OGC Geospatial to the Edge Plugfest Engineering Report

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Publication Date: YYYY-MM-DD

Approval Date: YYYY-MM-DD

Submission Date: YYYY-MM-DD

Reference number of this document: OGC 18-XXX

Reference URL for this document: http://www.opengis.net/doc/PER/t14-D003

Category: Public Engineering Report

Editor: Luis Bermudez

Title: OGC Geospatial to the Edge Plugfest Engineering Report

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OGC Engineering Report

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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.

Chapter 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. Non-compliance to open standards profiles prohibits mission critical operations from 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 ten data/service producers and clients of data following NSG profiles. It help discovered implementation issues and advance executable test suites.

Chapter 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. 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 suited are in beta, meaning that they have not been approved by the OGC Technical Committee. Feedback related to the executable test suites was provided by the participants and in particular the GeoPackage test was improved during the plugfest.

Chapter 3. Recommendations for Future Work

Activities like this plugfest should be performed for new profiles or new standards allowing participants to come together find interoperability issues and advance test suites.

Chapter 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
contributor	from org

Chapter 5. Foreword

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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 6. 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 7. Terms and definitions

For the purposes of this report, the definitions specified in Clause 4 of the OWS Common Implementation Standard OGC 06-121r9 [https://portal.opengeospatial.org/files/?artifact_id=38867&version=2] shall apply. In addition, the following terms and definitions apply.

- term name

```
text of the definition
```

- term name|synonym

```
text of the definition
```

7.1. Abbreviated terms

NOTE: The abbreviated terms clause gives a list of the abbreviated terms and the symbols necessary for understanding this document. All symbols should be listed in alphabetical order. Some more frequently used abbreviated terms are provided below as examples.

- CFP Call for Participation
- NSG …

Chapter 8. Overview

This Plugfest, co-sponsored by Army Geospatial Center and the National Geospatial-Intelligence Agency (NGA/CIO&T), will bring together technology implementers and data providers to advance the interoperability of geospatial products and services based on community profiles. The Plugfest will assist tool enhancement and provide 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 9. Results and Recommendations

9.1. WMS

9.1.1. 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

9.1.2. Naming of Layers

To provide a better client interaction layers should be name properly

9.2. WFS

9.2.1. Complex Queries

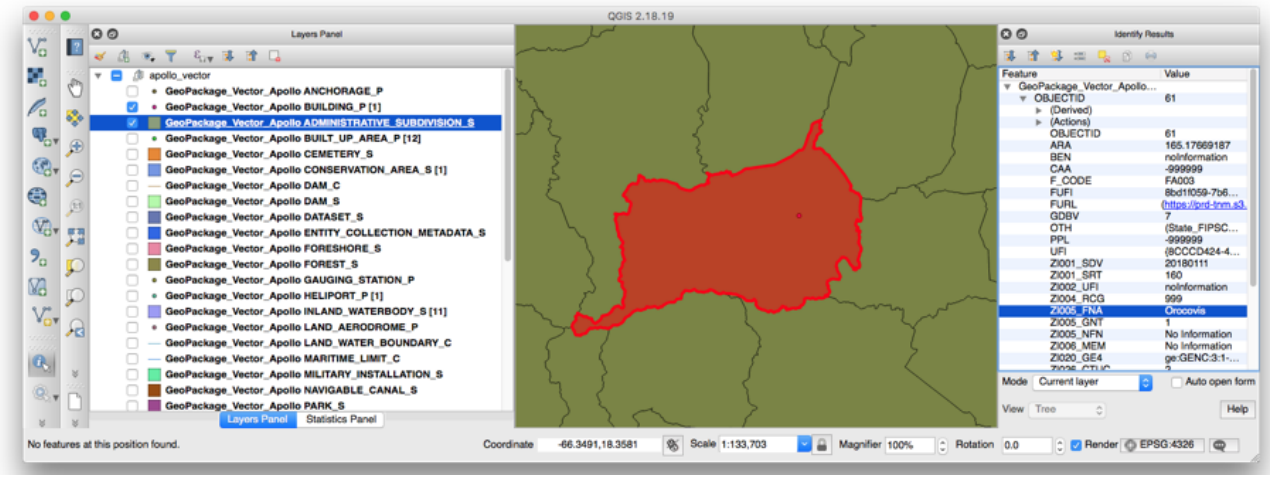
Some queries seem difficult to execute. Several clients reported that Query 10 can't be executed:

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

The process might involve a 2 step process:

```
Select the layer
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

9.2.2. Interacting with different versions WFS

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

TODO:add information from Client J report WFS Janus Final

9.3. WMS Recommendations

9.3.1. 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

9.4. GeoPackage Results

9.4.1. 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.

9.4.2. 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

9.4.3. 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

9.4.4. 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

9.4.5. 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

9.4.6. Investigate further transparency

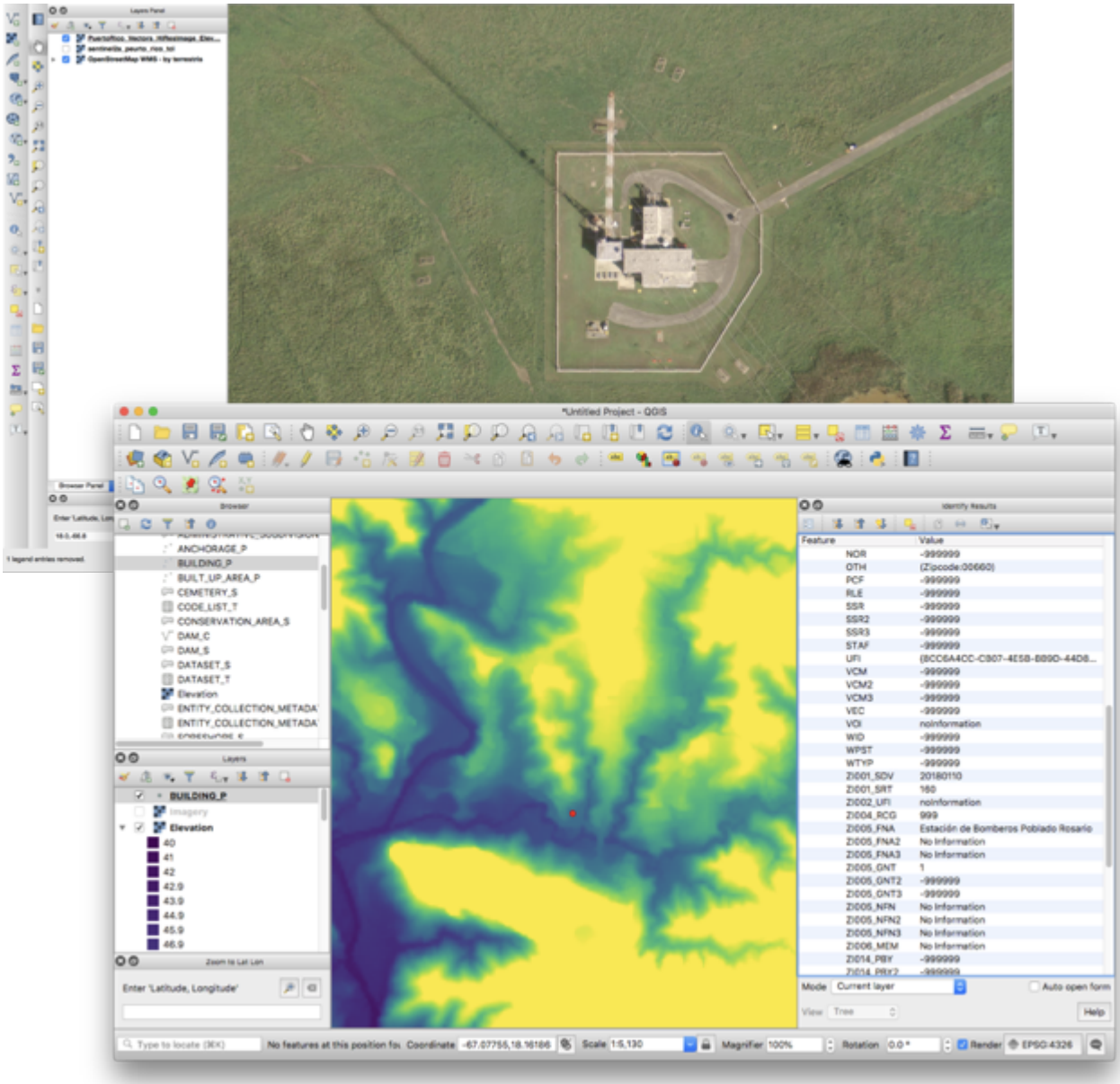
Some clients reported apparent transparency in raster layers.

Related issues:

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

9.4.7. 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 10. 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 11. 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 12. 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

12.1. Reported Tests Issues in Sprint 2

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

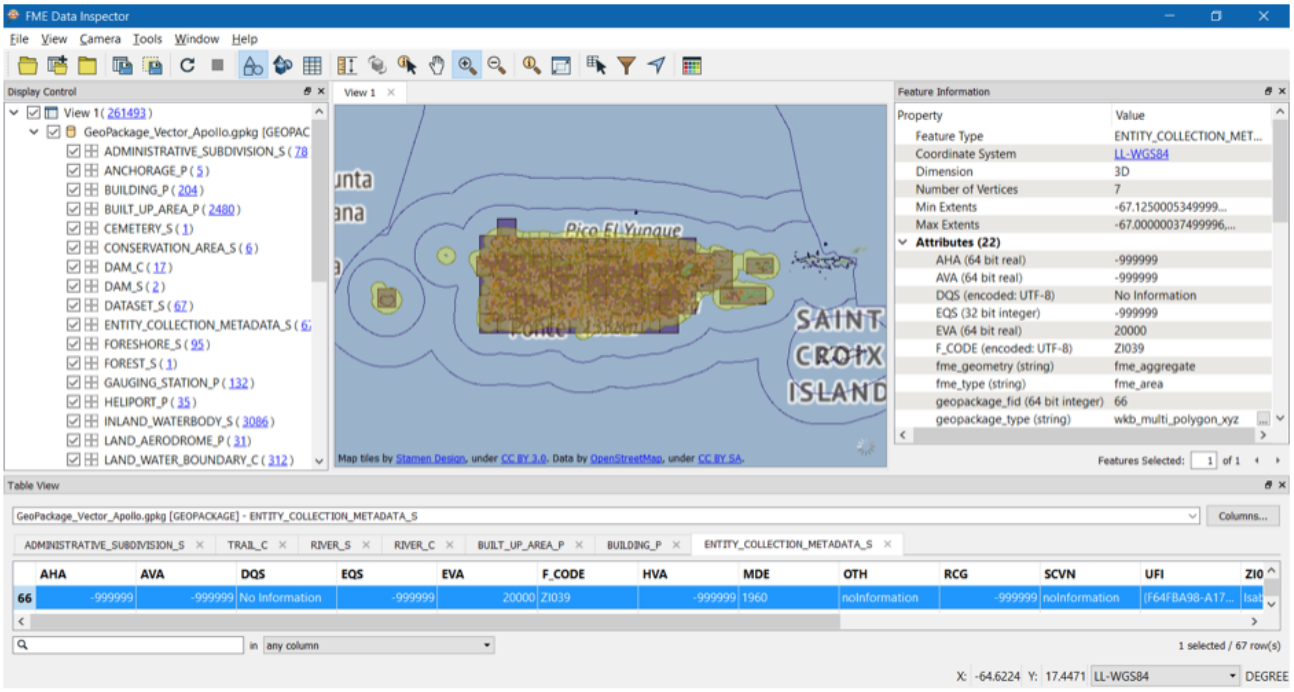
- GeoPackage 1.2 NSG test suite
  - https://github.com/opengeospatial/ets-gpkg12-nsg/issues/27
  - https://github.com/opengeospatial/ets-gpkg12-nsg/issues/30
- WMS 1.3 NSG test suite
  - https://github.com/opengeospatial/ets-wms13-nsg/issues/5
  - https://github.com/opengeospatial/ets-wms13-nsg/issues/16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

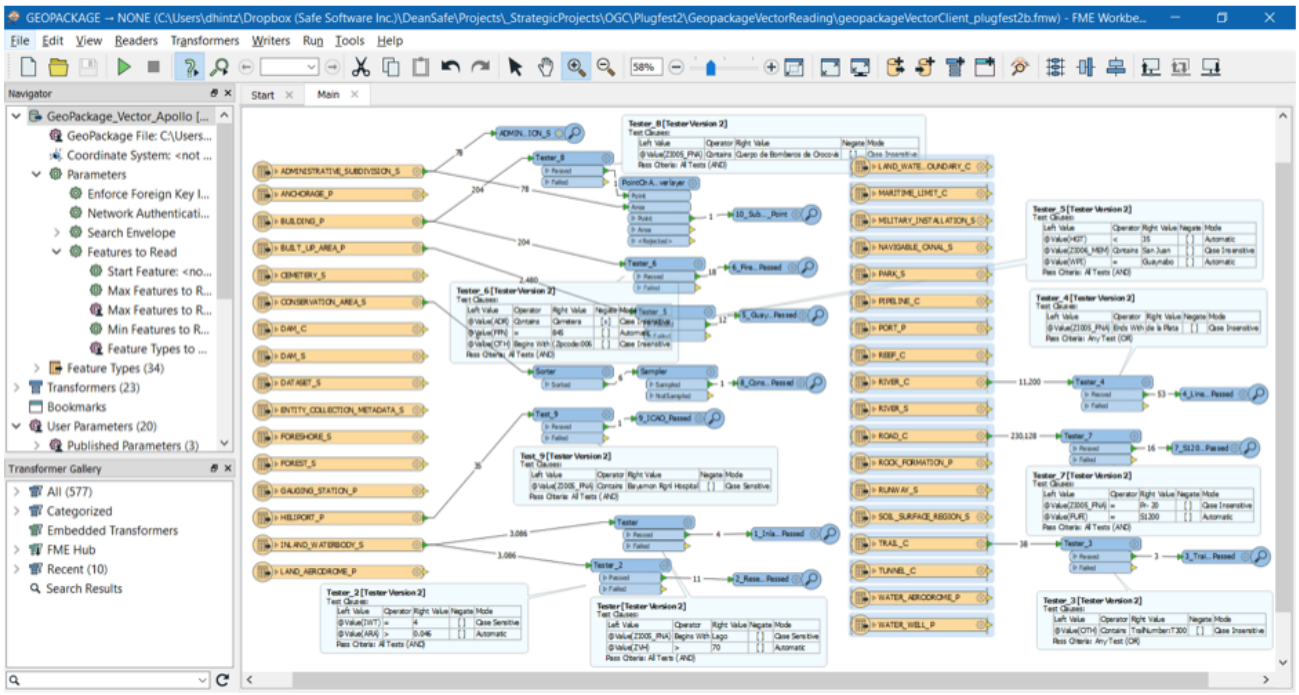
Chapter 13. Applications and Strategies for Implementers

13.1. FME Raster and Vector Client

13.1.1. 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





13.1.2. 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.

13.2. 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.

13.3. GeoSolutions

13.3.1. 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 \ labelled 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).

13.3.2. 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 auxiliar 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 who make sense for the layer. By default all the tile matrix sets defined by the WMTS NSG profile were available.

Chapter 14. Initiative Feedback

14.1. 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 (debugable 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 actions \ 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 [https://qgis.org/en/site/]QGIS for example.

Appendix A: Sprint 1

Sprint 2

Appendix B: Revision History

Date	Editor	Release	Primary clauses modified	Descriptions
Aug 10 2018	L Bermudez	.1	all	initial version
Sep 4 2018	L Bermudez	.2	all	added section test issues, applications and initiative feedback