



NGA

Tech Focus Areas **2022**





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NGA MISSION

The National Geospatial-Intelligence Agency (NGA) is a unique combination of combat support agency and intelligence agency. We are the world leader in providing timely, relevant, accurate, and actionable geospatial intelligence (GEOINT). Anyone who fights wars, locates targets, sails a U.S. ship, flies a U.S. aircraft, makes national policy decisions, responds to natural disasters, or even navigates with a cellphone relies on NGA.

Our agency, community and nation continue to face the challenges from our adversaries, the COVID-19 pandemic and more. To rise above these challenges, we need the GEOINT community's help to meet our mission imperatives.

Mission Imperatives

- 1. Assured Positioning, Navigation, Timing, and Targeting**
- 2. Accelerated Tasking Orchestration**
- 3. Data Access and Data Integrity**
- 4. Analytic Workflow Modernization**

These mission imperatives are the specific and concrete functions and capabilities we know we must do and must do well to achieve our operational mission. This progress will be determined by the value we provide to others: the speed, accuracy, and precision with which we deliver actionable information to decision-makers and warfighters at every level.

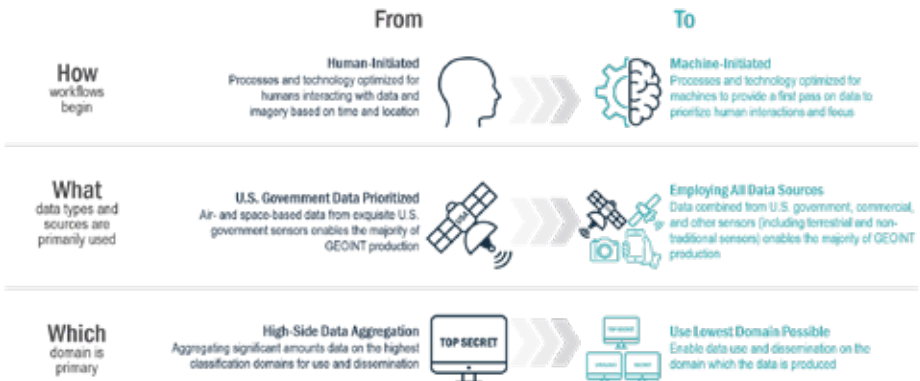
We exist to “show the way.”

It is our time to lead — together, we can and will win!

Letter from the Chief Technology Officer

We are in a GEOINT revolution. While our previous and current technologies, processes, and approaches delivered incredible, valuable results for our nation, they will not be sufficient for our future. As the NGA Director's Intent states, "We will not sit back and observe this revolution from the sidelines; we will lead it."

To lead this revolution, we must fundamentally change how GEOINT workflows begin, which data types and sources are prioritized, and which domain is primary.



In delivering these changes, NGA has defined specific and concrete functions and capabilities required to deliver on our operational mission — we call these our mission imperatives. For most of this document, rather than focus on the future with purely a technology lens, we will focus on it with a mission lens, sharing our mission imperatives and the key initiatives within them. These mission imperatives are determining how we allocate our time, energy, people, and resources, so they are crucial to understanding where we are heading.

Progress against these imperatives will not come easily, but we are committed to delivering on them. We know, however, that the only way we will make them a reality is as a team and with our partners, so we look forward to working with you to deliver on these together.

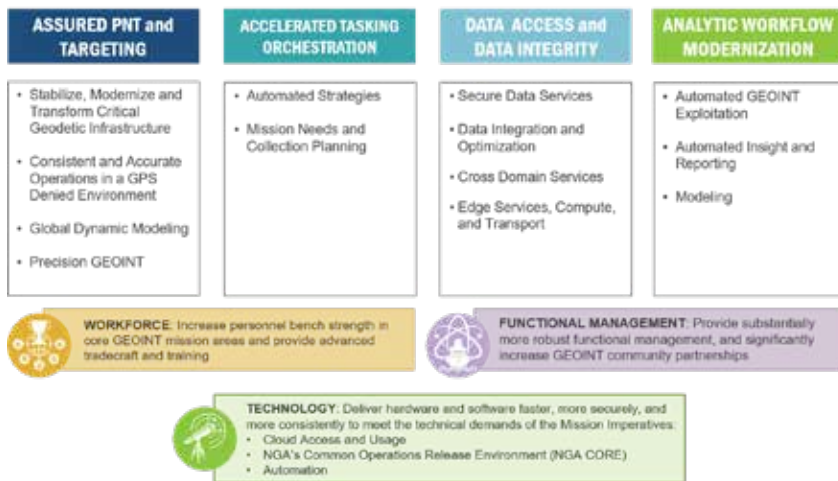
Alex Loehr

Chief Technology Officer
National Geospatial-Intelligence Agency

NGA Mission Imperatives

We are at a historic inflection point for our agency, our community, and our nation. In addition to the hurdles we have faced from the COVID-19 pandemic, strategic competition has reemerged as a key challenge to U.S. prosperity and security.

To meet these challenges and lead the GEOINT revolution, NGA is focused on delivering four mission imperatives and three enabling capabilities that cut across these mission imperatives.



1. Assured Positioning, Navigation, Timing, and Targeting

Assured Positioning, Navigation, Timing, and Targeting (APNT&T) is the mission imperative to reliably provide timely and accurate geospatial positioning, navigation, and timing information to support uninterrupted military and intelligence operations under all conditions. This information is critical to broad elements of the global economy and infrastructure, as all modern communication and navigation systems depend upon precise timing signals to operate. Navigation systems require precise location data to track where users are and provide the guidance they need to safely get to their desired locations. Delivering the right information at the right time and to the right place is essential to enable military forces to defend assets and support the ability to navigate, maneuver, and target adversary assets in the land, air, sea, and space domains.

These basic functions that enable safety of navigation apply to civilian and military applications alike. In addition, military targeting applications depend on extremely precise positioning information to ensure accurate weapons performance. APNT&T begins with the collection and sharing of topographic, magnetic, and gravitational data that can be modeled to accurately depict the shape, features, and motion of Earth, cis-lunar, lunar, and deep space environments. Understanding and applying this information requires a workforce of highly trained scientists with extensive knowledge in physics, math, geography, and Earth sciences, as well as consistent data management and modern algorithm and software development practices.

To deliver APNT&T, NGA is investing in:

Stabilizing, Modernizing, and Transforming Critical Geodetic Infrastructure: World Geodetic System 1984 (WGS 84) is the heart of GEOINT, and the systems that make up WGS 84 represent the foundation of GEOINT. The primary components of WGS 84 are the Terrestrial Reference Frame, Earth Gravitational Model, and World Magnetic Model. Efforts will focus on streamlining processes, eliminating legacy manual activities, enabling greater efficiency, utilizing artificial intelligence (AI) and machine learning (ML), and automating standards implementation.

NGA enables GEOINT accuracy through geodetic, geophysical, and photogrammetric sciences and content. This includes measuring and modeling the Earth, describing the magnetic and gravitational fields, providing the WGS 84 Reference Frame, establishing ground truth, collecting and analyzing GPS constellation data, and providing foundational materials for Target Coordinate Mensuration.

Consistent and Accurate Operations in a GPS-Denied Environment: NGA needs new and novel approaches and technologies to ensure we can fight and win when an adversary denies us our GPS-capable battlespace. We must look back at how we operated before GPS and bring those strategies and techniques into the 21st century, while identifying minimum requirements for APNT&T under contested conditions. This includes hardening our delivery of the WGS 84 system, along with developing theater models built with higher fidelity, accuracy, and new phenomenologies exploitable by next-generation warfighters, weapons, and collections systems. We must also modernize our Safety of Navigation capabilities, including integrating alternative foundational data and techniques.

Global Dynamic Modeling: NGA is moving to global dynamic modeling, using fully automated data normalization and event-driven workflows. This will enable us to deliver consistently accurate, high-resolution, continually updated representations of the Earth's surface, terrain, and features, available on-demand. This includes instituting standards as well as developing advanced algorithms to generate and train models from a variety of data and sensors. Additionally, NGA will transform data management practices, moving from data that is owned, stored, managed, and accessed by individual users and applications to system-independent, enterprise-managed data services accessible to all authorized users.

Precision GEOINT: NGA must automate precise imagery processes, including geopositioning data to derive precise points for targeting, to speed delivery of trusted GEOINT to decision-makers and warfighters at every level. This will enable crucial capabilities, such as georegistration for algorithms, exploitation tools, and analytic workflow automation. NGA needs to incorporate computer vision in precise imagery production to implement automated workflows and services for geopositioning. To do this, NGA needs data services that provide rapid and global imagery discovery, access, chipping, streaming, and processing — across all security domains.

2. Accelerated Tasking Orchestration

Accelerated Tasking Orchestration is the mission imperative to revolutionize GEOINT tasking, discovery, and acquisition using all available suppliers, platforms, sensors, sources, and services. To sustain GEOINT supremacy, ensure resiliency, and hold our adversaries at risk, NGA must synchronize available suppliers’ constellations and platforms into an integrated environment that achieves global persistence and minimizes the time from information need to direct delivery of GEOINT data to the end user. We must significantly reduce critical timelines to deliver the highest-quality geospatial data, information, and imagery to our customers.

NGA requires significant advancements within two critical capabilities to evolve, accelerate, and simplify GEOINT tasking orchestration:

Automated Strategies: Automated Collection Strategies are indicator-driven, machine-enabled collection processes and mission strategies to automatically task collection capabilities. New tradecraft, technologies, and training are required to build, use, manage, and evolve collection strategies that dynamically task collection in response to mission indicators. These approaches must support secure, rapid data dissemination and, where possible, process directly to forward-based operational elements, enabling decision advantage and resilience.

NGA develops, maintains, and manages automated collection strategies that integrate multiple collection capabilities and data services, including commercial sources. The rapid growth in geospatial data and services is driving implementation of automation technologies. These technologies will significantly increase speed, coverage, and persistence in the GEOINT collection and production cycle. Specific technology focus areas for Automated Strategies are software and process automation, including:

- Automation mechanisms to integrate, design, and build automated tipping and cueing services across multiple domains and government and commercial providers. This includes sense-making and decision tools to automate collection strategies
- Modeling products and services to build, share, and rapidly execute mission models and algorithms

- Process and procedure management capabilities to enable rapid documentation, process standardization, and performance tracking, reporting, and assessment mechanisms
- Multi-domain resilient technology ecosystems to enable strategies to securely traverse multiple security domains and operate across primary, alternate, contingency, and emergency communication plans
- Non-traditional tasking pathways to provide easy-to-use, sensor neutral, supplier management for tasking resilience in denied, disconnected, intermittent, and limited conditions. These pathways will ensure critical GEOINT reaches theater and tactical locations when needed regardless of communication status

Mission Needs and Collection Planning: NGA captures customer mission needs for the delivery of geospatial content. To meet these needs, NGA will deliver existing content if available or plan the acquisition of new remote sensing data or services, if required. To do this, NGA provides capabilities for rapidly capturing mission needs and planning, building, and orchestrating multi-supplier collection strategies that leverage the expanding set of suppliers for all GEOINT users.

Emerging technologies are key to accelerating, searching and ordering content from across multiple supply chains with spatial and spectral diversity. It also matches that content to GEOINT customer needs. Technology focus areas for Mission Needs and Collection Planning are AI, software, interfaces, and databases for rapid remote sensing and geospatial data collection needs and planning, including:

- AI-Driven System Management for multi-option mission scenario planning, recommendations, and decision support
- Massive-Scale Graph Databases to store and reveal multi-faceted spatial data relationships and related data sets
- Automated Mission Planning Software and Services to conduct remote sensing simulations, forecasting, planning, and testing
- Analytic-Powered Collection Tracking and Reporting to anticipate geospatial needs based on customer interactions, patterns of behaviors, observations, and feedback loops
- Decision-Analysis Tools to gather, process, expose, and visualize data to help analysts determine highest-value collection strategies and supply selection

3. Data Access and Data Integrity

Data Access and Data Integrity is the mission imperative to deliver trusted GEOINT data that is readily discoverable, accessible, and interoperable while preserving and protecting its integrity. This includes not only imagery, but all types of geospatial data, products, and services. The rapid globalization and commercialization of geospatial data and technology has vastly increased the variety of sources available for use by the GEOINT community and has also potentially increased opportunities for skilled adversaries to manipulate or compromise data and reduce our ability to provide crucial GEOINT in support of national security.

Data integrity, or the reliability and trustworthiness of data throughout its lifecycle, coupled with data access, or the ability to acquire, store, and process the increasing diversity of available geospatial data, provides the foundation for all NGA's mission imperatives. NGA will provide our customers the ability to find, get, and use GEOINT on all domains in a secure manner as they need it, whether in a web-based user interface or via application programming interface (API).

To maximize Data Access and Data Integrity, NGA is investing in:

- **Secure Data Services:** NGA must assure the reliability and trustworthiness of GEOINT data throughout its lifecycle. The speed and scale of NGA's mission demand automated processes to detect and identify interference to GEOINT data in time to enact mitigations and restore trust. This includes validating the authenticity of data upon receipt, deep content inspection to identify potentially manipulated data, and ensuring integrity throughout the data lifecycle. NGA must consistently document its data sources to understand what it has and make the data available through easily accessible and documented APIs to enable data reuse across the organization and community.
- **Data Integration and Optimization:** NGA maintains massive, geographically distributed data stores and must ensure data is readily available for the intended use when called upon. This requires standardized and structured approaches to GEOINT data processing, analysis, sharing, and storage. NGA will also develop a detailed understanding of how data is used and by whom to efficiently manage enterprise data holdings and provide transparency into data state changes. Modern, secure storage and compute capabilities, automated data tracking and monitoring, data virtualization, and robust yet flexible governance mechanisms are key to achieving effectiveness in this area.
- **Cross-Domain Services:** Underpinning the utility of the GEOINT data enterprise is the ability to move data across security enclaves at the speed and scale our mission requires. NGA will continue to expand our capability to safely transport substantial amounts of diverse data to wherever analysis and exploitation is occurring and deliver results to the environment of choice, without compromising security. Much of today's competition is happening

in the unclassified domain, and based on future NGA missions, our ability to meaningfully conduct unclassified reporting will be crucial to deliver advantage before and during conflict.

- **Edge Services, Compute, and Transport:** NGA will focus on GEOINT data delivery assurance to theater and tactical edge users and denied, disconnected, intermittent, and limited connectivity conditions. These edge services will provide the tools, data, services, and storage needed to execute GEOINT mission support where it is needed most and provide a resilient, global GEOINT architecture.

4. Analytic Workflow Modernization

Analytic Workflow Modernization is the mission imperative to accelerate GEOINT creation, exploitation, and analysis for decision advantage in our nation's security. This will enable the GEOINT community to elevate its understanding of the world, anticipate future events, adapt faster, and integrate opportunities for innovation before our adversaries.

To modernize analytic workflows, NGA will automate significant portions of imagery exploitation and reporting workflows. This includes leveraging computer vision to rapidly exploit data, using advanced modeling techniques to understand, correlate, and predict activity, and integrating automation and modeling capabilities to prompt dynamic collection. To this end, NGA is investing in:

- **Automated GEOINT Exploitation:** NGA needs to integrate state-of-the-art computer vision and AI capabilities into analytic workflows to automatically detect, identify, characterize, extract, and attribute features and objects in imagery and video. This includes machine-assisted GEOINT exploitation, fully automated GEOINT exploitation, and exploitation of data from advanced sensors. Use cases for computer vision at NGA include monitoring known locations for known objects and activity, detecting objects and activity in areas not previously known, and identifying and characterizing specific objects in an image or video.
- **Automated Insight and Reporting:** NGA must speed up the dissemination of GEOINT-derived information for timely situational awareness and insight to customers across the intelligence, defense, and first responder communities. To do this, NGA expects — and will enable with standards and best practices — that our capabilities will automatically generate textual reports derived from GEOINT observations.
- **Modeling:** NGA needs to institute modeling techniques that enable analysts to represent and analyze relationships between objects and activities to elevate their understanding and knowledge of intelligence issues and generate new insights. NGA will accomplish this by implementing knowledge models that we retain and enrich over time, using these to make inferences about adversary activity, test hypotheses, conduct exploratory analysis, and automate our GEOINT

collection. Our knowledge models will be built from data and enhanced by analysts' knowledge in a discoverable and collaborative graph of observed and inferred objects, activities, and relationships. Modeling concepts NGA requires in knowledge models include object models, data models, and analytic models.

- Object models represent objects — physical entities like equipment or facilities that exist in the world — by attributing and associating essential elements of information, such as what the object is, where it is located, and its affiliation. The attributes are based on observations of the object in an image, video, or other spatially referenced primary source of data.
- Data models represent data and the ways in which it is connected and interacts with automated processes, such as enabling and enhancing Automated Tasking Orchestration and tipping GEOINT collection.
- Analytic models represent the mathematical relationship between indicators to simulate, explain, or make predictions or inferences. These models will provide deterministic or probabilistic estimates of events and intelligence analysis outcomes, such as assessments of activities and their associated indicators and interrelationships.

Enabling Capabilities

During the process of developing mission imperatives, NGA identified a set of key enabling capabilities and baseline principles. These principles are integral and interwoven with the agency's national security mission and all four mission imperatives. The principles are:

1. Workforce

NGA's workforce will lead this revolution. Ingenuity, creativity, and innovation will underpin the fundamental changes we must achieve to address today's most complex challenges and national security issues. The workforce will face unprecedented challenges in making sense of a tremendous volume and variety of data to provide a coherent story. Technology infrastructure, in line with industry and best practices for human capital processes and programs, is crucial to efficiencies and modernization. Employees must continuously learn and adapt as the human-machine interface evolves and new tradecraft emerges. NGA will leverage strategic workforce plans and skills assessments to identify critical data skills and competency gaps and provide upskilling and reskilling through focused training, educational opportunities, and experiential assignments.

To enable the workforce to effectively operate with data and software platforms and tools, NGA will buy, reuse, and adapt training from industry, academia, and partners and create the unique, niche, and specialized training required. Recruitment

efforts will source talent from colleges and universities with candidates in GIS, STEM, cybersecurity, and other data-related programs. Motivating people to reach their highest level of performance requires having and sustaining a culture where all teammates feel they belong and are able to bring their whole authentic self to work each day.

2. Functional Management

These Tech Focus Areas are a key enabler to achieving the 2035 CONOPS End State of an Integrated GEOINT Operating Environment that is part of a data-centric, multi-domain ecosystem. Functional Management will play a critical role in the form of promulgating standards, ensuring compliance with those standards, and leveraging GEOINT resources for the greatest effect. The GEOINT Functional Manager will leverage governance fora and existing authorities to drive the community towards this mutually defined end state.

3. Technology

We must deliver hardware and software faster, more securely, and more consistently to meet the technical demands of the mission imperatives. Within this enabling capability, NGA is focused on:

Cloud Access and Usage: Cloud services are essential for NGA. NGA has been and must continue to be a leader in delivering content from hyperscale cloud environments to the tactical edge. This commitment made a major impact on the workforce's ability to telework during the pandemic and will continue as NGA plans for its new campus in St. Louis, N2W, moving workstations away from thick clients and to a virtualized environment. NGA's compute architecture consists of multiple tiers:

- We leverage commercial cloud to ingest, manage, and share massive volumes of data every day
- We have two core, geographically distributed data centers
- We globally provide compute and data forward in support of our customers
- We have edge devices forward deployed in theater to push data and software to the tactical edge, such as Navy carriers at sea, cockpits, and unclassified mobile phones during disaster response

Delivering capabilities across these environments enables NGA to get GEOINT products and services to our customers when and where they need them. Across this architecture, we will deliver GEOINT data for use in advanced analysis and as the foundation for AI and ML to enhance analytic missions.

NGA's Common Operations Release Environment (NGA CORE): At NGA, we will provide the best available tools to every team building and operating software. Those tools must communicate with one another as part of a common, reliable, and efficient tool set, and NGA is investing in this once, rather than expecting every program to build and maintain its own environment. We will accomplish this through metrics and elements defined in The NGA Software Way and through capabilities that are part of NGA CORE, including:

- **DevSecOps:** Where we develop, review, document, and test code
- **Platform as a Service:** Where we deploy and run code and containers
- **API Management:** Where we document and discover available data and services
- **Developer Experience:** How we grow NGA's software tradecraft
- **Continuous Monitoring:** Where we get real-time metrics, monitoring, and alerting
- **Workflow Orchestration:** Where we enable modern GEOINT workflows
- **Messaging:** Where we publish and consume NGA data streams

NGA CORE is part of NGA's architectural pivot from focusing on individual systems to enterprise services and must continue to evolve and grow as a shared environment and the fastest way to deliver software at NGA.

NGA CORE

COMMON OPERATIONS RELEASE ENVIRONMENT



Automation: NGA will relentlessly automate business and operational processes. NGA requires automation technology to support this transformation and will perform a systematic evaluation of business and operations workflows to maximize this transition from manual to automated.

We will automate testing, deployment, and monitoring across all products on all domains. NGA will continue to invest in DevSecOps tooling and processes and expand this to include DataOps and MLOps, bringing these principles of faster iterations, collaboration, and automation into how we manage our data and use ML models.

Finally, leveraging AIOps across NGA's IT infrastructure will enable faster response times with a decreased risk to mission disruption. Historically, there has been a correlation between speed and risk — when one increases, so does the other. Automation has changed this formula, and we must integrate this approach across NGA's infrastructure and processes to increase delivery speed across the organization in a scalable and consistent manner with fewer mistakes and lower risk.

Collaborating with NGA

There are a few initial steps educational institutions, not-for-profits, and businesses, large and small, must take to do business with the federal government:

1. **Register in the System for Award Management (SAM):** SAM is a consolidated portal used across the U.S. government to conduct acquisition and financial assistance processes and share information on the latest solicitations. SAM is unclassified.
For additional information, visit <https://sam.gov>.
2. **Register in the Acquisition Resource Center (ARC):** ARC is a website for members of the U.S. intelligence community (IC) to exchange information with industry on business opportunities and conduct source selection activities. ARC is both unclassified and classified.
For additional information, visit <https://acq.westfields.net>.
3. **Register with Grants.gov:** Grants.gov operates under the governance of the Office of Management and Budget to provide a centralized location for grant seekers to find and apply for federal funding opportunities. Grants.gov is unclassified.
For additional information, visit <https://grants.gov>.
4. **Leverage cross-government collaborations** Resources such as the General Services Administration (GSA) provide a wealth of information on how to work with NGA.
For additional information, visit <https://gsa.gov>.
5. **Explore opportunities:** NGA uses Federal Acquisition Regulation (FAR), the Defense Federal Acquisition Regulation Supplemental (DFARS), and non-FAR-based agreements for collaborating with non-government entities. Through SAM, Grants.gov, and ARC, you can stay on top of opportunities to work with NGA. Thoughtful responses to FAR-based solicitations, such as broad agency announcement (BAA) requests, requests for information (RFIs), and requests for proposals (RFPs), help us understand your capabilities and make more informed decisions on our acquisitions.

NGA Collaboration Tools

- ❑ **Broad Agency Announcements.** BAAs solicit innovative ideas on basic and applied research. BAAs are normally posted on SAM, Grants.gov, and/or ARC. NGA's primary BAA is the Boosting Innovative GEOINT Research BAA (BIG-R BAA).

For additional information, contact BigRBAA@nga.mil.

- ❑ **NGA Bailments.** NGA uses bailments to create a no-cost agreement between NGA and a commercial vendor to test, evaluate, and analyze a product or service. A bailment is appropriate for mature products and services with an identified mission requirement and mission user.
For additional information, contact SC_Industry_Engagement@nga.mil.
- ❑ **Cooperative Research and Development Agreement (CRADA).** A CRADA is a low-risk, flexible opportunity to collaborate on a research and development (R&D) project. Although CRADAs do not come with funding, agreement members can share resources (personnel, facilities, equipment, data, etc.)
For additional information, contact CRADA@nga.mil.
- ❑ **Education Partnership Agreements (EPAs).** NGA uses EPAs to develop joint education projects and curriculum that support and enhance STEM education objectives. Although an EPA has no direct funding, partners can share resources (personnel, equipment, facilities, etc.).
For additional information, contact EPA@nga.mil.
- ❑ **In-Q-Tel (IQT) Investments.** As a non-profit 501c(3) corporation, IQT helps the IC and DoD invest in early-stage technology companies. Using NGA problem sets, IQT works on NGA's behalf with companies via specific, one-to-three-year work programs.
For additional information, contact ngaqicall@nga.mil.
- ❑ **Partnership Intermediary Agreements (PIA).** NGA uses PIAs to engage with non-traditional organizations, companies and small businesses in order to transfer unclassified technology, drive the geospatial market, and conduct pre-acquisition discovery support.
For more information, contact nga_research@nga.mil.
- ❑ **Other Transactions (OTs).** An OT agreement is a flexible acquisition tool for prototype projects that enhance the mission effectiveness of the DoD. A competitively awarded prototype OT can include an option for a noncompetitive follow-on production OT to be awarded after successful completion of the prototype.
For more information, contact OT@nga.mil.
- ❑ **Prize Competitions.** Competitions provide an opportunity to crowdsource NGA's most difficult problems by leveraging the public for innovative solutions. For a sample of past NGA challenges, visit www.challenge.gov and search "NGA."
For more information, contact prize_competition@nga.mil.

- ❑ **Small Business Innovation Research (SBIR).** NGA uses DoD's SBIR program to fund early-stage research and development at small technology companies for projects serving a DoD need and with commercial and military market potential.

For more information, contact SBIR@nga.mil.

- ❑ **Tearline.** Tearline is an example of a real-world analytic outreach effort where NGA collaborates with non-profits to create content of mutual benefit. It functions like an online journal hosting quality GEOINT in a brand designed for mobile-friendly interaction.

For additional information, contact tearline@nga.mil.

Contact Us

We have offices that can help with specific opportunities to work with NGA. For more information, reach out to any of the following:

- ❑ **Small Business Program Office.** You must complete a SAM Small Business Profile for Dynamic Small Business Search (DSBS) at https://web.sba.gov/pro-net/search/dsp_dsbs.cfm before reaching out to NGA. For specific assistance on an existing contract, contact smallbusiness@nga.mil.
- ❑ **NGA Industry Engagement.** To talk with us or ask us anything, to discuss your solutions and provide a capabilities demo, contact IndustryEngagement@nga.mil.
- ❑ **NGA Research.** For GEOINT research opportunities, contact nga_research@nga.mil.
- ❑ **NGA Academic Engagement.** For inquiries on research grants and possible EPAs, contact academia@nga.mil.





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