



NGA

Technology Strategy

Mission Today
Mission Tomorrow



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FOREWORD & INTRODUCTION

Foreword & Introduction

Letter from the Director



As I stated up front in my Director's Intent, we're engaged in a pivotal competition of grave consequence; a competition we must, and will win. We are taking all necessary actions to sustain GEOINT supremacy. Maintaining our advantage as the world leader in geospatial intelligence requires a sound digital enterprise. We operate a technologically complex system-of-systems in our quest to "show the way"—to literally get our customers from point A to point B, to help illuminate options and inform decisions, and to facilitate actions being taken with speed, accuracy and precision. Dependency on technology is not our goal—we must leverage and master it. NGA, our mission partners, and, most importantly, our industry partners must never cease the innovative development of geospatial technologies to maintain comparative advantage over our adversaries. We're in a race, and can't afford to stand still. NGA's first Technology Strategy will help guide us to improving the state of our current technology to arm our people and partners to meet today's mission, while charting the course toward meeting future mission. As always, we will adapt and adjust wherever and whenever needed.

A handwritten signature in blue ink, appearing to read "R. D. Sharp".

Robert D. Sharp
VADM, USN
Director, National Geospatial-Intelligence Agency



Foreword & Introduction

Letter from the Chief Technology Officer



What does it take to meet future mission with future technology? It requires technologists who understand the mission and how GEOINT is evolving to meet the mission. Driving future mission requires that technologists are *leading* the GEOINT mission. NGA is the world's leader in geospatial intelligence because of the passion held by our people to deliver timely and relevant information to members of the national security apparatus, policy makers, and international partners.

That passion is also embedded in the builders and makers of geospatial technology—whether analysts, scientists, software developers, data professionals, designers, or product managers—who all have a driving passion to make better tools and services that enable speed and accuracy, delivering the best intelligence to our nation and our allies.

NGA is a software and data enterprise. Our fundamental capabilities are supported by software manipulating data. We must invest in key areas to increase our expertise and ability to build software faster, increase database pipelines, be more reliable and flexible, and most importantly, be better than our adversaries. If our adversaries build better software faster, we lose.

Software and data are strategic assets. NGA will adopt modern software engineering practices now to advance technology for the future mission. We must practice unrivaled DevSecOps and apply modern development practices to all our software. We must move our software from a legacy environment to a modern cloud and high-performance computing environment and provide guidance to our industry partners to build modern, service-centric applications on common platforms. We must adopt a product management approach to build customer-centric products employing leading-edge technology to become a modern software enterprise.

We must empower the builders and makers of geospatial technology. This strategy focuses on enabling those who build and make technology to support NGA and the Systems for Geospatial Intelligence. We firmly believe that the most important technology problem is not the adoption of artificial intelligence, or quantum computing, but fostering a technology workforce steeped in GEOINT and enabling them with an environment to deliver the best applications and services in the world. By working with our industry partners, allies, and the geospatial technology ecosystem, we will accomplish this and lift the Nation's capability to provide the best GEOINT on the planet. The only way we can show the way is to know the way. This is the way.

A handwritten signature in black ink that reads "Michael J. Minnear".

Chief Technology Officer (CTO), National Geospatial-Intelligence Agency

Executive Summary

Our Vision

NGA's technology future will propel the continued dominance of GEOINT, protecting US interests and delivering strategic advantage. In doing so, NGA will deliver a technology environment that empowers the workforce and mission customers in order to meet the needs of certain challenges and an uncertain future battlespace.

Flexible, responsive, user-centered technology—delivered at the speed of mission—to truly “show the way” for those who depend on us.

Our Principles

Technology has been—and will continue to be—increasingly fundamental for NGA to achieve its strategic goals. We must look beyond reacting to circumstances and events and toward a model that anticipates and proactively provides technology to serve the heart of NGA’s mission. To achieve this mission, NGA’s enterprise will adopt principles to guide how we will enact the vision.

- Deepen Understanding of Mission Customers
- Deliver With Velocity; Adapt to Reality
- Enable Technology Through Partnership
- Meet Future Mission With Future Technology
- Empower Workforce With Tech & Training

The Story of Today

NGA, along with the broader defense and intelligence apparatus, is in an era where technology is deeply intertwined with mission objectives. Be it warfighter support, safety of navigation, or support to policy makers, NGA is leveraging technology at an accelerating pace to address present and future challenges. Improving the planning and execution of technology projects is a key enabler for all four goals defined in NGA Strategy 2025.

The Way Ahead

To deliver on this strategy, NGA will pursue five key initiatives focused on addressing the needs of mission today and grounded in industry-leading practices. These key initiatives will empower people, improve processes, and leverage industry-leading technology.

Enable Builders & Makers

Transform Digital Workspaces

Build With Customers

Treat Data as a Strategic Asset

Bring AI, Cloud & HPC Into GEOINT Mainstream



TECHNOLOGY VISION

The background of the image is a complex, layered collage of various technological and surveillance-related imagery. At the top, there's a satellite in space, a world map with hexagonal patterns, and several line graphs and charts showing data trends over time. A prominent feature is a large, sleek, grey UAV (Unmanned Aerial Vehicle) flying through a sky filled with a dense, glowing blue wireframe mesh. Below the UAV, the scene transitions into a dark, futuristic landscape where a city is visible through a grid of glowing windows and lights. Numerous small icons representing technology, such as location pins, cars, and data points, are scattered throughout the image, creating a sense of a highly interconnected and monitored world.

Technology Vision

NGA's technology future will **propel the continued dominance of GEOINT**, protecting US interests and delivering strategic advantage. In doing so, NGA will deliver a technology environment **that empowers the workforce and mission customers** in order to meet the needs of certain challenges and an uncertain future battlespace.

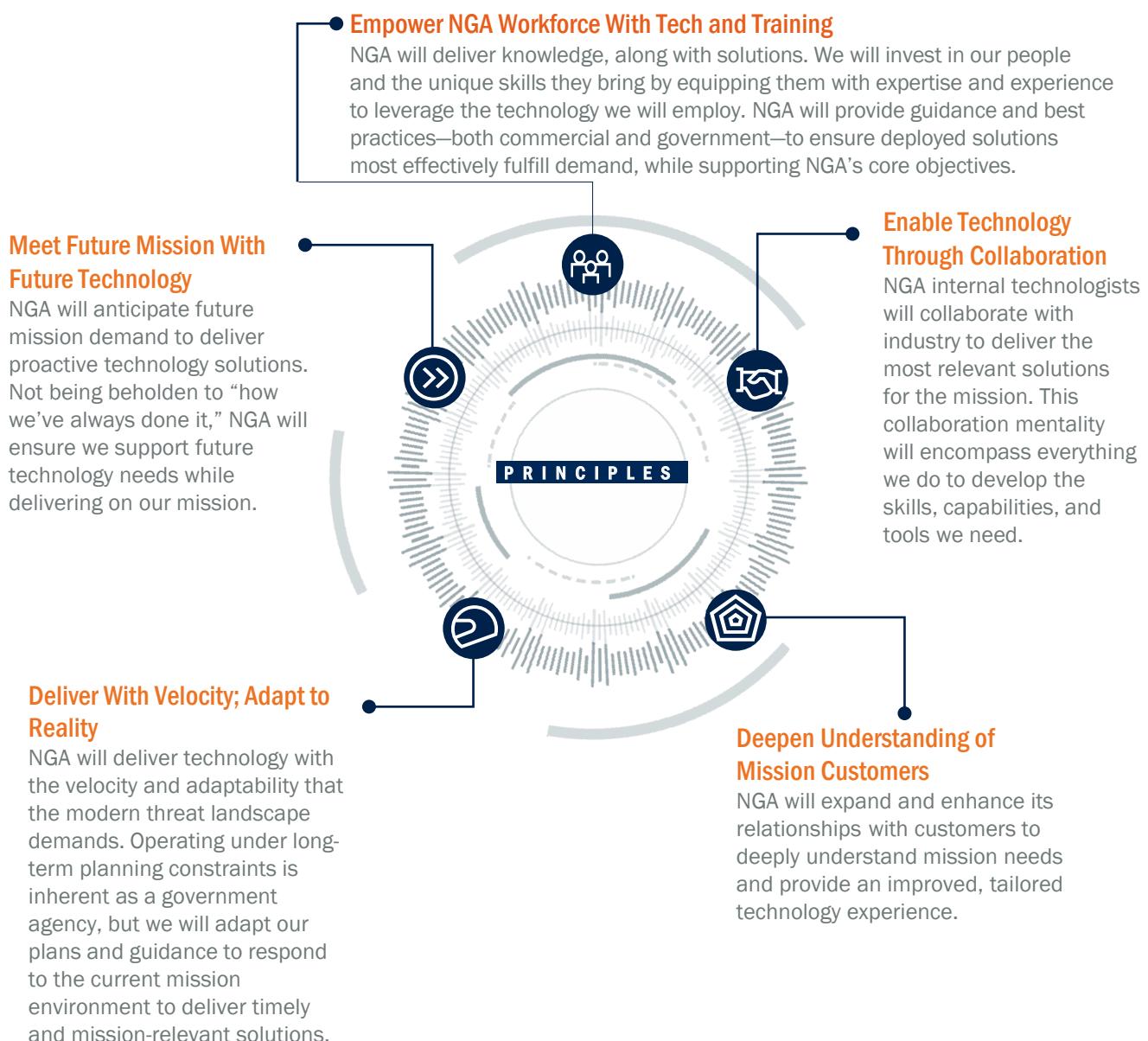
Our Vision of the Future

Flexible, responsive, user-centered technology—delivered at the speed of mission—to truly “show the way” for those who depend on us.

Technology Vision

Our Principles

Technology has been—and will continue to be—increasingly fundamental for NGA to achieve its strategic goals. We must look beyond reacting to circumstances and events and into a model that anticipates and proactively provides technology to serve the heart of NGA's mission. To achieve this vision, NGA's enterprise will adopt the following principles to guide how we will deliver on our objective to provide the technology and products our workforce, analysts, decision makers, and warfighters demand and deserve.





NGA TODAY & TOMORROW



NGA Today & Tomorrow

Findings

NGA, along with the broader defense and intelligence apparatus, is in an era where technology is deeply intertwined with mission objectives. Be it warfighter support, safety of navigation, or support to policy makers, NGA is leveraging technology at a continually accelerating pace to address present and future challenges. Improving the planning and execution of technology projects and scaling existing pockets of innovation are key enablers for all four goals defined in the NGA Strategy 2025.



Technology is a key enabler for each of the goals in the NGA Strategy 2025

In the past few years, NGA has made definitive strides in how we build and deliver technology, including:

Increasing adoption of DevSecOps practices for specific initiatives

Leveraging more advanced and non-traditional data analysis for GEOINT production

Increasing commercial cloud usage

Hiring and training a workforce of developers, data scientists, and IT professionals (e.g., Data Corps)

Strengthening linkages between mission and IT by standing up Integrated Program Offices (IPOs)

While these are positive examples of digital transformation for NGA to build upon, the expectations of NGA's workforce, IC customers, and the warfighter continue to rise. The workforce demands a seamless digital experience that includes improvements in foundational end-user systems as well as advanced analytic systems. Partner agencies want better collaboration during the GEOINT production cycle. Lastly, the warfighter needs simpler, ubiquitous access to GEOINT products.

To build off the work that has already begun and to meet the evolving mission needs, we identified seven findings, as well as corresponding pledges to address those findings.

Finding 1: Desire for Increased Productivity

While NGA continues to constantly improve its infrastructure, the digital workspace still has challenges with desktop and virtual desktop infrastructure (VDI) disruptions, printing and scanning challenges, network outages, and login issues. Continued investment in tools, processes, and appropriate governance will enable builders and makers to scale innovations for the benefit and use of the enterprise.

Pledge

Focus on Getting the Basics Right

Finding 2: Need for the Mission Customer Perspective

NGA's new strategy has a keen focus on warfighter and policy maker support but capability development and delivery lifecycle focus heavily on internal users rather than a sustained focus on external GEOINT customers. This internal focus leads to more acute challenges for external customers who desire ease of access to GEOINT products in a consistent and reliable fashion.

Prioritize Mission Customer Needs

Finding 3: Data Are Not Leveraged to Full Potential

NGA realizes the significance of data during the GEOINT production cycle, but currently siloed environments and inconsistent implementations and governance limit the ability to readily access necessary data. Current enterprise data management processes and tools will need to enable data access through documented application program interfaces (APIs), as well as support the emerging flood of data types, to extend NGA and its customers' capabilities in critical areas such as security, advanced analytics, and artificial intelligence (AI).

Unlock the Value of Data

Finding 4: Need for Coordinated and Scaled Modernization Efforts

While NGA has made great improvements in integration with IPOs, directorates are modernizing independently of each other and proceed with limited orchestration or central governance. A conscious effort to provide enterprise-wide discovery and integration of mission-led IT is needed to reduce redundancy, centralize technology strategy, and provide more mature capabilities.

Enable a Pathway for Enterprise Adoption

Finding 5:

Program Over Product Focus

NGA has begun to embrace building applications using DevSecOps practices. But most NGA programs produce applications that live beyond their useful life, instead of products that are continually developed, iterated on, and replaced over time. Without focusing on hiring and empowering product management and user experience professionals, it is difficult for NGA to build and deliver products that delight customers and meet the needs of mission today and tomorrow.

Pledge

Meet Mission Needs With Product Management Practices

Finding 6:

Engagement With Industry

NGA directorates are empowered to engage industry to assist with specific mission and technology objectives that can sometimes have the desired outcome for small portions of the enterprise. While any particular engagement with industry may lead to a meaningful outcome, when assessed at scale, the impact is either minimal for the enterprise at large or redundant when compared to other initiatives. Strategic, coordinated management of desired mission and technology outcomes is needed to improve industry engagement at scale.

Improve Strategic Needs Definitions and Investments Approach

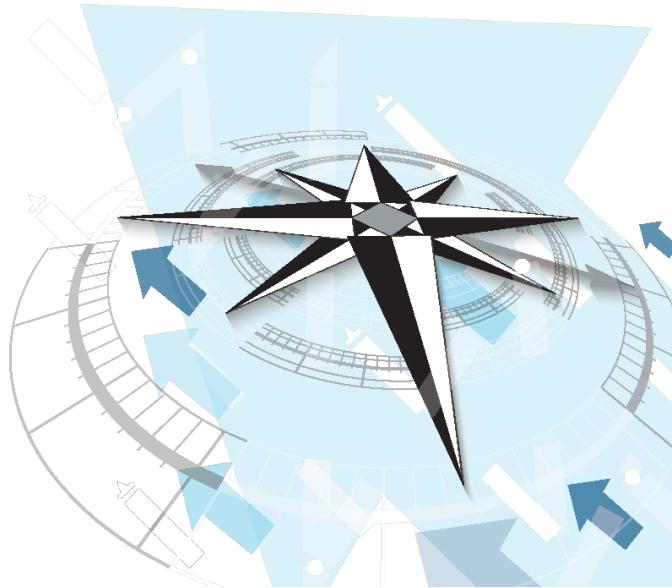
Finding 7:

Opportunity to Improve Return on Investment (ROI)

While many users report high utility and mission impact, NGA could improve ROI measures by an increased use of business intelligence and data analytics. By institutionalizing these key metrics at the design phase of IT, NGA can increase transparency on how the overall IT portfolio is divided with respect to sustainment versus modernization and increased mission utility of its products and services.

Make Data-Driven Technology Investments with Improved ROI

The Story of Today & The Vision of Tomorrow



The geospatial intelligence profession is in an era of rapid transformation. To stay ahead of its adversaries, NGA will embrace new approaches to delivering its core mission. GEOINT is evolving beyond providing imagery and geospatial awareness to be the nexus of data fusion, responsible for the interpretation and visualization of highly disparate, differentiated data streams. While many challenges persist—including constantly changing threat landscapes, commoditization of previously restricted data sources, and ever-growing customer expectations—the opportunity to meet those challenges has never been greater. NGA technology leaders, in collaboration with their mission counterparts, must step up efforts to deliver enhanced capabilities and new technology products and platforms to secure and deliver the nation's most trusted GEOINT.

To accelerate the effort to achieve NGA's 2025 desired target state, NGA will pursue five key initiatives that will provide the greatest impact over the next 18–24 months.

While these initiatives have already started to take root across NGA, the Agency must develop a coordinated, cross-directorate focus in each of these areas to achieve the GEOINT transformation NGA and the National System for Geospatial Intelligence (NSG) require. Each of these initiatives is critical to breaking down traditional information silos and improving how NGA focuses its resources toward developing technology. To maintain US information and intelligence dominance, NGA will successfully deliver on these initiatives.

The Story of Today & The Vision of Tomorrow

Key initiatives address the needs of mission today to engineer a better tomorrow

Mission

Today

Key Initiative

Mission

Tomorrow

Developers experience confusion on the process and technology available to the enterprise for software development, resulting in added complexity, increased time to production, and multiple application environments.

Users within NGA frequently experience inconsistent functionality of desktop and productivity tools, severely limiting their overall efficiency and effectiveness.

NGA has inconsistent approaches to engaging and planning with customers. Stakeholders report a lack of understanding of costs for applications, difficulty sunsetting legacy systems, and a desire for a more agile way to adopt new products.

NGA internal and external customers consistently experience difficulty finding data and products and sharing them across domains, with IC and international partners, and with warfighters.

Cloud and high-performance computing (HPC) is being used to respond to mission, but needs additional guidance on how to optimize it across the enterprise.

Empower Builders and Makers

Transform Digital Workspaces

Build With Customers

Treat Data as a Strategic Asset

Bring AI, Cloud & HPC Into GEOINT Mainstream

Builders across the enterprise work in an environment that provides modern development tools, facilitates compliance with security standards, and streamlines processes for implementation on all security domains.

NGA's workforce has access to a responsive, personalized desktop experience and is able to deliver mission objectives with productivity tools tailored for the work.

Internal and external customer needs are met through continuous product improvements and developments using product management and user experience skillsets and tradecraft.

NGA's workforce can easily and securely find and share products and data in standardized formats internally as well as with customers and partners, wherever and whenever they need them.

NGA builders and makers have self-service access to large volumes of storage and compute, as well as modern software services, to augment intelligence, build innovative products, and grow NGA's capabilities.

THE WAY AHEAD



Empower Builders and Makers

INITIATIVE OVERVIEW

Create an ecosystem that provides modern development tools, facilitates compliance with security standards, and streamlines processes for implementation on all security domains. Establish a development and deployment platform to support modern DevSecOps practices and API-first development.

Problem Statement

NGA applications are too difficult to build and update as mission needs change, and NGA's technology leaders rarely have full transparency or authority over the applications in use across the Agency. This approach to application development and management spreads resources thin and starves the builders and makers of the tools they need to deliver products at the speed of mission.

Current NGA Application Development Landscape

Layer	Owner(s)
Application Frameworks, Code	Decentralized Throughout Directorates
Platform Interface OS, Middleware, Runtime	Decentralized Throughout Directorates
Infrastructure Interface Virtualization	Partially Centralized to CIO-T
Infrastructure Servers, Storage	Mostly Centralized to CIO-T

Current State Challenges

- ❖ **Agility:** Many existing applications are based on a monolithic architecture, which was common 10+ years ago, requires significant effort to change, and is often difficult to integrate with.
- ❖ **User Experience:** Many existing applications provide a single, bloated web application interface across personas and workflows, which limits user experience (UX) and productivity.
- ❖ **Capabilities:** Software products across directorates often provide similar functionality to small user groups rather than providing solutions that address the needs of the majority of enterprise users. In addition, applications are not associated with mission capabilities, making it difficult to identify redundant applications that perform the same function.

Over the past few years, NGA has started to address these challenges by attempting to converge on a unified software delivery approach that enables the “builder and maker” culture. For example, GEOINT Services stood up a new Digital Maker Services product line to enable DevSecOps, a new development-focused workforce was hired (DevCorps) to bolster NGA’s internal government software development competency, and multiple acquisition teams throughout NGA started to award new agile contracts. While all of these actions were important steps in the right direction, NGA will focus on key steps over the next 18–24 months to ensure a modern software delivery approach reaches all parts of NGA.

Recommendation

NGA's key focus to develop a builder and maker culture should be to:

- 1) Develop implementation guidance for NGA based on best practices and internal software development experience gained over the past few years;
- 2) Add APIs to legacy applications to enable consistent integration patterns and easier interactions with other systems;
- 3) Adopt a service-centric architecture as the prevailing framework for how most NGA applications will be designed. NGA will focus on spreading these three concepts as consistently and widely as possible throughout the enterprise; and
- 4) Implement, document, and broadly adopt reusable application platforms.

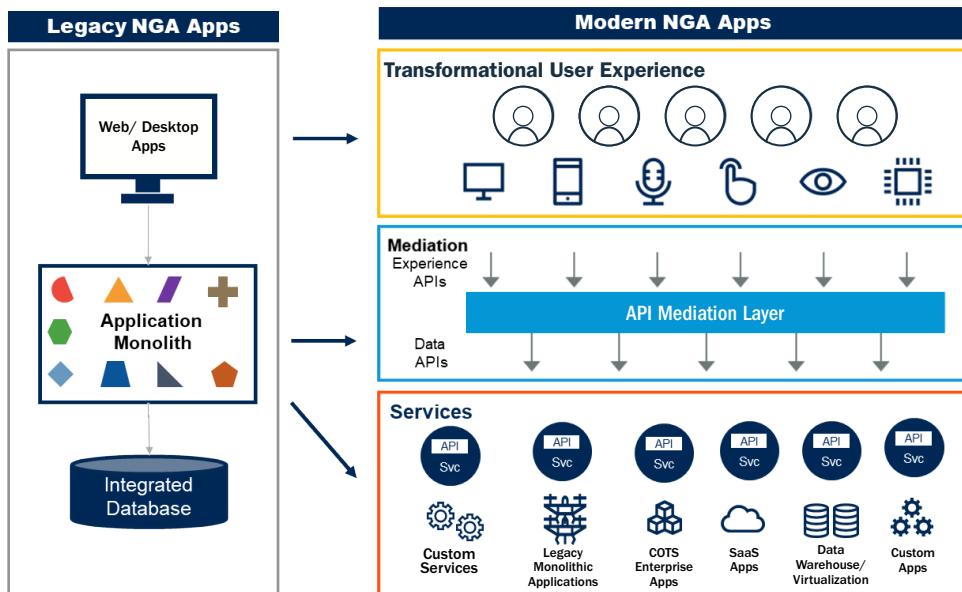
Value to NGA

NGA's pivot to a more consistent DevSecOps experience for builders and makers will significantly improve its ability to design, develop, and deliver applications that support current and future GEOINT capabilities.

Solution Overview & Benefits

The key mission outcome of enabling a builder and maker culture will be to advance the GEOINT tradecraft and rapidly develop and update products to meet emerging mission needs. Building applications API-first enables functionality to be more easily integrated and allows products to be independently and continually modernized over time.

An API-first approach includes supporting two sets of APIs—data and orchestration APIs and experience APIs. The data and orchestration APIs are the APIs that expose functionality in the back-end systems and services. The experience APIs are APIs that NGA can design to support the needs of the individual fit-for-purpose application experiences.

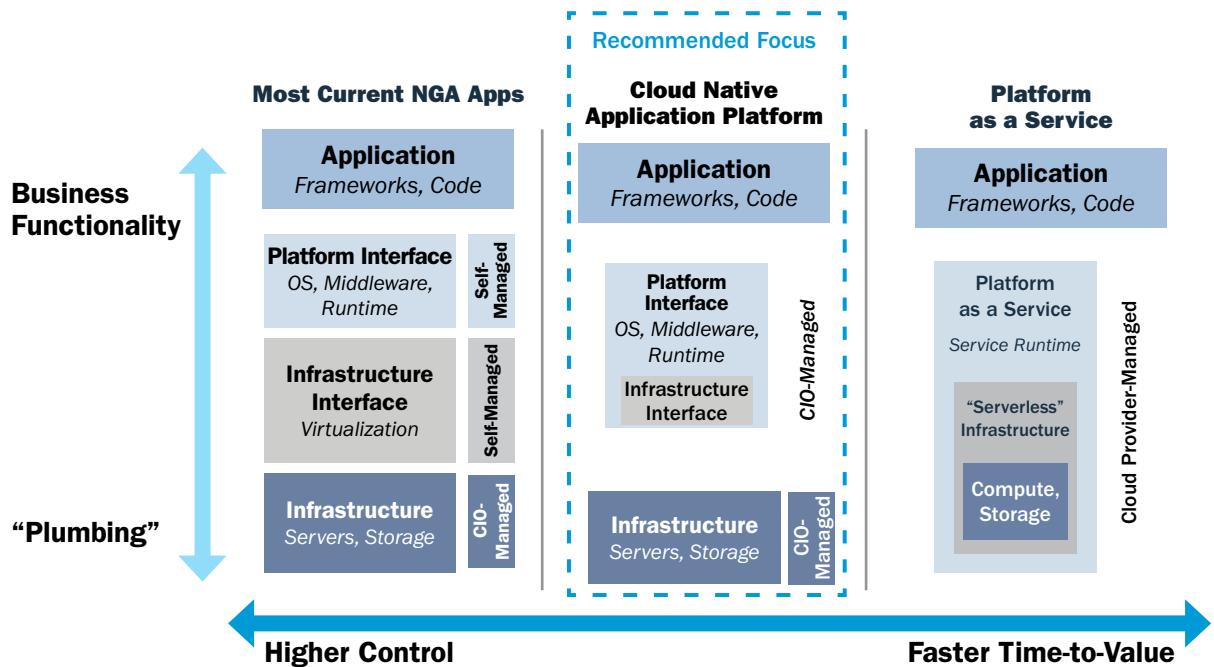


Solution Overview & Benefits (cont'd)

Monolithic applications without APIs are no longer sufficient, as they constrain agility in both back-end and front-end development. A modern service-centric architecture will enable:

- ❖ Personalized user experiences (web, mobile, conversational, immersive, etc.) to internal and external customers, including defense, intelligence, and civilian decision makers;
- ❖ Agility and rapid delivery of new application features and capabilities based on business needs; and
- ❖ Improved security, scalability, visibility, reliability, and resiliency.

Other crucial pieces to growing the builder and maker culture and moving to a service-centric architecture at NGA include (1) continuous integration and continuous deployments, including automated deployments to production; (2) active monitoring and alerting; and (3) automated unit, integration, and end-to-end testing in a deployment pipeline. All of these need to be in place so applications can be part of a service-centric architecture and used on a modern platform.



NGA already has one cloud-native application platform that is actively managed and used, which is a critical first step to help the enterprise pivot to service-centric applications. This centrally managed platform delivers a uniform environment to developers across environments, enables an improved accreditation process that speeds time to deployment, and provides visibility to application owners about what is running and how it is being utilized. This type of work needs to be supported, resourced, and expanded, as NGA needs to be able to adapt to the rapidly changing and improving platform ecosystem in the commercial sector.



Develop Implementation Guidance for Application Development Teams Across NGA

- Document best practices from the private sector and experience developing at NGA over the past few years.
- For areas with multiple or conflicting tools, attempt to standardize on one tool or document which tool should be used in specific scenarios.
- For areas where no tools currently exist, attempt to standardize on a single tool for the enterprise.
- Provide implementation guidance in contracting language to enable consistent development practices across internal and external software development.



API-Enable Legacy Applications and Utilize the Service-Centric Framework for New Applications

- Add APIs and apply a modern service-centric architecture iteratively to large applications, avoiding the temptation to fix direct integrations all at once or do entire rewrites.
- Adopt DevSecOps practices and develop skills in API design, API-based integrations, and full stack application development.
- Adopt iterative sprint cycles, tight feedback loops with users, continuous integration, and cross-functional teams.
- Develop internal technical expertise in the frameworks, runtimes, and platforms used to deploy and manage the services.



Enhance Governance and Related Processes for New and Existing Applications

- Provide additional coordination, cooperation, and governance across multiple roles, teams, and potentially different groups.
- Support product focus by replacing one-size-fits-all governance with adaptive governance that contextualizes decision rights while balancing product needs with enterprise goals.
- Enable standard policies and implementation paths for building low and moving code high as the norm, rather than the exception.
- Provide reliable application metrics to help builders and makers deploy new capabilities that give mission stakeholders the greatest impact.



Apply an API-First Approach

- Add standard contract language that products must have documented APIs that follow the implementation guidance detailed above.
- In alignment with the “Build With Customers” initiative, apply a product-driven mindset and consumer-driven design in implementing APIs.



Expand and Resource an Application Platform for Use Across the Enterprise

- Work with security experts to ensure that the enterprise application security strategy and access policies are applied correctly in the platform layer rather than independently configured and managed.
- Standardize how to get software libraries approved for use on the platform and across NGA.
- Build automation into the application and integration platforms to streamline observability, incident response, policy enforcement, and security of modern distributed architectures, whether deployed on-premise, at the edge, or in a cloud environment.
- Provide funding resources to the application platform to allow for 24/7 support and continued development to keep pace with open-source baseline updates.

Transform Digital Workspaces

INITIATIVE OVERVIEW

Modernize desktop services and experience to provide proactive technology services for boosting productivity and workforce satisfaction.

Problem Statement

The process for creating highly valuable, data-rich GEOINT products requires new toolsets and capabilities. These tools can be a force multiplier for accomplishing mission goals, enabling productivity, and supporting product offerings.

The desktop continues to be the primary technology for NGA's workforce and plays a significant role in the overall digital experience. The current decentralized approach to maintaining and refreshing workstations creates operational challenges in planning, maintaining, and investing in a desktop strategy that provides consistent and scalable ways to improve the workforce's digital experience.



Current State Challenges

- ❖ **Productivity:** The enterprise regularly experiences intermittent interruptions with productivity tools and services, leading to frustration and lost productivity.
- ❖ **Technology Refresh Cycles:** The replacement of enterprise endpoint devices was deferred beyond the planned refresh timelines due to competing priorities. A continued lack of investment in the digital experience results in continued technical debt, increased shadow IT throughout the organization, and a declining work environment that could undermine the organization's culture and ability to achieve its desired target state.
- ❖ **Contract Strategy Challenges:** Existing legacy contracts are not aligned with performance incentives, which often leads to unclear expectations and a lack of accountability for service delivery.
- ❖ **Personalizing Experiences:** NGA is limited in its ability to serve its diverse internal customers effectively (e.g., imagery analysts, data scientists, developers, or back-office support). There is no consistent method for managing needs of multiple "user roles" across a set of baseline personas for prioritized and personalized service delivery, leading to a one-size-fits-all approach or the fulfillment of one-off implementations for services.

Recommendation

In order to mature the NGA workforce's digital workspaces, NGA will:

- 1) Provide personalized desktop services for multiple enterprise persona types;
- 2) Refine refresh processes to incorporate new industry offerings at a faster pace;
- 3) Enforce governance mechanisms; and
- 4) Allow the self-service installation of approved, common software packages.

Value to NGA

NGA's pivot to more capable workforce tools will result in greater workforce productivity and help to accelerate improved engagement with NGA customers.

Solution Overview & Benefits



NGA recognizes both the importance of improving its approach to delivering GEOINT products to external customers and the direct link between internal employee experience and external customer satisfaction. Improvements to how NGA provisions and maintains technology for its builders, makers, and enterprise workforce will have a direct and significant impact to its external customers.

The choice among physical desktops, VDI, and desktop as a service (DaaS) is a function of multiple considerations. As DaaS adds features to narrow the gap with VDI, NGA technology leaders will need to determine the degree to which DaaS will extend or replace virtual and/or physical desktops. To identify the optimal solution, NGA will consider factors including a rationalized application portfolio, solution complexity, data security requirements, and user experience. The ability for one style of deployment to meet all of the NGA workforce needs is unlikely, given the complexity and diversity of mission functions. Regardless of which desktop technology NGA uses, end users want a better experience, secure access to the applications and data, and the right amount of governance that can improve install, migration, and configuration processes.

NGA will ultimately adopt a hybrid workspace approach if both on-premise VDI and cloud-based DaaS are required, selecting the most effective strategy based on the existing VDI footprint and speed of cloud service adoption.

Solution Overview & Benefits (cont'd)

Creating an engaging and empowering digital workplace experience has become a cornerstone for digital business success. NGA's sourcing, procurement, and vendor management leaders will center new managed workspace service contracts on improving the digital experience, instead of on traditional IT Service Level Agreements. Benefits can include but are not limited to:

- ❖ **Mapping the existing “user roles” to end-user personas** and their different IT services needs, and relating those to productivity improvement opportunities for the mission. Persona mapping identifies archetypical users whose needs represent the needs of a larger group of users to facilitate service delivery management.
- ❖ **Metrics and incentives for achieving the transformed digital experience** by identifying two or three mission key performance indicators (KPIs) that are easy to measure and have a positive effect on the digital workspace experience, and tracking those metrics automatically and transparently, so anyone in the organization can see how NGA is performing against them.
- ❖ **Self-service installation of approved, common software packages** to enable NGA employees to access and use the open-source, government-developed, and commercial applications and products they need without creating a help desk ticket.

Establishing Experience-Level Agreements (XLAs) With a Focus on the User’s Digital Experience





Gather User Persona Requirements

- Identify a cross-functional team that can work across directorates to incorporate technical and mission-specific input to define and rationalize each persona type.
- Establish a process for gathering and assessing both qualitative and quantitative data to create delivery services tailored to enterprise personas. Data points and requirements gathered for each persona will include, but are not limited to:
 - Application capabilities and services required to perform mission duties/role(s)
 - Bandwidth
 - Collaboration
 - Visualization
 - Interfaces
 - Data/information source/utilization
 - Latency

Note: A persona could include multiple NGA “user roles”



Establish Service Delivery Aligned With Personas

- Prioritize and establish the cadence process and governance mechanisms for supporting tiered service delivery.
- Assess opportunities for enabling software automation for end users, leveraging baseline personas.



Enable Self-Service Software Delivery

- Monitor usage of software downloaded and software requested but not yet available to prioritize which applications should be available via self-service.
- Expand the number of open-source, government-developed, and commercial applications and products available to users without having to interact with a human or ticketing system.



Reassess the Long-Term Refresh Strategy

- Reassess the long-term refresh strategy with funding and resourcing for the organization, leveraging lessons learned from the near-/mid-term user persona service delivery, contracting, and budgeting.



Define and Track Metrics

- Identify two or three mission KPIs that are crucial to the digital workspace experience.
- Track those metrics automatically and transparently, so anyone in the organization can see how NGA is doing against them.

Build With Customers

INITIATIVE OVERVIEW

Focus on meeting mission customer needs and empowering product managers and user experience professionals. Employ product management to modernize offerings and capabilities with a common vision, strategy, and objectives. Build and iterate on products customers love and that meet their evolving needs.

Problem Statement

The traditional approach to program management is insufficient to support the rate of change required by NGA's current and future technology initiatives. NGA has focused historically on tool acquisition to fill capability gaps. Much of this tool acquisition has occurred without central oversight or consistent, direct user input and has resulted in both shadow IT and a lack of full lifecycle planning, increasing the burden on both resources and infrastructure. The move from programs to products will be key to enabling continuous modernization efforts across all NGA directorates.

Tool Focus

DevSecOps

Process Focus

CI/CD

Customer Focus

Product Management

NGA has historically focused its efforts on DevSecOps and initiated Continuous Integration (CI) and Continuous Delivery (CD) but not product management.

Investment in all three areas will result in modern product delivery that is aligned with mission customer needs.

Current State Challenges

- ❖ **Capabilities:** As NGA develops new applications without phasing out existing or older applications, there are significant capability redundancies across the NGA enterprise because of the focus on the acquisition of tools to bridge capability gaps.
- ❖ **Spend:** Limited product management results in ballooning sustainment costs for applications because of a lack of full lifecycle planning.
- ❖ **Interface Between Technology and Customers:** NGA has not developed consistent ways to engage and plan with customers when a new mission need is identified.
- ❖ **UX Focus:** There is limited expertise and focus in UX design across NGA, with fragmented and nascent capabilities, which leads to applications being underutilized and frustrated customers.

Recommendation

NGA's key focus to improve its ability to build with customers should be to:

- 1) Work across the NSG to understand the wide variety of customer needs to develop a common product vision, strategy, and objectives;
- 2) Understand the current capabilities within NGA and develop product lines;
- 3) Prepare the cultural and organizational shifts required to hire and empower product managers, designers, and user experience professionals; and
- 4) Grow the community of NGA employees delivering products focused on user needs to increase transparency and trust among the workforce and NGA customers.

Value to NGA

NGA's successful shift to product-centric delivery will result in the ability to build and acquire capabilities based on mission needs with a focus on minimum viable products that will be delivered in weeks or months, not years. Products will undergo continuous iteration by development teams that are as close to the user as possible. Lastly, improved UX design will provide critical user-centric capabilities to ensure maximum adoption of new products.

Solution Overview & Benefits

The product management model is geared toward providing value through technology with a focus on the customer's requirements and experience to accelerate mission outcomes.

Shifting focus from programs to GEOINT product lines will help NGA:

- ❖ Focus more directly on customer needs and requirements;
- ❖ Better align funding, development resources, and management support to the organization's most critical mission capabilities;
- ❖ Reduce complexity and improve the experience for all users;
- ❖ Increase speed and flexibility to respond to changing customers' and mission partners' needs;
- ❖ Simplify and rationalize its technology portfolio while modernizing and redesigning core legacy applications to meet the needs of today and tomorrow; and
- ❖ Guide the sunsetting of legacy systems and adoption of new technology.



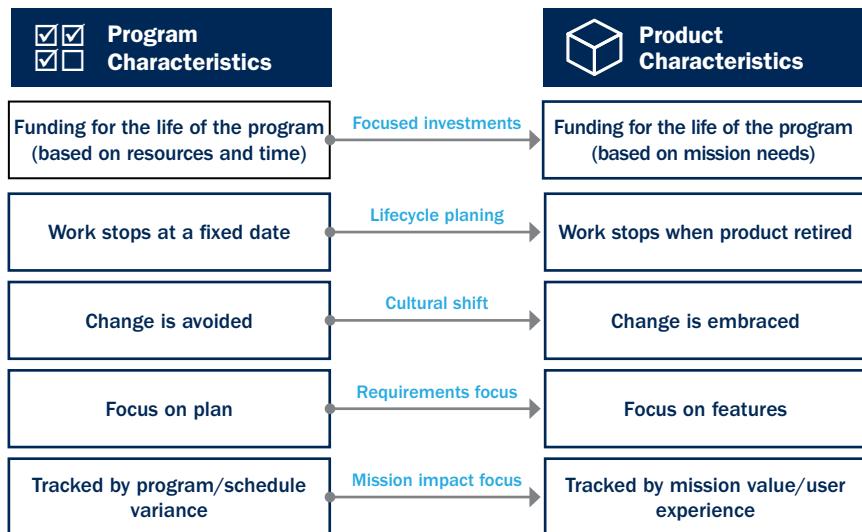
Impactful product management occurs at the nexus

Solution Overview & Benefits (cont'd)

Product management aligns technologies by how NGA consumes them, not how they are produced. It facilitates the better management of the people, processes, data, and technologies that support mission outcomes with established standing teams to continually enhance and innovate. It is not about replacing current skills with new ones, but rather balancing the traditional program management skills with product management, and having them work together.

Product managers will work with business relationship managers (BRMs), who will serve as the strategic interface with assigned program offices and a trusted advisor for technology. The BRM's main focus will be to establish and maintain value-driven, strategic relationships with one or more program offices and proactively manage mission requirements. The BRM will provide direction and guidance to mission partners to enable the best technology solutions that meet the mission needs.

Benefits of evolving from program to product management



Ultimately, NGA will need coordination across all directorates to develop strong product strategies and roadmaps. This whole-of-Agency effort includes hiring and training, the way contracts are written and managed, and the way new products get tested before release; it is a cultural shift as much as a technical one.

Quality is the foundation of successful applications, both those that are new and those undergoing modernization efforts. Successful development teams across NGA will test and validate their applications for efficacy, reliability, security, and performance to ensure quality as part of the product management process. Modern applications require effective, automated monitoring to understand reliability as well as system usage for product decisions.

Especially important to this approach is the concept of balanced product teams, including software engineers, designers, data scientists, and product managers working together and directly with end users. These balanced teams must constantly build and earn trust over time, iteratively improving the products they deliver.



Develop a Product Strategy and Product Objectives

- Determine the key objectives for the product management discipline for NGA.
- Incorporate UX design considerations into product strategy.
- Determine the proper workforce requirements, such as the skills needed as well as alignment and positioning of product managers within NGA's workforce.
- Develop an NGA product management strategy.



Hire and Empower Product Managers, Designers, and User Experience Staff

- Adopt a multidisciplinary team-building approach by targeting team members who can be both generalists and specialists.
- Strengthen the business relationship manager role that builds and maintains strong relationships with mission partners and acts as a liaison between NGA technology teams and the mission partner.
- Establish a product manager role that drives all product launch activities for new and existing technologies and applications, as well as ensuring user needs are understood and met through regular releases and updates.
- Establish UX experience roles that drive a “fit-for-purpose app” design approach utilizing customer segments, personas, user flows, prototyping, and user research.



Define NGA's Product Lines Based on the Feedback of Mission and Technology Stakeholders

- Determine the key, achievable areas from the customer point of view in which NGA can deliver immediate value in product management for the workforce.
- Determine the key defining and differentiating features of the product lines.
- Determine the responsible entity for the chosen product lines.
- Conduct a maturity assessment to understand NGA's ability to deliver the product lines and the existing gaps.



Develop a Product Management Migration Roadmap

- Determine the appropriate roadmaps for each product line.
- Develop an NGA product roadmap to address any current state gaps to deliver the desired future state of product management capabilities for the Agency.
- Coordinate change management investments required to address the prioritized gaps.



Embed Testing into the Product Lifecycle

- Design an effective testing initiative that incorporates developer-led best practices such as continuous integration, static code analysis, peer review, and unit testing.
- Incorporate usability testing with customers.
- Use and reuse tests through a layered strategy that leverages test automation at each tier of the application stack.



Develop an Enterprise Communication Plan

- Determine the best mechanism to communicate each step of the roadmap activities to the workforce for maximum early buy-in.
- Communicate product lines and expectations early and often to the workforce to promote transparency in the process.

Treat Data as a Strategic Asset

INITIATIVE OVERVIEW

Treat data as a strategic asset, enhancing and enforcing data governance for discovery, curation, and use of traditional and nontraditional data, as well as analytics and reporting.

Problem Statement

A core element of NGA's vision is to leverage data as a strategic asset to continually improve the impact its GEOINT products have for its customers.

Presently, NGA has gaps in awareness of its information assets, where these assets are located, and how they should be disseminated, leading to information-sharing challenges both within NGA directorates and outside NGA with its customers.

The operating model to facilitate information sharing is immature, as mission data are housed in multiple disparate systems, across multiple domains, with a lack of a comprehensive data taxonomy or a common governance mechanism.

NGA Will Refocus its Operating Models to Build the Data and Analytic Foundations to Support Mission Objectives

	Mission Yesterday	Mission Today	Mission Tomorrow
Outputs and Outcomes	Sporadic automation and innovation, frequent issues	Services and solutions, efficiency and effectiveness	Mission and operating model transformation
Mission Engagement	Isolated, disengaged internally and externally	Directive, compliance-driven, risk-averse	Dynamic, collaborative, risk-aware
Governance Capabilities	Tactical, siloed governance	Center-out governance control-oriented	Adaptive, contextual, platform-oriented, trust-based
Delivery Focus	Technology-centric	Process-centric	Product-centric, people and outcomes

NGA leadership must focus on these efforts to establish the governance, technology, and security foundations for data-sharing across NGA.

Current State Challenges

- ❖ **Siloed Data:** There is a lack of awareness of the data that reside within the organization, which leads to challenges in locating and coordinating access to data for exploitation, organizing data in new ways, and disseminating data to those who need it.
- ❖ **Real-Time Collaboration:** Basic sharing of data, files, products, and content can be challenging across directorates, with mission partners, and with customers.
- ❖ **Cross-Domain Features:** Data and information reside across multiple security domains with limited features or functionality to enable discoverability and accessibility where customers need it most.
- ❖ **Risk-Averse Posture:** In an effort to address risks associated with unauthorized disclosures and data leakage, the Agency sometimes errs on the side of over-classifying data and information, which inhibits leveraging data as an asset.

Recommendation

In order to harness the power of data and channel information within the Agency, to mission partners, and to customers, NGA will:

- 1) Identify and catalog the data NGA has today, as well as the data required to meet NGA's mission-critical priorities and use cases;
- 2) Grow a data-driven workforce by supporting activities such as creating a data-literacy baseline for new contributors across the Agency, training individuals to increase their data knowledge and skills, and employing real-time decision automation;
- 3) Identify infrastructure modifications needed to support increased usage of data and required new tradecraft and technologies, including considerations for data security;
- 4) Identify and implement technology proofs of concept to support data governance initiatives; and
- 5) Create a master data management (MDM) program to support mission-critical priorities, products, and services.

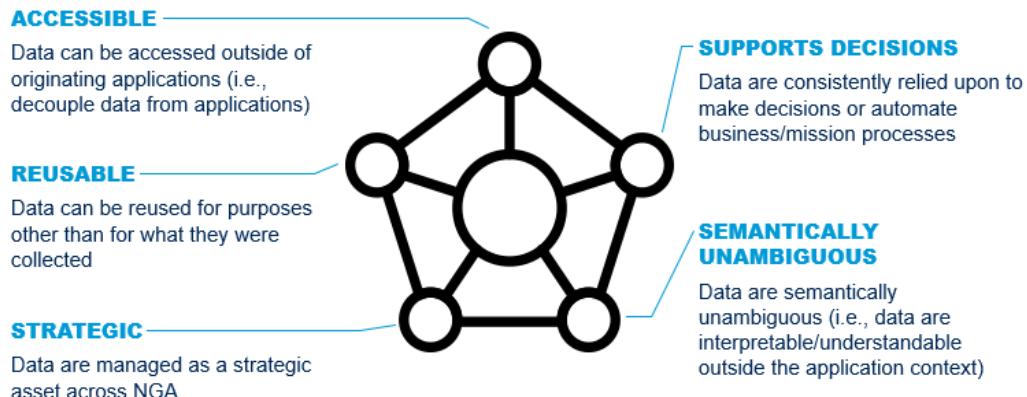
Value to NGA

A holistic approach to improving data-centric capabilities will accelerate NGA's ability to harness data across the NSG to support the exploitation and evolution of GEOINT. NGA will also empower data stewards across the enterprise to leverage technology and facilitate automation and augmentation efforts where appropriate.

Solution Overview & Benefits

The Agency has initiated efforts to become a more data-centric organization by reviewing its data governance practices and updating its data strategy to support NGA Strategy 2025 mission objectives.

Data-Centricity Defined



Applying an integrated approach to data management connects collective actions of the enterprise to enable:

- ❖ Improved efficiency in accessing secure and reliable data in a timely manner.
- ❖ Enhanced customer and mission partner data sharing and reusability.
- ❖ Consolidation of data and superior data quality.
- ❖ Advancement of anticipatory capabilities.

Solution Overview & Benefits (cont'd)

Effective data governance combined with corresponding technology investments is key to enhancing data quality, reliability, and access. NGA will build a data-centric program that delivers value to NSG; enables data discoverability, access, and reuse; and ensures NGA has the required skills and training to succeed in a data-centric environment and to avoid the “costs” associated with bad data.

Reasons Why Governance Fails

- Implies control, not value
- Slows down mission
- More an IT concern than business
- Failed too many times before
- Too big in overall scope
- Nice to have but not core to what we do or need



How to Make Governance Succeed

- Provide right level of enterprise control/coordination with the agility and flexibility for NGA to meet mission objectives
- Differentiate between the governance, decisions, and controlled actions that need to occur at the enterprise level
- Support a variety of different activities (e.g., collaboration to acquisition)

Streamlined data governance will be a shared responsibility among the Chief Information Officer (CIO), Chief Data Officer (CDO), CTO, Chief Information Security Officer (CISO), and other key stakeholders, including legal and compliance offices. The CDO will establish NGA's data priorities through the NGA Data Strategy and the high-level operating model in the Data Governance Operating Model. Using these strategic documents, NGA will identify the right technology insertion points to streamline this data governance capability and set the foundation for implementing a technology-enabled solution. Examples of technology solutions to enable and streamline NGA's data governance activities include, but are not limited to:

- ❖ **Project data evaluation:** Data inventory and catalog, data storage, data integration, data discovery, and data modeling tools.
- ❖ **Metadata updates:** Minimum metadata standards and metadata management solutions.
- ❖ **Data ownership:** Data inventory, metadata management, and data modeling.
- ❖ **Data governance metrics:** Data reporting tools, data quality, master data management, and data management and security.

1 Align Mission-Critical Priorities With Data Initiatives

- Identify and prioritize use cases that support analytics, information sharing, and Agency operations that NGA will support for mission today and mission tomorrow. Each use case should highlight (at a minimum):
 - Needs of both internal and external stakeholders
 - Stakeholder value
 - Mission value
 - Information value
 - Data levers
 - Data assets

2 Evaluate Enterprise Capabilities and Deficits

- Develop a synopsis of capabilities that exist within the enterprise to support mission-critical priority use cases and assess gaps that could impact technology implementation efforts.
- Identify technology opportunities and overlaps to address requirements and redundancies for data-centric capabilities with technology solutions.

3 Improve Enterprise Data Governance and Set Standards

- Refine the existing NGA data governance framework to ensure data are identified and exposed to the appropriate NSG stakeholders while maintaining privacy, security, and compliance.
- Update/create an NGA-wide conceptual data model to depict the high-level, stable entities and data relationships.
- Rationalize enterprise-class data tools to help automate data and analytic services to conduct metadata management and to automate master data management.

4 Empower Workforce to Support Data-Centric Transformation

- Assess NGA's data workforce to determine roles and responsibilities necessary for data-centric governance, processes, and technology implementation.
- Identify where gaps exist in existing talent pool and strategy for upskilling, insourcing, and/or outsourcing.
- Obtain executive leadership support of proposed talent strategy and investment requirements.

5 Enable Data Access in a Secure Manner

- Enable data to be accessed via APIs without manual process intervention.
- Identify infrastructure requirements for implementing the data strategy (e.g., collecting, storing, processing, and sharing information).
- Refine and adapt data security requirements to protect data properly while allowing sharing among authorized users.

Bring AI, Cloud & HPC Into GEOINT Mainstream

INITIATIVE OVERVIEW

Establish enterprise-wide access to modern HPC and cloud offerings to handle data that support automation, augmentation, and AI initiatives.



Problem Statement

Cloud computing continues to be a platform for innovation on which a variety of GEOINT capabilities will be based. Whether it is serving and storing geospatial data, enabling microservices for more efficient application development, developing computer vision algorithms, or analyzing multi-sourced information, cloud and edge computing will play a central role in countless mission and IT functions for NGA.

Despite pockets of progress and well-intentioned planning efforts, NGA has struggled to make a coordinated and purposeful migration to the cloud. Additionally, in order to truly benefit from advanced technologies involving AI and HPC, NGA will need to improve its ability to execute coordinated, large-scale compute projects, whether they are cloud, on-premise, or hybrid in nature.

Top Compute Trends, 2019-2024



Current State Challenges

- ❖ **Execution:** Compute infrastructure has been acquired, maintained, and deployed on a case-by-case basis without sufficient consideration for broader coordination or data integration.
- ❖ **Cost Expectations:** NGA leaders and practitioners expect cost savings when migrating systems to the cloud, when in fact those savings are difficult to achieve. Data show that typical organizations experience a near-term 20 percent increase in hosting cost when moving workloads to the cloud, with the potential for long-term savings only if cloud workloads are managed carefully and on-premise counterparts are truly sunsetted.
- ❖ **Network:** Existing NGA networks spanning unclassified and classified domains may not be able to accommodate bandwidth and performance requirements for growing workloads.
- ❖ **Workforce:** Many cloud, HPC, and AI-related projects need specialized skillsets. Government roles take time to fill and subsequently train while industry subject matter experts (SMEs) can also be expensive and hard to find.
- ❖ **Hybrid Cloud Strategy:** Not all HPC or AI workloads can be migrated into the cloud. Starting cloud journeys with non-cloud-friendly workloads often results in failed initiatives.

Recommendation

NGA's key focus to mature its infrastructure and compute access and enable AI includes the need to:

- 1) Develop use cases and a governance body that drives the selection of which compute environment is suitable for specific workloads and tasks. Ensure use cases are based on common capabilities that can support different mission programs;
- 2) Iterate upon the existing NGA Hybrid Cloud Strategy to ensure it considers multi-cloud, edge, and on-premise offerings and capabilities;
- 3) Select compute location for applications by mission need, with a priority to leverage cloud capabilities, including products and services built by the cloud service providers, whenever possible;
- 4) Baseline AI use cases for automation and augmentation with a focus on both mission and business process enablement, as well as the ethical use of AI; and
- 5) Select edge products and technologies that focus on key challenges such as network optimization, data management, analytics, and autonomous operations at the edge.

Value to NGA

The future of GEOINT requires robust offerings and coordination across infrastructure, applications, and data teams. If NGA can execute a holistic strategy to embrace hybrid cloud, integrate the edge, and improve its HPC access, it will be in a prime position to meet future GEOINT technology requirements.

Solution Overview & Benefits

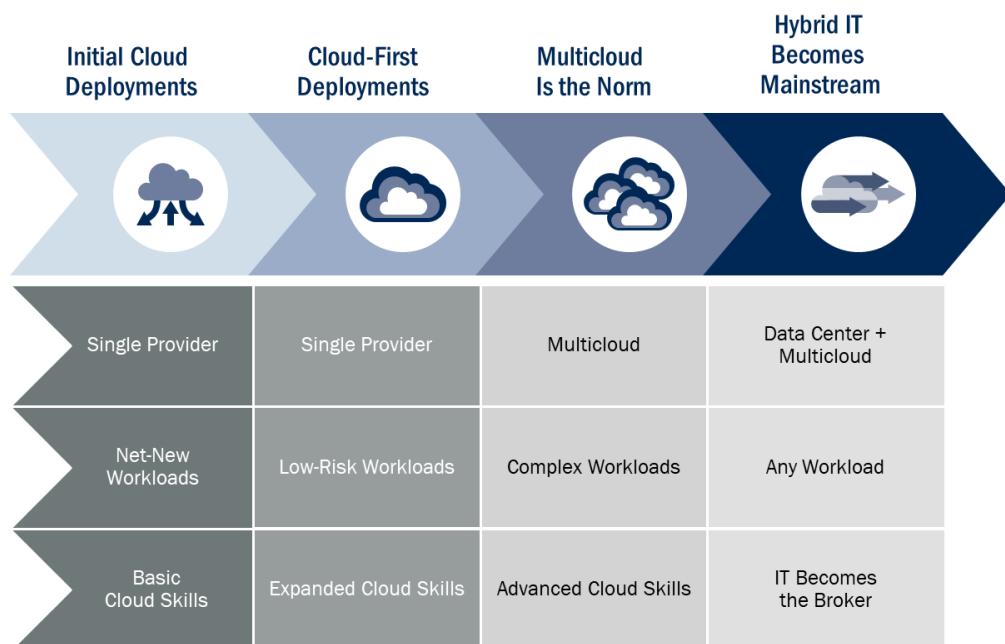
Despite higher adoption rates in industry, cloud migration and adoption have only recently experienced a surge across the DoD and IC—a trend that will accelerate as NGA continues to tackle cloud-related acquisition, governance, and security challenges while industry providers simultaneously mature their IC-specific cloud offerings. Throughout these industries, automation and AI combined with cloud have steadily improved the quality, efficiency, and timeliness of human decisions.



Solution Overview & Benefits (cont'd)

Cloud and AI are becoming a prerequisite for much of what is considered to be the future of the GEOINT tradecraft—whether it is incorporating diverse data streams from the exponential growth of sensors, leveraging new imagery sources, or evolving foundation GEOINT. Large portions of the IC have already started benefiting from these modalities, and NGA recognizes it must coordinate its own hybrid solutions to achieve the NGA Strategy 2025. NGA's future compute environment will not merely be a more efficient version of today's infrastructure but, rather, an environment to enable emerging technologies and provide improved governance, increased cost transparency, increased reliability, and broader geographic distribution, among other benefits.

However, compute is evolving not to a “cloud only” future, but instead to a dynamic mix of on-premise and off-premise computing. Core systems, including ones inextricably linked to on-premise compute, will not disappear. Where those highly customized systems bring unique value to the NGA mission, they will continue to get new investment.

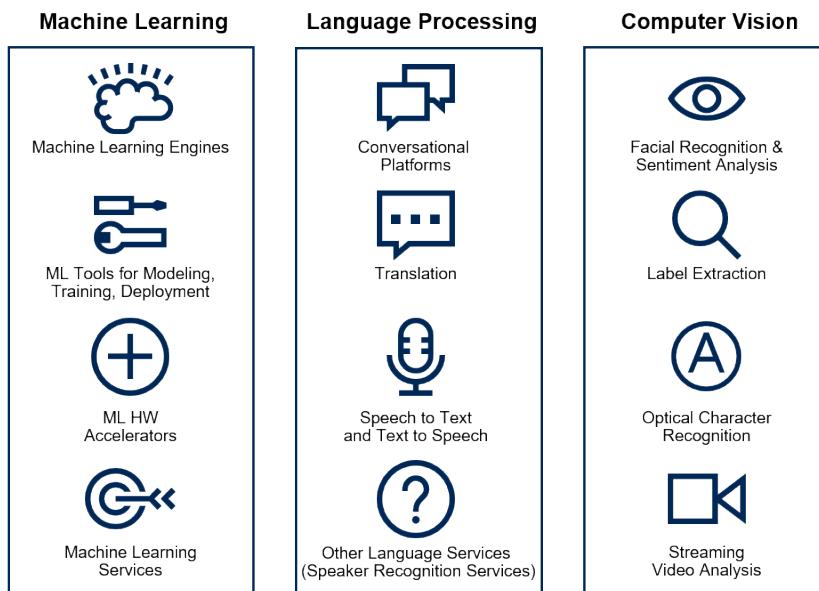


The amount of computation devoted to AI will increase dramatically over the next five years, as NGA cultivates new use cases for AI beyond traditional AI techniques. As standard processors no longer deliver the predictable performance gains predicted by Moore's Law, accelerators must play a primary role in adding compute horsepower. Specialized accelerators such as graphics processing units (GPUs) will be required for many AI machine learning (ML) models. However, a capital-intensive “build” strategy for such infrastructure is not the only solution, as this horsepower is also available through DoD-/IC-specific cloud service providers and ML software as a service (SaaS) products.

Solution Overview & Benefits (cont'd)

Use cases should drive the selection of AI technology. NGA's technology leaders must partner with major programs to identify and prioritize AI use cases and select infrastructure based on the specific needs. In other words, compute frameworks and decisions should be baked into NGA's existing technology development workflow. For example, when mission data are cloud-hosted, data gravity recommends a selection of compute resources within those clouds for training AI systems. Ethical use of AI, as well as recognizing and working within compliance, legal, and oversight requirements, must be core to NGA's AI approach.

Classification of AI Services



NGA will build a community of practice around automation, augmentation, and AI to leverage the Agency's knowledge for accelerating adoption across the enterprise. Crucially, such teams can identify when to prefer classical ML techniques over skill, and infrastructure-heavy deep learning techniques where cloud and/or HPC capabilities can provide game-changing abilities for NGA.

Despite the stereotypes, AI capabilities and advancements are not trending to replace human beings. Rather, they are accelerating or augmenting the human workforce's ability to acquire knowledge and improve productivity. As GEOINT evolves beyond providing imagery and geospatial awareness toward being the nexus of data fusion, even AI use cases focused on augmentation will require exponentially greater infrastructure and application resources. These resources must be coordinated across the NGA enterprise to ensure mission success. Multiple AI environments dedicated to specific mission functions without the benefit of interconnections to other mission functions will have diminishing value.

As compute shifts to a mix of on- and off-premise, the near-total reliance of IT on centralized computing will change as certain NGA projects appear at the edge. Edge use cases will vary widely, with a variety of partnerships and ecosystems delivering for different requirements. While application needs (including latency, bandwidth, privacy, and autonomy) will push computing to the edge, other factors will shape the nature of that computing. NGA technology leaders should use the physical location, nature of the endpoints, amount of information required, and needed resilience to dictate edge compute adoption.



Develop Holistic Hybrid Cloud, Edge, and On-Premise Strategy

- Iterate and improve the existing NGA Hybrid Cloud Strategy to include multi-cloud considerations.
- Evaluate distributed cloud and edge options and establish a governance body that drives the selection of which compute environment is suitable for specific workloads and tasks.
- Rethink the network architecture for a hybrid end-state.



Create a Hosting Decision Framework

- Create a framework for all of NGA that selects an infrastructure service depending on the unique characteristics of the application by mission need, with a priority to leverage cloud capabilities.
- Empower an NGA Cloud Center of Excellence (COE) to tailor and govern cloud solutions that should be available to the entire enterprise.
- Drive new ROI analysis that provides increased cost transparency into infrastructure spend and the value and/or savings provided by adopting new hosting solutions.



Deliver AI Platforms

- Develop and enhance the ability to discover, build, and share analytics outputs.
- Move to constantly operating and streaming analytics as the norm.
- Equip data scientists and developers to monitor, integrate, and customize machine-assisted models.



Plan and Coordinate HPC Investments Across the Enterprise

- Minimize risk by using workload profiles to identify cloud-capable HPC applications based on their parallelism and resource consumption profiles.
- Increase cloud adoption success rates by using the right set of middleware designed to simplify usability of cloud-hosted HPC resources.
- Address input/output (I/O) performance challenges in the cloud by utilizing the latest-generation techniques that enable parallel file I/O capabilities in the HPC environment.



Build a Community of Practice for AI

- Attach AI to an existing COE or create a new AI COE.
- Select use cases that augment workers but do not set replacement as a goal. Choose measurements such as faster resolution, improved breadth of issues addressed, or customer satisfaction.
- Leverage cloud to build converged AI platforms with multiple mission stakeholders.
- Upskill workforce to support diverse data and analytics pipelines.
- Promote ethical and transparent AI use and explainable AI frameworks.

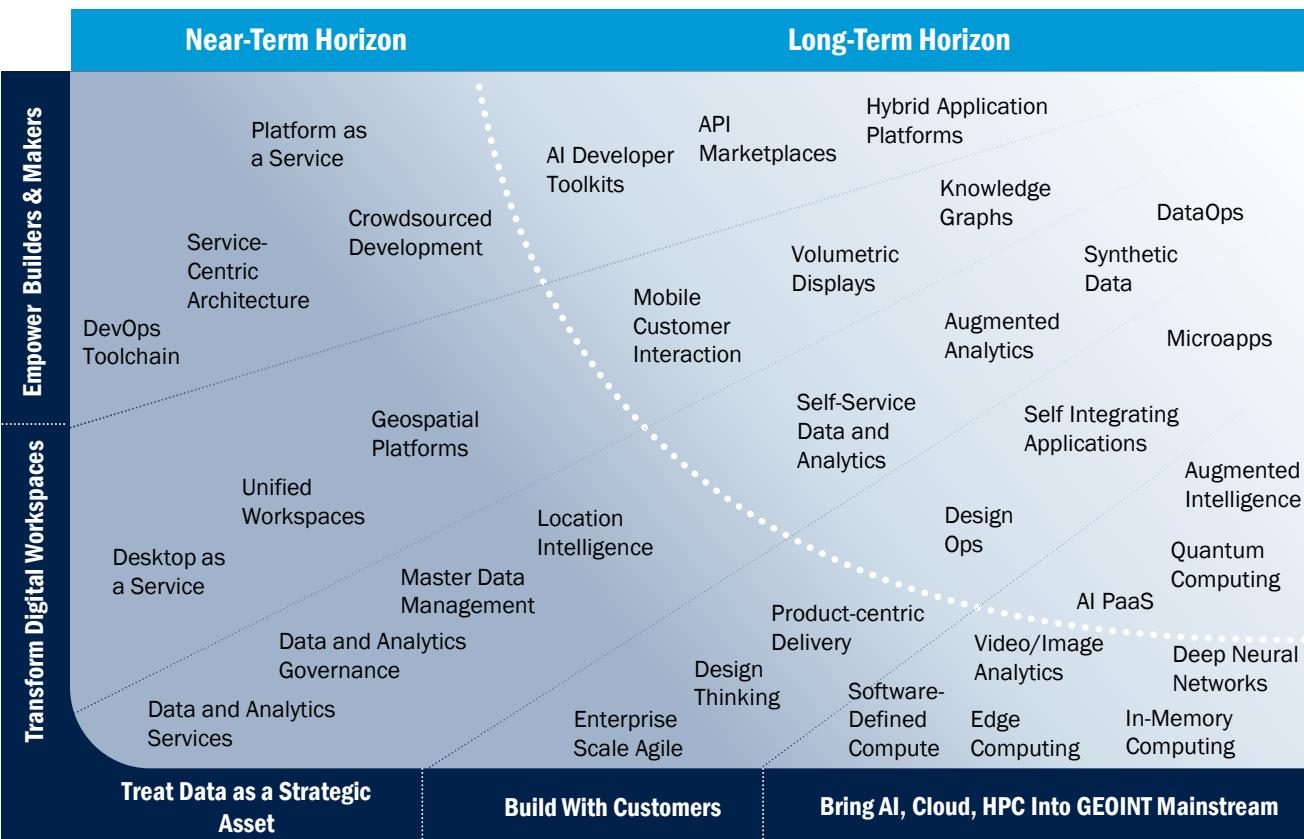


Appendices

Appendix A

Industry-Leading Practices on NGA's Technology Horizon

This view provides a baseline of industry-leading practices that NGA should consider in the near and long term. The technology opportunities on the near-term horizon are key prerequisites for the Agency to achieve more ambitious and transformative technologies on the long-term horizon. The terminology used in this view is consistent with industry parlance—detailed definitions are included in the pages that follow.



NGA will address real-time events and improve its ability to understand the world and anticipate future events for increasing decision advantage of decision makers, policy makers, partners, warfighters, and emergency responders to act swiftly and adapt faster ahead of adversaries.

Industry offers several solutions and products that will deliver tremendous value to NGA and its stakeholders. Of these key technologies, NGA will prioritize a near-term focus on:

- ❖ AI to augment the human analytical workforce to deliver timely intelligence faster in response to an increasing pace of mission requirements.
- ❖ Image and data analytics to handle the increasing volume of data coming from both classified and commercial sources.
- ❖ Iterative and responsive development processes (including DevSecOps and agile development) for NGA to deliver relevant application capabilities at the speed of mission.
- ❖ Data security that protects NGA's most valuable products, making them available to the right audience, for the right purpose, at the right time.

NGA's forthcoming Technology Focus Areas Playbook will provide additional details on the current and future technologies NGA plans to invest in, as well as how industry can best interact with NGA.

Industry-Leading Practices on NGA's Technology Horizon (cont'd)

Technology Priority Definitions

Empower Builders and Makers

Near-Term Horizon

- ❖ **DevOps Toolchain:** A DevOps toolchain comprises tools used to support DevOps pipeline activity and provide fast feedback. It typically covers six main activities: plan, create, verify, release, configure, and monitor. Pipeline activities have started with discrete tools for various steps, but vendors can deliver solutions right across the application development and delivery cycle. The mix of tools is determined by business need, product platform, language, product domain, and the skills of the people who will use the tools.
- ❖ **Service-Centric Architecture:** The mesh app and service architecture is implemented as a set of distributed, loosely coupled, autonomous components, including multiple fit-for-purpose apps and composable backend services that support the distinct workflows of each app. Each app provides an optimized user experience for specific personas and interface channels. Apps and services communicate via mediated APIs. Those APIs can cross application and organizational boundaries, enabling a flexible mesh of capabilities.
- ❖ **Platform as a Service:** Platform as a service (PaaS) is a type of a cloud offering that delivers application infrastructure (middleware) capabilities as a service. There are multiple types of PaaS (xPaaS), including, among many more, application platform as a service (aPaaS), integration PaaS (iPaaS), API management PaaS (apimPaaS), function PaaS (fPaaS), business analytics PaaS (baPaaS), internet of things PaaS (IoT PaaS), and database PaaS (dbPaaS). PaaS capability can be delivered as provider-managed or self-managed, multitenant or dedicated.
- ❖ **Crowdsourced Development:** Crowdsourced developers are employees who create new business applications for consumption, normally by themselves but potentially with others, using development and runtime environments sanctioned (or at least not actively forbidden) by corporate IT or the enterprise line-of-business organizations.

Long-Term Horizon

- ❖ **AI Developer Toolkits:** AI developer toolkits are applications and software development kits (SDKs) that abstract data science platforms, frameworks, analytic libraries, and devices to enable software engineers to incorporate AI into new or existing applications.
- ❖ **API Marketplaces:** An API marketplace is a platform for API providers to publish and market APIs. Consumers—mainly developers—use API marketplaces to discover APIs and (in some cases) purchase access to APIs. API marketplaces differ from API portals since they are more likely to include APIs from multiple providers, may showcase applications (e.g., mobile apps) using the APIs, and may involve API monetization. Although public API marketplaces are more well-known, a growing number of organizations, including banks, now have deployed internal API marketplaces.
- ❖ **Hybrid Application Platform:** A hybrid application platform is an IT organization's governed portfolio of on-premise, on-edge, and cloud-based application platform components that supports past, present, and future applications—including legacy, heritage, commercial off-the-shelf (COTS), SaaS, homegrown, third-party, and digital business applications.

Industry-Leading Practices on NGA's Technology Horizon (cont'd)

Technology Priority Definitions

Transform Digital Workspaces

Near-Term Horizon

- ❖ **Desktop as a Service:** Desktop as a service provides a virtualized desktop experience, delivered to a customer on demand from a vendor-owned, remotely hosted location, via a utility or operating expenditure consumption model. The service must include basic user image provisioning. However, it may have a wider scope of application and security lifecycle management.
- ❖ **Unified Workspaces:** The unified workspace is a user-centric computing model that delivers a contextual and adaptive work experience designed to empower individuals and drive productivity and satisfaction. The strategy allows for personal preferences for devices and, in its most advanced form, the application of analytics and machine learning to provide alerts, suggest actions, and automate responses across applications within the workspace experience.
- ❖ **Geospatial Platforms:** Geospatial platforms include PaaS and data-as-a-service offerings in the context of spatial data processing, such as web mapping, mobile geospatial apps, location services, imagery services, analytics, and geoevent processing. They also include other features such as digital marketplaces with subscription-based licensing and revenue-sharing mechanisms for partner- and customer-generated apps and content.

Long-Term Horizon

- ❖ **Mobile Customer Interaction:** The mobile customer interaction channel enables the delivery of information and services to customers using smartphones or tablet computers. Communications and services delivered via SMS are included. It also includes responsive design websites that render well on mobile devices, as well as native applications for leading mobile operating systems including Apple iOS and Google Android.
- ❖ **Volumetric Displays:** Volumetric displays create visual representations of objects in three dimensions, with a 360-degree spherical viewing angle in which the image changes as the viewer moves. Unlike most 3D planar displays, which create the illusion of depth through a stereoscopic or an autostereoscopic technique, volumetric displays create lifelike images in 3D space.
- ❖ **Knowledge Graphs:** Knowledge graphs are data structures in which disparate data about entities (including people, companies, and digital assets) are codified as a graph—a network of nodes and links (“edges”)—rather than tables of rows and columns. This enables information (“knowledge”) to be located (knowledge graph as an index) or synthesized (knowledge graph as a data source) on demand.

Industry-Leading Practices on NGA's Technology Horizon (cont'd)

Technology Priority Definitions

Build With Customers

Near-Term Horizon

- ❖ **Enterprise-Class Agile Development:** Enterprise-class agile development is the use of business-outcome-driven, customer-centric, collaborative, and cooperative practices with continual stakeholder feedback. Feedback is done in dynamic and changing heterogeneous environments throughout the software lifecycle, to support continuous delivery of enterprise-class adaptive products and services.
- ❖ **Design Thinking:** Design thinking is a multidisciplinary process used to improve the design of everything from business software to consumer products and services. It is a creative process starting with empathy for users and the gathering of insight into their needs and motivations. Based on this insight, it is possible to identify solutions that users would value. These are then developed using an iterative, experimental approach. Deep customer insight combined with a creative process is ideal for digital innovation and digital product development.
- ❖ **Product-Centric Delivery:** Digital business requires a fundamental shift in delivery model for application organizations, from project and application to backlog, product, and platform. This shift allows the organization to respond more rapidly to demands using agile methods, combined with a continuously updated backlog. It also allows the organization to focus on delivering the most important and customer-satisfying features first, rather than waiting for long-lasting projects to complete.

Long-Term Horizon

- ❖ **DesignOps:** DesignOps is a set of product design practices that combines user experience, product management, and technology operations to enable efficient and DevOps-compatible plans, estimates, and processes that increase quality, enable collaboration, and shorten product delivery timelines. DesignOps impacts product design throughout the entire product lifecycle, from initial discovery to final testing and launch, but is primarily focused on product definition, concept exploration/development, testing, and design production.
- ❖ **Self-Integrating Applications:** Self-integrating applications use a combination of automated service discovery, metadata extraction and mapping, and machine learning to enable applications to integrate themselves into an existing application portfolio.
- ❖ **Microapps:** A microapp is a discrete, yet reusable and portable, app function, process, or workflow that operates within the context of a larger app or application—and across multiple apps or applications. The microapp runs as a self-contained activity, but may rely on services, such as identity services or access to location data, provided by an app client runtime or container. The microapp must be tightly scoped and is composed of UI, logic, and data components typically bound to back-end microservices through a mediated API layer.

Industry-Leading Practices on NGA's Technology Horizon (cont'd)

Technology Priority Definitions

Treat Data as a Strategic Asset

Near-Term Horizon

- ❖ **Data and Analytics Services:** Data and analytics services comprise activities around the data and analytics value chain, which include data acquisition, data processing, storage, analytics, and data exposure. They may also involve the use/provisioning of anonymized demographic or location data obtained from the communications service providers' (CSPs') own subscriber bases. CSPs may also create niche analytics and offer data science or consultancy services to their enterprise customers.
- ❖ **Data and Analytics Governance:** An independent third party defines data and analytics governance as the specification of decision rights and an accountability framework to ensure appropriate behavior in the valuation, creation, storage, access, analysis, consumption, retention, and disposal of all information assets. Data and analytics governance includes the principles, guidelines, standards, policies, procedures, and links to outcomes and metrics that ensure the effective and appropriate use of data and analytics in enabling an organization to achieve its goals.
- ❖ **Master Data Management:** MDM is a technology-enabled business discipline in which business and IT work together to ensure the uniformity, accuracy, stewardship, governance, semantic consistency, and accountability of the enterprise's official shared master data assets. Master data is the consistent and uniform set of identifiers and extended attributes that describes the core entities of an enterprise, such as existing customers, prospective customers, citizens, suppliers, products, assets, sites, hierarchies, and the chart of accounts.
- ❖ **Location Intelligence:** Location intelligence is the process of deriving meaningful insight from geospatial data relationships—people, places, or things—to solve particular challenges such as demographic analysis, movement analysis, environmental analysis, and navigation. Location intelligence consists of a combination of GIS software, web mapping solutions, position technologies such as GPS, and location-based data.

Long-Term Horizon

- ❖ **Self-Service Data and Analytics:** Self-service data and analytics refers to technology and processes that business users use directly without involvement from IT departments. Established in areas such as modern business intelligence and analytics tools, self-service data preparation, and data catalogs, self-service is moving into other areas including MDM and database management.
- ❖ **Augmented Analytics:** Augmented analytics uses machine learning to automate data preparation, insight discovery, data science, machine learning model development, and insight sharing for a broad range of business users, operational workers, and citizen data scientists. It is expanding insights by using AI and ML techniques to deliver analytics to everyone in the organization, with less time, skill, and interpretation bias than current manual approaches.
- ❖ **Synthetic Data:** Synthetic data is a class of data that is artificially generated, i.e., not obtained from direct measurements. Generation can use different methods such as statistically rigorous sampling from real data, semantic approaches, or Generative Adversarial Networks, or by creating simulation scenarios where models and processes interact to create completely new datasets of events.
- ❖ **DataOps:** DataOps is a collaborative data management practice focused on improving the communication, integration, and automation of data flows between data managers and data consumers across an organization. The goal of DataOps is to create predictable delivery and change management of data, data models, and related artifacts. DataOps uses technology to orchestrate and automate data delivery with the appropriate levels of security, quality, and metadata to improve the use and value of data in a dynamic environment.

Industry-Leading Practices on NGA's Technology Horizon (cont'd)

Technology Priority Definitions

Bring AI, Cloud & HPC Into GEOINT Mainstream

Near-Term Horizon

- ❖ **Software-Defined Compute:** Software-defined compute takes the concepts and abstraction of virtualization and applies them across physical servers, hosts, and virtual machines. This can happen at many levels, not just inclusive of hypervisors, but it requires an abstracted management and control plane from the data plane.
- ❖ **In-Memory Computing:** In-memory computing (IMC) is an application architecture style which assumes that all the data required by applications for processing are located in the main memory of their computing platforms. In IMC-style applications, a persistent, nonvolatile data store (hard drives, solid state drives) is used to permanently store in-memory data for recovery purposes, to manage overflow situations, to manage the information lifecycle, and to transport data to other locations, but is not used as the primary location for the application data.
- ❖ **Edge Computing:** Edge computing describes a distributed computing topology in which information processing is placed close to the things or people that produce and/or consume that information. Drawing from the concepts of mesh networking and distributed data centers, edge computing looks to keep traffic and processing local and off the center of the network. The goals are to reduce latency and unnecessary traffic and establish a hub for interconnection between interested peers and for the data thinning of complex media types or computational loads.
- ❖ **Video/Image Analytics:** Video/image analytics for customer experience is the application of data science methods to automate the identification of significant information contained in images, image streams, or pixels in order to generate insight and actions that contextually improve the customer experience.
- ❖ **Deep Neural Networks:** Deep neural networks are large-scale neural networks, often with many processing layers. They underpin most recent advances in AI by enabling computers to process much better complex data, such as video, image, speech, and textual data.

Long-Term Horizon

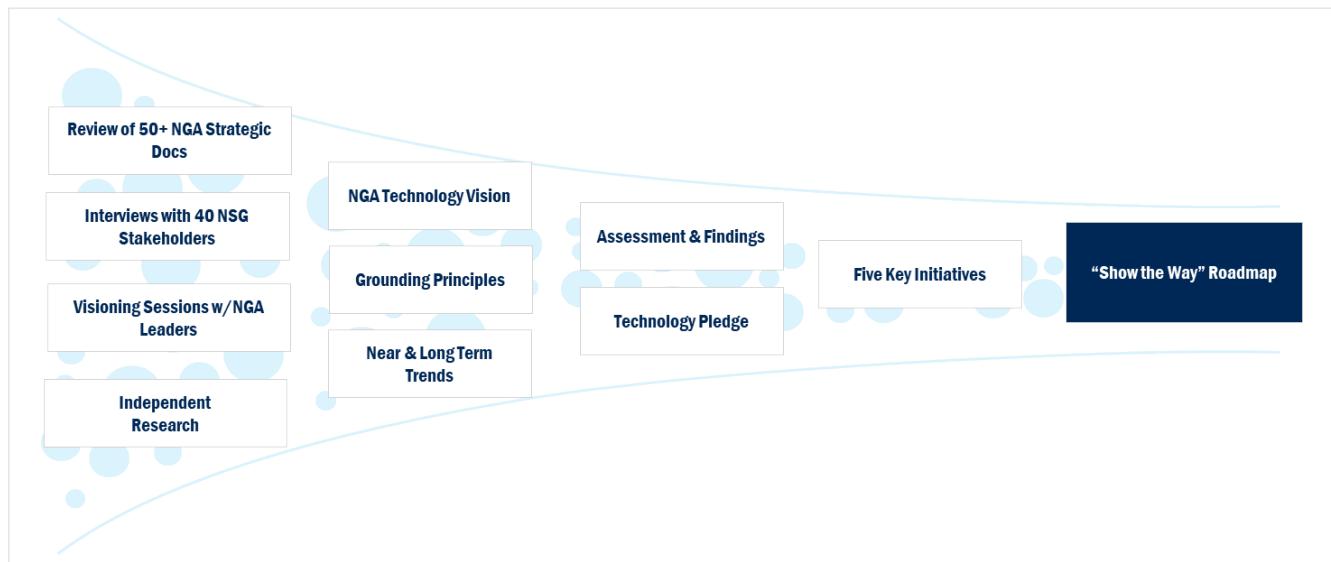
- ❖ **Artificial Intelligence PaaS:** Cloud artificial intelligence and machine learning platform services are known collectively as AI cloud services. These solutions provide AI model building tools, APIs, and associated middleware that enable the building/training, deployment, and consumption of machine learning models running on prebuilt infrastructure as cloud services. These cover vision, voice, and general data classification and prediction models of any type.
- ❖ **Quantum Computing:** Quantum computing is a type of nonclassical computing that operates on the quantum state of subatomic particles. The particles represent information as elements denoted as quantum bits (qubits). A qubit can represent all possible values simultaneously (superposition) until read. Qubits can be linked with other qubits, a property known as entanglement. Quantum algorithms manipulate linked qubits in their undetermined, entangled state, a process that can address problems with vast combinatorial complexity.
- ❖ **Augmented Intelligence:** Augmented intelligence is a human-centered partnership model of people and AI working together to enhance cognitive performance, including learning, decision-making, and new experiences. Augmented intelligence is sometimes referred to as “centaur intelligence.” It is different from augmented analytics: augmented intelligence is about people taking advantage of AI; augmented analytics is about data and analytics technologies enhanced with AI.

Appendix B

About This Report

NGA's Chief Technology Officer sponsored this strategy to set the Agency's direction for mission-enabling technology of the future. The primary goal of this strategy is to "show the way" and empower builders and makers at the NGA. We got to this strategy by:

- ❖ Setting a **vision** of where NGA will be from a technology perspective.
- ❖ Defining five grounding principles to achieve this vision.
- ❖ Creating an honest assessment and findings related to the current state, highlighting strengths and opportunities for improvement.
- ❖ Determining the need for the five key initiatives for the way ahead.



While the CTO sponsored this strategy, an independent third party facilitated its development.

The third-party advisor notably received outstanding support from mission representatives and executive leaders across NGA to develop the findings and recommendations in this report. Inputs to this report include:

- ❖ Perspectives from stakeholders spanning the NGA enterprise. This included in-depth interviews with 40 mission and IT leaders throughout the Agency that provided insight, expertise, and context to create this collective vision for the future.
- ❖ Visioning sessions with technology leaders within NGA.
- ❖ Reviews of 50+ strategic documents across NGA, the IC, and the DoD.
- ❖ Leading practices defined by an independent industry technology analyst.

Appendix C

List of Acronyms

AI	Artificial Intelligence
aPaaS	Application Platform as a Service
API	Application Program Interface
apimPaaS	API Management PaaS
baPaaS	business analytics PaaS
BRM	Business Relationship Manager
CIO	Chief Information Officer
COE	Center of Excellence
COTS	Commercial-Off-The-Shelf
CSP	Communication Service Provider
CTO	Chief Technology Officer
DaaS	Desktop as a Service
dbPaaS	database PaaS
fPaaS	function PaaS
HPC	High-Performance Computing
I/O	Input/Output
IMC	In-Memory Computing
IoT PaaS	Internet of Things PaaS
iPaaS	Integration Platform as a Service
IPO	Integrated Program Office
MDM	Master Data Management
ML	Machine Learning
PaaS	Platform as a Service
Qubits	Quantum bits
ROI	Return on Investment
SDK	Software Development Kits
SME	Subject Matter Expert
UX	User Experience
VDI	Virtual Desktop Infrastructure
XLA	Experience Level Agreement

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