

Department of Commerce (DOC) Fiscal Year 2021 Agency Report

1. Please provide a summary of your agency’s activities undertaken to carry out the provisions of OMB Circular A-119, “Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities” and the National Technology Transfer and Advance Act (NTTAA). The summary should contain a link to the agency’s standards-specific website(s) where information about your agency’s standards and conformity assessment related activities are available.

The mission of the DOC is to create the conditions for economic growth, jobs creation, and opportunity within the US by ensuring fair trade nationally and internationally, providing the data necessary to support commerce and constitutional democracy, and fostering innovation by setting standards and conducting foundational research and development. Together with other bureaus of DOC, the five listed in this report support the strategic goals of accelerating US leadership, enhancing job creation, strengthening US economic and national security, fulfilling constitutional requirements, and delivering excellent customer service. The following report compiles information about how these organizations used their engagement in voluntary consensus standards and conformity assessment activities during FY2021 to support these critical mission areas.

The US Census Bureau (Census Bureau)

The US Census Bureau (Census Bureau) completed the 2020 Census, delivering the small area geography and “basic tabulations of population” to each state as required by P.L. 94-171. Voluntary consensus standards from organizations such as the International Organization for Standardization (ISO), the American National Standards Institute (ANSI), the Open Geospatial Consortium (OGC), and the Federal Geographic Data Committee (FGDC) were applied in the Census Bureau’s statistical surveys, economic analysis, and geographic programs. The collection and analysis of data for geographic programs continues with programs such as:

- The Census Bureau’s 2020 [urban-rural](#) classification is a delineation of geographic areas, identifying both individual urban areas and the rural areas of the nation. The Census Bureau’s urban areas represent densely developed territory, and encompass residential, commercial, and other non-residential urban land uses. The Census Bureau delineates urban areas after each decennial census by applying specified criteria to decennial census and other data. “Rural” encompasses all population, housing, and territory not included within an urban area.
- The [2020 Public Use Microdata Areas](#) (PUMA) which occurs every ten years after the decennial census publishes the population count to allow State Data Centers from each state, the District of Columbia, and Puerto Rico to delineate PUMAs using specific standards and criteria (specifically using the census population counts and updated census tracts from the 2020 Census). Participation is voluntary and allows a 90-day review period for State Data Centers to delineate, review, and submit their PUMAs.

The Census Bureau led the development of ISO 19160-3, *Addressing – Part 3: Quality management for address data* and is actively involved in the development of ISO 19160-2, *Addressing - Part 2: Assigning and maintaining addresses for objects in the physical world* (see item 4 below). These standards and programs, in addition to ongoing research and innovation activities, were designed to improve public access, discoverability, integration, and data sharing, and to support the open government initiative and the provisions of OMB Circular A-016 <<https://www.whitehouse.gov/wp-content/uploads/2017/11/Circular-016.pdf>>.

In 2021, the following activities exemplified the Census Bureau’s application of VCS.

1. The Census Bureau applied the International Committee for Information Technology Standards (INCITS) data standards in their contribution to the National Spatial Data Infrastructure (NSDI). Census Bureau staff continued participation in FGDC’s Geospatial Data Act of 2018 (GDA) Covered Agency Report and GDA Lead Covered Agency report surveys as a requirement of the GDA to provide information on their use of the ISO standards for all geospatial data, including 34 National Geospatial Data Assets (NGDAs).
2. The Census Bureau’s NGDA datasets represent a federal portfolio of geospatial datasets derived from the Topologically Integrated Geographic Encoding and Referencing (TIGER) System. The Census Bureau’s TIGER/Line shapefiles for these NGDAs are accessible by the general public and discoverable on [Census.gov](https://www.census.gov), the Federal Geographic Data Committee’s [Geospatial Platform](https://www.fgdl.gov), and [Data.gov](https://www.data.gov).
3. The Census Bureau submitted responses, to the FGDC, for the NGDA Baseline Standards Inventory Survey in October 2020 and has renewed licensed subscriptions to the following voluntary consensus standards through ANSI:

INCITS 31-2009 (R2019) Information Technology - Codes for the Identification of Counties and Equivalent Areas of the United States, Puerto Rico, and the Insular Areas.

INCITS 38-2009 (R2019) Information Technology - Codes for the Identification of the States and Equivalent Areas within the United States, Puerto Rico, and the Insular Areas.

INCITS 446-2008 (R2018) Information Technology - Identifying Attributes for Named Physical and Cultural Geographic Features (Except Roads and Highways) of the United States, Territories, Outlying Areas, and Freely Associated Areas, and the Waters of the Same to the Limit of the Twelve-Mile Statutory Zone.

INCITS 454-2009 (R2019) Information Technology - Codes for the Identification of Metropolitan and Micropolitan Statistical Areas and Related Statistical Areas of the United States and Puerto Rico.

INCITS 455-2009 (R2019) Information Technology - Codes for the Identification of Congressional Districts and Equivalent Areas of the United States, Puerto Rico, and the Insular Areas.

INCITS/ISO 19110:2016 (2018) Geographic information - Methodology for feature cataloguing.

INCITS/ISO 19111:2007 [R2012] Geographic information - Spatial referencing by coordinates.

INCITS/ISO 19115-1:2014 (R2019) Geographic information - Metadata- Part 1: Fundamentals.

INCITS/ISO 19115-2:2019 (2019) Geographic information - Metadata - Part 2: Extensions for acquisition and processing.

INCITS/ISO TS 19139:2007 [2015] Geographic information - Metadata XML schema implementation.

INCITS/ISO/TS 19139-2:2012 (2017) Geographic information - Metadata XML schema implementation - Part 2: Extensions for imagery and gridded data.

INCITS/ISO 19157:2013 (R2019) Geographic information - Data Quality.

INCITS/ISO 19115-2003 Geographic information - Metadata.

INCITS 453-2009 [R2014] Information Technology - North American Profile of ISO 19115:2003 - Geographic Information - Metadata (NAP - Metadata).

INCITS/ISO/TS 19115-3:2016 (2017) Geographic information – Metadata – Part 3: SML Schema Implementation for Fundamental Concepts.

4. To support 2020 Census operations, the Census Bureau developed various web mapping applications using open web service formats including GeoServices Representational State Transfer (REST) Specification services and OGC's OpenGIS Web Map Service (WMS). These applications allowed users to interact with Census Bureau data in many ways including but not limited to selecting features and viewing their attributes, searching for features by name or geocode, and identifying features by selecting them from a map. The underlying services were exposed to allow other web developers to use the Census Bureau's authoritative data in their own maps, too. A list of the web mapping applications is below:

- [TIGERweb](#) is a web-based mapping tool developed to allow users to visualize geospatial data derived from the U.S. Census Bureau's Master Address File (MAF)/TIGER database (MTDB) without geographic information system (GIS) software and without downloading TIGER data. It provides a simple way to select and view features and their attributes, to search for features by name or geocode, and to identify features by selecting them from an on-screen map. The spatial data within TIGERweb covers the 50 states, the District of Columbia, the Commonwealth of Puerto Rico, and the Island Areas. TIGERweb includes attribute information from

- the Decennial Census, Economic Census, and the American Community Survey (ACS). The Census Bureau exposes TIGERweb's GeoServices REST Specification services and OGC's OpenGIS Web Map Service (WMS), which allows developers to integrate them into their own GIS or custom web-based applications.
- Response Outreach Area Mapper ([ROAM](#)) was developed to make it easier to identify hard-to-survey areas through the analysis of socioeconomic and demographic characteristic profiles of these areas using ACS estimates available in the Census Bureau's Planning Database. Learning about each hard-to-survey area allowed the Census Bureau to create a tailored communication and partnership campaign, and to plan for field resources including hiring staff with language skills specific to the local area. These and other efforts improved response rates. The Census Bureau exposes ROAM's GeoServices REST Specification services to allow for developers to integrate them into their own GIS or custom web-based applications.
5. The Census Bureau is now actively involved in the development of ISO 19160-2, *Addressing - Part 2: Assigning and maintaining addresses for objects in the physical world*. This standard specifies how to plan, implement, and maintain addresses and corresponding address data to gain maximum benefits for governance and society. While the Census Bureau does not assign addresses within local communities, it has extensive experience in national address data management, and understanding of the principles and requirements necessary to create an address maintenance system. This standard will be valuable to stakeholders embarking on new addressing systems (e.g., developing countries, communities planning or considering a re-addressing initiative) as well as those that want to enhance their existing systems. Through participation in the development of ISO 19160-2, the Census Bureau gains valuable knowledge about how other nations maintain their data. This project also has the potential to help the Census Bureau's partners improve their address assignment and maintenance systems, which in turn will benefit the Census Bureau and other federal agencies seeking to obtain current, complete, and accurate address data.

The International Trade Administration (ITA)

ITA strengthens the competitiveness of US industry, promotes trade and investment, and ensures fair trade through the support of rigorous enforcement of US trade laws and agreements. Through its participation on US delegations addressing global standards development and trade-related standards issues, ITA works to improve the global business environment and helps US organizations compete at home and abroad. Information on ITA's work on standards can be found at: <https://www.trade.gov/about-us/office-standards-and-intellectual-property>.

In FY2021, ITA participated in a variety of trade-related international standards activities including standards development along with engaging in policy dialogues and capacity building

efforts. ITA experts participated in the US Technical Advisory Group (TAG) to ISO/TC293, Feed Machinery to support US industry's engagement through ITA's Market Development Cooperator Program (MDCP). ITA representatives also joined the virtual TAG for the recently formed ISO Special Advisory Group on Smart Farming (SAG SF), tasked with developing a gap analysis and standardization road map for smart farming applications.

ITA regularly notifies relevant US stakeholders about opportunities to participate in new standards development activities that might have trade implications with the aim of preventing future market access issues for US exporters. In FY2021 ITA also worked with the National Institute of Standards and Technology (NIST), the National Telecommunications and Information Administration (NTIA) and the Department of State to publish a monthly newsletter highlighting international standards development activities in critical and emerging areas where US engagement could benefit commercial goals.

ITA participates in the ANSI Unmanned Aircraft Systems Standards Collaborative. An ITA specialist continues to participate in the Smart Textiles Subcommittee of ASTM International (ASTM) Committee D13 on Textiles and a staff member of the Commercial Section in the US Embassy in Mexico City participates in the monthly sessions of Mexico's National Textile Standards Committee to monitor standards that could impact US textiles and apparel exporters.

In FY2021 ITA was represented on interagency teams addressing standards policy and development in the International Civil Aviation Organization (ICAO), the World Health Organization (WHO), and in Codex Alimentarius. ITA worked on standards capacity building in the Asia-Pacific Economic Cooperation (APEC) Forum and the Association of Southeast Asian Nations (ASEAN) in areas including food safety, medical devices, cybersecurity, electric vehicles, wine, blockchain and distributed ledger technology, and conformity assessment. ITA has joined inter-agency efforts led by the Department of State to shape 5G and telecommunications standardization taking place at the International Telecommunications Union (ITU), including preparations for the World Telecommunications Standardization Assembly (WTSA).

ITA engaged on standards issues with the ASEAN Consultative Committee on Standards and Quality, including organizing workshops, additive manufacturing (3D printing), and digital trade standards – particularly those related to cybersecurity and promoting digital trust - and work on standards for critical and emerging technologies through the Quadrilateral Security Dialogue (Quad) with Australia, India, and Japan, including on AI and advanced communications. ITA also supported standards engagement under the Pan-American Standards Commission (COPANT).

Bilateral engagement on standards issues was ongoing with various trading partners including through the US-Brazil Commercial Dialogue, the US-Canada Regulatory Cooperation Council, the US-EU Executive Working Group, and the US-EU Trade and Technology Council (TTC), among others. ITA maintained Standards Attaches in Beijing, Brussels, Jakarta, Johannesburg, Mexico City, and Sao Paulo.

ITA is a part of the US delegation headed by the Office of the US Trade Representative (USTR) to the World Trade Organization's (WTO's) Committee on Technical Barriers to Trade (TBT) that addresses specific standards-related trade concerns. ITA in coordination with USTR, pursued standards-related trade concerns on the floor of the WTO TBT Committee against several countries in FY2021. During FY2021, ITA also participated as part of the US Government's delegation for trade agreement negotiations with the United Kingdom, specifically the TBT, Good Regulatory Practices (GRP), and Sectoral chapter negotiations. ITA regularly works with US industry to address issues of non-compliance with trade agreement commitments found in the WTO TBT Agreement and respective Free Trade Agreement (FTA) TBT chapters.

Finally, ITA co-manages the Industry Technical Advisory Committee on Standards and Technical Trade Barriers (ITAC 14) with the Office of the US Trade Representative (USTR) which provides input to the Secretary of Commerce and USTR on standards-related policy matters.

National Institute of Standards and Technology (NIST)

NIST's mission is to promote US innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve the quality of life. As specified in the National Technology Transfer and Advancement Act (NTTAA), in authorizing legislation, and in the Office of Management and Budget (OMB) Circular A-119, NIST, through its Standards Coordination Office (SCO), assists and guides federal agencies in leveraging voluntary consensus standards and private sector conformity assessment mechanisms in their programs, procurement, and regulatory activities. SCO chairs the Interagency Committee on Standards Policy (ICSP) and works closely with federal agencies to reduce unnecessary duplication and complexity in standards and conformity assessment practices. SCO provides consultation and advice to other Federal agencies in implementing conformity assessment programs, and holds leadership roles in ANSI governance, policy, and program oversight committees. SCO also hosts www.Standards.gov to serve as a standards and conformity assessment related resource for Federal agencies, industry, and the public.

During FY2021, NIST played leadership roles in the areas of advanced communications, Artificial Intelligence (AI), cybersecurity, and quantum computing, and developed a guidance document on using inclusive language in standards for NIST staff. An estimated 570 NIST staff members participated in just under 3,500 committee activities across 327 standards developing organizations.

Advanced Communications

NIST leads the government-wide Advanced Communications Technologies Working Group (ACTWG) chartered under the ICSP to facilitate coordination of Federal agency advanced communications technologies (ACT) standards activities. The working group meets monthly and has been gathering information through presentations by participating agencies.

In addition, over 50 people across NIST come together as part of an all-of-government approach to wireless standards and contribute to global standards and specification development organizations such as 3rd Generation Partnership Project (3GPP), Institute of Electrical and Electronics Engineers (IEEE), Internet Engineering Task Force (IETF), International Telecommunication Union Radiocommunication Sector (ITU-R), Alliance for Telecommunications Industry Solutions (ATIS), and International Organization for Standardization/International Electrotechnical Commission Joint Technical Committee 1 (ISO/IEC JTC1).

Working through public-private partnerships such as the NIST-led Next G Channel Model Alliance and the National Science Foundation (NSF)-led Resilient Intelligent Next Generation Systems Program, NIST experts work with Industry and the research community to provide communication measurements, methods, and tools to enable the rapid development and deployment of Next G standards and technologies. NIST's decades of standards-setting leadership reflects its continued commitment to wireless research and development and public-private partnerships.

Artificial Intelligence (AI)

The National Science and Technology Council (NSTC) Machine Learning/Artificial Intelligence (ML/AI) Subcommittee established the role of the US Government AI Standards Coordinator with responsibility to gather and share AI standards-related needs, strategies, roadmaps, terminology, use cases, and best practices in support of reliable, robust, and trustworthy AI in government operations, including:

- planned and ongoing standards approaches and engagement activities, including a robust feedback loop with Standards Developing Organizations (SDOs);
- specific horizontal or vertical areas for prioritization;
- requirements for input into proposed standards activities; and
- analyses of whether ongoing standards activities meet Federal Government needs and whether additional guidance is appropriate.

- The Subcommittee selected the Chief of Staff of the NIST Information Technology Laboratory to fulfill the role of US Government AI Standards Coordinator.
- As part of the U.S. Government AI Standards Coordinator responsibilities, the AI Standards Coordination Working Group (AISCWG) was established in April 2021, to facilitate coordination of government agency activities related to development and use of AI standards. The group operates under the charter of the ICSP. Participants include representatives across federal agencies with expertise and/or an agency stake in the development and implementation of AI standards. The AISCWG is responsible for

assisting the ICSP in promoting effective and consistent federal policies leveraging AI standards cited in the AI Standards Plan.

The AISCWG raises awareness of federal agencies' standards needs based on their use of AI; fosters agency interest and participation in AI standards activities; fosters coordination of US Government positions regarding draft standards, standards work items, and other standards activities based on consensus processes; and establishes effective means of coordinating AI international standards activities with those of the private sector.

Delivering the needed measurements, standards, and other tools is a primary focus for NIST's AI efforts, and much of its work focuses on aspects of trustworthiness. Over the past two years, NIST has expanded and made noteworthy progress in carrying out research specifically addressing standards-oriented research. It has selected priority topics and activities based on its statutory mandates and the needs expressed by US industry, other federal agencies, and the global AI research community. Among other things, NIST recently:

- Initiated research efforts in explainable and interpretable AI, bias in AI, secure AI, user trust in AI, and evaluation of AI.
- Developed a series of reports on aspects of AI trustworthiness, including: *A Method for Evaluating User Trust in AI Systems*; *A Taxonomy and Terminology of Adversarial Machine Learning*; *Psychological Foundations of Explainability and Interpretability in AI*; and *A Proposal for Identifying and Managing Bias in AI*.
- Organized a series of ongoing workshops to build communities and advance scientific discussions, beginning with a series kickoff and consisting of one-, two-day, and multi-week sessions involving working sessions aiming to forge agreement on key terms and aspects of trustworthiness that can be incorporated into the development of standards.
- Organized a joint workshop with the Food and Drug Administration (FDA) and Defense Advanced Research Projects Agency (DARPA) on AI for Drug Development in August 2021.

Cybersecurity

NIST develops cybersecurity standards, guidelines, best practices, and other resources to meet the needs of US industry, federal agencies and the broader public. In FY2021, NIST staff actively participated in VCS committees addressing cybersecurity risk management and measurement, identity and access management, the Internet of Things, and privacy. NIST continued its effort to evaluate candidates for standardization of one or more quantum-resistant cryptographic algorithms.

Quantum Computing

NIST participates in and chairs INCITS/Quantum Computing committee serving as the US TAG to ISO/IEC JTC 1/WG14 *Information technology - Quantum computing*. This committee serves as a focus of and proponent for JTC 1's standardization program on Quantum Computing by identifying gaps and opportunities in Quantum Computing standardization and developing deliverables in the area of quantum computing. The TC maintains relationships with other relevant SDOs, and other entities involved in QC standardization. The main focus of both the US TAG and JTC 1/WG14 is on its first developing deliverable, ISO/WD 4879 *Quantum computing – Terminology and vocabulary*. This document is developing the language that will be used among quantum computing professionals as products come into fruition. NIST has acted to ensure a strong and balanced US industry input by working with US industry organizations such as the Quantum Economic Development Consortium (QED-C) to solicit feedback and has also been added to the international editorial team that manages the written content. A second document, ISO/TR *Information technology – Introduction to quantum computing*, has been posted with an updated outline.

Inclusivity Language in Standards

NIST published a Guidance for NIST Staff on Using Inclusive Language in Documentary Standards (NISTIR 8366) for the benefit of NIST staff experts who participate in the development of documentary standards as expert collaborators and leaders. The publication provides guidance on how to reduce bias in terminology used in standards development.

National Oceanic and Aeronautic Administration (NOAA)

Standardization of data acquisition and data management practices are vital to NOAA's mission and the effective sharing of its data for use by the public, industry, and academia. NOAA seeks to establish voluntary standards with selected industrial associations, academia, and national organizations of state and local governments (e.g., the American Association of State Climatologists), as well as through participation in professional societies (e.g., American Meteorological Society) and SDOs (e.g., Open Geospatial Consortium). All NOAA line organizations participate in standards development activities, which are typically coordinated through NOAA's Environmental Data Management Committee (EDMC). NOAA also participates in the Commerce Data Governance Board (established in September 2019) and subsequent Commerce Geospatial Standards Users Group (established in May 2020).

In general, standards used in many NOAA activities are established in conjunction with other Federal agencies either through joint participation in national (e.g., FGDC) and international (e.g., United Nations committee of experts on Global Geospatial Information Management) organizations or by means of bilateral and multilateral agreements with other nations. The recent implementation of the Geospatial Data Act of 2018 (GDA) and the Digital Accountability and Transparency Act (DATA Act) bring NOAA activities into sharper focus regarding standards within the FGDC. Likewise, the adoption by the US of the UN Global Geodetic Reference Frame

(UN GGRF) has affirmed US commitment to international standards. These standardization activities apply to all phases of environmental data acquisition, processing, and distribution.

- NOAA has created and is developing an implementation for the NOAA Data Strategy, its first-ever NOAA Data Strategy and Implementation Plan. The purpose of the NOAA Data Strategy is to dramatically accelerate the use of data across the Agency and with other key partners, maximize openness and transparency, deliver on mission, and steward resources while protecting quality, integrity, security, privacy, and confidentiality. The overall strategy is designed to serve as a framework for consistency that builds upon existing laws and regulations related to how NOAA uses and manages data, while being flexible and adaptable to external influences such as new policies, Executive Orders, stakeholder input, and new technologies that drive innovation within the Agency.
- NOAA is updating its data governance approach through the creation of the new NOAA Data Governance Committee and the establishment of NOAA Line Office Assistant Chief Data Officers. The NOAA Data Governance Committee (DGC) coordinates the implementation of the NOAA Data Strategy, including oversight of policies that ensure NOAA data assets are strategically and efficiently managed on behalf of the NOAA enterprise. A series of DGC Working Groups and Task Teams will be established under the DGC to include Metadata, Data Catalogs, Data Licensing, and Data Innovation.
- The Big Data Program (BDP) is an enterprise service that eliminates friction and provides public access to NOAA's open data via the cloud partner's platforms and outside the NOAA FISMA boundary. Ten-year Indefinite Delivery, Indefinite Quality (IDIQ) contracts with Amazon, Google, and Microsoft ensure public access to NOAA data with no egress charges incurred for the user or the agency. These partners and NOAA have also begun to transform data from environmental data standards (e.g., netcdf4) to more generalized and cloud-optimized standards (e.g., Cloud-Optimized GeoTIFF) of interest to the wider data science community. As of Q4 FY21, the BDP disseminated more than 220 datasets, equaling over 14 petabytes of data, including atmospheric, satellite, oceanic, fisheries, climate data and much more through the BDP public-private partnerships. The BDP also works with the cloud partners to understand users' needs, based on interactions and communications, and is developing an approach that also incorporates other DoC data, to address specific climatic and societal challenges.
- NOAA shares thousands of its datasets through the Environmental Research Division Data Access Program (ERDDAP) service (<https://coastwatch.pfeg.noaa.gov/erddap/index.html>) and the Weather and Climate Toolkit (<https://www.ncdc.noaa.gov/wct/>) which allows for the delivery and translation

of data among multiple formats. NOAA data providers use the open-standard Data Access Protocol v2.0 to support interoperable data access.

- In October 2019, NOAA's National Geodetic Survey (NGS) published a framework for defining and maintaining the State Plane Coordinate System of 2022 (SPCS2022). This standards framework is key to guide the transition from the North American Datum of 1983 (NAD 83) to the 2022 Terrestrial Reference Frames (TRFs). SPCS2022 will replace SPCS 83 (NAD 83). NGS recognizes that there is significant interest within the geospatial community as to how SPCS2022 is defined, and many wish to have a voice in the development of SPCS2022. As this framework also specifies the characteristics and requirements for SPCS2022, the intent is to define SPCS2022 such that it is a technically sound and practical projected coordinate system for the modernized National Spatial Reference System (NSRS).
- NOAA and Census co-lead the planning and implementation of all requirements under the Geospatial Data Act (GDA) of 2018. Key examples of progress include: the creation of a Commerce Geospatial Strategy and Implementation Plan; chartering and leading the Commerce Geospatial Working Group, Commerce Standards Users Group, and Commerce Imagery Users Group; successfully submitting all required GDA reports including the annual Commerce Covered Agency and 6 Geospatial Theme reports; and participating in bi-annual audits of Commerce's performance under the GDA. All of these efforts include strategic and tactical direction to Commerce bureaus to adopt data standards in the execution of their missions.
- NOAA published the NOAA Data Strategy and is in final review of the NOAA Data Strategic Action Plan as of March 2022. The purpose of the NOAA Data Strategy is to dramatically accelerate the use of data across the agency and with other key partners, maximize openness and transparency, deliver on mission, and steward resources while protecting quality, integrity, security, privacy, and confidentiality. The overall strategy is designed to serve as a framework for consistency that builds upon existing laws and regulations related to how NOAA uses and manages data, while being flexible and adaptable to external influences such as new policies, Executive Orders, stakeholder input, and new technologies that drive innovation within the agency. The strategic action plan serves as a roadmap for implementation of the NOAA Data Strategy. This action plan will establish a modernized and unified NOAA data enterprise in support of the missions across NOAA, including close coordination with the NOAA science and technology focus areas.
- NOAA has expanded its use of the international OpenSearch standard and schema.org

community metadata standards to support data discovery. These standard metadata have continued to be utilized by Google in their free-text DataSetSearch capability (<https://toolbox.google.com/datasetsearch>) which has now become a regular Google service. NOAA has continued to provide feedback to Google on the rankings of NOAA datasets.

- NOAA's newest satellites all use the open-standard Network Common Data Form (NetCDF-4) format rather than an agency-developed data format. NOAA has supported the collaborative development and is currently using standards for NetCDF-4 profile to handle in situ data from stationary and moving sensors. NOAA promotes the use of ISO-19115-2 metadata standards and encourages use of Climate and Forecast Conventions (CF) and Attribute Conventions for Dataset Discovery (ACDD) community standards for naming conventions in NetCDF file production for satellite data. NOAA's National Centers for Environmental Information (NCEI) has defined multiple NetCDF templates to guide those submitting data to NCEI in the NetCDF data format. Use of NetCDF and these templates reduces the data analysis overhead as many scientific data analysis applications readily support the NetCDF data format.
- NOAA uses the ISO 19115: "Geographic information – Metadata" family of geospatial metadata standards and participates in US representation in ISO TC211 Geographic information/Geomatics, with Census Bureau serving as the lead for DOC. NOAA continues its gradual transition to the newest version of ISO 19115.
- NOAA uses ISO 26324: "Information and documentation -- Digital object identifier system" to assign unique, resolvable, and persistent identifiers to archival datasets and technical reports.
- NOAA National Weather Service meteorological data and reports comply with World Meteorological Organization (WMO) Standards. NOAA serves as one of the WMO Information System (WIS) Global Information System Centres (GISC) and provides a portal to search all WMO Region IV data center metadata.
- Light Detection and Ranging (lidar) is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. NOAA has adopted the American Society of Photogrammetry and Remote Sensing (ASPRS) Lidar Exchange Format (LAS) standard format for lidar data and the open-source LAZ (laszip.org) for the compression of lidar data.

- NOAA/US Integrated Ocean Observing System (IOOS) requires adherence to standards as a part of its core capabilities and supports development of those standards. IOOS contributes to the Attribute Convention for Data Discovery (ACDD) via Earth Science Information Partners (ESIP), a broad-based, distributed community of data and information technology practitioners, and promulgating scientific metadata standards via <https://ioos.github.io/ioos-metadata>. IOOS also supports the development of Darwin Core and EML for biodiversity data and the development of ISO 19115 as the schema required for describing geographic information and services by means of metadata. IOOS Regional Associations must practice open data sharing via the Global Earth Observing System of Systems (GEOSS), use of ERDDAP and Thematic Real-Time Environmental Distributed Data Services (THREDDS) servers for data discovery and access, and provide metadata using relevant standards and the IOOS metadata profile – <https://ioos.github.io/ioos-metadata/>. The IOOS Catalog is the master inventory of IOOS Data Management and Communications (DMAC) datasets and data access services. Data providers are expected to register their datasets in the Catalog using standards given in <https://ioos.noaa.gov/data/contribute-data/catalog-registration/>. IOOS provides directions for setup and a gold standard ERDDAP at <https://github.com/ioos/erddap-gold-standard>. For full details in IOOS' use of standards see <https://ioos.noaa.gov/data/data-standards/> and <https://ioos.noaa.gov/data/data-standards/data-publishing/>. IOOS also coordinates efforts to establish authoritative QA/QC procedures for the U.S. IOOS core variables, as necessary, including detailed information about the sensors and procedures used to measure the variables via Quality Assurance/Quality Control of Real-Time Oceanographic Data (QARTOD).
- NOAA remained a Principal Member of the Open Geospatial Consortium (OGC), and various data providers have adopted key OGC standards, including the Catalog Service for Web (CS/W), Web Map Service (WMS), Web Coverage Service (WCS), Web Feature Service (WFS), and Sensor Observation Service (SOS). NOAA participates in OGC Working Groups to help evolve the suite of voluntary-consensus standards.
- NOAA uses GitHub to allow the standardization of NOAA code sharing with the scientific and data communities.
- NOAA has submitted data to NIH's Genbank, following established standards. GenBank is part of the International Nucleotide Sequence Database Collaboration, which comprises the DNA DataBank of Japan (DDBJ), the European Nucleotide Archive (ENA), and GenBank at the National Center for Biotechnology Information (NCBI) (<https://www.ncbi.nlm.nih.gov/genbank/>).
- NOAA's Office of Coast Survey (OCS) and the Center for Operational Oceanographic Products and Services (CO-OPS) represent the US in the International Hydrographic Organization (IHO) and on several regional hydrographic commissions. OCS surveys and nautical charts are produced to IHO standards that ensure consistent nautical charts so

that mariners can confidently use charts compiled by any member organization across the world. OCS engages heavily in the IHO working groups on standards for digital data formats, data display, and product authentication (<https://iho.int/en/standards-and-specifications>). CO-OPS adheres to IHO standards in providing water level and current information for the marine navigation community.

- NOAA's Center for Operational Oceanographic Products and Services represents the US on the Global Sea Level Observing System Group of Experts (GLOSS GE). This group establishes best practices and standards for the collection, processing, and dissemination of water level data for climate studies. CO-OPS transmits its long-term data sets to GLOSS data centers along with data from many of the world's water level organizations so that the climate research community has access to high quality water level records in a standard format on a single database.
- NOAA's National Geodetic Survey (NGS) represents the US on the UN Committee of Experts on Global Geospatial Information Management (UN-GGIM)'s Subcommittee on Geodesy (UN SCoG). The Subcommittee is developing a Global Geodetic Reference Frame (GGRF) to provide a globally consistent approach to geodesy involving a common reference system, geodetic infrastructure, standards, and education/training. The UN GGRF was adopted by the US Government along with the governments of other nations. As such, the US Government has agreed to abide by these international standards - including the adoption of a modernized NSRS that is based on the International Terrestrial Reference System (ITRS) and the International Height Reference System (IHRF). NGS is working to modernize and improve the US NSRS to do just that. A new geopotential datum and four terrestrial reference frames aligned with the UN GGRF are planned for release in 2022 and will replace the current vertical and horizontal datums. NGS also participates in the UN-GGIM:Americas regional committee to ensure that the updated NSRS is regionally consistent with the Sistema de Referencia Geocéntrico para Las Américas (SIRGAS) Reference System for the Americas, which is also based on the UN GGRF.
- NGS also represents the US on the ISO TC 211 on Geographic information/Geomatics. Definitional parameters for US reference frames, datums, and geoid models were loaded into the ISO Geodetic Registry (ISOGR), guided by ISO 19127/19135. The ISOGR is intended as a tool for GIS application developers and US Government Agencies to provide look-up tables to make reference frame transformations simpler and authoritative. ISO TC 211 also authored two standards: *ISO 19111:2019 Geographic information — Referencing by coordinates* and *ISO 19161-1:2020 Geographic information*

— *Geodetic references — Part 1: International terrestrial reference system (ITRS)*. The first updates datums and reference frames to account for time-varying movement (i.e., not just earthquakes - the whole frame moves). The second specifies adoption of the International Association of Geodesy's (IAG) International Terrestrial Reference System (ITRS), which is a component of the UN GGRF. NGS also participates in ISO TC 172 SC6 *Optics and photonics, Geodetic and surveying instruments* on geodetic instrumentation standards to ensure that appropriate standards are maintained for equipment and usage of equipment to meet positional accuracy requirements desired in the NSRS. NGS also participates in the OGC as well as ISO to ensure US FGDC standards are consistent with - if not based on entirely - internationally accepted standards following the guidance of the Geospatial Data Act of 2018 (GDA). Additionally, NGS leads efforts in the International Federation of Surveyors (FIG) to implement these standards and hold appropriate training and education seminars to effect transfer of this knowledge.

- NOAA's National Centers for Environmental Information (NCEI) has defined multiple Network Common Data Form (NetCDF) templates to guide those submitting data to NCEI in the NetCDF data format. Use of NetCDF and these templates reduces the data analysis overhead as many scientific data analysis applications readily support the NetCDF data format.
- NOAA's National Centers for Environmental Information (NCEI) uses the ISO 14721 Open Archival Information System (OAIS) Reference Model standard as the basis for archival activities supporting NOAA environmental data. In addition to being the foundation for on premise activities, it is being used as the guide for current development of a Cloud archive workflow.

National Telecommunications and Information Administration (NTIA)

NTIA contributes to the development and application of national and international telecommunication standards by leading, participating in, and making technical contributions to various voluntary national and international telecommunication standards committees, such as the 3rd Generation Partnership Project (3GPP), International Telecommunication Union (ITU-R, ITU-T), the Institute of Electrical and Electronics Engineers (IEEE) Standards Association, Radio Technical Commission for Aeronautics (RTCA), and Alliance for Telecommunications Industry Solutions (ATIS). In addition, NTIA's [Institute for Telecommunication Sciences](#) (NTIA-ITS) founded and continues to play a significant role in the [Video Quality Expert Group](#) (VQEG), which performs technical validation that is a prerequisite to standardization. VQEG is currently focused on collaborative efforts to develop new and improved methods for subjective and objective video quality assessment. VQEG contributes these updated methods to the ITU,

where ITU Recommendations are modified to accommodate rapid changes in video technologies.

In FY 2021, NTIA-ITS staff held 32 positions in seven standards bodies, including eight Chair/Co-chair/Vice-chair positions. NTIA-ITS staff filled key leadership positions in the ITU-R, including Head of the U.S. Delegation to Study Group (SG) 3 (Radiowave Propagation), International Chair and U.S. Chair of SG3 Working Parties 3K and 3L (Point-to-area propagation and ionospheric propagation and radio noise), and U.S. Chair of Working Party 3J (Propagation fundamentals). NTIA-ITS staff also filled key leadership positions in the ITU-T, including Head of U.S. Delegation to Study Group 13 (Future Networks) and Study Group 11 (Signaling Requirements, Protocols and Test Specifications). NTIA-ITS also continued its technical leadership and contributions to communications standards for emerging 5G technologies through participation in 3GPP and in that capacity, and at the behest of the National Security Council, is responsible for driving collaboration between U.S. Departments/Agencies participating in 3GPP. Finally, NTIA-ITS provided technical leadership and contributions to IEEE standards for local/personal/metropolitan area networks (LAN/PAN/MAN) through participation in IEEE 802.

NTIA-ITS leads US efforts at the ITU-R Study Group 3 (SG3), the technical group that focuses exclusively on radio wave propagation. At SG3, NTIA-ITS contributes inputs and ensures the technical accuracy and correctness of international radio wave propagation standards. SG3 Recommendations on radio wave propagation are treaty-level agreements and play a role in international agreements on spectrum allocations and sharing scenarios, such as the on-going discussions of 5G mid-band spectrum and mmWave spectrum.

In FY 2021, NTIA-ITS contributed one of the 11 U.S. technical contributions to Study Group 3. NTIA-ITS proposed an update to Recommendation ITU-R P.528 (a propagation prediction method for aeronautical mobile and radionavigation services using the VHF, UHF and SHF bands) to support requests from the International Civil Aviation Organization (ICAO). As a result of the NTIA-ITS contribution, ICAO will be able to use P.528 in their frequency management system. NTIA-ITS submitted an update to the previously proposed replacement software to support Recommendation ITU-R P.368 (Ground-wave propagation curves for frequencies between 10 kHz and 30 MHz), which is used to support broadcast services. NTIA-ITS chairs three Study Group 3 Correspondence Groups, which were active during the intersessional period. Correspondence Group CG-3K-3M-9 on aeronautical propagation produced and submitted to Working Part 3K a new revision to ITU-R P.528 (a propagation prediction method for aeronautical mobile radionavigation services using VHF, UHF and SHF bands). NTIA-ITS submitted multiple input contributions to this work, both theoretical text and software. This update supports WRC-23 sharing studies for possible new International Mobile Telecommunications (IMT) services. Correspondence Group CG-3L-7 on radio noise produced and submitted to Working Party 3L a new revision on ITU-R P.372 (radio noise). NTIA-ITS also submitted multiple input contributions to this new revision, including supporting software. Correspondence Group CG-3J-11 on reference standard atmospheres continues to work towards integrating updated weather prediction model data to improve atmospheric models for radio-wave propagation prediction methods.

NTIA's Office of International Affairs (OIA) followed and/or provided inputs to various ITU-T Sector Study Groups, which consider "Recommendations" on such diverse subjects as M2M/IoT (Machine to Machine/Internet of Things) traffic, OTT (Over the Top), Distributed Ledger Technology (DLT), Revised Internet Network Architecture proposals (e.g., New IP, Polymorphic Networking), facial recognition, and Security by Design and Cybersecurity testing, and IoT/Smart Cities. In addition to these topics, OIA, with technical support from NTIA-ITS, has been participating heavily in ITU-T Study Groups 11 and 13 to counter regional adversary efforts to develop alternate Internet Protocol standards in the ITU rather than in more appropriate SDOs; NTIA-ITS led the U.S. delegation in those study groups. NTIA's work in ITU-T focuses on industry-led, bottom-up, consensus-based standards and appropriately working with U.S. Government colleagues to help ensure the ITU-T avoids duplication of efforts with other standards development organizations such as 3GPP. NTIA-OIA also provides U.S. leadership in the ITU-T Telecommunications Specification Advisory Group (TSAG). Additionally, NTIA-OIA has also followed work in the Internet Engineering Task Force (IETF).

Direct participation by NTIA in the 3rd Generation Partnership Project (3GPP), the dominant cellular communications standards development organization, allows NTIA to advance U.S. commercial, economic, and government interests by providing technical input to promote strong unbiased standards that support fair competition in next generation/5G cellular technologies. NTIA-ITS attends 3GPP Working Groups for Services (SA1), System Architecture (SA2), and Security (SA3). Additionally, NTIA-ITS attends the Radio Access Network Working Group 1 (RAN1) focused on the physical layer for LTE and 5G. Additionally, NTIA-OIA participates in 3GPP at a Plenary level Technical Specification Group (TSG) SA and RAN.

In FY 2021, NTIA-ITS's focus was on four topics in 3GPP: spectrum sharing, non-terrestrial network, unmanned aerial systems and vehicle-to-everything communications. With the aim of contributing to the standards, NTIA-ITS proposed a study item related to spectrum sharing among incumbent and commercial users in SA1 working group.

NTIA's Office of Spectrum Management (NTIA-OSM) attends 3GPP Technical Specification Group Radio Access Networks Working Groups 1 (RAN 1) and 4 (RAN 4). NTIA-OSM's goals are to: gain a more in-depth understanding of 3GPP standards and models used in compatibility studies; monitor 3GPP proposals that have a potential to impact federal operations; identify 3GPP spectrum standards that could be adopted for federal systems; and verify that 3GPP standards are being properly used in domestic and international spectrum sharing studies.

For a number of years, NTIA-ITS has provided technical guidance to other government agencies in advocating for standardization of service features specific to public safety, emergency communications, and transportation. A continued focus in FY 2021 was to ensure that NTIA and other interested agencies obtained a comprehensive understanding of the 3GPP New Radio (5G NR — the global standard for the air interface of 5G networks) capabilities, the services 5G NR was built to deliver, and deployment scenarios in both licensed and unlicensed spectrum for the evolution to 5G. NTIA's overall goals also include monitoring regional adversary

participation efforts to subvert the open consensus-based standards processes and developing and promulgating expertise in cutting edge mobile broadband technology trends.

United States Patent and Trademark Office (USPTO) contributes to the development of international standards for patent and trademark information and documentation primarily through participation of USPTO scientific and technical experts to the Committee on WIPO Standards (CWS) of the World Intellectual Property Organization (WIPO). The standards developed are used by the USPTO and other international intellectual property organizations around the world to harmonize intellectual property information practices. The standards harmonize practices regarding electronic data processing procedures with respect to filing, examination, and publication of intellectual property data. The standards facilitate the exchange, sharing, dissemination, access and retrieval of intellectual property data and documents. USPTO staff also participate in standardization activities of the International Patent Classification (IPC) Union. The IPC provides a hierarchical system for the classification of patents according to different areas of technology. The worldwide access to patent and trademark data and documents supports US industry and organizations' knowledge of national and international intellectual property. <https://www.uspto.gov/patents-application-process/patent-search/understanding-patent-classifications/international>.

2. Please list the government-unique standards (GUS) your agency began using in lieu of voluntary consensus standards during FY 2020. Please note that GUS which are still in effect from previous years should continue to be listed, thus the total number in your agency's report will include all GUS currently in use (previous years and new as of this FY): 0