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Implementation and adoption of standards for the global geospatial information community

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Note by the Secretariat

Summary

The present paper contains the report prepared jointly by the Open Geospatial Consortium, technical committee 211 of the International Organization for Standardization and the International Hydrographic Organization for consideration by the Committee of Experts on Global Geospatial Information Management.

At its ninth session, held in New York from 7 to 9 August 2019, the Committee of Experts adopted decision 9/113, in which it noted with appreciation the many diverse and collaborative standards development and implementation activities carried out by the three standards development organizations in the global geospatial information management community. The Committee welcomed the ongoing contributions to the development of guidance and recommended actions on the standards pathway for the Implementation Guide of the Integrated Geospatial Information Framework. It requested the three organizations to continue to liaise and work with Member States on developing and adopting technical standards and to keep the Committee informed of their ongoing work. In this present report, the three organizations elaborate on their collective efforts, including the Open Geospatial Consortium's work on the development of standards for open application programming interfaces and the integration of geospatial information, statistics and other data; the continuing development of the ISO 19152 Land Administration Domain Model and the ISO 19144 series on land cover by technical committee 211; and the work on the S-100 framework to support the creation and maintenance of interoperable maritime data product specifications compliant with the ISO 19100 series of geographic information standards by the International Hydrographic Organization. This present report also provides an overview of the organizations' work regarding the use of geospatial standards in supporting the measurement and monitoring of the Sustainable Development Goals, and the development and preparation of the implementation guidance, options and actions for the standards pathway for the Implementation Guide of the Integrated Geospatial Information Framework.

* E/C.20/2020/20

I. Introduction

1. At its ninth session, held in New York from 7 to 9 August 2019, the Committee of Experts, in adopting decision 9/113, expressed its appreciation to the three standards development organizations (SDOs), namely, the Open Geospatial Consortium (OGC), technical committee 211 of the International Organization for Standardization (ISO/TC 211), and the International Hydrographic Organization (IHO), for their continuing support and valuable work. The Committee also requested that the three SDOs to continue to liaise and work with Member States on developing and adopting technical standards and to keep the Committee informed of their ongoing work regarding the use of geospatial standards in supporting the implementation of national geospatial data and systems, the Integrated Geospatial Information Framework (IGIF) and the measurement and monitoring of the Sustainable Development Goals (SDGs) and to broadly support the work of the Committee.

2. This present report details the collective efforts of the SDOs in the intersessional period since the ninth session. This includes: OGC's work on the development of standards for open application programming interfaces and the integration of geospatial information, statistics and other data; ISO/TC 211's continuing development of the ISO 19152 Land Administration Domain Model and the ISO 19144 series on land cover; and, IHO's work on the S-100 framework to support the creation and maintenance of interoperable maritime data product specifications compliant with the ISO 19100 series of geographic information standards. The Committee of Experts is invited to take note of the progress made by the SDOs in standards development and the implementation of standards.

II. Update on the work of the Standards Development Organizations

Update from the Open Geospatial Consortium

3. The OGC has fostered efforts to convene global thought leaders and technical experts to make geospatial information findable, accessible, interoperable and reusable in support of the needs of the global geospatial information management community, including those related to the SDGs. Through its member meetings, workshops, forums and summit events, OGC is addressing an expanding range of geospatial interoperability challenges facing the international community and is leading dialogue on the implications of fast changing technology and community trends. In-person quarterly member meetings were convened in North America, Europe, and Asia until early 2020 with the OGC hosting region and nation-specific forum meetings in India, Canada and the United Kingdom of Great Britain and Northern Ireland, with more activities planned for 2020.

4. The OGC has approved over a dozen new and revised standards over the past year, with a significant priority being the technology modernization of OGC's Web Services/ Application Program Interface (API) standards. The first API standard, OGC API – Features: Part 1, was approved in 2019. Work by its members is currently underway for the OGC API – Common, Records (Catalogue), Styles and Processes standards. Standards working groups are being re-chartered to advance OGC API – Maps, Coverages, and Tiles standards. In addition, the OGC Environmental Data Retrieval (EDR) API standard[1] is nearing completion, which supports the efficient and simplified access to location and time relevant environmental data from across Big Data repositories. Other approved standards include a revision of GeoPackage to further improve the flexibility and utility of this broadly implemented standard, GeoTIFF, and Earth Observation Extension for OpenSearch. In support of the Land Administration Domain Model (LADM), developed by ISO/TC 211,

[1] https://www.ogc.org/projects/groups/edr-apiswg

OGC published the Cadastre and Land Administration Thesaurus (CaLAThe) on the OGC Definitions Server for open access by applications from across the global community.

5. A comprehensive, publicly available Standards Roadmap[2] was implemented in 2019, offering insight into the status of all OGC standards under development. Moreover, to more rapidly test, validate and capture feedback regarding in-work standards from the broader developer community, OGC has also increased its use of Hackathons and Development Sprints.

6. A range of OGC innovation testbeds, pilots, and industry studies have been designed to unite technology providers and users to rapidly test, validate and advance new community interoperable solutions. Key initiatives include:

(a) The conclusion of the Maritime Limits and Boundaries Pilot[3] convened in conjunction with IHO. This pilot produced a prototype implementation of the IHO S-121 data model and an OGC – IHO standards architecture to support the digital creation, management, integration, dissemination, and onward use of official data for maritime baselines, limits, zones and boundaries information;

(b) The completion of the Disaster Resilience Pilot[4] in late 2019, with planning currently underway for a future operational exercise with first responders. This is aimed to demonstrate the applicability of OGC's standards and complementary open standards and spatial data infrastructure architecture to address the disaster lifecycle;

(c) The application of artificial intelligence and cloud computing for disaster resilience is being explored in an OGC Testbed 16[5] initiative to reduce wildfire risk and improve wildfire response, recovery, and resilience; and,

(d) An interoperability study "Modernizing SDI: Enabling Data Interoperability for Regional Assessments and Cumulative Effects"[6] was initiated in 2020 to explore solutions to enable scientists and citizens through spatial data infrastructures (SDI) to better leverage the vast amount of environmental, foundational/framework, biological, socio economic and other meaningful data, collected over time from multiple different sources, and with varying levels of standardization available.

7. OGC continued its emphasis on smart, safe and resilient cities through several interoperability pilot and industry study initiatives, including developing a 3D Internet of Things (IoT) Platform for Smart Cities[7] pilot that addresses the use of open standards for integrating environmental, building, and IoT data in Smart Cities; an Indoor Mapping and Navigation Pilot[8] demonstrated open standards approaches for the scanning, mapping and navigation of interior spaces to support first responders in fields such as firefighting; and, Building Energy Mapping and Analytics Concept Development Concept Study[9] was initiated to assess the current state of energy use within the built environment and to propose interoperable information and technology architectures to support efficient mapping and analytics related to improve energy efficiency.

2 https://www.ogc.org/roadmap
3 https://www.ogc.org/projects/initiatives/mlbp
4 https://www.ogc.org/projects/initiatives/dp
5 https://www.ogc.org/testbed16
6 https://www.ogc.org/projects/initiatives/modernizingsdi
7 https://www.ogc.org/projects/initiatives/3d-iot-platform
8 https://www.ogc.org/projects/initiatives/indoor-pilot
9 https://www.ogc.org/projects/initiatives/bdgenergycds

8. OGC's Technology Trends and Forecasting[10] program works with OGC members and experts from the global community to identify and prioritize emerging and disruptive technology trends, assess their inter-relationships and implications and determine actions that can be taken by the OGC and its partners in the SDO community to accommodate their integration into the marketplace. This program, has been both a contributor to and benefactor to the "Future Trends in geospatial information management: the five to ten year vision" report of the Committee, has recently been enhanced with an Artificial Intelligence-based Geospatial Technology Explorer application to automate the processing of over 100,000 domain artefacts (textbooks, manuscripts, and other web content) to produce an integrated and understandable visualization of the technology trend landscape for geospatial information. OGC will continue to coordinate and develop this work in alignment and cognisance of the latest edition of this Future Trends report.

9. OGC's work is guided by representatives from over 500 member organizations worldwide, representing industry, government, academia and nongovernmental organizations. OGC maintains over 40 formal liaisons and partnerships with the three SDOs and other standards organizations and associations such as the W3C, the Group on Earth Observations (GEO) and others to ensure that open geospatial standards are effective, coordinated, and that location is applied consistently across information technology standards and community applications. Moreover, OGC welcomes the participation of the Committee within OGC quarterly member meetings and public reviews of standards being formalized for approval.

Update from the technical committee 211 of the International Organization for Standardization

10. ISO/TC 211[11] develops and maintains an aligned set of standards focused on providing and recommending standards for the use of standards in other domains which can benefit from the application of geospatial information. ISO/TC 211 aims to gather its members and observers in plenary meetings twice a year. It uses these opportunities to convene its working groups, advisory groups and project teams. The 49th plenary meeting week was held in Omiya, Japan, in December 2019, with the 50th plenary convened virtually in June 2020. The upcoming 51st plenary week is planned for Stockholm, Sweden during 30 November to 4 December 2020.

11. Through establishing joint working groups (JWG), TC 211 continues to strengthen its relationship with ISO's other committees. This fosters the use of geospatial information in roughly 25 liaison committees; highlights include the development of JWG 11 on GIS and intelligent transport systems together with ISO/TC 204 and JWG 14 supporting interoperability between geospatial information and building information models with ISO/TC 59/SC 13.

12. To date, ISO/TC 211 has published 78 standards, with 22 standards currently under development or revision. Recent standards of potential interest to the Committee include: ISO 19168-1 "Geographic Information - Geospatial API for Features - Part 1: Core", to be published in July 2020 which is a result of the successful collaboration with OGC; and, ISO 19170-1 "Discrete Global Grid Systems (DGGS)", expected to be published in early 2021 to support the integration of statistical and geospatial information. Moreover, many ISO/TC 211 standards are referenced in legislation, for example there are 20 standards referenced by the European Commission's INSPIRE implementing rules. The Committee is encouraged to use the resources available to support standards implementation on ISO/TC 211 website[12],

[10] https://www.ogc.org/OGCTechTrends
[11] https://committee.iso.org/home/tc211
[12] https://committee.iso.org/sites/tc211/home/re.html

including information its standards, strategic business plan, programme of work, UML models and XML schemas.

13. Consisting of 38 participating and 32 observing members, ISO/TC211 members are drawn from national standard making bodies. Collaboration with other organizations is essential for increasing the benefits of the work, and 36 organizations are liaised with the committee. The cooperative agreement between ISO/TC 211 and OGC fosters the alignment of the working processes of the two organizations. Moreover, in 2019 a liaison arrangement was established with the W3C to further strengthen interlinkages with the main international standards organization for the World Wide Web. The work of ISO/TC 211, in cooperation with the SDOs, has a strong relevance to the work of the Committee of Experts, with the following developments during the intersessional period.

Global Geodetic Reference Frame (GGRF)

14. Several outcomes of ISO/TC 211 have a direct impact on the Global Geodetic Reference Frame (GGRF). A new standard ISO 19161-1:2020 "Geodetic references – Part 1: International Terrestrial Reference System (ITRS)" was developed to support the adoption of the ITRS as the reference system of the GGRF. The standard defines the requirements for realizing the ITRS to assist countries in defining their own ITRS-based reference systems in a consistent and compatible way to facilitate interoperability of geodetic data and products.

15. To further support interoperability, ISO/TC 211 developed the ISO Geodetic Registry[13] (ISOGR), a structured, quality assured and authoritative database of coordinate reference systems and transformations. Freely available online, the ISOGR is based on ISO standards and is controlled by a group of international geodetic experts, chaired by representatives of the International Association of Geodesy (IAG).

16. The primary standard for ISOGR is ISO 19111:2019 "Referencing by coordinates", following its revision to include developments in dynamic reference systems and geoid-based vertical datums. The development of ISOGR was supported by resources provided by Canada, enabling more robust data entry by contributing organizations. Current development efforts are focused on both the long-term financing and maintenance of the ISOGR through ongoing discussions with the geodetic community, as well working towards updating the ISOGR to meet the ISO 19111:2019 standard.

Land Administration

17. The preparation for the revision of the standard ISO 19152:2012 "Land Administration Domain Model (LADM)" has engaged the SDOs and the Food and Agriculture Organization of the United Nations (FAO), the United Nations Office of Legal Affairs' Division for Ocean Affairs and Laws of the Sea (DOALOS), the United Nations Human Settlement Programme (UN-Habitat), the World Bank, and the International Federation of Surveyors (FIG), to ensure that the proposed new parts to this standard will cover the organizational requirements. The result of the consultation of the proposed revision from July 2019 is an agreement on a multi-part standard: (1) Land Administration Fundamentals; (2) Land Registration; (3) Marine Space; (4) Land Valuation; (5) Spatial Planning; and, (6) Implementations.

18. Further preparatory work on ISO 19152 has continued, including support for the work of IHO on its S-121 standard for Maritime Limits and Boundaries. A working draft for Part 1 – Land Administration Fundamentals has been completed and will be submitted to ISO/TC 211 in July for a ballot to place it on its work programme. A working draft for Part 2 – Land Registration could possibly be available towards the end of 2020.

[13] https://registry.isotc211.org

Land Cover and Land Use

19. The fourteen Global Fundamental Geospatial Data Themes developed and adopted by the Committee of Experts have been extensively implemented by the global geospatial community and beyond, with "Land Cover and Land Use" one of these themes. To further support their implementation, ISO/TC 211 recognises the urgent need for an agreed upon Land Cover and Land Use meta-language and is developing the ISO 19144-2:2012 "Geographic information - Classification systems -- Part 2: Land Cover Meta Language (LCML)" standard. Under the leadership of FAO, future work on this standard will include a broad discussion among the entities of the United Nations system, regional bodies and related stakeholders. To develop and prepare this work, ISO/TC 211 is considering the development and revision of ISO 19144-2:2011 on Land Cover; ISO 19144-4 on Registers; and ISO 19144-3, a new meta language standard for Land Use.

20. A review summary for a study on Land Cover and Land Use was published in November 2019, and two new work items proposals have been submitted, for 19144-2 and 19144-3. The ISO 19144 series of standards is jointly developed with FAO and integrated into global observing programs and a series of meetings have been held to revise and extend these standards.

Addresses

21. Addresses provide one of the most common ways to unambiguously determine a physical object for purposes of identification and location; assisting such services as postal delivery, emergency response, marketing, mapping, utility planning and land administration. ISO/TC 211 has published a multi-part ISO 19160 "Addressing" standard to assist the many stakeholders involved in addressing activities. The various parts of ISO 19160 cover topics, such as conceptual data model; terminology for addressing; good practice for address maintenance and assignment; quality of address data; and international postal addressing, jointly developed with the Universal Postal Union:

(a) An early working draft is now available for Part 2 of the ISO 19160 standard, which focuses on assigning and maintaining addresses for objects in the physical world. The standard will facilitate the implementation of address assignment and maintenance, to contribute to global efforts on addressing the unaddressed;

(b) ISO 19160-3:2020 "Addressing - Part 3: Address data quality" has been published; and,

(c) Part 6 of ISO 19160 has been submitted for comment to the member bodies. The aim of this standard is to facilitate the digital exchange of addresses conforming to country-, region- or domain-specific profiles of ISO 19160-1. The standard will make it possible to capture and verify addresses in online forms against respective national address standards and datasets.

Update from the International Hydrographic Organization

22. The IHO has continued its development of the S-100 Universal Hydrographic Data Model, the standard is a framework[14] to support the creation and maintenance of interoperable maritime data product specifications compliant with the ISO-19100 series of geographic information standards. This includes the continued testing and evaluation of product specifications for bathymetric surface (S-102); surface currents (S-111); marine protected areas (S-122); and, under keel clearance management (S-129) for vessels navigating in waters of restricted depths. Pilot projects are underway for developing dynamic S-100 based products and services for operation in key maritime traffic areas. These projects

[14] http://s100.iho.int/S100/home/s100-introduction

include the provision of high-density S-102 data through an online cloud-based service. Portable pilot unit (PPU) manufacturers and pilots are also being included in the evaluation of the data and services.

23. New publications are under development, include a guidebook for product specification developers (Edition 1.1.0 of S-97); the "Interoperability Specification" for S-100 based navigation systems (S-98); and a proposal to implement an "S-100 Technical Readiness Levels" concept for controlling and monitoring the development of S-100 based products for inclusion in S-97. These developments will ensure that the products can be used at the operational level together with S-101 (Electronic Navigational Chart), which also means that all data flows are well managed, that data qualification requirements are consistent and data protection schemes can be applied to products before distribution to end-users and stakeholders.

24. The IHO has also approved an S-100 implementation strategy, which centres on the future provision of S-101 ENCs – the next generation of Electronic Navigational Charts. The main drivers to develop S-100 are further digitization in the shipping industry - for classic and autonomous navigation – and the benefits of "smart hydrography". S-100 will not only improve safety of navigation and shipping in ports, but will provide a cyber-secure, easily maintained software foundation that will support creative industry policy. The IHO will coordinate with International Maritime Organization (IMO) and industry stakeholders concerning the transition to the S-101 ENC production, coverage and utilization in end user applications.

25. IHO is continuing its assistance to DOALOS with the development of an S-100 based standard for maritime limits and boundaries (S-121) aiming to support Member States in their United Nations Convention on the Law of the Sea (UNCLOS) depository obligations. The first version (Edition 1.0.0) of this technical standard has now been published by the IHO for implementation and testing purposes only.

26. The IHO also featured a questionnaire to assess the status of maturity of a Marine Spatial Data Infrastructure (MSDI) and of Marine Spatial Planning (MSP) at the national level. As a result, the IHO is working on an online publication on MSDI, which will be continuously updated in a decentralized approach. An important undertaking is the OGC-IHO MSDI Concept Development Study[15] (CDS), with resources provided by National Geospatial Intelligence Agency of the United States of America. The goal of the CDS is to demonstrate to stakeholders the diversity, richness and value of a MSDI, specifically in the prevailing data, analysis, interoperability and associated services (which include web services) in addressing the needs of the marine domain.

27. In order to improve the rather fragmented image of the oceans and develop the availability of usable seabed topography from all available data resources, IHO has started its "Crowdsourced Bathymetry Campaign". A fundamental building block to this is the provision of technical guidance (IHO B-12) on how vessels can contribute depth soundings to the IHO´s Data Centre for Digital Bathymetry (DCDB) collected by using standard navigation instruments, while engaged in routine maritime operations. The resulting General Bathymetric Chart of the Oceans (GEBCO) grid of global ocean seabed topography is publicly available under open data policy terms for download and re-use. The grid is now updated on an annual basis.

[15] https://www.ogc.org/blog/2996 and https://iho.int/en/body-of-knowledge

Developing the work of the Standards Development Organizations

28. At its eighth session in August 2018, the Committee of Experts appreciated the revision of the report entitled "A Guide to the Role of Standards in Geospatial Information Management"[16] and its "Companion document on Standards Recommendations by Tier"[17], and commended the three SDOs for their efforts and resources in updating the documents following wide consultations with Member States and the professional geospatial information community.

29. The SDOs aim to commence a revision of these documents beginning in October 2020, with an expected release of a draft for consultation by Member States in early 2021. The SDOs are revising the Guide to reflect evolving community practices, and to present new and revised standards relevant to the Committee.

III. Geospatial standards in measuring and monitoring the Sustainable Development Goals

30. The SDOs continue to maintain and advance new standards, and socialise good practices within the geospatial community to help strengthen the contribution of the geospatial community to help achieve the targets and goals of the SDGs.

31. The OGC supports the application of geospatial information in relation to the SDGs, primarily through its Domain Working Groups (DWGs) and its OGC Innovation Program; ISO/TC 211 supports the development of tools that help committees to map their projects to the SDGs[18]; and, the IHO works to ensure that all the world's seas, oceans and navigable waters are surveyed and charted, providing a basis for the relevant interlinkages between the marine environment and sustainable development.

32. Interlinkages between the work of the SDOs and the SDGs include: Goal 2 - Zero Hunger (land cover/land use – ISO/TC 211); Goal 3 - Good Health and Well Being (Health Spatial Data Infrastructure - OGC); Goal 7 - Affordable and Clean Energy (OGC's Building Energy Mapping initiative, Energy and Utilities DWG); Goal 11 - Sustainable Cities and Communities (Smart Cities DWG is supporting use case definition including SDGs and standards, SCIRA and 3D IoT for Smart Cities Projects - OGC); and, Goal 14 - Life Below Water (Maritime Boundary Limits - IHO).

IV. The work of the Standards Development Organizations towards COVID-19

33. The ongoing global coronavirus (COVID-19) pandemic has further highlighted the crucial role of geospatial information to inform decision-making, through its integration with official statistics and other data. The standards developed by the SDOs underpin this capacity.

34. The OGC has fully transitioned its member meetings and other events to a virtual environment beginning in mid-March 2020. OGC community engagement has included a range of focus areas including: tutorials on OGC's API standards suite; examination of novel space-based earth observation capabilities; advancements in geospatial data science, agriculture, smart roads, the IoT, maps for the web (a joint OGC/W3C initiative), and member contributions and OGC standards applications in response to COVID-19. OGC is planning to commence a Health Spatial Data Infrastructure Pilot initiative in 2020 to

[16] http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/Standards_Guide_2018.pdf
[17] http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/Standards-by-Tier-2018.pdf
[18] https://www.iso.org/sdgs.html

define, prototype and demonstrate how to better connect heterogeneous systems and information to enable rapid and informed decision making during pandemic crises.

35. ISO/TC 211 has increased its general outreach activities. In light of the renewed need for reliable geospatial information, available standards should be usable, useful and used. In compiling emergency response visualizations from disparate sources, geospatial metadata standards are an important interoperability enabler and provide demonstrations for countries to support their own capacity building efforts. In the current fight against COVID-19, several countries report the use of the ISO 19160-1 standard on addressing, or a national profile of this standard. In South Africa, the standard for addressing is now freely available. In New Zealand, the Ministry of Health, in May 2020, mandated the use of the addressing standard for public health purposes. In China, address data based on the standard is widely used in monitoring and blocking the contagion chain of the disease. Similar use is found in the Republic of Korea. Addresses and address data are turning out to be crucial in the fight against COVID-19. Authorities need accurate and reliable address data in order to identify and trace individuals infected by the disease, as well as others who have been in contact with infected persons. Unfortunately, non-standardized addresses significantly hinder the response to COVID-19.

V. Developing the Implementation Guide of the Integrated Geospatial Information Framework (IGIF)

36. To respond to the request of the Committee of Experts, made in its decision 9/113, the SDOs have supported the continued development of the IGIF, primarily through Strategic Pathway 6: Standards of Part 2: Implementation Guide. The approach taken within the Strategic Pathway is to establish best practice standards and compliance mechanisms to strengthen integrated geospatial information management and, in particular, to enable different information systems to communicate and exchange data, enable knowledge discovery and inferencing between systems using unambiguous meaning.

37. Collectively, the SDOs support the IGIF and have been progressively addressing the need for open consensus-based standards and frameworks for integrated geospatial information management. The SDOs seek to address the priority needs of countries to foster efforts on interoperability, promote awareness raising and sharing of good practices in the use of geospatial information standards, to avoid duplication of effort, and to more efficiently leverage our collective resources.

VI. Recommended for noting by the Committee of Experts

38. The Committee of Experts is invited to take note of this present report of the SDOs and express its views on their progress, work and plans. The Committee is also invited to urge Member States to participate, through membership, in the international geospatial standards development processes and meetings of the OGC, ISO/TC 211, and IHO to follow, provide input into, and review in-work standards as they are developed, finalized and approved.