic information from multiple sources.



Advanced Collection Management Tools

and Actionable

As we modernize our systems, digital data processing technology is enabling NIMA and the NSGI to provide geospatial intelligence that is more usable and relevant than ever before. Geospatial intelligence is the key to interoperability, serving as the foundation for the Common Operational Picture (COP) and providing users in the military services, civil agencies, and allied forces a common geospatial framework for conducting joint, interagency, and coalition operations. Digital geospatial intelligence can be accessed by our consumers in a wide range of forms according to their needs and can be tailored by the analyst to meet their unique operational requirements. Used in conjunction with Global Positioning System (GPS) navigation and guidance technology, our digital products are increasingly actionable, allowing rapid sensor-to-shooter dissemination and integration. Digital information technology provides the flexibility to produce geospatial intelligence in a wide range of forms, improving its utility to intelligence consumers.

Remote Sensing Capabilities

The discipline of geospatial intelligence unites a broad range of evolving and emerging remote sensing capabilities, including traditional imagery systems; sources associated with geodetic, gravimetric, geomagnetic, and hydrographic surveying; and imagery-derived MASINT systems. Our ability to effectively leverage these capabilities is growing appreciably as they are integrated more fully into the NSGI architecture, allowing more integrated collection management and data analysis. A growing range of collection platforms and sources is improving our access to targets and increasing our ability to conduct persistent surveillance, to obtain broad area coverage, and to more effectively employ national collection capabilities. The NSGI leverages all available sources, whether government or commercial; space-based, airborne, seagoing, or ground-based. Sensor advances are expanding our use of the electromagnetic spectrum and other physical phenomena, improving our ability to counter denial and deception measures, to conduct surveillance and track moving targets, to precisely measure terrain features, and to remotely characterize materials and substances.

Based on a common geospatial and temporal reference frame, geospatial intelligence is a key to interoperability.

capabilities provide our nation an unprecedented ability to understand the global security situation through remote sensing.

Reconnaissance Satellites

The clandestine reconnaissance satellites operated by the National Reconnaissance Office (NRO) provide the most advanced imagery collection capability in the world. With a range of classified capabilities, these systems provide near-real-time medium- to high-resolution imagery to support analysis of area and point targets and digital geospatial production. Reconnaissance satellites provide the regular imagery of denied areas that is essential for our most demanding national security requirements. The next generation of imagery satellites, the Future Imagery Architecture (FIA), is now in development and will offer evolutionary improvements in our coverage and sensor capabilities as it is deployed.

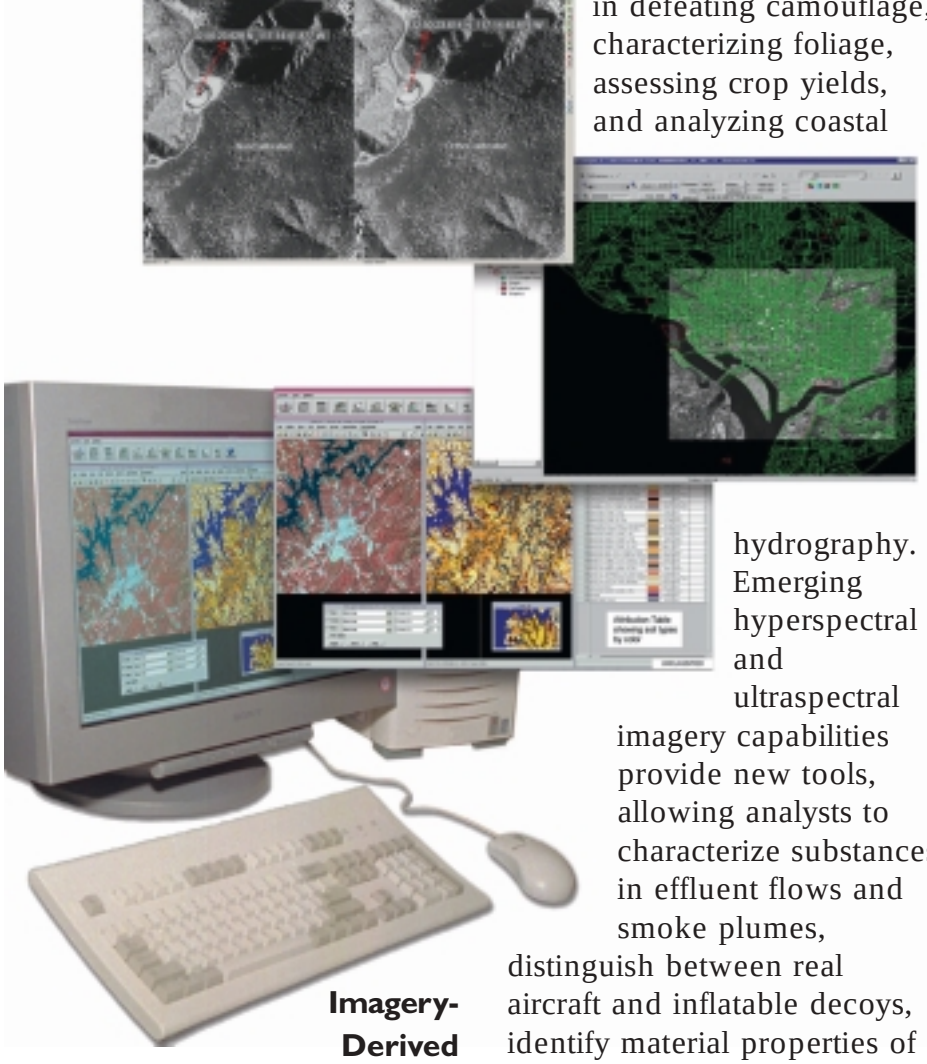
Airborne Platforms

Airborne imagery collection platforms, including Unmanned Aerial Vehicles (UAVs), provide persistent and responsive coverage of high-interest target areas and offer a variety of sensor capabilities. Emerging high-endurance UAVs are dramatically improving our ability to conduct persistent surveillance of high-interest targets and support time-critical strike operations. A wide range of airborne platforms is operated by strategic, operational, and tactical commands as well as by civil agencies.

Commercial Imagery

The commercial imagery industry is an important emerging data source for geospatial intelligence producers. With growing capacity in both satellite and airborne imagery collection, commercial providers are able to produce a greater share of the data needed to support non-time-dominant low and medium-resolution imagery needs for applications such as geospatial production. The high-resolution commercial imagery now available provides an important advantage in multinational coalition operations, as it can be shared with allies without compromising the capabilities and operating characteristics of U.S. reconnaissance systems.

ARQ-1 Global Hawk UAV



Imagery-Derived MASINT

Spectral Imagery

Expanding our use of the electromagnetic spectrum, we are dramatically increasing our ability to defeat denial and deception and understand developments in the national security situation. Panchromatic imagery, both electro-optical and film-based, has been the mainstay for Imagery Intelligence (IMINT) for years and continues to be our most important source. Infrared imagery enables analysts to detect and identify activity based on thermal signatures. Multispectral imagery in defeating camouflage, characterizing foliage, assessing crop yields, and analyzing coastal hydrography. Emerging hyperspectral and ultraspectral imagery capabilities provide new tools, allowing analysts to characterize substances in effluent flows and smoke plumes, distinguish between real aircraft and inflatable decoys, identify material properties of new weapons systems, and detect vehicles based on their unique paint signatures.

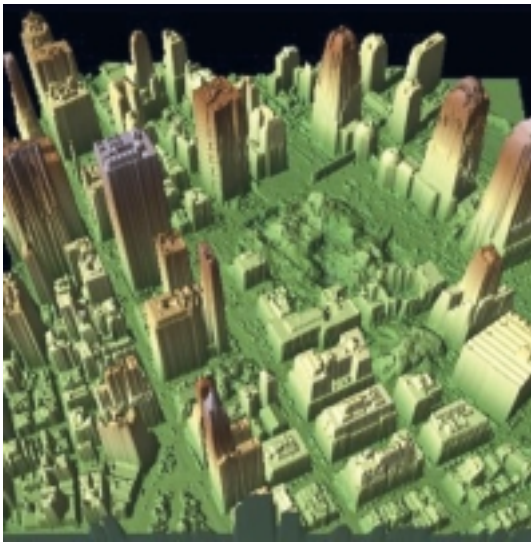
Motion Imagery

The emergence of motion imagery sensors, such as the real-time video capability of the Predator UAV system, has provided a valuable new tool for persistent imagery from an endurance platform, analysts can monitor high-interest activities in the mission space, to include tracking moving, fleeting, and emerging targets and observance of rapidly developing events as they occur. Motion imagery provides increased resolution in the time domain, offering combatant commanders and civil authorities a level of situational understanding of dynamic events that far surpasses what is possible with single-frame imagery.

UAV Motion Imagery

Active Sensing Technologies

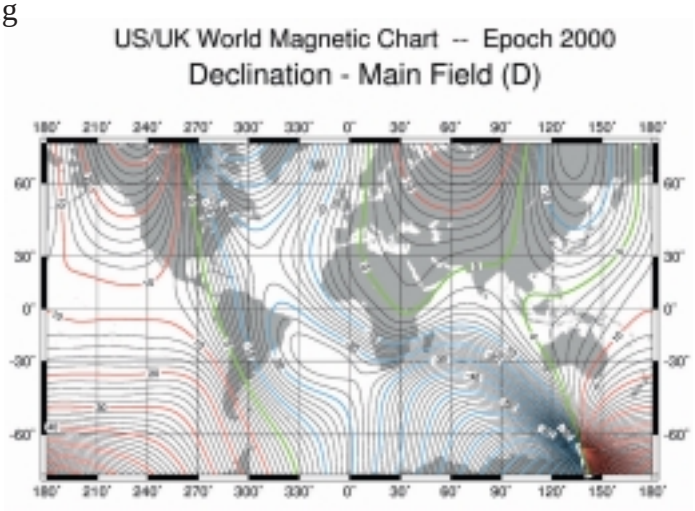
A growing range of active sensing capabilities that includes Synthetic Aperture Radar (SAR) and laser imaging systems serves as a powerful complement to spectral imagery. SAR is useful in countering denial and deception and essential for imaging in weather and lighting conditions that prohibit optical collection. SAR can also be used to provide a Moving Target Indicator capability for the detection and tracking of mobile

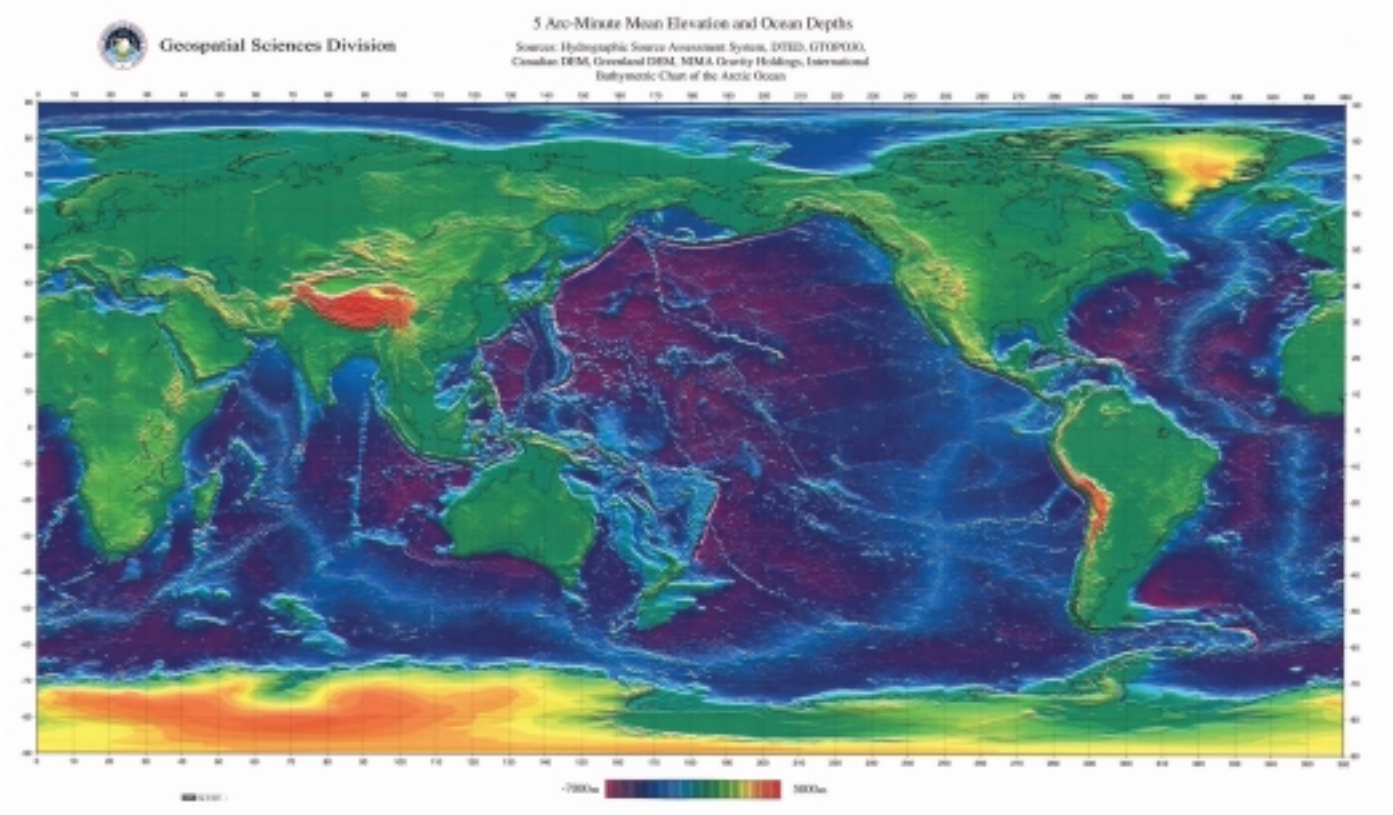


LIDAR Image of World Trade Cente Debris Field

technologies like Light Detection and Ranging (LIDAR) and Interferometric SAR (IFSAR), integrated into airborne or space-based platforms, enable us to characterize the Earth's surface elevation and hydrography with unprecedented speed and precision. Airborne LIDAR is increasingly supplanting the Navy's oceangoing research vessels, increasing by orders of magnitude our ability to collect precise hydrographic survey data over large areas. LIDAR and IFSAR systems have made possible the production of high-resolution digital elevation data on a large scale. Such data can be used to generate highly detailed, accurate three-dimensional models of structures and terrain for detailed operational planning and mission rehearsal.

Advances in geodetic and geophysical remote sensing are enabling analysts to characterize the Earth in unique ways. Gravimetric sensors residing on airborne platforms, satellite systems, and survey ships measure changes in the Earth's gravity field for a variety of applications, from long-wavelength global mapping to detailed analysis of underground features. New satellite systems are collecting precise geomagnetic data for developing world magnetic models. GPS technologies have revolutionized the collection of geophysical and geodetic survey data by allowing a wide range of sensors, including radar, to be precisely positioned anywhere on the globe. These geophysical sensing capabilities provide new dimensions of knowledge about the mission space, enabling production of tailored geospatial intelligence to give U.S. policymakers, warfighters, and civil agencies a unique information advantage. ❑





With respect to collaboration and fusion of the various collection disciplines, or INTs, the Commission believes that NIMA should hold a premier place because it 'owns' the geospatial construct. NIMA provides the logical context for fusion of Signals Intelligence (SIGINT), especially Electronic Intelligence (ELINT), with imagery.

Report of the Independent Commission on NIMA

Breaking the Stovepipes

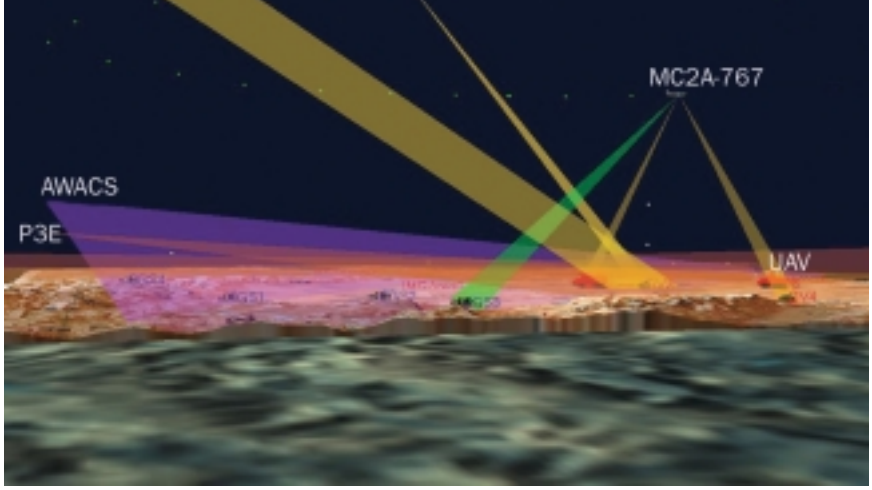
The emergence of geospatial intelligence as a cohesive, integrated discipline has fundamentally altered the way imagery and geospatial specialists contribute to the overall mission of the Intelligence Community. The series of consolidations that ultimately resulted in the establishment of NIMA in 1996 provided the community a center of excellence for the imagery and geospatial tradecrafts and an environment conducive to the development of innovative new concepts. Geospatial intelligence is emerging as a better, stronger partner among the intelligence disciplines, speaking with one voice and equipped to play a more substantial role in solving the problems facing the Intelligence Community.

The major challenge for the Intelligence Community today is to provide information superiority for an expanded base of operational users against adversaries who are growing increasingly sophisticated in their own intelligence and denial and deception capabilities. Overcoming this challenge requires us to break some of the barriers to information sharing—the stovepipes—that limit interoperability and cooperation among the intelligence disciplines. It means more closely integrating multiple data streams, leveraging all of our collection and production capabilities, while simultaneously accelerating cycle times for producing usable, finished intelligence.

Geospatial intelligence offers great promise to facilitate unprecedented collaboration and rapid fusion of information from multiple intelligence sources and producers in the emerging all-digital environment. Building on the long-established precedent of maps and charts as a basis for intelligence fusion, geospatial intelligence provides new approaches for multidisciplinary collaboration, both in the collection and distribution of intelligence source data and in the analysis and production of fused, finished intelligence.

Collaborative Source Data Collection and Distribution

A key concept for rapid, multi-source integration is to conduct collaboration and information sharing among intelligence producers as far upstream in the intelligence cycle as possible. Collaboration in the collection and distribution of source data shortens the collection stovepipes, allowing early information sharing and concurrent processing and analysis of data by intelligence producers in multiple disciplines and at multiple echelons.



Multi-Sensor Collection Strategy

Multidisciplinary Collection Strategies

Cooperation among Imagery Intelligence (IMINT), SIGINT, Human Intelligence (HUMINT), and Measurement and Signals Intelligence (MASINT) collection requirements managers has become increasingly important as our adversaries seek to use mobility, denial, and deception to conceal their activities. Cooperative, multidisciplinary collection strategies play an important role in time-sensitive targeting and defeating denial and deception. Tipoffs by a particular type of sensor or source are increasingly used to cue collection by other means, with SIGINT sensors triggering dynamic IMINT retasking and vice-versa. Developments in technical architectures are improving our capabilities to conduct simultaneous same-target collection by multiple collectors and sensors. This synchronization in the tasking phase allows concurrent, rather than serial, collection, processing, and exploitation of multi-source data, accelerating overall production timelines for multidisciplinary intelligence. These cooperative collection methods leverage the full range of intelligence sources, whether space-based, airborne, or ground-based and at all echelons, national, theater, and tactical.

Source Data Posting for Concurrent Exploitation

An emerging geospatial intelligence business model expedites distribution of newly collected imagery and other geospatial intelligence source data to analysts throughout the Intelligence Community, enabling concurrent exploitation at multiple echelons. In a shift from the traditional business model of task-process-exploit disseminate (TPED) to a new model of task-post-process-use (TPPU), all newly collected data is posted immediately to shared databases rather than delaying distribution until the data has been exploited. With immediate posting, imagery and other source data from collectors at any echelon can be made available to be simultaneously exploited by national agency, unified command, and tactical unit purposes and according to their own timelines.

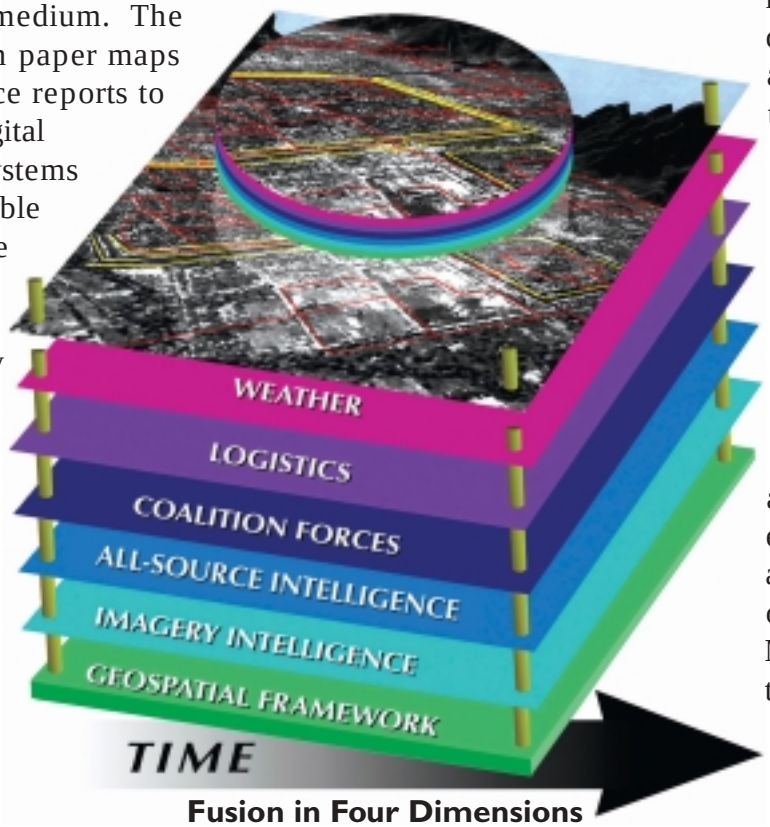
A Collaborative Medium for Intelligence Fusion

The use of a geospatial construct as the foundation for fusing intelligence from many sources is nothing new. Maps and charts have always provided the foundation for visualizing and understanding the adversary and the environment. Historically, military intelligence analysts have used overlays superimposed on paper maps and charts to display and track friendly and enemy orders of battle, analyze military aspects of terrain, and project possible adversary courses of action. Sand-table models of battlefields have long been used for visualizing and rehearsing combat operations. This fundamental role of geospatial information is a key principle of Intelligence Preparation of the Battlespace (IPB) methodology.
A geospatial foundation is simply the most useful medium for integrating intelligence information from multiple sources.

The geospatial intelligence construct is the best medium for visualization of many intelligence problems, regardless of the source of the information.

Digital technologies have dramatically increased the collaborative power of geospatial intelligence in two important ways. First, they have restored the geospatial specialist as a collaborative partner in multidisciplinary intelligence production. Because maps and charts have historically been produced in mass quantities as finished goods, the role of the mapmakers and chart makers in the overall intelligence effort has been easily overlooked. Near-real-time digital remote sensing and networked data processing systems are changing that, enabling geospatial specialists to be fully engaged as collaborative partners in the fusion process.

Second, these technologies have enabled the emergence of digital geospatial information as a powerful collaborative medium. The evolution from paper maps and intelligence reports to networked digital information systems makes it possible for intelligence analysts and collectors in geographically dispersed locations to collaborate in virtual networks, overlaying multiple layers of intelligence information on a common geospatial framework. Precisely geo-referenced and time stamped data from multiple sources can be accurately plotted on a two or three-dimensional visual representation of the mission space. As new data is collected and analyzed, it can be added to the picture, automatically referenced to the common geospatial and temporal framework. The use of digital geospatial information as the common framework means that the work of these far-flung collaborators can be easily, rapidly, and precisely integrated into a single picture, with each analyst or collector providing and updating a separate layer of information as new data becomes available.



Fusion in Four Dimensions

Emerging Approaches to Intelligence Fusion

Geospatial intelligence producers and their partners in other intelligence disciplines are increasingly turning to alternative models for the fusion of multi-source and multidisciplinary intelligence information that better meet the demanding requirements of operational users. In addition to the traditional all-source analysis model, where an all-source analyst integrates single-source intelligence products from many producers into finished intelligence, the community is employing more collaborative approaches to multi-source fusion.

Multidisciplinary Analyst Teams

Increasingly, we are relying upon multidisciplinary teams of intelligence analysts to solve hard intelligence problems, defeat denial and deception, and track and fix mobile targets. Multidisciplinary cells of imagery analysts and cryptologists, for example, have been particularly successful, and partnerships among other disciplines are growing. By bringing together specialists from multiple disciplines, along with their unique tradecrafts and toolsets, in an interactive environment, we are better able to apply the full range of our intelligence capabilities. Multidisciplinary intelligence teams have made great

progress in reducing the intelligence production cycle times typically associated with the traditional, serial all-source analysis model by working concurrently to produce an integrated product from the start.

Fused Geospatial Intelligence

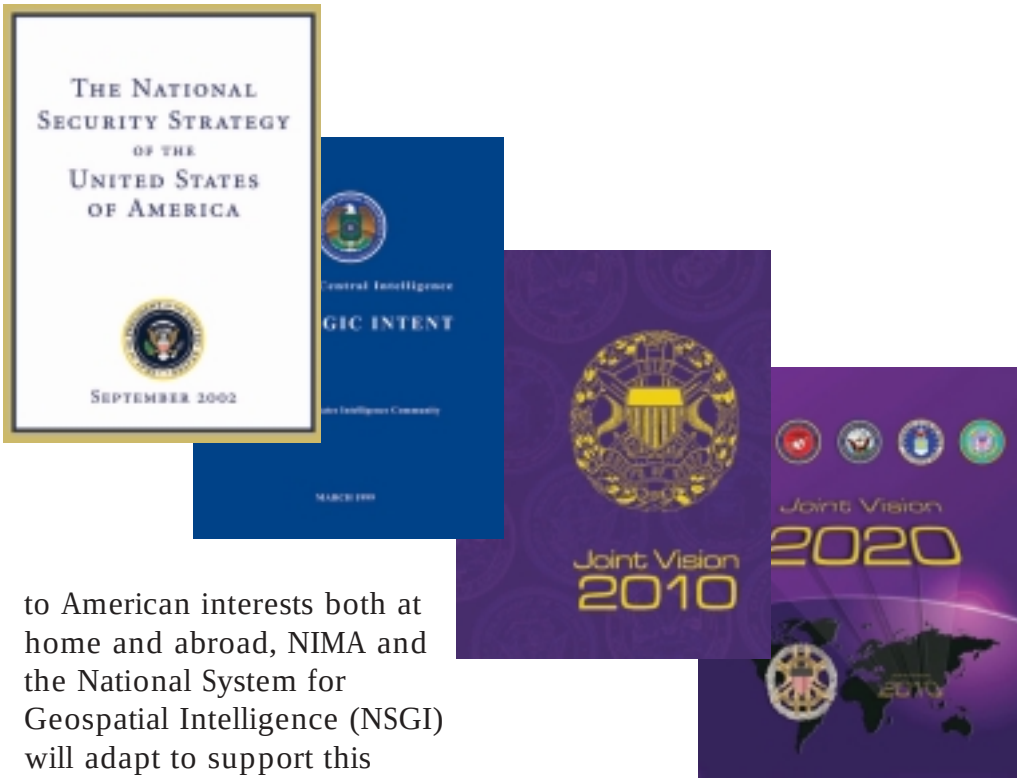
Information from multiple sources can also be integrated into fused, finished geospatial intelligence products. While IMINT has traditionally been our primary data source, other collection disciplines provide essential information about the mission space not otherwise available. Information obtained from HUMINT sources, such as architectural drawings, or SIGINT sources, such as the location of radar or communications emitters, adds tremendous value to our own source data when fused in the digital, visual medium of geospatial intelligence. Geospatial intelligence tradecraft and tools have proven valuable in the analysis of information obtained from these collateral sources, providing unique insight into spatial aspects of the data. When fused into finished geospatial intelligence, these sources add important dimensions to analysis of the mission space, resulting in a more complete picture for intelligence consumers.

Through these collaborative multidisciplinary approaches, geospatial intelligence producers are playing a much more significant role in the Intelligence Community. Leveraging our common geospatial and temporal framework as a collaborative medium, engaging our partners interactively, and taking advantage of digital networks and tools, we are making tremendous progress in accelerating the speed of multi-disciplinary intelligence. Multidisciplinary intelligence collaboration brings to bear the full capability of the Intelligence Community to reduce uncertainty, compress our intelligence cycle timelines, and provide unprecedented knowledge of the global security environment. ❑

We must transform our intelligence capabilities and build new ones to keep pace with the nature of the threats. Intelligence must be appropriately integrated with our defense and law enforcement systems and coordinated with our allies and friends. We need to protect the capabilities we have so that we do not arm our enemies with the knowledge of how best to surprise us.

National Security Strategy

As we move forward and beyond this time of dramatic change, geospatial intelligence will continue to face new challenges and new opportunities. *The National Security Strategy*, *Joint Vision 2010*, *Joint Vision 2020*, and the *Strategic Intent for the U.S. Intelligence Community* outline a vision for our national security in this new era that requires significant geospatial intelligence capabilities that do not yet exist.



The evolving threat environment confronts us with new challenges. Our mission in the Global War on Terrorism requires us to be engaged in new ways and with new customers. As our nation responds to the terrorist threat to American interests both at home and abroad, NIMA and the National System for Geospatial Intelligence (NSGI) will adapt to support this changing mission.

Advances in technology will continue to provide us opportunities to incorporate new sources of data, new capabilities for processing and integrating data, and new ways for customers of geospatial intelligence to access and visualize our collective base of trusted knowledge. Our national security in this information age requires from us the capacity to be flexible and adaptable in employing these new technologies, supporting a growing base of customers against current and emerging threats.

Geospatial Intelligence Online

Fully realizing the vision of NIMA's founders—a seamless integration of our imagery and geospatial capabilities from the national to the tactical levels—requires us to complete the transformation that began with NIMA's creation.

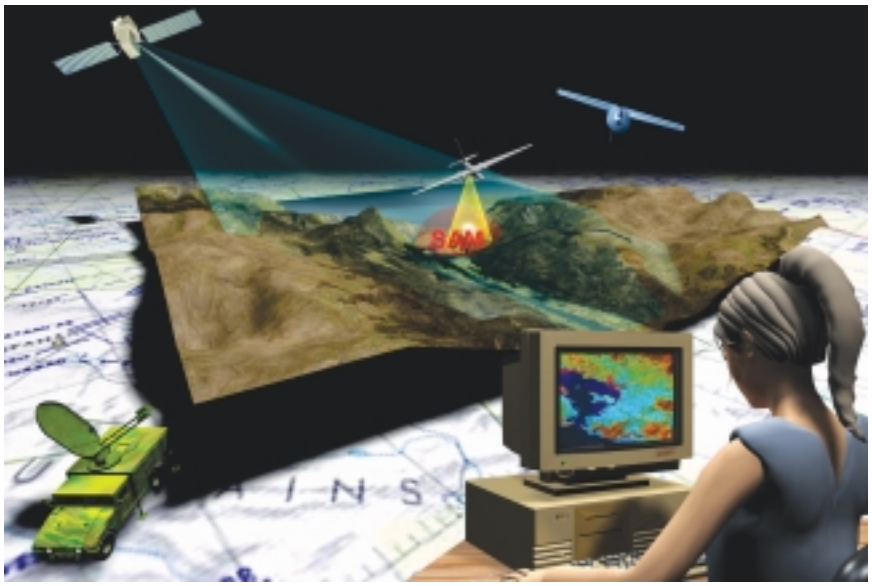
This transformation is comprehensive, affecting every aspect of NIMA and the NSGI. Its objective is a future state that will enable us to guarantee information superiority for our national security in the digital age. In that state, we will be increasingly interoperable and adaptable, responding more rapidly to changing world conditions. We will make capabilities that today seem exotic more widely available, less expensive, and more timely. This future state is defined by four characteristics:

- **Geospatial Intelligence Analysis.** We will fully integrate the processes, products, and tools of imagery analysts and geospatial specialists, while maintaining the advanced capabilities of each specialty. The complete integration of our discipline will enable us to apply our tradecraft to provide more predictive analysis and place more emphasis on decision support intelligence.

- **Digital Environment.** We will migrate our processes, systems, and tools to an all-digital, data-centric environment, beginning with significant improvements to our infrastructure. Our networks, systems, applications, and databases must be integrated so that the needed content can be quickly retrieved and delivered electronically. Migration to this integrated digital environment will be the key to future collaboration and interoperability, providing accessibility to users and partners worldwide, facilitating dynamic updates to our knowledge base, and accelerating our processes.

- **A Seamless, Comprehensive E-Business Strategy.** We will embrace comprehensive e-business most timely, relevant, and accurate online content possible. We will provide customers what they need when they need it, anticipating their future information needs.

- **Ubiquitous Knowledge Map.** We will provide the ubiquitous knowledge map, the foundation of the Common Operational Picture (COP), on which other forms of information can be overlaid. This comprehensive, geospatially referenced database links our base of intelligence knowledge to a precise, digital model of the Earth, enabling the COP to serve as a powerful, intuitive medium through which we can collaborate with our partners and our customers can better visualize the mission space.



Geospatial Intelligence: The Future Foundation of the COP

The convergence of our nation's imagery and geospatial capabilities is an imperative of the current era, made necessary by the challenges of the changing national security environment and the emerging concepts of warfare, and made possible by the revolution in information technology. The demands of the current global environment require a robust ability to provide a growing set of intelligence consumers a fully integrated visual picture of the security situation.

Geospatial intelligence is a unique intelligence discipline, defined by its analytical methods and its fundamental spatial and temporal nature. It unifies our imagery and geospatial tradecrafts, capitalizing on our abilities both to precisely model the Earth and to obtain detailed and dynamic understanding of world events through remote sensing. Through greater interaction between the imagery and geospatial specialties, enabled by increasingly common processes and tools and a new emphasis on integrated teams, we are expanding our tradecraft beyond old boundaries to help our

of understanding.

Our integrated discipline unites a broad range of evolving and emerging information processing and remote sensing capabilities, providing a comprehensive set of tools for characterizing the security situation. This convergence enables us to leverage an expanded set of powerful analytical tools, bringing together capabilities such as the power of Geographic Information Systems for organizing and accessing information and the enhanced perception made possible by Measurement and Signals Intelligence processing techniques. We are able to integrate a growing range of data sources, including national, theater, tactical, and commercial data providers, expanding both our access to targets and our use of the electromagnetic spectrum and other physical phenomena to provide new dimensions of knowledge about the national security situation.

The emergence of geospatial intelligence has given new significance to the role of our discipline in the Intelligence Community, offering promise as the foundation for collaboration in this new all-digital environment. As a robust partner to our counterparts in the community, we are working to break the stovepipes that limit collaboration and information sharing, both among the disciplines and across multiple echelons. Geospatial intelligence revitalizes the long history of maps and charts as the critical tools of the intelligence trade, providing a powerful medium that enables faster, more responsive processes for multidisciplinary intelligence fusion.

We will continue to work to fulfill the vision of NIMA's founders as we build the future National System for Geospatial Intelligence architecture, translating concepts into capabilities. Our goal is a future state that provides geospatial intelligence online, taking advantage of the full potential of our geospatial intelligence tradecrafts, leveraging an all-digital infrastructure, harnessing the best practices of e-business, and using the visual power of the evolving COP to provide our customers the knowledge advantage for decision, planning, and action. ❑

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The National System for Geospatial Intelligence (NSGI) is the integration of technology, policies, capabilities, and doctrine necessary to conduct geospatial intelligence in a multi-intelligence environment


NATIONAL IMAGERY AND MAPPING AGENCY