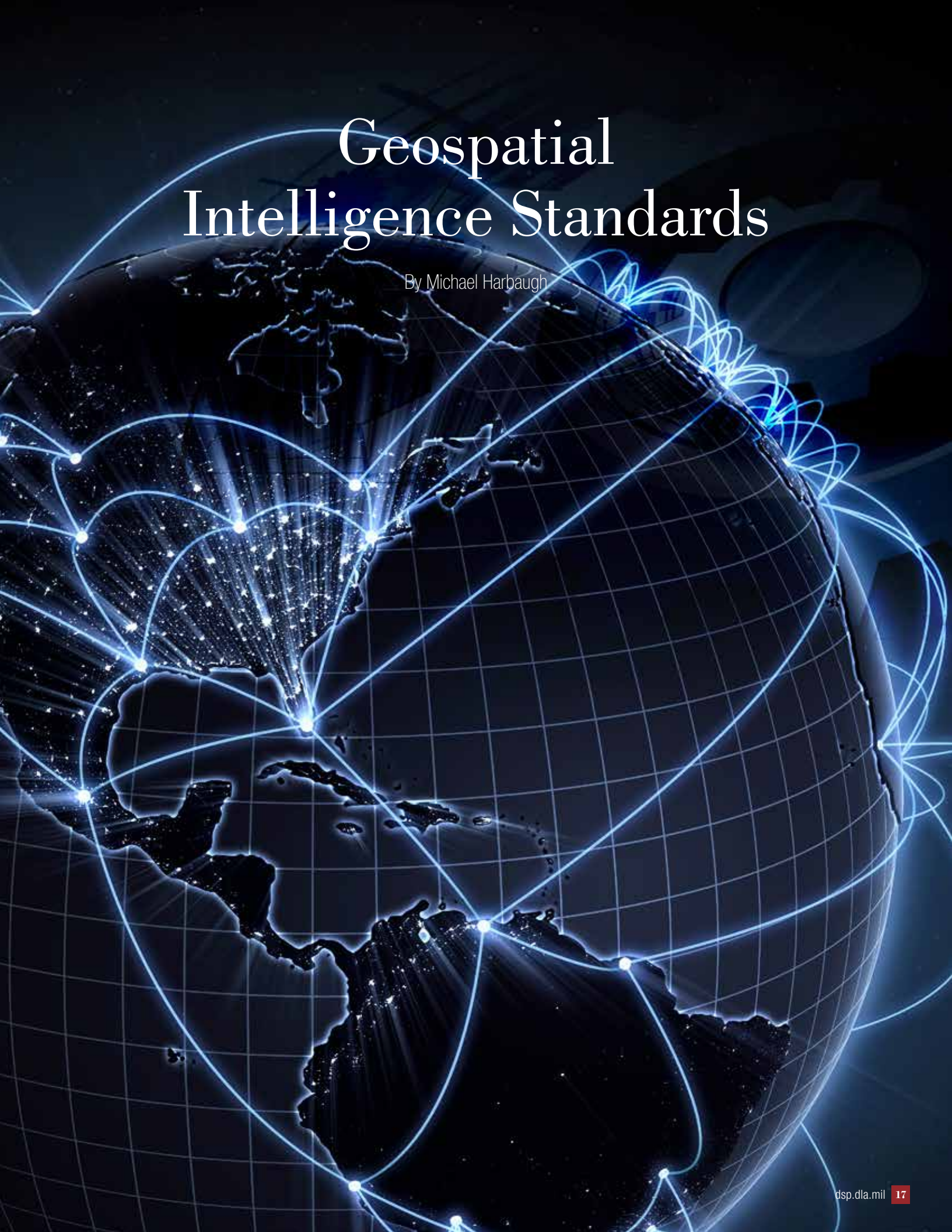
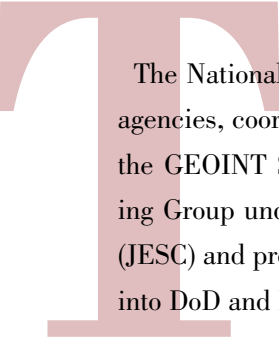


Geospatial Intelligence Standards

By Michael Harbaugh





The National Geospatial-Intelligence Agency (NGA), in concert with other DoD departments and agencies, coordinates geospatial intelligence (GEOINT) standards and standardization activities via the GEOINT Standards Working Group (GWG). The GWG functions as a Joint Technical Working Group under DoD and the Intelligence Community (IC) Joint Enterprise Standards Committee (JESC) and provides recommendations regarding the integration of geospatial intelligence standards into DoD and IC enterprise standards baselines.

The GWG emphasizes standards and standardization activities that enable data, product, and service interoperability across the National System for Geospatial-Intelligence (NSG), and it focuses on standards concerning geospatial information and still and motion imagery. Today, the JESC has mandated the use of 139 government and nongovernment geospatial intelligence standards.¹ The JESC cites another 34 as “emerging,” with the possibility of being mandated in the future. To facilitate the adoption of nongovernment standards, NGA—along with members of the NSG²—developed partnerships with a variety of national and international standards development organizations, including the following:

- The International Organization for Standardization Technical Committee (ISO) Technical Committee 211–Geographic Information-Geomatics
- The American National Standards Institute International Committee for Information Technology Standards
- The Open Geospatial Consortium.

Through active participation in these organizations, NGA and the NSG community have leveraged the knowledge, skills, and talent of the broader geospatial community, which has yielded the following:

- Reduced risk by aligning with industry to address new and emerging technologies
- Expedited technology integration into systems and services through the use of open solutions

¹ For a listing of JESC-approved GEOINT standards, go to <https://nsgreg.nga.mil/JESC-approved.jsp>.

² The NSG consists of the armed services, the combatant commands, the intelligence agencies, and federal organizations.

- Improved choice in the marketplace by influencing the development and adoption of open standards in commercial solutions
- Reduced overall system life-cycle costs by reducing or eliminating custom integration through the use of open standards.

NGA emphasizes the need to work collectively with its international partners to develop a common approach to solving shared problems. Without this collaboration, solutions may not be interoperable among nations participating in NATO or allied operations. This, in turn, could reduce multinational forces' speed and efficacy, and it could potentially put those forces at increased risk.

A principle forum for allied standardization has been the Defense Geospatial Information Working Group (DGIWG). Although the DGIWG is not a NATO body, NATO and NATO nations rely on it for technical advice and the provision of standards-based solutions that facilitate the creation, sharing, and use of geospatial information within the alliance. DGIWG standardization documents that meet NATO needs are covered by NATO standardization agreements such as 2592, the NATO Geospatial Information Framework.

A majority of GEOINT standards are either adoptions or adaptations of open standards. Although some mission requirements will dictate specific solutions for government use only, those will be the exception rather than the rule. As NGA continues to partner with standards development organizations, the need for these government-unique solutions will diminish substantially. The following section highlights key GEOINT standardization initiatives that NGA is leading under the oversight of the GWG.

The GEOINT Structured Implementation Profile

To effectively create, share, and use GEOINT across the NSG, NGA created a common data model that integrated feature concepts (real-world entities and phenomena) from multiple disciplines. The data model, known as the NSG Application Schema (NAS), is platform independent and defines the syntactic structure of feature concepts captured by the NSG Entity Catalog (NEC). The NEC, supported by the NSG Feature Data Dictionary (NFDD), provides the semantics for the model by defining attributes, domain values, and associations that one feature concept may have with another. Collectively, the NFDD, the NEC, and the NAS are known as the GEOINT Structure Implementation Profile (GSIP). The GSIP has continued to evolve since its inception in 2007, as new and emerging requirements are addressed. These include adding an object class for devices (e.g., equipment) in 2015 and consumables (e.g., munitions) in 2016.

The NAS provides a clear and logically consistent data schema that may be used in system-specific implementations. It is engineered to support a one-feature-one-time solution, which alleviates the need to collect and store multiple instances of the same feature based on use (e.g., aeronautical, maritime, and topographic), thereby facilitating data exchange between systems with conformant implementations.

To address the human element of conflict, a set of Human Geography (HG) concepts were integrated into the data model (see Table 1). HG uses an interdisciplinary approach to describe spatial and temporal patterns of human behavior in the context of their environment as it applies to GEOINT. NGA is working with its NATO partners to standardize HG concepts to ensure consistent collection and use in multinational operations.

Table 1. Human Geography Concepts and Nature of Information

HG concept	Nature of information
Demographics	Measurable characteristics of a population
Economy	Economic factors that determine how the members of a population support themselves
Education	Educational and literacy characteristics of a population
Health and medical	Health information about a population and the availability of treatment
Groups and organizations	Formal and informal groups within a population, including structure, objectives, and leaders
Ethnicity	Ethnic affiliation and characteristics of a population
Religion	Religious affiliation(s) and characteristics of a population
Language	The language(s) of a population
Communications and media	The means by which information is disseminated, who owns and controls the content, and who has access
Transportation use	Transportation routes and the means by which people and goods circulate within a geographic region
Water supply and control	The supply of surface water and groundwater in a given geographic area, including control and access
Ownership	Ownership of land parcels in a given geographic area
Land use and cover	Information about land use (e.g., industrial, commercial, or residential) for a given area, and its dominant vegetation cover
Cultural heritage	Information about the architecture style, historical and archeological remains, monuments, and sacred places of a given geographic area
Significant events	Information about events that have shaped a population

A new set of semantic standards is planned to replace the NFDD and the NEC in the next 3 years. This new set of standards will enable the publication structured data and the ability for it to be interlinked with data from different sources on the web. It will also consist of appropriate semantic resources to specify domain vocabulary and concepts for human use and for automated exchange between machines. These semantic resources are encoded artifacts containing standardized structures that capture the meaning of the data, a controlled vocabulary to explain terminology, structured sets of terms related based on relationships (i.e., taxonomy), and specifications of concepts in a logic-based language. This language will use properties, a subclass structure, and relationships between terms and meanings specified as formal concepts that will be captured in the NSG Enterprise Ontology.

Metadata

The NSG Metadata Foundation (NMF) is a multipart standard adapted from ISO standards 19115-1, “Geographic Information–Metadata Part 1: Fundamentals,” and 19115-2, “Geographic Information–Metadata Part 2: Extensions for Imagery and Gridded Data.” The NMF is compliant with the ISO standards but includes extensions and values required by the defense community, such as security markings. NGA has also worked with and supported standardization efforts in NATO and the DGIWG to ensure interoperability with our allies, including NATO Standardization Agreement 2586, NATO Geospatial Metadata Profile, and the DGIWG Metadata Foundation document.

Integrating the metadata into the data model, to form a single comprehensive logical model for the NSG, is an ongoing initiative in the development of NAS v8.0. The metadata elements defined by the NMF Ed. 3.0 (August 2016) will be included in NAS v8.0 when it is released in late 2016. This new version of the NMF will serve as the mandatory core for GEOINT metadata; will be explicitly applicable to services, data sets, and series; and will meet the mandatory minimum to support the government’s cloud migration.

Geopolitical Entities, Names, and Codes

The Geopolitical Entities, Names, and Codes (GENC) standard is the U.S. government profile of ISO 3166, “Codes for the Representation of Names of Countries and Their Subdivisions.” The GENC defines codes for the representation of names of geopolitical entities and their subdivisions that have been approved by the U.S. Board of Geographic Names and captures unique U.S. government requirements, including restrictions in recognition of the national sovereignty of a country, identification and recognition of geopolitical entities not included in ISO 3166, and the use of names of countries and country subdivisions that have been approved by the U.S. Board of Geographic Names. This standard supersedes Federal Information Processing Standard (FIPS) 10-4, “Countries, Dependencies, Areas of Special Sovereignty, and Their Principal Administrative Divisions.” Although FIPS 10-4 was withdrawn by the National Institute of Standards and Technology on September 2, 2008, NGA continued to maintain its content in an online registry known as Geopolitical Entities and Codes (GEC) until December 31, 2014, GEC was retired on March 31, 2015.

The code entries of the GENC standard reside in an online registry and may be queried for ease of use. See <https://nsgreg.nga.mil/genc/discovery>.

Elevation Surface Models

In collaboration with the DGIWG, NGA developed the Defense Gridded Elevation Data (DGED) Product Implementation Profile. The DGED defines a uniform, orthogonal, grid-based geospatial elevation model for a wide range of geospatial resolutions, including levels 1 and 2 as covered by

MIL-PRF-89020B, “Digital Terrain Elevation Data” (DTED). This standard, an implementation profile of ISO standards and technical specifications, enhances elevation data tailored to meet specific needs. Unlike traditional DTED products, the DGED product standard has several encoding options to choose from—such as GeoTIFF—depending on user needs. Use of this standard is expected to increase interoperability with and between organizations producing and using elevation data.

Geospatial Web Services

Standards for geospatial web services, as well as metadata, are focal areas for NGA, as these standards are key to the discovery, retrieval, and use of data and products—especially those that may be served up by nontraditional producers and suppliers stemming from the “Internet of things.” One way in which NGA is addressing this standardization need is through its participation in the Open Geospatial Consortium (OGC) as a strategic member, working collaboratively with its membership³ to create open standards that enable geospatial information on the web.

To ensure that these standards perform according to design, NGA is one sponsor of the OGC’s annual test bed. The test bed is designed to evaluate the interoperability of internal OGC standards and, depending on sponsor requirements, the interoperability of standards developed externally from the OGC process. The test bed provides valuable input into the applicability of those standards in a real-world scenario, usually set by the sponsors. Validation of standard readiness provides valuable benefit in the procurement process. Recent test bed activities have included Web Feature Service 2.0, Web Map Service 1.3, and Web Coverage Service 2.0. Among current efforts, NGA is working within the DGIWG to develop and test implementation profiles for the OGC’s GeoPackage 1.0 and Web Map Tile Service 1.0, which are expected to be completed in the 2017–2018 time frame.

Summary

The standards highlighted in this article represent a handful of NGA standardization initiatives that have been achieved through collaborative efforts with NSG members and partners. These standards provide an enterprise solution that enables different systems with different data to be interoperable

³ As of August 17, 2016, the OGC’s membership consists of 527 companies, government agencies, and academia from around the globe.

with one another, provided the implementations are conformant. NGA will continue to proactively work with industry partners to leverage new and emerging technologies and seek opportunities to engage and influence standardization efforts in the civil and defense domains. New standardization will focus on embracing technological advances—for example, 3D imaging, data on mobile devices, and new phenomenologies—to give our warfighters and decision makers the GEOINT needed, in the manner needed (i.e., format), when it's needed.

About the Author

Michael Harbaugh is a data architect with NGA with more than 20 years of experience in the standardization field. He serves as NGA's Departmental Standardization Officer to the DSP, working with civil and defense partners to address geospatial intelligence standardization requirements.