OGC Testbed-21 Call for Sponsors

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Chapter 1. Introduction

The Open Geospatial Consortium (OGC) is delighted to invite potential sponsors to contribute funding to the OGC Testbed-21 initiative. This document presents a Call for Sponsors (CFS) for the OGC Testbed-21 initiative. The OGC Testbed series brings sponsors together with several participants to tackle interoperability challenges and advance OGC practices and Standards. If you are interested in sponsoring OGC Testbed-21, please contact OGC's Standards Program before March 14th, via the contact form to discuss your organization's technology integration and other technological challenges. Please ensure that you select the 'Standards' request category on the contact form.

The OGC Testbed series is an annual research and development program that explores geospatial technology while taking current and potential future OGC Standards into account. Building on the success and outcomes of previous Testbeds as well as other OGC initiatives, OGC is now making preparations for OGC Testbed-21. A key part of the preparations is integrating requirements and ideas from potential sponsors to identify synergistic effects. OGC is therefore inviting organizations that are interested in sponsoring the Testbed to get in contact with OGC Staff to discuss requirements.

As part of the Testbed development process, OGC Staff will refine the challenges put forward by the sponsoring organizations and map those challenges to a set of work items that OGC member organizations will compete to address. OGC Staff, together with the Testbed sponsors, will then select the most qualified organizations to serve as Testbed participants and to address the work items. During the Testbed execution, OGC Staff and Testbed participants will work jointly to address the interoperability challenges identified by the sponsors.

Chapter 2. Synergistic Effects

OGC Testbeds provide a unique opportunity to explore how interoperability could be optimized within a given context. Combining technologies in a single initiative, and bringing several sponsors together, creates an environment that closely resembles the interoperability challenges faced in real-world situations. Consequently, Testbeds bring about synergetic effects by facilitating collaboration among several sponsors and experts from member organizations.

As multi-sponsor initiatives, Testbeds benefit from synergistic effects caused by overlapping interests. Sponsorship for individual tasks can be shared across sponsors, which enables the Testbed to explore new technology more deeply and ensures more realistic use cases and scenarios. OGC Staff collect the sponsors' areas of interest early in the process and share the full picture among all sponsors. This enables the sponsors to identify common interests and leads to more efficient use of the available resources.

To start the discussion process, this OGC Testbed-21 Call for Sponsors provides suggestions for the upcoming Testbed. The suggestions reflect recent discussions in recent OGC Testbeds, working groups and other initiatives as well as requirements collected from direct conversations with geospatial scientists, software architects, and practitioners. The following listed suggestions are by no means exhaustive and will be complemented with additional requirements as identified by sponsoring organizations.

Chapter 3. Suggested Topics

This section presents various topics that have emerged in discussions across the OGC Membership. Some of those topics relate to technology and practice trends that can be integrated, whereas others focus on individual technology trends. The release of this CFS follows the review of responses to the recent Testbed-21 Request for Information (RFI), as well as the review of the outputs of several OGC initiatives. The topics mentioned in this CFS also reflect ideas that have been recommended by recent OGC initiatives, as well as ideas recommended by OGC Strategic and Principal members. The topics also include other ideas that have not been discussed in any OGC fora before.

3.1. Advancement of GeoDataCubes

GeoDataCubes are multi-dimensional arrays of data that have one or more spatial dimensions. Advancement of GeoDataCubes offers several potential benefits. First, it could improve the ability to integrate information from multidimensional datasets and thus lead to greater efficiency. Second, it could help to grow the community of scientific users of Earth Observation data.

Progress from Testbed-20 included development of a GeoDataCube API Profile [1], testing of the usability of GeoDataCubes [2], and demonstration of how to handle the provenance of GeoDataCubes [3]. While significant progress has been made on the definition of GeoDataCubes, there has not been sufficient progress to advance the GeoDataCube concept towards standardization. Consequently, the following ideas for Testbed-21 have been suggested jointly by OGC staff, participants of previous Testbeds, and the sponsor community.

- Collect vendor and data provider feedback: The Testbed could include a study to determine which organisations or communities are implementing related standards (e.g. OGC API - Coverages candidate Standard, OGC API - Environmental Data Retrieval Standard, CoverageJSON community Standard, Coverage Implementation Schema Standard etc.). The study could engage directly with vendors to determine their plans for supporting coverages in the future, as well as data providers to determine their plans for publishing coverage data.
- Users of EO data workshop: Previous engagement has focused on a small fraction of the user community, typically from a specialist domain. There are, however, other communities that make extensive use of coverage data. For example, the Energy (Oil and Gas) sector or the mineral exploration community. A workshop would help to determine whether current standards meet the needs of these communities, or help to validate the geospatial community's understanding of the needs of those user communities. Potential results from the workshop(s) could include a prioritization of access interfaces based on user personas; identification of the communities and characterization of how they use coverage data; determination of what delivery methods and interfaces make their job easier.
- Switch from advancing standards to advancing usage of existing standards: The Testbed could focus on a variety of tools, for example Jupyter Notebook (JNB), Google Collab, Esri ArcGIS, Hexagon ERDAS and potentially lead to a series of Best Practice documents, code samples, and other guidance elements that help the user community in making their daily work easier.
- Focus on data access: The Testbed could also focus on the various data platforms used by the user communities and potentially front-end several data archives with standardized interfaces. This could lead to, for example, Best Practices on how to use various software to leverage data

platforms offered by space agencies and other data providers.

Respondents to the Testbed-21 RFI highlighted the need for lowering the access barrier to geospatial data for the wider scientific community, while preserving reliable, trustable and explainable results, especially for situations where geospatial data is leveraged for the training of Artificial Intelligence (AI) models or decision-making support.

3.2. Analysis Ready Data

The Committee on Earth Observation Satellites (CEOS) defines Analysis Ready Data (ARD) as "satellite data that have been processed to a minimum set of requirements and organized into a form that allows immediate analysis with a minimum of additional user effort and interoperability both through time and with other datasets." In the previous OGC Testbed-19 initiative, this definition was expanded to define ARD "as geospatial data that have been processed to a minimum set of requirements and organized into a form that enables immediate analysis with a minimum of additional user effort and interoperability both through time and with other datasets."

These definitions highlight that ARD has the potential to offer several benefits to a wide variety of users. First, it could increase the speed at which users are able to analyze data. Second, it could reduce the risk of analysts missing key information in the data that they analyze. Third, it could improve the ability of cross-functional teams to collaborate in analysis across disciplines.

In discussions with Strategic and Principal Members, they expressed interest in experimentation with existing standards to facilitate the description and publication of ARD, as well as clearly defining the scope and levels of readiness. Such experimentation could also involve the following activities recommended by previous OGC Testbeds for further investigation:

- Standardization and Integration: Research on standardizing the format and metadata of synthetic data to facilitate integration into an ARD standard.
- Quality Assessment and Evaluation: Development of methods for assessing the quality and suitability of training data for specific Artificial Intelligence/Machine Learning (AI/ML) tasks.
- Generation of Realistic and Representative Synthetic Data: Exploration of techniques for generating synthetic data that accurately represents real-world geospatial phenomena and incorporates realistic levels of complexity and variability.
- Integration with AI/ML Frameworks and geophysical models: Investigation of methods for integrating synthetic data into existing AI/ML frameworks and tools or geophysical models for earth science analysis.

Respondents to the Testbed-21 RFI highlighted the increasing role of reanalysis model data in Earth Observation applications across atmospheric, marine, and terrestrial domains. Both ARD and the OGC Training Data Markup Language for AI (TrainingDML-AI) Standard could play a role in such reanalysis use cases.

3.3. Artificial Intelligence (AI) for Geoinformatics

The adoption of Artificial Intelligence (AI) in geoinformatics has progressed at an exemplary speed over the past decade. Whereas many of the early applications that leveraged AI focused feature extraction and classification supported by Machine Learning (ML), many of the recent applications have explored productivity of the data user - supported by Generative AI. There is therefore wide-ranging interest, from prototyping of AI-focused extensions of existing OGC Standards (e.g., facilitating query); to prototyping of new AI-focused OGC Standards.

AI offers several benefits to geospatial applications. First, the ability to automate functionality offers a potential increase in productivity. Second, greater automation also offers the potential for cost savings. Third, the capabilities of generative AI applications offer the potential to increase the creativity of geospatial users involved in regional planning, or Architecture, Engineering and Construction (AEC).

Extensive research has been undertaken on the topic of AI for urban geography [4] . Many of those studies focus on socio-economic aspects, such as population flow analysis, urban growth, and social differentiation. The variability of the studies and the semantics they use highlight the need for common semantics where possible. Some of the advances made in combining Machine Learning and Semantic Web technologies, such as those by Breit et al. [5], suggest that there could be an opportunity to leverage a common model such as CityGML within the context of AI for Urban Geography. To this end, work on prototyping CityRDF, an RDF encoding of CityGML and CityJSON, could play a role in this endevor.

OGC was one of the first standardization organizations to publish a standard for describing training data, the OGC Training Data Markup Language for AI (TrainingDML-AI) Standard. Whereas TrainingDML-AI has addressed many of the challenges related to the description of training data used for AI, some challenges remain. For example, the use of common identifiers in describing the provenance of AI/ML models and the storage of such models continue to be areas of active interest. Testbed-21 could therefore explore the following:

- Protoyping of a register that leverages Semantic Web and Linked Data technologies to support unique naming of ML models and implementation of associated governance policies. Such a register could then be referenced in metadata documents that conform to the TrainingDML-AI Standard.
- Prototyping of a profile of the OGC CDB Standard with the goal of storing ML models. Such a profile could be supported by the TrainingDML-AI Standard.
- Prototyping of TrainingDML-AI records of popular AI models such as the Gemma Open Models by Google or the Llama models by Meta.

Other ideas for AI-related topics that Testbed-21 could explore include:

- An extension of OGC API - Features that uses Generative AI to facilitate the querying and interrogation of a vector feature dataset, for example through Prompt Engineering and Natural Language Processing (NLP).
- An extension of OGC API - Environmental Data Retrieval that uses Generative AI to facilitate the querying and interrogation of a coverage dataset, also through Prompt Engineering and NLP.
- A profile of OGC API - Records to support the publishing of metadata records conforming to TrainingDML-AI.

3.4. Building Blocks for Geospatial Ecosystems

A Building Block is a package of functionality defined to meet specific business needs. Many OGC Standards are structured with modular sets of requirements (or requirement classes) that collectively function as a reusable building block (OGC 05-020r29). A building block fulfils a function that can operate in the larger context of an implementation, including through combination with other OGC building blocks to create novel implementations. Building blocks developed for one Standard can be reused in another Standard.

The benefits of the building blocks approach are numerous. First, the approach could potentially offer greater availability of the full provenance of components of a standard. Second, the modularity could enable easier integration of components into larger solutions. Third, the wider pool of potential components could potentially offer greater reliability of systems.

Recently published research by OGC Staff and OGC Members considered the different approaches for conceptualizing data spaces, their structures and components [6]. The research also mapped data space components and structures to well-established data standards. A previous initiative, OGC Testbed-19, identified the following characteristics as generic for a building block (OGC 23-050):

- a package of functionality defined to meet the business needs across an organization;
- has published interfaces to access the functionality;
- may interoperate with other, inter-dependent building blocks;
- considers implementation and usage, and evolves to exploit technology and standards;
- may be assembled from other building blocks;
- may be a subassembly of other building blocks;
- ideally is re-usable, replaceable, and well-specified; and
- may have multiple implementations but with different inter-dependent building blocks.

To support the development of building blocks, OGC has been developing a Building Blocks register. Whereas the register is already showing great potential for facilitating interoperability, there still exists a need to enhance its ability to support Spatial Data Infrastructure (SDI) initiatives. In parallel with the research presented by Noardo et al. [6], which focused on building blocks for data spaces, Testbed-21 could explore how the same concepts transfer to spatial data infrastructure such as the Canadian Geospatial Data Infrastructure (CGDI) or the US National Spatial Data Infrastructure (NSDI).

3.5. Citizen-centric data

Citizen-centric data has long been an active area of research, particularly in relation to Smart Cities. Amongst its many benefits are increased public engagement, and the potential for greater trust in data. Some previous relevant work on citizen-centric data includes research by Aguilera et al. [7] and Ju et al. [8]. Aguilera et al. [7] explored citizen centric data services for Smart Cities, whereas Ju et al. [8] considered the role of citizen-centered big data analysis. What has changed in recent years has been the increasing need to make information more available and understandable to the citizen, not just the expert. This means enabling users to understand the lifecycle and provenance of their data. More recently, Meenken et al. [9] proposed a lifecycle for citizen-centric data.

Citizen-centric data also presents opportunities for the GeoPackage Standard as the Standard could improve the ability of basic users to store data on personal devices or even to move data from one device to another. For instance, Testbed-21 could build upon the security approaches developed in previous Testbeds such as Testbed-17 [10] and Testbed-18 [11] in order to prototype an approach for storing citizen-centric data in a standards-based way. Moreover, respondents to the Testbed-21 RFI highlighted the need to explore GeoParquet or GeoZarr support in cloud computing environments. Such exploration could potentially enable basic users to move their geospatial data between cloud computing environments more efficiently.

3.6. Digital Object Identifier (DOI) usage for geospatial resources

In recent years, there has been a growing need to improve the discoverability and accessibility of scientific publications based on their geographic relevance. This need has, in part, been fueled by the increasing use of location-referenced data in scientific studies. Consequently, there have been calls for the integration of geospatial metadata into scientific articles. One possible approach to achieve this is the Digital Object Identifier (DOI) system. The DOI system is used by many research publishers such as universities, as well as government organizations such as NASA, ESA, European Commission, and CNES. Some of the benefits of DOIs include persistent identification, enhanced discoverability, greater integration with journal systems, and more efficient tracking of metrics.

The DOI system is a persistent identifier used to uniquely identify documents, datasets, and other types of objects. The specification for DOIs is standardized by the International Organization for Standardization (ISO) as ISO 26324:2012 Information and documentation — Digital object identifier system. By associating DOIs with geographic information, resource publishers would then be able to carry out more effective querying, visualization, and analysis of scientific publications. Testbed-21 could explore possible solutions for associating DOI records with geospatial data. This could, for example, involve prototyping an extension of the DataCite and Crossref metadata schemas. DataCite and Crossref are some of the DOI registration agencies that have published their metadata schemas.

The Testbed could also examine possible alignment with OGC Standards, for example:

- Use of OGC API Standards to support the querying and visualization of publication data
- Alignment or leveraging of ISO 19115 metadata standards to ensure that the DOI metadata for each publication adheres to geospatial metadata standards
- Employment of JSON-FG, GeoJSON or GML for the exchange of geospatial data.

3.7. GEOINT Imagery Media for ISR (GIMI)

The GEOINT Imagery Media for ISR (GIMI) Profile of the ISO base media file format (ISOBMFF) standard is a candidate standard that provides a modular container format for both still and time-based multimedia data such as single images, motion imagery, tiled imagery, and audio. GIMI is also a profile of the High Efficiency Image File Format (HEIF). GIMI supports the incorporation of security marking, timing, and content identification, as well as other information. Some of the benefits envisaged for GIMI include support for long term sustainment of Enterprise software capabilities, support for integration of current and future imagery domain metadata models, minimizing of the risk of file size bloat, and so on.

To support the development of GIMI, Testbed-20 defined a candidate Standard for Geographic High Efficiency Image Format (GeoHEIF) [12]. The Testbed also identified several lessons and best practices [13], supported by experiences from extending open source software during the Testbed [14]. The candidate Standard specified requirements and encoding rules for using the High Efficiency Image File Format (HEIF) for the exchange of georeferenced or geocoded imagery. The Testbed proposed that the candidate Standard should be extended to support use cases based on Motion Imagery (video, streaming). Further, the Testbed proposed that future work, for example in Testbed-21, could specify a binary encoding to describe dimensions and properties of the images. The addition of the offset and scale factor in the description of the continuous properties could allow for a more compact binary encoding. For example, temperature is typically represented as a floating number but using a scale factor could be encoded as an integer.

Testbed-21 could explore inclusion of a tiling mechanism to address requirements for making GeoHEIF a Cloud Optimized format, a concept referred to in the previous Testbed as COHEIF (Cloud Optimized GeoHEIF). Testbed-21 could therefore involve benchmarking of COHEIF and contrasting with Cloud Optimized GeoTIFF (COG), both in a local drive and over the Internet using HTTP range use cases. This could build on the benchmarking successes of Testbed-20 [15]. Furthermore, the use of HEIF with a high efficiency codec can produce significant file size reduction over PNG tiles, and in combination with a low-overhead image file format, it is likely that it will probably be of the same order as PNG even for very simple files. Therefore, further benchmarking of compression algorithms, geo-enabled HEIF drivers against COG drivers, and video metadata handling would improve the understanding of available options for optimizing the performace of GeoHEIF. The benchmarking could inform future use cases, building on the use cases identified in the previous Testbed [16].

Another area of potential development of GIMI is in relation to the ontology used for describing metadata. There are at least three related standardization efforts that could facilitate development of an ontology for GIMI. The first is the on-going standardization of GeoDCAT. The second is the Semantic Sensor Network Ontology (SSN), a standard jointly developed by OGC and the World Wide Web Consortium (W3C). The third relates to the National System for Geospatial Intelligence (NSG) and the associated NSG Enterprise Ontology (NEO). In previous Testbed work, OGC members prototyped NEO Application Profiles that facilitate Linked Data applications in the NSG [17]. Since then, the NEO has been registered as a standard for the NSG. Therefore, Testbed-21 could examine the potential for an ontology that leverages NEO and the SSN to support the embedding of metadata in GIMI files whilst also being in alignment with GeoDCAT.

3.8. Integrity, Provenance, and Trust (IPT)

There is a growing need for data integrity, provenance, and trust (IPT) across the various domains that make use of geospatial data. Therefore, agile reference architectures that are reinforced with IPT frameworks are essential. These frameworks are well-positioned to expand into areas beyond geospatial data, as demonstrated in the OGC Testbed 20 IPT activity. Some of the areas that could benefit from the deployment of interoperable IPT frameworks include public health, and defense, where continuous monitoring, data integration, and interoperability are crucial.

Testbed-21 activities could involve experimentation with approaches for validating resource integrity, and building trust, as well as ensuring provenance verification through the implementation of metadata and OGC API Standards. For example, a Testbed activity could involve development of additional IPT Building Blocks that remain agnostic to specific encoding formats. By leveraging IPT frameworks, it is envisaged that geospatial solutions will be able to support the management and use of data across dynamic and complex networks, thus ensuring that data remains reliable and trustworthy. Furthermore, as highlighted by Testbed-20, by applying IPT in public health the risk of zoonotic spillover could potentially be mitigated [18].

Respondents to the Testbed-21 RFI highlighted the need for definition of metadata requirements, guidance and representations needed to achieve IPT, according to the relevant application use cases for AI and ARD. They also highlighted the need to determine how to best manage provenance in a standards-based way. They noted that the Testbed could examine the specification of provenance business logic such that such logic could be implemented in geospatial applications in order to automate the documentation of a chain of trust in data processing. They reiterated the role of Federated Agile Collaborating Trusted Systems (FACTS) and APIs in helping to implement IPT frameworks.

Respondents to the Testbed-21 RFI also expressed interest in decentralized solutions for data storage and identity management which are related to the "agile reference architecture" and IPT topic. They gave an example of exploring use of a decentralized Interplanetary File System (IPFS) solution with Amazon S3 data backend stores and applying decentralized authentication through SOLID.

3.9. Metadata and data infrastructures

There are at least three areas of standards development emerging in relation to metadata and data infrastructures. First, the Features and Geometry JSON (JSON-FG) candidate Standard is nearing completion. The candidate Standard is now stable and thus offers a path towards a JSON encoding for new data models such as MUDDI, as well as long-established data models that use other encodings. Examples of those long-established data models include the GeoSciML, IndoorGML, PipelineML, GroundWaterML, WaterML, InfraGML and CityGML Standards - all of which currently solely use the Geography Markup Language (GML).

The second area of standards development is that of metadata infrastructures. Within this area, the development of ISO 19115-4 (the JSON encoding of ISO 19115) is one of the most significant activities. Once completed, ISO 19115-4 will offer a path for profiles of ISO 19115-1 standards such as the NSG Metadata Foundation (NMF) and DGIWG Metadata Foundation (DMF) specifications.

The third area of standards development relates to infrastructures for High-Performance Computing (HPC). The increasing complexity and volume of geospatial data necessitates the application of HPC for efficient analysis and processing. Testbed-20 noted that research into the potential use of existing cloud-optimized formats as HPC-optimized formats, best practices for geospatial data indexing and partitioning, and optimal solutions for an HPC-optimized format could guide future developments in the field of HPC [19].

Respondents to the Testbed-21 RFI highlighted the need to experiment with interoperability challenges of data lakehouse solutions, with a focus on OGC Standards. A data lakehouse is data architecture that combines the capabilities of a data lake with those of a data warehouse. As a data lakehouse can hold both structured and unstructured data, the RFI respondents highlighted the issues surrounding the documentation of metadata about data quality and confidence of processing results. Respondents to the Testbed-21 RFI also highlighted the need to address the exact mechanisms to find-bind interfaces that conform to OGC API Standards, especially given the emerging GeoDCAT candidate Standard and its potential support in OGC API - Records.

The Testbed-21 RFI respondents also noted the potential to integrate the OGC 3D Tiles Community Standard and other OGC Standards into the draft Hyperspace Modelling Language (HSML) standard of the IEEE. The requirements for HSML are listed in the IEEE P2874 Standard for Spatial Web Protocol, Architecture and Governance.

3.10. Policy and Standards

Calls for data-driven policy making have grown over the past few decades [20] [21]. This has led to the growth of the market for services supporting the reporting of global indicators. The scale and growth of the market suggests significant global demand for geospatial services that support reporting against global schemes, both related to corporate financial disclosures and targets for progress against the United Nations Sustainable Development Goals (UN SDGs). However, currently there lacks the standardization needed for robust diligence, monitoring, and verification processes that could support data-driven policy making. To address this need, the OGC established the OGC Geospatial Reporting Indicators Standards Working Group to develop standards that support transparency in international reporting indicators which rely on geospatial data, referred to as Geospatial Reporting Indicators (GRI). The initial focus areas of the working group is the standardization of indicators associated with Land Degradation Neutrality (LDN) and Climate resilience. To facilitate the standardization activities of the SWG, Testbed-21 could explore both the infrastructure needs and the data model requirements for GRI.

3.11. Representation of triaxial bodies

The representation of triaxial bodies (e.g., asteroids, moons, comets) in the context of the solar system is becoming increasingly important. OGC Testbed-18 evaluated the potential use of existing OGC/ISO Standards for applications on celestial bodies other than planet Earth. These applications include data for other planetary bodies, for objects in orbit around those planetary bodies, and for objects in free flight within our solar system. Building on the lessons identified by Testbed-18, Testbed-19 addressed three threads related to non-terrestrial applications. The first thread focused on coordinate reference systems and coordinate transformations. The second thread focused on the use of 4D GeoPose (NeoPose) for highly dynamic non-terrestrial and terrestrial applications. The third thread advanced the work on Moving Features and Sensor Integration with an eye toward incorporation of the work from the first two threads.

The modeling and visualization of celestial bodies in the solar system often involve complex three-dimensional (3D) shapes; therefore, there is a need for standardized methods for representing their geometries. Whereas previous Testbeds explored the representation of positions of celestial objects, interoperability challenges for the modeling and visualization of celestial bodies such as planets, moons, asteroids, and comets endure. These celestial bodies exhibit triaxial ellipsoidal forms due to their rotation and gravitational forces and thus involve complex three-dimensional (3D) shapes. Therefore, there is a need for standardizing the methods for representing the geometries of such celestial bodies in order to more effectively manage and visualize the objects in geospatial systems. To help address this need, Testbed-21 could establish a standards-based framework for managing triaxial bodies within the context of the solar system. Further, as highlighted by respondents to the Testbed-21 RFI, the Testbed could explore the potential use of Discrete Global Grid Systems (DGGS) to support 3D and 4D indexing of celestial bodies (not just the Earth). Furthermore, respondents to the Testbed-21 RFI also highlighted the need to research and document the effectiveness of 4D radiance field models for visual positioning use cases, e.g. responding to the presentation of a video or image with a sequence of OGC GeoPose objects or single GeoPose, respectively.

3.12. Semantics and data integration challenges

This topic seeks to advance data integration on multiple fronts. First, the Arazzo specification from the OpenAPI initiative potentially offers a means of chaining implementations of OGC API Standards together. A Testbed activity to help understand how the Arazzo specification could be applied by the OGC API - Processes Standard, as an alternative workflow specification amongst others such as the Common Workflow Language (CWL), would help to broaden the potential adopter community. Second, prototyping of a JSON encoding for Coordinate Reference System (CRS) definitions that is consistent with ISO 19111 could also be a Testbed activity. The CRS Standards Working Group has already started considering options for a CRS JSON encoding.

Finally, a series of activities that leverage or enhance OGC RAINBOW, the definitions server. Some ideas for those activities include:

- Prototyping a new CRS Resolver capability for OGC RAINBOW
- Demonstrating potential application of the Sensor Model Register hosted on OGC RAINBOW
- Prototyping of an ISO 19157-based data quality measures register that is supported by Linked Data capabilities and can be hosted on OGC RAINBOW

3.13. Space Situational Awareness

The World Economic Forum recently stated that "The space economy is expected to be worth $1.8 trillion by 2035 as satellite and rocket-enabled technologies become increasingly prevalent, according to a new report." [22]. As the space economy grows, it can be expected that it will become increasingly important to provide the means to more effectively monitor, visualize and analyze the space domain. Such monitoring, visualization and analysis can help to achieve Space Situational Awareness (SSA). Therefore, Testbed-21 could demonstrate the potential role of OGC Standards in the location, modeling and representation of space objects, space debris and space weather phenomena.

Respondents to the Testbed-21 RFI highlighted the need for testing and demonstrating the application of Discrete Global Grid Systems (DGGS) to support the identification and tracking of space objects, space debris and space weather phenomena in space and time. Such an approach could potentially make it possible to assess and represent various risks in space such as collisions with space debris and extreme solar storms. Respondents to the Testbed-21 RFI also highlighted the need to explore the interoperability challenges of radiance field modelling. This could include the use of artificial neural networks, spatio-temporal elements such as 3D/4D Gaussians, and high-performance rendering via splatting or raytracing from a Radiance Field Modelling Service (RFMS) that supports the OGC GeoPose Standard.

3.14. Additional topics

Other topics have featured in recent discussions across the OGC. Those additional topics have included:

- 3D data access and seamless 2D/3D/4D transitions
- Big Data Analytics
- Cloud-native geospatial
- Data-Centric Security
- Digital Twins
- Distributed data processing and data processing pipelines
- Event driven approaches and Publish/Subscribe workflows
- Feature extraction and modeling from Full Motion Video
- Federated Security
- Geospatial for the Metaverse
- High-Performance Geospatial Computing
- New Space; the combination of technology and market advances from rocket launches, small satellites, orbital planes, evolving sensor modalities and new ground infrastructures, and the uptake of agile thinking and new business models
- OGC API Standards coordination effort and building of resource models

Chapter 4. The Testbed-21 Development Process

The development of Testbed topics is a collaborative process between OGC and interested sponsors. Early in the process, sponsors and OGC staff work together to refine use cases and requirements in order to transform those requirements into actual work items. Once those discussions are complete, OGC will develop a Call for Participation that would be released to the public once completed. When the response period of the CFP closes, OGC staff will meet with the sponsors to select the best participants to address the work items, based on the received proposals. The organizations that submit responses to the CFP will then be notified of the outcome of selection. Thereafter, the Testbed will begin its execution stage with a kick-off meeting.

Chapter 5. Main Schedule

The following Gantt chart, presented in Figure 1, highlights all major milestones of Testbed-21.

Figure 1. Gantt chart

The estimated dates are listed in Table 1. Please note that the dates are subject to change.

Table 1. Main schedule

Milestone/Activity	Date
Request for Information (RFI) is released	2025-01-24
RFI Responders Q&A; online answers will be provided as questions are submitted	2025-01-29
RFI responses due	2025-02-07
Call for Sponsors (CFS) is released	2025-02-12
Sponsor commitments due	2025-03-21
Call for Participation (CFP) is released	~~2025-03-31~~ Delayed
Sponsor contracts due	~~2025-04-15~~ Delayed
CFP Responses due	~~2025-05-15~~ Delayed
Participants selected	~~2025-06-02~~ Delayed
Testbed Kick-off meeting	~~2025-06-27~~ Delayed
Initial Draft Reports due	2025-11-15
Final demonstrations	2025-12-15
Final Draft Reports due	2026-01-15

Milestone/Activity	Date
Final deliverables due	2026-02-27

Chapter 6. Call to Action

Interested? Please contact OGC's Standards Program, via the contact form and ensure that you select the 'Standards' request category on the contact form. If you are interested, please get in contact no later than March 14th. To enable potential sponsors to discuss synergies and common needs, OGC Staff will arrange multiple sponsor coordination teleconferences until the CFS response period closes. To download a PDF copy of this Call for Sponsors, please click here https://portal.ogc.org/files/?artifact_id=110397.

References

[1] Eberle, J.: GDC API Profile Engineering Report. OGC 24-035 (Draft). Open Geospatial Consortium, available from http://ogc.pages.ogc.org/T20-GDC/.

[2] Zellner, P., Eberle, J.: OGC Testbed-20: GeoDataCubes Usability Testing Engineering Report, available from http://ogc.pages.ogc.org/T20-GDC/. OGC 24-037 (Draft). Open Geospatial Consortium.

[3] Eberle, J.: OGC Testbed-20: GeoDataCube Provenance Demo Engineering Report. OGC 24-036 (Draft). Open Geospatial Consortium, available from http://ogc.pages.ogc.org/T20-GDC/.

[4] Liu, P., Biljecki, F.: A review of spatially-explicit GeoAI applications in Urban Geography. International Journal of Applied Earth Observation and Geoinformation. 112, 102936 (2022).

[5] Breit, A., Waltersdorfer, L., Ekaputra, F.J., Sabou, M., Ekelhart, A., Iana, A., Paulheim, H., Portisch, J., Revenko, A., Teije, A.ten, others: Combining machine learning and semantic web: A systematic mapping study. ACM Computing Surveys. 55, 1–41 (2023).

[6] Noardo, F., Atkinson, R., Bastin, L., Maso, J., Simonis, I., Villar, A., Voidrot, M.-F., Zaborowski, P.: Standards for Data Space Building Blocks. Remote Sensing. 16, (2024).

[7] Aguilera, U., Peña, O., Belmonte, O., López-de-Ipiña, D.: Citizen-centric data services for smarter cities. Future Generation Computer Systems. 76, pp. 234–247 (2017).

[8] Ju, J., Liu, L., Feng, Y.: Citizen-centered big data analysis-driven governance intelligence framework for smart cities. Telecommunications Policy. 42, pp. 881–896 (2018).

[9] Meenken, E.D., Stevens, D.R., Turner, J., Zydenbos, S., Warbrick, L., Pletnyakov, P., Yoswara, H., Palmiero, C., Espig, M., King, W.W.M.G., others: A Citizen-Centric Data Lifecycle: Acknowledging Relationships, Roles and Responsibilities of Data Citizens in Digital Innovation in the Agri-Food Sector. SSRN.

[10] Balaban, A., Matheus, A.: OGC Testbed-17: Data Centric Security Engineering Report. OGC 21-020r1. Open Geospatial Consortium, available from https://docs.ogc.org/per/21-020r1.html.

[11] Matheus, A.: OGC Testbed-18: Key Management Service Engineering Report. OGC 22-014. Open Geospatial Consortium, available from https://docs.ogc.org/per/22-014.html.

[12] Pau, J.M., Selvas, N.J.: OGC Testbed-20: GEOINT Imagery Media for ISR (GIMI) Specification Report. OGC 24-038 (Draft). Open Geospatial Consortium, available from http://ogc.pages.ogc.org/T20-GIMI/.

[13] Pau, J.M., Selvas, N.J., Smith, R.: OGC Testbed-20: GIMI Lessons Learned and Best Practices Report. OGC 24-040 (Draft). Open Geospatial Consortium, available from http://ogc.pages.ogc.org/T20-GIMI/.

[14] Taghavikish, S.: OGC Testbed-20 GIMI Open Source Report. OGC 24-042 (Draft). Open Geospatial Consortium, available from http://ogc.pages.ogc.org/T20-GIMI/.

[15] Taghavikish, S.: OGC Testbed-20: GIMI Benchmarking Report. OGC 24-041 (Draft). Open

Geospatial Consortium, available from http://ogc.pages.ogc.org/T20-GIMI/.

[16] Pau, J.M., Selvas, N.J.: OGC Testbed-20: Coverage Format Selection Report. OGC 24-039 (Draft). Open Geospatial Consortium, available from http://ogc.pages.ogc.org/T20-GIMI/.

[17] Fellah, S.: OGC Testbed-14: Characterization of RDF Application Profiles for Simple Linked Data Application and Complex Analytic Applications Engineering Report. OGC 18-094r1. Open Geospatial Consortium, available from https://docs.ogc.org/per/18-094r1.html.

[18] Churchyard, P.: Testbed-20: Integrity, Provenance, and Trust (IPT) Report. OGC 24-033 (Draft). Open Geospatial Consortium, available from http://ogc.pages.ogc.org/T20-IPT/.

[19] Yu, E., Di, L.: OGC Testbed-20: High-Performance Geospatial Computing Optimized Formats Report. OGC 24-044 (Draft). Open Geospatial Consortium, available from https://gitlab.ogc.org/ogc/T20-HPGC.

[20] Buttow, C.V.: Data-Driven Policy Making and Its Impacts on Regulation: A Study of the OECD Vision in the Light of Data Critical Studies. European Journal of Risk Regulation. 1–19 (2024).

[21] World Health Organization: Data-driven policy-making and sharing of information on a common platform. In: Data-driven policy-making and sharing of information on a common platform (2023).

[22] World Economic Forum: Space is booming. Here’s how to embrace the $1.8 trillion opportunity, https://www.weforum.org/stories/2024/04/space-economy-technology-invest-rocket-opportunity/, (2024).