OGC Geospatial to the Edge Plugfest Engineering Report

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OGC Engineering Report

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Chapter 1. Summary

The Geospatial to the Edge Interoperability Plugfest, co-sponsored by Army Geospatial Center and the National Geospatial-Intelligence Agency (NGA/CIO&T) brought together technology implementers and data providers to advance the interoperability of geospatial products and services based on OGC profiles. Servers and data available via GeoPackage, WFS, WMS and WMTS, all following National System for Geospatial Intelligence (NSG) profiles were exercised and improved in various clients. Compliance Tests were executed and advanced based on feedback from the participants.

1.1. Motivation

The geospatial communities supporting defense, emergency response, and intelligence rely on geospatial data and open standards to accomplish their mission. To make sharing of data meet their specific needs, they used profiles. Profiles provide strict implementation guidance to ensure interoperability of geospatial systems in these highly specialized and demanding environments. Implementations following profiles compliant to open standards support mission critical operations for executing effectively and efficiently.

A Plugfest, an initiative of the OGC Innovation Program [http://www.opengeospatial.org/ogc/programs/ip], provides the right venue for sponsors and technology implementers to come together in a collaborative agile process to solve geospatial challenges. The Plugfest assisted tool enhancement and provided guidance to improve the delivery of enterprise geospatial data to end users. In this initiative, a Plugfest was used to bring more than thirteen data/service producers and clients of data following NSG profiles. It help discovered implementation issues and advance executable test suites.

1.2. Prior-After Comparison

Before the Plugfest very few implementations were able to interact with NGS profiles. This is commonly the case when communities want to restrict a rule from the base standard or want to extend what the base standard offers. The support for these profiles is not commonly a feature that comes packaged in software products. After the Plugfest more implementations were available implementing the NSG profiles.

The profiles implemented in the Plugfest had corresponding executable test suites. These profiles test suites were in beta by the end of the initiative, ready to be move forward for public release by the OGC Technical Committee. Feedback related to the executable test suites was provided by the participants. In particular, the GeoPackage test was improved during the Plugfest.

1.3. Recommendations for Future Work

Activities like this Plugfest should be performed for new profiles or new standards allowing participants to come together to solve interoperability issues. The result, of high value to the geospatial community, is improvement of the standards and advancement of test suites.

1.4. Document contributor contact points

All questions regarding this document should be directed to the editor or the contributors:

Contacts

Name	Organization
Luis Bermudez	OGC

1.5. Foreword

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

Chapter 2. References

The following normative documents are referenced in this document.

NOTE: Only normative standards are referenced here, e.g. OGC, ISO or other SDO standards. All other references are listed in the bibliography. Example:

- NSG GeoPackage 2.1 (raster and vector data), based on the OGC GeoPakage 1.1 standard: https://nsgreg.nga.mil/doc/view?i=4379
- NSG WMS 1.0 (raster data), based on the OGC WMS 1.3 standard: https://nsgreg.nga.mil/doc/view?i=4209&month=11&day=13&year=2017
- NSG WMTS 1.1 (raster data), based on the OGC WMS 1.0 standard: https://nsgreg.nga.mil/doc/view?i=4448
- NSG WFS 1.0 (vector data), based on the OGC WFS 2.0 standard: https://nsgreg.nga.mil/doc/view?i=4388&month=11&day=17&year=2017

Chapter 3. Overview

This Plugfest, co-sponsored by Army Geospatial Center and the National Geospatial-Intelligence Agency (NGA/CIO&T), brought together technology implementers and data providers to advance the interoperability of geospatial products and services based on community profiles. The Plugfest assisted on tool enhancement and provided guidance to improve the delivery of enterprise geospatial data to end users.

Examples of how end user communities will benefit form this work are:

- First responders, relief workers and fire fighters preparing for and operating in austere network environments.
- Emergency planners and managers supporting hurricane, wildfire, and earthquake preparedness, relief/response activities and damage assessment.
- Soldiers/warfighters during planning and executing operations specifically in disconnected, intermittent, and limited network environments.

The geospatial communities supporting defense, emergency response, and intelligence rely on geospatial data and open standards to accomplish their mission. To make sharing of data meet their specific needs, they used profiles. Profiles provide strict implementation guidance to ensure interoperability of geospatial systems in these highly specialized and demanding environments. Non-compliance to open standards profiles prohibits mission critical operations from executing effectively and efficiently.

Additionally, members of the IC, DoD, non-DoD/IC Federal agency members of the NSG, international partners, state/local municipalities, and Native American tribal organizations that are responsible for the operation, acquisition and/or development of systems and applications which collect, procure, produce, serve, exchange, or use GEOINT data are mandated to comply NSG implementation standards (NSGM 3202). The support of these profiles affect government acquisition decisions to ensure that all systems within the government can communicate appropriately. [From GEOINT Functional Manager Standards Assessment (GFMSA) Program Manual, NSGM 3202, June 2016]

A Plugfest, an initiative of the OGC Innovation Program [http://www.opengeospatial.org/ogc/programs/ip] provides the right venue for sponsors and technology implementers to come together in a collaborative agile process to solve geospatial challenges. A Plugfest provides the scenarios and testing environment to advance implementation of profiles in commercial and open source software products. A Plugfest allows organizations to test and validate that their software products can interoperate with other products implementing the same standards.

Chapter 4. Plugfest Description

4.1. Goal

The goal of the Plugfest was to increase interoperability of information system using community profiles. The Plugfest assisted on tool enhancement and provided guidance to improve the delivery of enterprise geospatial data to end users.

4.2. Profiles

The profiles used in the initiative were:

- NSG GeoPackage 2.1 (raster and vector data), based on the OGC GeoPackage 1.1 standard: https://nsgreg.nga.mil/doc/view?i=4379
- NSG WMS 1.0 (raster data), based on the OGC WMS 1.3 standard: https://nsgreg.nga.mil/doc/view?i=4209&month=11&day=13&year=2017
- NSG WMTS 1.1 (raster data), based on the OGC WMS 1.0 standard: https://nsgreg.nga.mil/doc/view?i=4448
- NSG WFS 1.0 (vector data), based on the OGC WFS 2.0 standard: https://nsgreg.nga.mil/doc/view?i=4388&month=11&day=17&year=2017

4.3. Plugfest Participation Roles

The participants in the Plugfest took the following roles:

- **Data Providers** were organizations providing data sources either serving it via OGC services or providing file.
- **Service Providers** were organizations that produced services for clients to access.
- **Client Providers** were organizations that provided clients that consumed GeoPackage data and services to be used for a specific purpose.

4.4. Sprints

Sprints happened virtually allowing participants around the world to participate and to minimize costs related to travel. Each sprint lasted for 1 week. During the sprint week participants were available to respond to inquires posted by other participants. In the sprint time clients performed a set of operations following a scenario and documented their success and failures.

Two sprints were planned on this Plugfest.

Sprint 1 tested existing commercial and/or open source products against the scenarios. A limited

(not for public dissemination) report on Sprint 1 findings, not revealing vendor information, was shared with the Sponsors and relevant OGC Standards Working Groups. The findings (need for improvement in data structure, servers and clients) was properly documented.

Sprint 2 Occurred 3 months after the Sprint 1. It repeated the test performed in Sprint 1. Participants had three months to improve their software to better create the GeoPackage files and improve their services and clients based on the feedback from Sprint 1.

4.5. Schedule

- March 6 - Participants kickoff (Pre-sprint clarification open to registered participants)
- March 30 - Update scenarios
- April 16 - Information about sources (data and servers) was provided to OGC
- April 20 - Data and Servers ready for Sprint 1
- April 23-27 - Sprint 1 clients testing
- April 30-May 11 - Compilation of results by OGC
- April 30-July 16 - Discussions in GitHub issue tracker
- July 16 - Information about data and servers was provided to OGC
- July 20 - Data and Servers ready for Sprint 2 (Improved services based on feedback from Sprint 1)
- July 23-Aug 2 - Sprint 2 clients testing
- September 9 - Draft report
- September 28 - Report submission to OGC TC for public release approval

4.6. Data

Two types of data, based on NSG Profiles, were used in the initiative: - **Vector data** used to create, publish and ingest GeoPackage files as well as to publish to and ingest data from WFS servers. - **Raster data** used to exercise WMS and WMTS servers.

4.6.1. Vector Data

Vector data used in the Plugfest was based on the Ground-Warfighter Geospatial Data Model (GGDM 3.0), which is based on the [NSG Application Schema (NAS) version 7](https://nsgreg.nga.mil/doc/view?i=81104&month=2&day=9&year=2016). Various files were created following this model to be used by participants to create GeoPackage or vector files to be served via a WFS.

The NAS Model Entity Catalog provides a set of features, attributes and enumeration values to be used when encoding vector information. It was provided as an Excel File

[https://portal.opengeospatial.org/files/?artifact_id=77705]. It was used by participants to understand better the feature types (semantics) of the data.

The data region was based on Puerto Rico. The datasets contained the following layers: * USGS Puerto Rico data for roads and trails, airports, rivers, selected buildings, built-up areas, and some surface areas including runways, counties, a forest, cemeteries and conservation areas. * US Transportation Data from which Heliport and Water Aerodrome points pulled from airport data; ports and anchorages pulled from port data. * US Maritime data for maritime limits restricted to Puerto Rico area. * US Census Bureau coastlines restricted to land/water boundaries for the Puerto Rico area.

The Data was available for download in the following formats:

- GML [https://portal.opengeospatial.org/files/?artifact_id=77716]
- Composite ArcGIS (10.1+) File Geodatabase [https://portal.opengeospatial.org/files/?artifact_id=77715] in flattened mode with feature datasets and with no subtypes.
- JSON [https://portal.opengeospatial.org/files/?artifact_id=77717]
- GeoJSON [https://portal.opengeospatial.org/files/?artifact_id=77718]
- CSV [https://portal.opengeospatial.org/files/?artifact_id=77719]

The list of features types contained in the source files was as follows:

- ADMINISTRATIVE_SUBDIVISION_S
- BUILDING_P
- BUILT_UP_AREA_P
- CEMETERY_S
- CONSERVATION_AREA_S
- DAM_C
- DAM_S
- DATASET_S
- DOLPHIN_P
- ENTITY_COLLECTION_METADATA_S
- FORESHORE_S
- FOREST_S
- GAUGING_STATION_P
- HELIPORT_P
- INLAND_WATERBODY_S

- LAND_AERODROME_P
- LAND_WATER_BOUNDARY_C
- MARITIME_LIMIT_C
- MILITARY_INSTALLATION_S
- NAVIGABLE_CANAL_S
- PARK_S
- PIPELINE_C
- PORT_P
- REEF_C
- RIVER_C
- RIVER_S
- ROAD_C
- ROCK_FORMATION_P
- RUNWAY_S
- SOIL_SURFACE_REGION_S
- TRAIL_C
- TUNNEL_C
- WATER_AERODROME_P
- WATER_WELL_P

4.6.2. Raster Data

The raster data was based on the Sentinel 2A Multispectral Instrument (MSI) [https://earth.esa.int/web/sentinel/user-guides/sentinel-2-msi/overview], made available by the European Space Agency (ESA) within the Global Monitoring for Environment and Security (GMES) programme. The true color composites (red, green, blue) from the orthorectified Level-lC products were used to generate map data for WMS, WMTS, and GeoPackage files.

The Sentinel data are freely available through the Copernicus Open Access Hub [https://scihub.copernicus.eu]. The data used in the Plugfest corresponded to the region of Puerto Rico and the True Color Image (TCI).

The Table below lists the subset Product ID's from the Sentinal 2A mission that were used by the data providers. From each image set, the `*TCI.jp2` image was used to create the output products. Participants used the [Copernicus Hub recommend API script](https://scihub.copernicus.eu/twiki/do/view/SciHubUserGuide/5APIsAndBatchScripting#Download_full_product_from_its_U) to download each dataset.

Product ID	Unique ID (API access)
S2B_MSIL1C_20171209T150709_N0206_R082_T19QFA_20171209T195400	a6a9d67d-fbd5-47be-b5c7-92d680b5028b
S2B_MSIL1C_20171209T150709_N0206_R082_T19QGA_20171209T195400	2c6a75a4-7327-45b0-b493-ea9a40982b13
S2B_MSIL1C_20171209T150709_N0206_R082_T19QGV_20171209T195400	2590351c-a1ae-4592-9b3d-83358d8b13f1
S2B_MSIL1C_20171209T150709_N0206_R082_T19QHA_20171209T195400	87f334c4-1993-409a-bd46-79a58a8ba243
S2B_MSIL1C_20171209T150709_N0206_R082_T19QHV_20171209T195400	96c5aee0-68d9-4c11-8182-e78b8adca7c1
S2A_MSIL1C_20161219T150712_N0204_R082_T19QFV_20161219T150714	31d6900f-3164-4243-84f8-84d39982a4fe

Table 1. Sentinel 2 Product IDs

After setting up an account, the unique id can be plugged in the URL string to form the link for download. For example: https://scihub.copernicus.eu/dhus/odata/v1/Products('a6a9d67d-fbd5-47be-b5c7-92d680b5028b')/$value

After downloading the data the participants were responsible for the merge and tiling of this imagery data as per the NSG specifications for raster data.

4.7. Data Consumer Testing Reports during Sprints

4.7.1. Organizations acting as clients/users

The following organizations acted as clients/users of the Plugfest.

- AGC-Nett Warrior
- AGC-Sitaware
- DCGSA
- Compusult
- Envitia
- Esri
- Image Matters
- Naval Research Laboratory
- VATC

4.7.2. Data, Services and Templates

The Data and Services were provided by:

- AGC-ENFIRE
- AMRDEC
- Compusult
- DCGSA
- Esri
- GeoSolutions
- NRL
- VATC

The name of the sources were anonymized. The links and templates used in Sprint 1 are detailed in the table bellow.

Source type	Source short name (with link)	Template used to report
GeoPackage_Vector	GeoPackage_Vector_Apollo [https://esri.box.com/s/q4j00xa8wi98kfhoqa0khzicfbpgy8vl]	GeoEdgePlugfest-S1-GeoPackageVector-sourceName-orgName [https://portal.opengeospatial.org/files/?artifact_id=78808]
GeoPackage_Raster	GeoPackage-Raster_Jupiter [http://tbd.com]	GeoEdgePlugfest-S1-GeoPackageRaster-sourceName-orgName [https://portal.opengeospatial.org/files/?artifact_id=]
WMS	WMS_Mercury [https://externaltest.dev.geocloud.com/server/services/PuertoRicoRaster/MapServer/WMSServer?request=GetCapabilities&service=WMS]	GeoEdgePlugfest-S1-WMS-sourceName-orgName [https://portal.opengeospatial.org/files/?artifact_id=]
WMS	WMS_Mars [http://mdms1-devel1.compusult.net/wes/GeopackageWMS/259?request=GetCapabilities]	GeoEdgePlugfest-S1-WMS-sourceName-orgName [https://portal.opengeospatial.org/files/?artifact_id=]
WMTS	WMTS_Pluto [https://externaltest.dev.geocloud.com/server/rest/services/PuertoRicoRaster/MapServer/WMTS/1.0.0/WMTSCapabilities.xml]	GeoEdgePlugfest-S1-WMTS-sourceName-orgName [https://portal.opengeospatial.org/files/?artifact_id=]
WMTS	WMTS_Oberon [http://mdms1-devel1.compusult.net//wes/GeopackageWMTS/258/1.0.0/WMTSCapabilities.xml]	GeoEdgePlugfest-S1-WMTS-sourceName-orgName [https://portal.opengeospatial.org/files/?artifact_id=]

The links and templates used in Sprint 2 are detailed in the table bellow.

Source type & Source short name	Template to provide feedback
GeoPackage_Vector_Apollo [https://portal.opengeospatial.org/files/?artifact_id=80149]	GeoEdgePlugfest-S2-GeoPackageVector-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80155]
GeoPackage_Vector_Jupiter [https://hawk.compusult.net/ogc/PR_GGDM_3.0_Profile_File_Geodatabase.gpkg]	GeoEdgePlugfest-S2-GeoPackageVector-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80155]
[GeoPackage_Vector_Rigel]	GeoEdgePlugfest-S2-GeoPackageVector-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80155]
GeoPackage_Vector_Orion [https://vatcinc-my.sharepoint.com/:u:/p/gjohnson/EQQH-HBsfjVEjZ8G_7Oh2goBFWtI7nOklduRJYWDraO3Gw?e=nWlA4p]	GeoEdgePlugfest-S2-GeoPackageVector-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80155]
GeoPackage-Raster_Apollo [https://portal.opengeospatial.org/files/?artifact_id=80148]	GeoEdgePlugfest-S2-GeoPackageRaster-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80154]
GeoPackage-Raster_Jupiter [https://hawk.compusult.net/ogc/sentinel2a_peurto_rico_tci.gpkg]	GeoEdgePlugfest-S2-GeoPackageRaster-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80154]
GeoPackage-Raster_Orion [https://vatcinc-my.sharepoint.com/:u:/p/gjohnson/EQQH-HBsfjVEjZ8G_7Oh2goBFWtI7nOklduRJYWDraO3Gw?e=nWlA4p]	GeoEdgePlugfest-S2-GeoPackageRaster-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80154]
WMS_Mercury [https://externaltest.dev.geocloud.com/server/services/PuertoRicoVectorRaster/MapServer/WMSServer]	GeoEdgePlugfest-S2-WMS-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80153]
WMS_Mars [https://wes-online.compusult.net/wes/GeopackageWMS/665?request=GetCapabilities]	GeoEdgePlugfest-S2-WMS-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80153]
WMTS_Pluto [https://externaltest.dev.geocloud.com/server/rest/services/PuertoRicoRaster/MapServer/WMTS/1.0.0/WMTSCapabilities.xml]	GeoEdgePlugfest-S2-WMTS-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80152]
[WMTS_Calypso]	GeoEdgePlugfest-S2-WMTS-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80152]
WMTS_Oberon [https://wes-online.compusult.net/wes/GeopackageWMTS/665/1.0.0/WMTSCapabilities.xml]	GeoEdgePlugfest-S2-WMTS-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80152]
WFS_Janus [https://externaltest.dev.geocloud.com/server/services/PuertoRicoVector/MapServer/WFSServer?request=GetCapabilities&service=WFS]	GeoEdgePlugfest-S2-WFS-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80151]
WFS_Neptune [http://cloudsdi.geo-solutions.it/geoserver/geoedge/ows?request=GetCapabilities&service=WFS]	GeoEdgePlugfest-S2-WFS-sourceName-orgName.doc [https://portal.opengeospatial.org/files/?artifact_id=80151]

4.7.3. Communications

If there were any issues with any test, the questions were logged to the issue tracker [https://github.com/opengeospatial/geoedge-Plugfest/issues]. Participants were encouraged to watch [https://help.github.com/articles/watching-and-unwatching-repositories/#watching-a-single-repository] the repository during the sprint so they were notified and able to provide comments if a question from another participant came up.

4.8. Templates

Each user (client) had to test a data or server and then answer a set of questions. The questions for the vector and raster sources are summarized in this section.

4.8.1. Vector Questions

Inland water body query

Find all inland water bodies where the full name starts with 'Lago’ and the highest elevation is greater than 70.

Reservoir query

Find all inland water bodies where the inland water type is reservoir and the area is greater than 0.046.

Traill Number query

Provide the full names of all trails that have specified domain value attribute containing the string subset: TraillNumber:T300.

Linear Rivers query

Find all linear rivers where the full name ends with 'de la Plata'.

Guaynabo query

Find all built up areas where the height is less than 35, the memorandum is ‘San Juan’, and the World Port Index Identifier is 'Guaynabo'.

Firefighting Carretera query

Find all buildings where the address does not contain Carretera, the feature function is firefighting, and the specified domain value starts with '(Zipcode:006'.

S1200 query

Find all roads where the geography name is 'Pr- 20', and where the feature unique identifier is S1200.

Conservation area query

Find the largest conservation area based on area and report the full name of that conservation area. What is the full name? What is the Area? Provide a screenshot.

ICAO query

Find the ICAO Location Indicator for the heliport located at the Bayamon Rgnl Hospital. What is the location indicator? Provide a screenshot.

Subdivision query

Find the administrative subdivision that contains the building “Cuerpo de Bomberos de Orocovis”. What is the name? Provide a screenshot?

4.8.2. Raster Questions

Provide screenshot for the zooms (and scales) specified.

Note: In the below requests, the center point of a designated area is identified. The participant should go to the center point and then zoom to the designated scale and take a screen capture of the resulting image. The screen capture should be bigger (contain) the image returned to ensure that we will be able to compare images returned by different clients.

Zoom to full extent of the layer

Scale: 1:500,000

The extent of the image returned should be centered on the centroid of Puerto Rico, which is approximately this location: EPSG 4326: - 66.66, 18.20 and then zoom to the 1:500,000 scale. If the designated scale is not available, zoom to the closest scale that is available and include that information along with the image..

Scale: 1:20,000

The extent of the image returned should be centered on the centroid of Puerto Rico, which is approximately this location: EPSG 4326: - 66.66, 18.20 and then zoom to the 1:20,000 scale. If the designated scale is not available, zoom to the closest scale that is available and include that information along with the image.

Chapter 5. Results and Recommendations

5.1. Summary of Experiments

The results of Sprint 1 were summarized in the following table.

Provider / Consumer	E	L	Z	H	G	J	F	C	B	A
GeoPackage_Vector										
Apollo	X	X	X		X	X	X			
Jupiter	X	X	X		X					
Rigel	X	X			X					
Orion	X	X	X		X					
								X		
GeoPackage-Raster										
Apollo		X	X		X		X		X	X
Jupiter		X	X		X				X	X
Orion		X	X		X	X			X	X
								X	X	X
									X	X
WMS										
Mercury		X	X	X	X					X
Mars			X	X	X					X
										X
WMTS										
Pluto			X	X	X		X			
Calypso			X	X	X		X			
Oberon			X	X	X		X			
WFS										
Janus		X			X	X				
Neptune		X			X	X				

The red marks indicate that the client was not able to interact with the server. Overall most servers were able to communicate with the clients.

For Sprint 2 it was capture if the client was able to perform successfully all the tests with a particular source. The green cells indicate a successful interaction.

Provider / Consumer	E	L	Z	H	G	J	F	C	B	A
GeoPackage_Vector										
Apollo	X	X	X		X		X			
Jupiter	X	X	X		X		X			
Orion	X		X		X		X			
GeoPackage-Raster										
Apollo	X	X	X		X		X		X	X
Jupiter	X		X		X		X		X	X
Orion	X				X		X		X	X
Astra										X
A_7_13									X	X
A_12_12									X	X
A_14_14									X	X
WMS										
Mercury	X	X	X	X	X		X			X
Mars	X		X	X	X		X			X
WMTS										
Pluto	X	X	X	X	X		X			
Calypso					X					
Oberon	X	X	X	X	X					
WFS										
Janus	X	X		X	X					
Neptune	X	X		X	X					

Figure 1. "Sprint 2 Results

5.2. Selected Screenshots

Following are some examples provided by the participants:

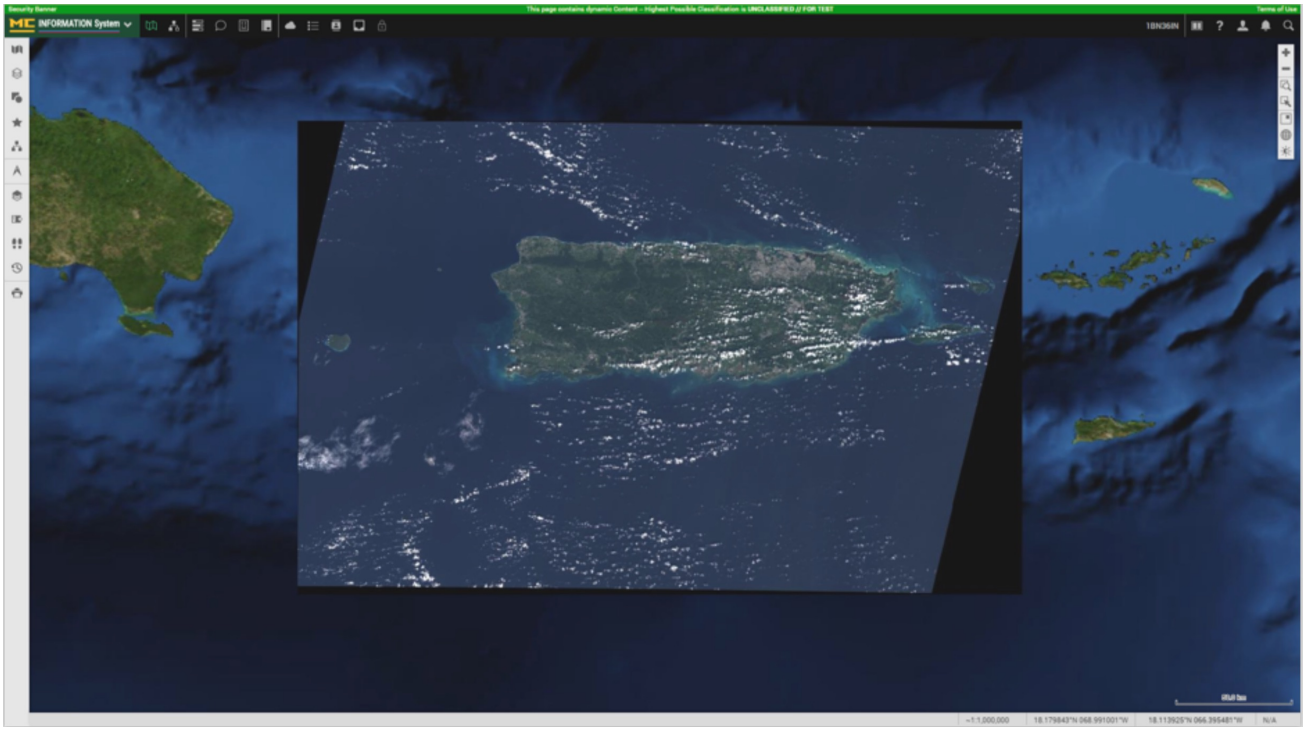


Figure 2. Full extent raster data from GeoPackage with Client A and GeoPackage Vector Apollo

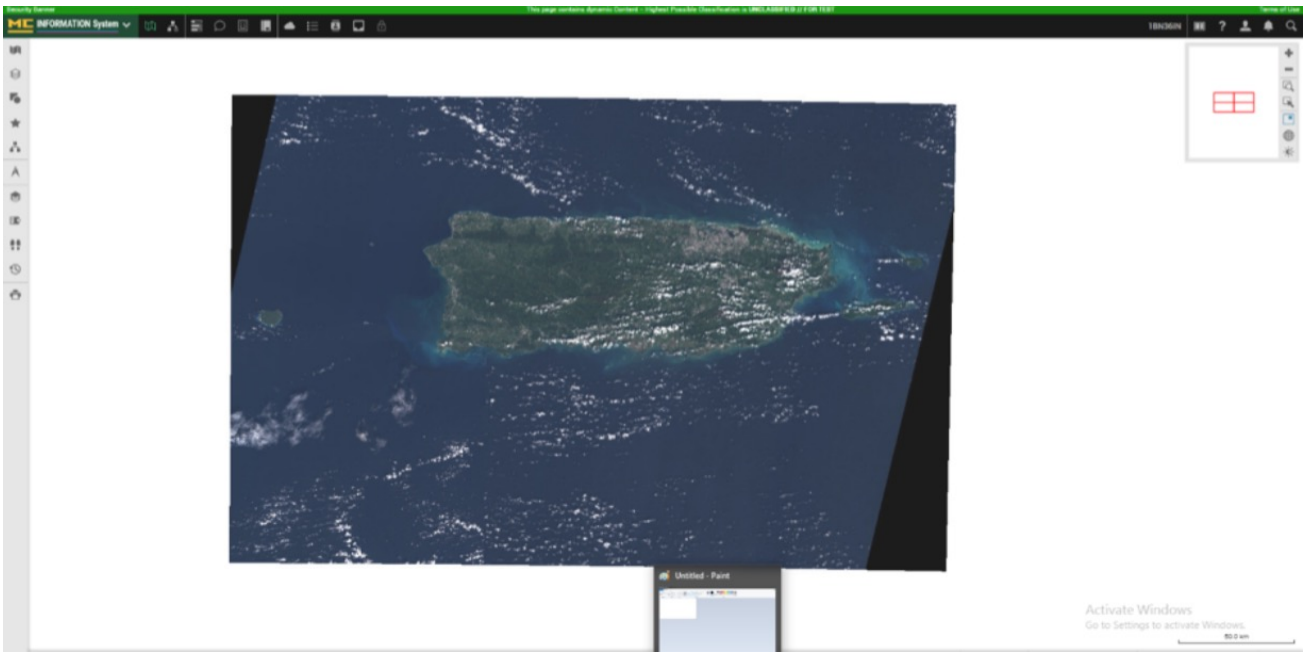


Figure 3. Full extent raster data from WMS with Client A and WMS Mercury

Figure 4. Full extent raster data from WMS with Client L and WMS Mercury

Figure 5. 1:25000 extent raster data from WMS with Client H and WMS Mercury

Figure 6. ~1:25000 extent raster data from WMS with Client G and WMS Mercury

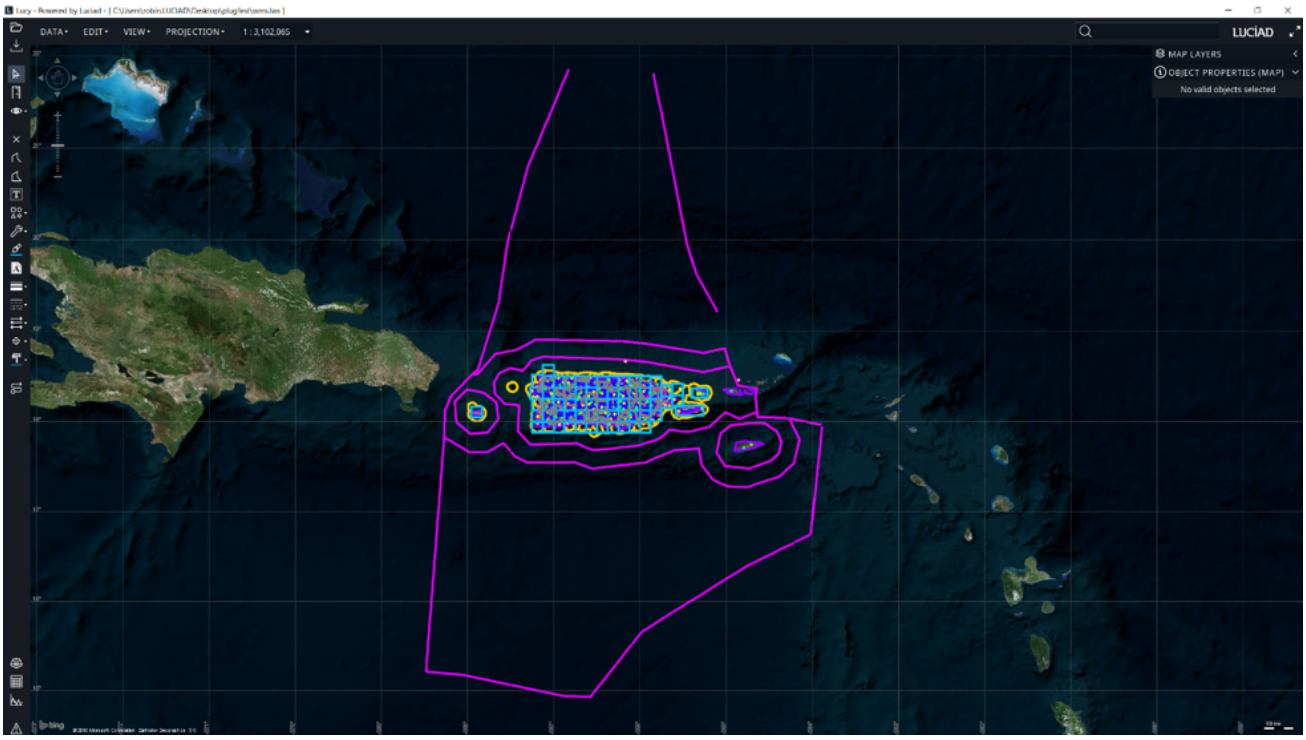


Figure 7. Vector and Raster data from WMS Mars by Client G

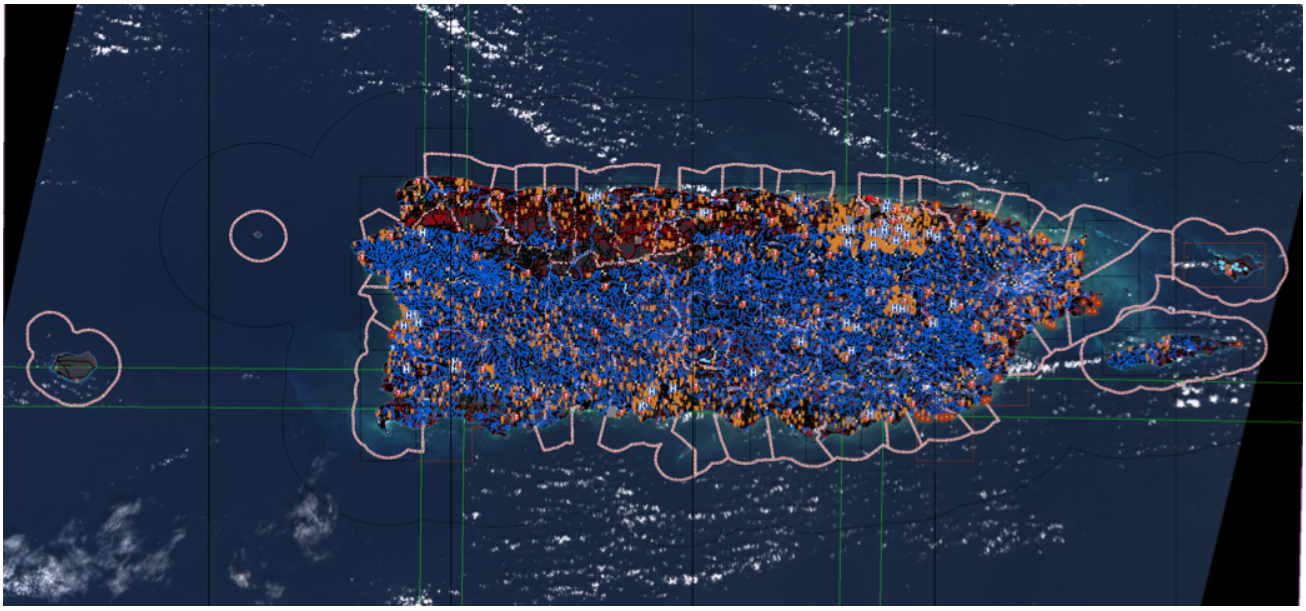


Figure 8. Client showing both GeoPackage vector and raster data

5.3. WMS

5.3.1. Axis Order

Data providers should treat properly urn:ogc:def:crs:epsg::4326 (or EPSG:4326) depending on the specification they are implementing. EPSG:4326 AXIS order is YX. Here is the guideline:

- OGC WMS 1.1.1 mandates XY - ordering
- OGC WMS 1.3 mandates official axis ordering. If EPSG:4326 is being used the axis order should be YX

Related issue:

- https://github.com/opengeospatial/geoedge-plugfest/issues/15

5.3.2. Naming of Layers

To provide a better client interaction layers should be named properly.

5.4. WFS

5.4.1. Complex Queries

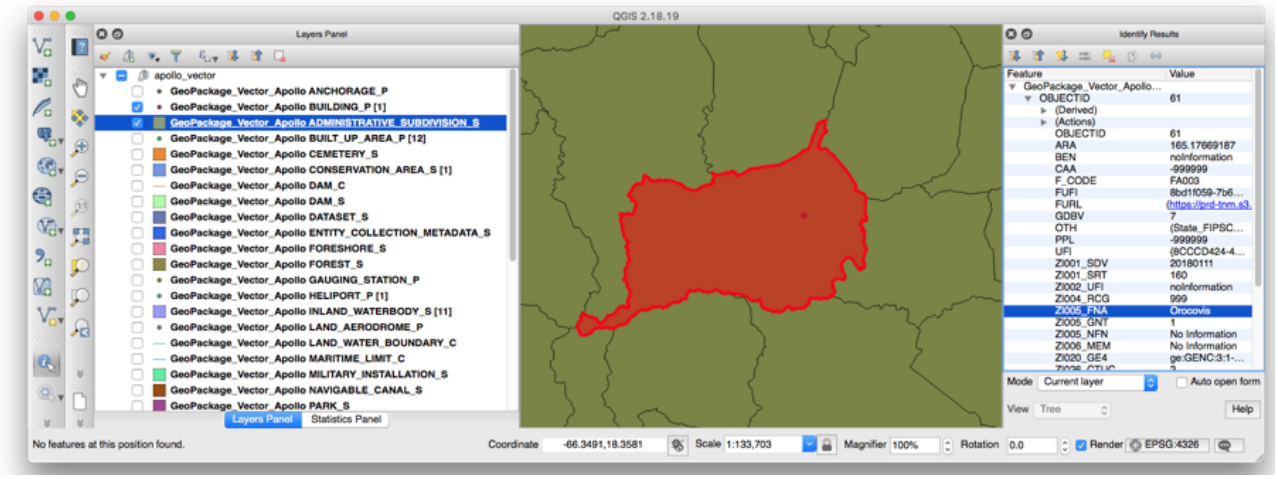
Some queries seem difficult to execute. Several clients reported that Query 10 can't be executed:

```
Query 10: Find the administrative subdivision that contains the building
"Cuerpo de Bomberos de Orocovis"
```

The process might involve a 2 step process:

1. Select the layer
2. Run a query inside that layer: select * from BUILDING_P WHERE ZI005_FNA="Cuerpo de Bomberos de Orocovis";

```
select * from BUILDING_P WHERE ZI005_FNA="Cuerpo de Bomberos de Orocovis";
```



Related issue:

- https://github.com/opengeospatial/geoedge-plugfest/issues/88

5.4.2. Interacting with different versions WFS

Some servers support multiple version of WFS, this will enable clients to get the data in different ways

5.5. WMS Recommendations

5.5.1. Axis Order

Data providers should treat properly urn:ogc:def:crs:epsg::4326 (or EPSG:4326) depending on the specification they are implementing. EPSG:4326 AXIS order is YX. Here is the guideline:

- OGC WMS 1.1.1 mandates XY - ordering
- OGC WMS 1.3 mandates official axis ordering. If EPSG:4326 is being used the axis order should be YX

Related issue:

- https://github.com/opengeospatial/geoedge-plugfest/issues/15

5.6. GeoPackage Results

5.6.1. Raster and vector files in one file

The initiative tested the capability of including both raster and vector data in one file. One file size was 5 GB which included high resolution data.

5.6.2. Sort Attributes in SQLite schema

Sort attributes alphabetically in the SQLite schema. If not, it is hard to find attributes in user interfaces to select features to filter.

Related issues:

- https://github.com/opengeospatial/geoedge-plugfest/issues/21

5.6.3. Remove local links

If GeoPackage files contain links to data producer local file system, some data (e.g styles) might not be accessible.

Related issues:

- https://github.com/opengeospatial/geoedge-plugfest/issues/22
- https://github.com/opengeospatial/geoedge-plugfest/issues/71

5.6.4. Investigate further GDAL Validation issues

Several GDAL validation issues were reported that require further investigation with GDAL developers:

Related issues:

- https://github.com/opengeospatial/geoedge-plugfest/issues/70
- https://github.com/opengeospatial/geoedge-plugfest/issues/69
- https://github.com/opengeospatial/geoedge-plugfest/issues/72
- https://github.com/opengeospatial/geoedge-plugfest/issues/73

5.6.5. Investigate further GeoPackage performance

Some files >600 MB were slower to load. Need to investigate further the raw causes of such behavior.

Two files in Sprint 1 with raster data were 1 GB and 5 GB. Raster queries were easy to perform.

Related issues:

- https://github.com/opengeospatial/geoedge-plugfest/issues/22

5.6.6. Investigate further transparency

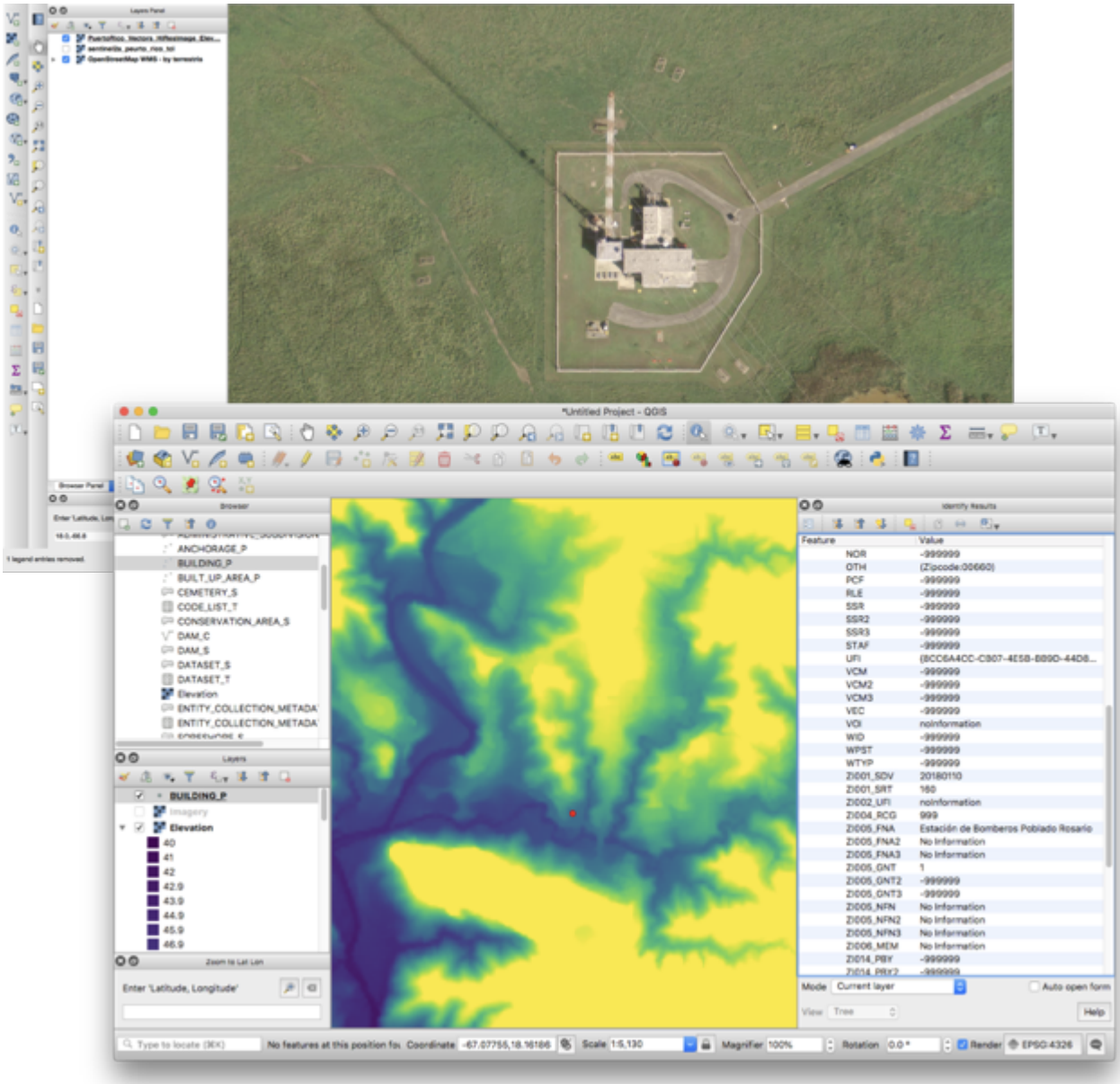
Some clients reported apparent transparency in raster layers.

Related issues:

- https://github.com/opengeospatial/geoedge-plugfest/issues/82

5.6.7. GeoPackage convenience packaging both raster and vector data

One participant provided a GeoPackage file containing both raster and vector data. Various clients were able to open the file. The GeoPackage contained high resolution satellite images and elevation data in the 2D gridded coverage extension schema. Tile-based, pyramidal, floating-point raster data is a distinguishing feature of GeoPackage.


*Untitled Project - QGIS
Browser
ANCHORAGE_P
BUILDING_P
BUILT_UP_AREA_P
CEMETERY_S
CODE_LIST_T
CONSERVATION_AREA_S
DAM_C
DAM_S
DATASET_S
DATASET_T
Elevation
Layers
BUILDING_P
Imagery
Elevation
40
41
42
42.9
43.9
44.9
45.9
46.9
Zoom to Lat Lon
Enter 'Latitude, Longitude'
Identify Results
Feature
Value
NOR -999999
OTH (Z(pcode:00660)
PCF -999999
RLE -999999
SSR -999999
SSR2 -999999
SSR3 -999999
STAF -999999
UFI {BCC6A4CC-C807-4E5B-B89D-44D8...
VCM -999999
VCM2 -999999
VCM3 -999999
VEC -999999
VOI noInformation
WID -999999
WPST -999999
WTYP -999999
ZI001_SDV 20180110
ZI001_SRT 160
ZI002_UFI noInformation
ZI004_RCG 999
ZI005_FNA Estación de Bomberos Poblado Rosario
ZI005_FNA2 No Information
ZI005_FNA3 No Information
ZI005_GNT 1
ZI005_GNT2 -999999
ZI005_GNT3 -999999
ZI005_NFN No Information
ZI005_NFN2 No Information
ZI005_NFN3 No Information
ZI006_MEM No Information
ZI014_PBY -999999
Mode Current layer
Auto open form
View Tree
Help
No features at this position fou
Coordinate -67.07755,18.16186
Scale 1:5,130
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326

Chapter 6. Test Suites Issues and Releases

The test results of Geospatial to the Edge Plugfest identified several bugs or shortcomings in test suites. This section provides a summary of the releases of updated test suites and issues reported as part of this initiative.

Chapter 7. Summary of Releases related to the Plugfest

- GeoPackage 1.2 NSG test suite [https://opengeospatial.github.io/ets-gpkg12-nsg/relnotes.html]
  - Release 0.5 (2018-08-28)
    - #21: Test NSG_filenameExtension is a duplicate of the test * filenameExtension
    - #36: Lack of metadata results in SQLITE ERROR hard failure
    - #38: Fortify scan reports issues
    - #37: Geopackage having no Tile data results in SQLITE ERROR
    - #27: Improve exception message of test * dataValidity_gpkg_spatial_ref_sys
    - #30: Test metadataSchemaValidation fails if table gpkg_metadata contains multiple values with at least one not NMIS valid entry
    - #42: Introduce Dockerfile and Maven Docker plugin
  - Release 0.4 (2018-07-13)
    - #33: Set GeoPackage 1.2 ETS dependency to version 0.7
    - #28: Remove duplicated test inherited from ets-gpkg12
    - #10: No Such Function: ST_MinX
    - #22: Test “dataValidity_gpkg_tile_matrix” fails if gpkg_tile_matrix contains zoom levels which are not present in data
    - #12: N S G_CRSdefinitions Test - java.lang.NoClassDefFoundError: org/geotools/util/UnsupportedImplementationException
    - #18: Clean up ETS
- GeoPackage 1.2 test suite [https://opengeospatial.github.io/ets-gpkg12/relnotes.html]
  - Release 0.7 (2018-07-13)
    - Fix #76: Several tests are executed multiple times
    - Fix #64: Failure due to space in filename
    - Merge #73: R146 147
    - Fix #51: Review test requiredSRSReferences
    - Fix #60: The spatial issue revisited
    - Merge #69: Adding two samples
    - Merge #65: Adding a test case with a file with a space in it

Chapter 8. Reported Test Issues in Sprint 1

The following GitHub issues were created or confirmed during analysis of Sprint 1 results:

- GeoPackage 1.2 NSG test suite
  - https://github.com/opengeospatial/ets-gpkg12-nsg/issues/10
  - https://github.com/opengeospatial/ets-gpkg12-nsg/issues/28
  - https://github.com/opengeospatial/ets-gpkg12-nsg/issues/31
  - https://github.com/opengeospatial/ets-gpkg12-nsg/issues/27
  - https://github.com/opengeospatial/ets-gpkg12-nsg/issues/30
- GeoPackage 1.2 test suite
  - https://github.com/opengeospatial/ets-gpkg12/issues/78
  - https://github.com/opengeospatial/ets-gpkg12/issues/74
- WMS 1.3 NSG test suite
  - https://github.com/opengeospatial/ets-wms13-nsg/issues/5
  - https://github.com/opengeospatial/ets-wms13-nsg/issues/16

8.1. Reported Tests Issues in Sprint 2

The following GitHub issues were created or confirmed during analysis of Sprint 2 results:

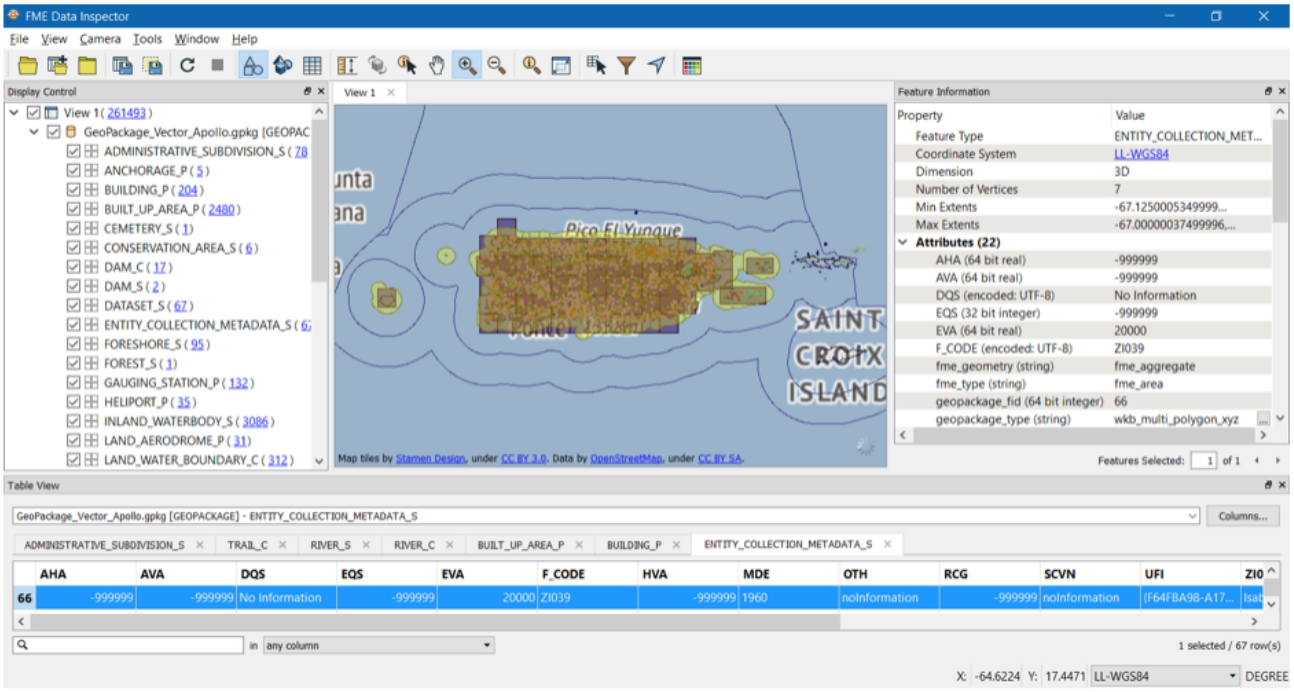
- GeoPackage 1.2 NSG test suite
  - https://github.com/opengeospatial/ets-gpkg12-nsg/issues/27
  - https://github.com/opengeospatial/ets-gpkg12-nsg/issues/30
- WMS 1.3 NSG test suite
  - https://github.com/opengeospatial/ets-wms13-nsg/issues/5
  - https://github.com/opengeospatial/ets-wms13-nsg/issues/16
- WMTS 1.0 NSG test suite
  - https://github.com/opengeospatial/ets-wmts10-nsg/issues/43
- WFS 2.0 (NSG) test suite
  - https://github.com/opengeospatial/ets-wfs20/issues/124
  - https://github.com/opengeospatial/ets-wfs20/issues/125

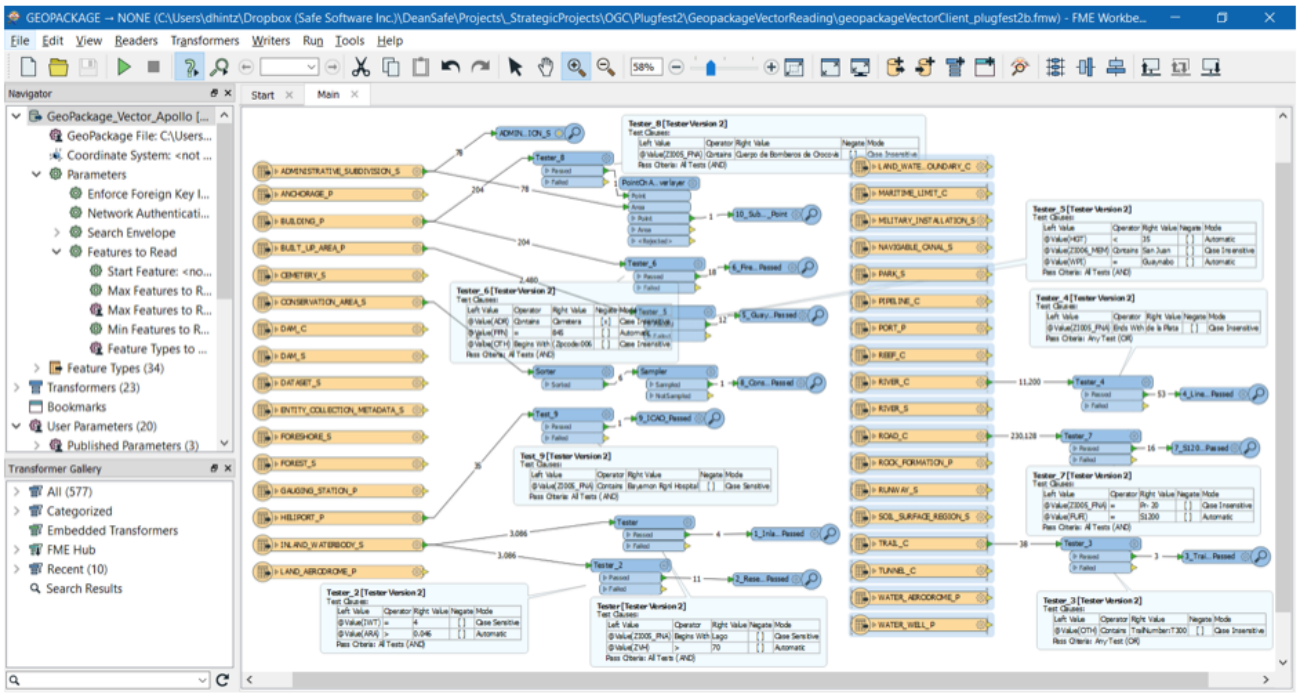
Chapter 9. Applications and Strategies for Implementers

9.1. FME Raster and Vector Client

9.1.1. Vector Queries

Vector queries in the FME Client can be performed two ways: - interactively using FME Data Inspector as the client alone - FME Workbench with a workspace script to automate the process





9.1.2. Raster Queries

When FME is used to read a GeoPackage raster tile dataset, the Data Inspector client optimizes the display by balancing the displayed resolution with the zoom level. Unless a specific zoom level is chosen, FME automatically chooses the highest resolution zoom level that can be displayed at the extents chosen, and then resamples as needed.

9.2. Esri Raster Tiles Server and GeoPackage

1) What were the steps you took to setup the mosaics? ArcGIS Desktop was used to Create Mosaic Dataset (Data Management Tools) and to add the images into the dataset. When adding the images the default parameters were kept including the calculation of raster statistics. With the calculation of the statistics the mosaics remain interactive and available to further analysis.

2) How did you determine and process the zoom levels? ArcGIS Desktop was used for publishing the Map Services with allows for the creation of 1-22 zoom levels. The default values were kept for all services.

3) Other tools? For the creation of the GeoPackages, Esri turn to the Data Interoperability Tool as opposed to the Add Raster To GeoPackage (Conversion Tool). Work is in progress to make the creation of GeoPackage files more straight forward, in particular, in ArcGIS Pro.

4) Did you went through any optimization process to save or speed up the delivery (or query) mechanism? Esri built the queries into the JavaScript and .NET apps, which is easy to use by non-experts. In ArcGIS Pro, the SQL statements were copied and referred back to them for each data source. Nothing special was done to speed up the return of the requests.

5) Any other feedback about setting the data or services? Esri stated that setting up the raster and vector GeoPackages, the WMS, WMTS, and WFS was fairly straight forward. Feedback was provided related to test engine irregularities. Esri achieved the goal to reduce the number of errors found in the NSG profiles.

9.3. GeoSolutions

9.3.1. Introduction

During this experiment two services where provided: WFS and WMTS, both based on the correspondent NSG profiles. The two services where make available with a single GeoServer instance and the necessary GeoServer NSG plugins, providing a different end-point for each service, i.e. WFS [http://cloudsdi.geo-solutions.it/geoserver/geoedge/ows?service=wfs&version=2.0.1&request=GetCapabilities] and WMTS [http://cloudsdi.geo-solutions.it/geoserver/geoedge/gwc/service/wmts?SERVICE=WMTS&REQUEST=GetCapabilities].

The provided vector and raster data [https://github.com/opengeospatial/geoedge-plugfest/wiki/Data] was also configured in the server. Vector data was stored in a PostgreSQL database, the database schema was adapted to support the NSG versioning needs. Auxiliary world files (.wld) where

created for the raster data and directly stored on the file system and served through image mosaic GeoServer [http://docs.geoserver.org/latest/en/user/data/raster/imagemosaic/index.html]extension. Clients tests feedback and the follow up was done with the support of GitHub issues. The provided WFS and WMTS services where respectively tagged as WFS_NEPTUNE [https://github.com/opengeospatial/geoedge-plugfest/labels/%40WFS_Neptune] and WMTS_CALYPSO [https://github.com/opengeospatial/geoedge-plugfest/labels/%40WMTS_Calypso]. A total of six issues where reported for the WFS service and three issues for the WMTS service (in both sprints).

9.3.2. Data and Services Setup

1) What were the steps you took to setup the mosaics? The raster data was published using GeoServer image mosaic extension [http://docs.geoserver.org/latest/en/user/data/raster/imagemosaic/index.html], which allow to publish a mosaic from a number of georeferenced rasters. An auxiliary world file (.wld) was created for each granule, and then an image mosaic datastore pointing to the granules directory was created in GeoServer [http://docs.geoserver.org/latest/en/user/data/raster/imagemosaic/tutorial.html].

2) How did you determine and process the zoom levels? The already available image overviews were used as is, image mosaic takes care of matching the correct overview with the requested zoom level.

3) Other tools? Tool ogr2ogr was used to insert the provided vector data into the PostgreSQL database and gdalinfo was used to get the necessary information to complete the auxiliary world files (.wld) content for each granule.

3) Did you went through any optimization process to save or speed up the delivery (or query) mechanism? The raster files were already optimized, e.g. tiled, compressed and with overviews (zoom levels). For vector data, an index was created for each primary key column of each dataset.

4) Any other feedback about setting the data or services? GeoServer NSG extensions \ plugins (one for WFS and another one for WMTS) need to be installed [http://docs.geoserver.org/stable/en/user/community/nsg-profile/index.html].

When configuring the tile matrix sets for a certain layer, special care should be taken to select only tile matrix sets that make sense for the layer. By default all the tile matrix sets defined by the WMTS NSG profile were available.

Chapter 10. Initiative Feedback

10.1. GeoSolutions

In a distributed initiative like this one, the ability to provide the necessary feedback, in a concise and straightforward way, and make the discussion happening between all the interested parts is fundamental. It is also important to be able to keep track of what happened and be able to get a quick status overview, e.g. show me all the issues related with WFS.

In our point of view, GitHub issues was a good choice for this. The simple UI (not simpler) make GitHub issues easy to use by both technical and non technical people. The labels mechanism provide a good way of managing the issues and the discussion mechanism (with the associated notifications mechanism) is very efficient to use. When creating an issue we have the possibility to assigning it to the interested persons, then GitHub will take care of notifying those persons, making them aware of that issue.

In an ideal world, everyone involved with the created issue should be able to reproduce it in their own environment (debuggable environment), unfortunately this is usually not the case. People work on different environments, they don't have access to the same clients or servers, etc. This means that special care should be taken when describing an issue.

Depending on the issue, a few approaches can be used to make issues descriptions more clear to all the interested parts. For example, when describing an issue related with an UI, a simple GIF visually showing the problem is usually easier to create and to interpret than a numbered list of steps. When describing an issue involving a client invoking a server, the actual request send by the client to the server is a fundamental piece of information, an alternative is to reproduce the issue with a client that is commonly available, like QGIS [https://qgis.org/en/site/] for example.

Appendix A: Revision History

Date	Editor	Release	Primary clauses modified	Descriptions
Aug 10 2018	L. Bermudez	.1	all	Initial version
Sep 6 2018	L. Bermudez	.2	all	Added section test issues, applications and initiative feedback and Plugfest description. Formatted document with better numbering.
Sep 8 2018	L. Bermudez	.3	all	Reviewed all the document, cleaned name of organizations acting as servers or clients, and added summary matrices of the sprints.