



OGC TESTBED-21 TRAINING FOR THE GIMI EXECUTABLE TEST SUITE

ENGINEERING REPORT

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OVERVIEW

Conformance testing is a key enabler of the adoption of any standard. Standards that enjoy high adoption rates are those that make it as easy as possible for implementers to successfully implement those standards. Therefore, the development of an ETS and the provision of training on the use of the ETS are necessary for the continued adoption of the GIMI standard.



EXECUTIVE SUMMARY

This report describes a training course on use of an Executable Test Suite (ETS) for the GEOINT Imagery Media for Intelligence, Surveillance, and Reconnaissance (GIMI). Developed as part of the Testbed-21 initiative, the training course is presented as a series of presentation slides and accompanying training materials.

GIMI is a family of standards that integrate advanced media standards such as the ISO Base Media File Format (ISOBMFF) and the High Efficiency Image File Format (HEIF). GIMI has been designed to support still images, motion imagery, tiled imagery, audio, security marking, timing information, and content identification (id) information.

To facilitate the development of applications that can produce GIMI-conformant files, the Testbed-21 initiative included a task to implement an ETS for GIMI. Along with the ETS, the Testbed was tasked with developing and delivering training on the use of the ETS.

This report presents the training course, which is available as a Markdown file that can be converted to slides using [Marp](#).



KEYWORDS

The following are keywords to be used by search engines and document catalogues.

gimi, testbed, training, team engine

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SUBMITTING ORGANIZATIONS

The following organizations submitted this Document to the Open Geospatial Consortium (OGC):

- Pixalytics
- Heazel Technologies
- Geomatys

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FUTURE OUTLOOK

The training presented in this report is focused on the ETS for version 1.0.0 of GIMI. There are associated specifications that are emerging around GIMI, for example NGA's Imagery Domain Ontology and OGC's GeoHEIF, that will likely require conformance testing tools of their own. Therefore, executable test suites for those associated specifications will also require training courses to help with their adoption.

There is also an growing trend on use of Artificial Intelligence (AI) to create interactive and adaptive training courses. This could be an avenue for a future testbed to explore, for example, how a training course on a specific ETS could adapt to the user's situation with the help of AI.



VALUE PROPOSITION

The training course will lead to:

- quicker understanding of how to use the ETS
- fewer mistakes in interpreting test results
- faster deployment of the ETS through greater proficiency



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INTRODUCTION

1

INTRODUCTION

Conformance testing is a critical enabler for the adoption of technical standards, as high adoption depends on making implementation as straightforward as possible for developers. To support adoption of the GEOINT Imagery Media for Intelligence, Surveillance, and Reconnaissance (GIMI) standard, the Testbed-21 initiative developed an Executable Test Suite (ETS) along with dedicated training on its use. GIMI integrates advanced media standards such as ISO Base Media File Format and High Efficiency Image File Format to support still and motion imagery, tiled imagery, audio, security markings, timing information, and content identification.

The training course, delivered through presentation slides and supporting materials, is designed to help implementers correctly apply the ETS when producing GIMI-conformant files. The training described focuses on the ETS for GIMI version 1.0.0 and aims to accelerate understanding, reduce errors in interpreting test results, and enable faster and more effective deployment of the ETS.



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TOPICS

Figure 1 is a cover slide that introduces those involved in developing the training material.

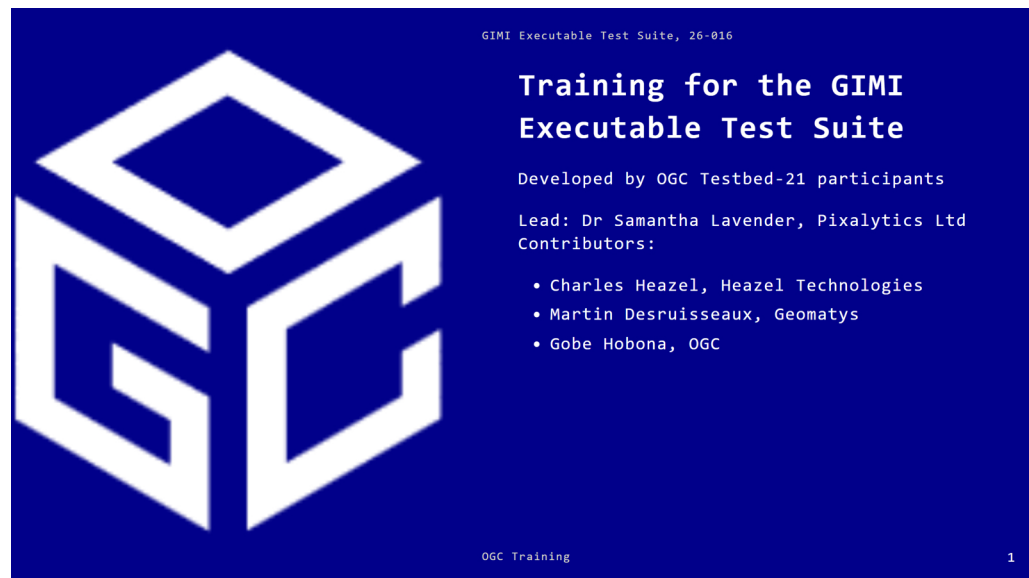


Figure 1 – Slide 1

Figure 2 introduces the concept of conformance, and the relevance of an Abstract Test Suite (ATS) and Executable Test Suite (ETS) to conformance testing. There are several additional concepts underneath those aforementioned. Therefore, the trainees are referred to relevant resources such as *The ModSpec Model: A Standard for Designing and Writing Modular Standards (ModSpec)*.

What is Conformance

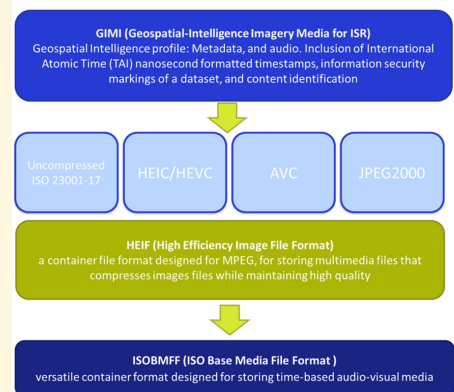
- Conformance can be claimed for data or software products or services or by specifications including any profile or functional standard, [ISO 19105:2022](#).
- The Abstract Test Suite (ATS) is a set of testable assertions about the functionality of a standard, which are based on the conformance classes defined in the standard to which the ATS belongs.
- An Executable Test Suite (ETS) is an implementation of the tests defined in ATS.
- When an ETS is run, an Implementation Under Test (IUT) is checked for conformance to the standard.
- For further information, see the [OGC ModSpec](#) and [OGC Compliance Program](#)

Figure 2 – Slide 2

Figure 3 introduces the GIMI standard and the base standards that GIMI extends, namely ISOBMFF and HEIF. The slide also explains the ownership of GIMI, that is the role of the GEOINT Media Standards Board (GMSB).

Introduction to GIMI

- GEOINT Imagery Media for Intelligence, Surveillance, and Reconnaissance (ISR) (GIMI) is maintained by the NGA Motion Imagery Standards Board (MISB) and NITFS Technical Board (NTB), under the umbrella of the [GEOINT Media Standards Board \(GMSB\) Focus Group](#).
- GIMI is built on a collection of existing industry Standards, including Moving Picture Expert Group (MPEG) and Joint Photographic Experts Group (JPEG), and it is a profile of:
 - ISO Base Media File Format (ISOBMFF): for storing time-based audio-visual media
 - High Efficiency Image File Format (HEIF): for storing and compressing images, image sequences and movies.



Courtesy of Joan Maso

Figure 3 – Slide 3

Figure 4 explains the structure of the GIMI format, introducing the concept of boxes — which is inherited from ISOBMFF.

GIMI Executable Test Suite, 26-016

The GIMI format

- The format is built from boxes, which can contain other boxes or data (not both).
- Data can be metadata or essence - imagery or sensor data.
- Each of the requirements in the GIMI v1.0.0 standard has an accompanying test in the Abstract Test Suite (ATS).
- The Executable Test Suite (ETS) has been developed to implement the tests defined in the ATS.

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Figure 4 — Slide 4

Figure 5 introduces the NGA's Imagery Domain Ontology (IDO). As the IDO is still in development, the introduction is intentionally meant to be brief.

GIMI Executable Test Suite, 26-016

Imagery Domain Ontology

- Ontology focused on supporting imagery analysis and use, including descriptive information and context about GIMI imagery media content.
- **Why needed?** Increasing need to meaning of information is made accessible and machine readable
- The initial effort is focused on "Collection" and the parameters associated with sensor systems and the entities within a scene.
- RDF Schema provides a data-modelling vocabulary
- It is part of a wider Government wide effort aimed at aligning data management and achieving cohesive understanding across different domains.

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Courtesy of NGA

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Figure 5 — Slide 5

Figure 6 offers an outline of the architecture of the ETS.

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Outline of the Architecture of the GIMI Executable Test Suite

- The GIMI executable test suite addresses the requirements of GIMI using a widely accepted conformance test tool, [TEAM Engine](#), alongside [Compliance Warden](#).
- The parser flattens that format into a Java class model and, in addition, it pre-processes information elements, making them easily accessible by the conformance tests.
- The selection of which Conformance Classes to test is driven by the content of the file being tested.

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Figure 6 — Slide 6

Figure 7 offers an outline of the approach adopted in conformance testing through the ETS.

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Outline - the approach adopted

- Testers have control over three test parameters:
 - The name or URI for the file to be tested
 - Choosing:
 - MPEG conformance testing or
 - GIMI conformance testing, which includes MPEG testing.

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Figure 7 — Slide 7

Figure 8 offers an outline of TEAM Engine, the test harness of the OGC. The GIMI ETS is implemented as a plug-in for TEAM Engine.

Outline - Team Engine

- The [OGC TEAM Engine](#) runs test scripts written in the Conformance Test Language (CTL): a structured terminology used to define and execute tests that verify if a product or service meets established standards or specifications
- However, most OGC Executable Test Scripts are written in the [TestNG](#) testing framework with a CTL script executing the TestNG tests.
- An understanding of this approach is important for developers and maintainers of Executable Test Scripts.

Figure 8 — Slide 8

Figure 9 offers an outline of the GIMI Abstract Test Suite (ATS).

Outline - Abstract Test Suite

- The [GIMI Abstract Test Suite \(ATS\)](#) is under development for NGA.STND.0076-01, and will be published as a standalone document NGA.STND.0076-02
- Unless otherwise specified, the order of precedence for the types of normative information in this standard is as follows:
 1. Requirements
 2. Tables
 3. Normative Text
 4. Figures

Figure 9 — Slide 9

Figure 10 offers an outline of the tests executed by the ETS.

Outline - Tests being executed

- GIMI-essential is mandatory metadata that provide universally recognised attributes about the media content within a GIMI file. There are two types:
 - Content Identification (Content ID): identifiers, enabling enterprise-wide uniqueness for each piece of content within a GIMI file.
 - High precision timing information: combination of a media timestamp and clock details
- For applications within the domain of the security domain, NGA.STND.0076-01 mandates each GIMI file include information security markings.
- Finally, application metadata addresses a large scope of contextual information about the content and includes details about the systems and components which originally captured the imagery, e.g., cameras, sensor balls, range finders, platforms, etc.

Figure 10 – Slide 10

Figure 11 explains the role of Apache SIS in facilitating the ingestion of GIMI files into the ETS.

Running the Executable Test Suite

- GIMI files are ingested into the Executable Test Suite (ETS) using the GeoHeif software developed for Apache SIS.
- The list of conformance class packages can be found at:
 - For ETS: `org.opengis.cite.gimi1`
 - For GeoHeif: `org.opengis.cite.gimi2`

Figure 11 – Slide 11

Figure 12 explains how to run the ETS through the Graphical User Interface (GUI) provided by TEAM Engine. Note that TEAM Engine is configured with the ETS, with the ETS appearing as module.

Running - GUI

- Once you have logged into the OGC Validator: example with local version running, longer term will be available via the [OGC website](#).
- The GUI interface to the GIMI 1.0 conformance test allows you to upload a GIMI image file.
- **To Note:** GIMI has a lot of capabilities, a lot of which will not be used any one file and so the conformance test components that are not relevant are skipped - resulting in lots of grey...

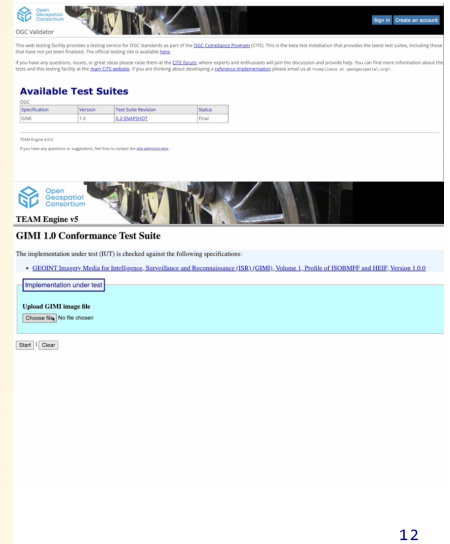


Figure 12 – Slide 12

Figure 13 presents an example output for a GIMI file that has passed the mandatory tests.

GUI Output (passed output)

- The GUI output is a report on the tests that have passed/failed.
- In this case, the core conformance classes have passed
- The output has been shortened, with a summary at the top: for more details, see the later slides on how to interpret the outputs.



Figure 13 – Slide 13

Figure 14 presents an example output for a file that has failed the mandatory tests.

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GUI Output (failed input)

- For the failed example, a non-GIMI file is uploaded.
- The first line of the results shows that the core conformance classed have not passed.

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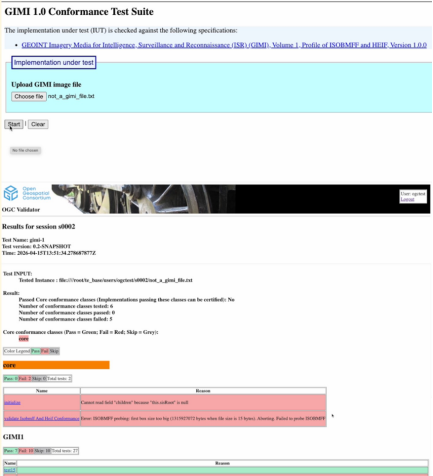


Figure 14 – Slide 14

Figure 15 presents the steps for invoking the ETS through the Command Line Interface (CLI).

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Running - Command Line Interface (CLI)

Clone the repository and clean:

```
git clone https://gitlab.ogc.org/ogc/T21-ets-gimi-1.git
cd T21-ets-gimi-1
mvn clean install site -Dmaven.javadoc.skip=true
```

Start using Java:

```
cd target
java -jar -DTE_BASE=[local-path]/cli-testing/te_base ets-gimi-1-0.2-SNAPSHOT-aio.jar
-o [local-path]/output [local-path]/cli-testing/test-run-props.xml
```

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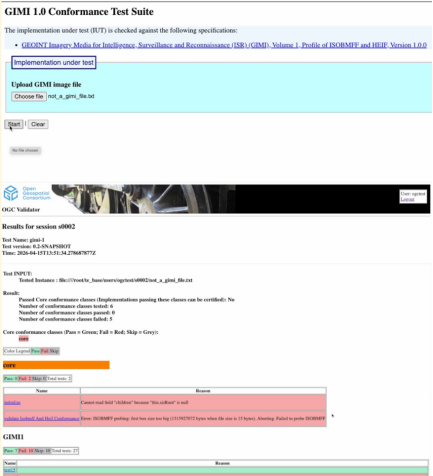
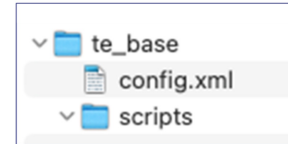


Figure 15 – Slide 15

Figure 16 presents a sample configuration file, which is used to integrate the ETS into TEAM Engine.

ETS Configuration

- config.xml file identifies the:
 - Name of the ETS
 - Standard that is tested, including version
 - Basic (mandatory) conformance classes
 - Revision number of the ETS
- Placed inside the TE_BASE folder identified in the execution command



```
<?xml version="1.0" encoding="UTF-8"?>
<config>
  <scripts>
    <organization>
      <name>OGC</name>
    </organization>
    <standard>
      <name>GIMI</name>
      <version>
        <name>1.0</name>
      </version>
      <suite>
        <namespace-uri>http://www.opengis.net/cite/gimi-1</namespace-uri>
        <prefix>tns</prefix>
        <local-name>ets</local-name>
        <title>ets-gimi-1 Conformance Test Suite</title>
        <description>Tests for compliance to the GIMI Standard.</description>
        <BasicConformanceClasses>
          <conformanceClass>Core</conformanceClass>
        </BasicConformanceClasses>
      </suite>
      <revision>
        <name>0.2-SNAPSHOT</name>
        <status>Final</status>
        <sources>
          <source>gimi-1/1.0/ctl</source>
        </sources>
        <webdir>gimi-1/1.0/site</webdir>
      </revision>
    </standard>
  </organization>
</scripts>
</config>
```

Figure 16 – Slide 16

Figure 17 presents a sample configuration file for setting the inputs to an ETS.

CLI - Configuration file

- test-run-props.xml is a configuration file used for setting the inputs to a conformance testing suite.
- Files referenced as inputs in a test-run-props.xml configuration file can be referenced through:
 - HTTP URLs for accessing a file across a network, or
 - File URLs for accessing files on the local filesystem.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
<properties version="1.0">
  <comment>Sample test run arguments</comment>
  <entry key="iut">file:///path/sample-image.heif</entry>
</properties>
```

Figure 17 – Slide 17

Figure 18 presents an example XML-encoded report of a test run. Note that whereas the GUI presents an HTML rendered report, the CLI presents the report as an XML-encoded file.

CLI Outputs

- The CLI outputs are held in an XML report, which details the tests that have passed/failed: the image shows just the start of the output.

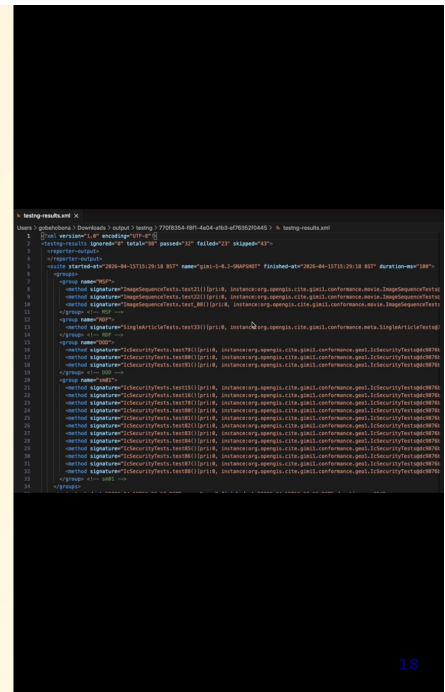


Figure 18 – Slide 18

Figure 19 presents a set of commands for building the Maven project of the ETS, and then running a docker container that includes the docker image created by the Maven project.

Running - Docker

Start the Docker container:

```
mvn clean install site -Dmaven.javadoc.skip=true -Pintegration-tests,docker
```

```
docker run -p 8081:8080 ogccite/ets-gimi-1:latest
```

Verify that TEAM Engine is running by visiting <http://localhost:8081/teamengine>

For further details see the [ER Docker Install section](#)

Figure 19 – Slide 19

Figure 20 introduces the use of the Java library of the ETS through an IDE.

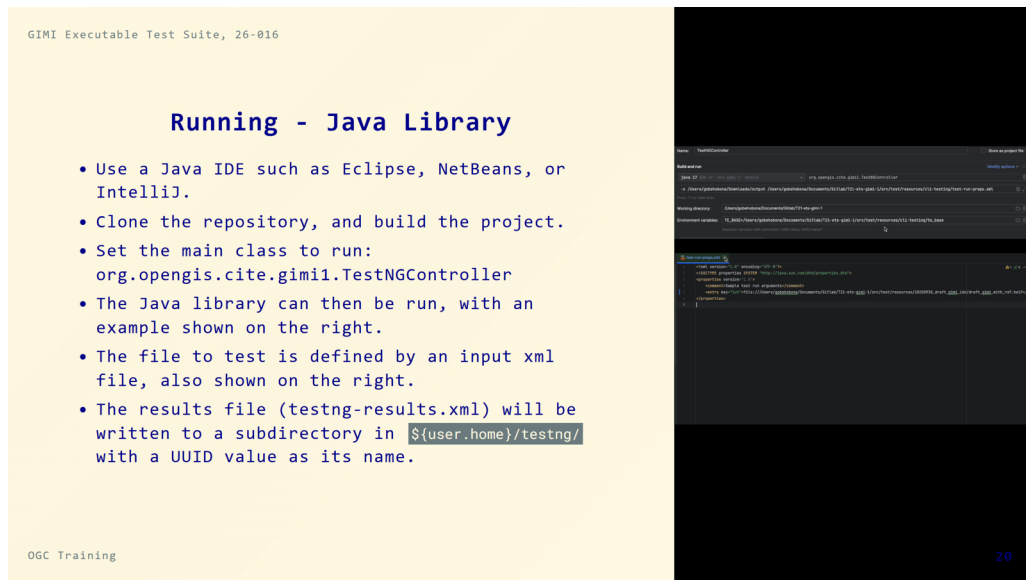


Figure 20 – Slide 20

Figure 21 explains how to interpret the test results.

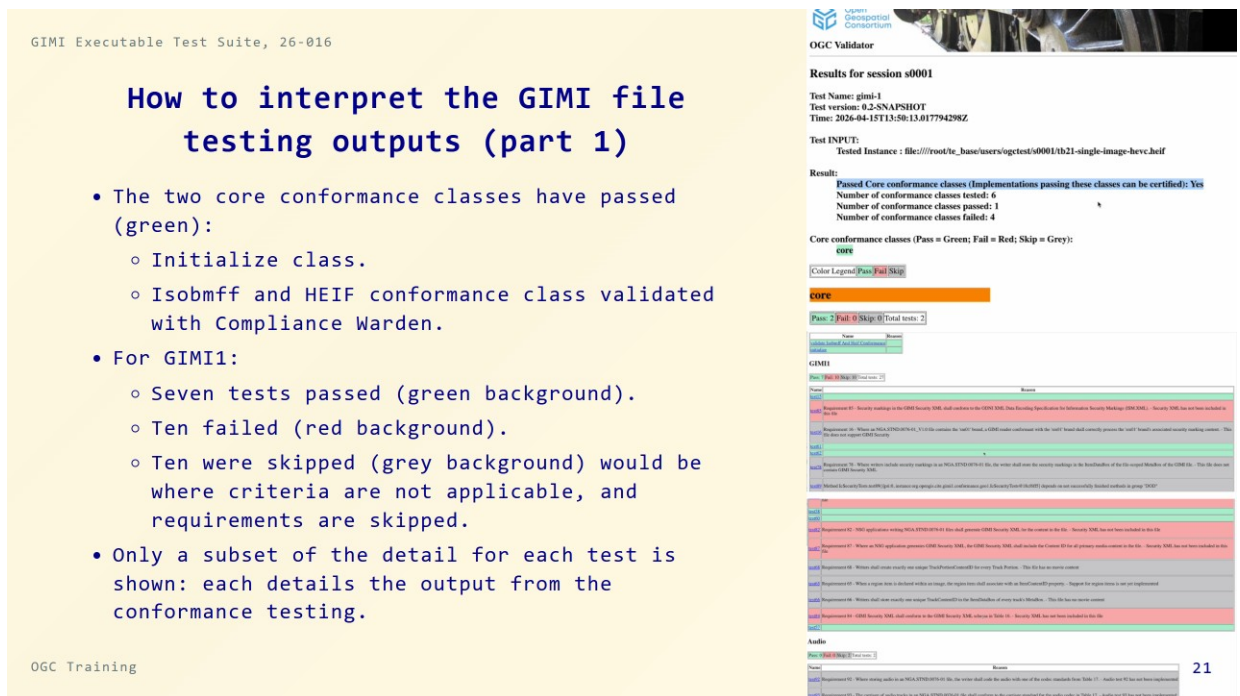


Figure 21 – Slide 21

Figure 22 provides some further explanation of how to interpret the test results.

- Further down the outputs, conformace testing of:
 - Audio: skipped
 - Heif: Eight passed and two failed
 - Metadata: Eleven passed, two failed and nine skipped.
 - Movie: Six passed, twenty three failed, six skipped.
- At the bottom the log file can be downloaded.



Figure 23 is an invitation for questions from the trainees.

Figure 23 is an invitation for questions from the trainees.

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Any Questions?

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OUTLOOK

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OUTLOOK

Looking ahead, additional specifications related to GIMI, such as NGA's Imagery Domain Ontology and OGC's GeoHEIF, are expected to require their own conformance testing tools and associated training. Therefore, it will be necessary to extend the GIMI ETS in such a way that it can leverage those additional conformance testing tools when they become available. Emerging approaches, including the use of artificial intelligence to deliver adaptive and interactive training, represent a potential future direction to further improve usability and adoption of executable test suites for geospatial and imagery standards.



4

SECURITY, PRIVACY AND ETHICAL CONSIDERATIONS

4

SECURITY, PRIVACY AND ETHICAL CONSIDERATIONS

No security, privacy nor ethical concerns were identified in the development of the Training course.



BIBLIOGRAPHY





BIBLIOGRAPHY

- [1] Joan Masó Pau, Núria Julià Selvas, Rob Smith, Open Geospatial Consortium: OGC 24-040r1, *OGC Testbed 20: GIMI Lessons Learned and Best Practices Report*. Open Geospatial Consortium (2025). <http://www.opengis.net/doc/PER/t20-D013>.
- [2] NGA: GEOINT Imagery Media for Intelligence, Surveillance, and Reconnaissance (GIMI) Volume 1, Version 1.0.0 (2024).



ANNEX A (NORMATIVE) ABBREVIATIONS/ACRONYMS

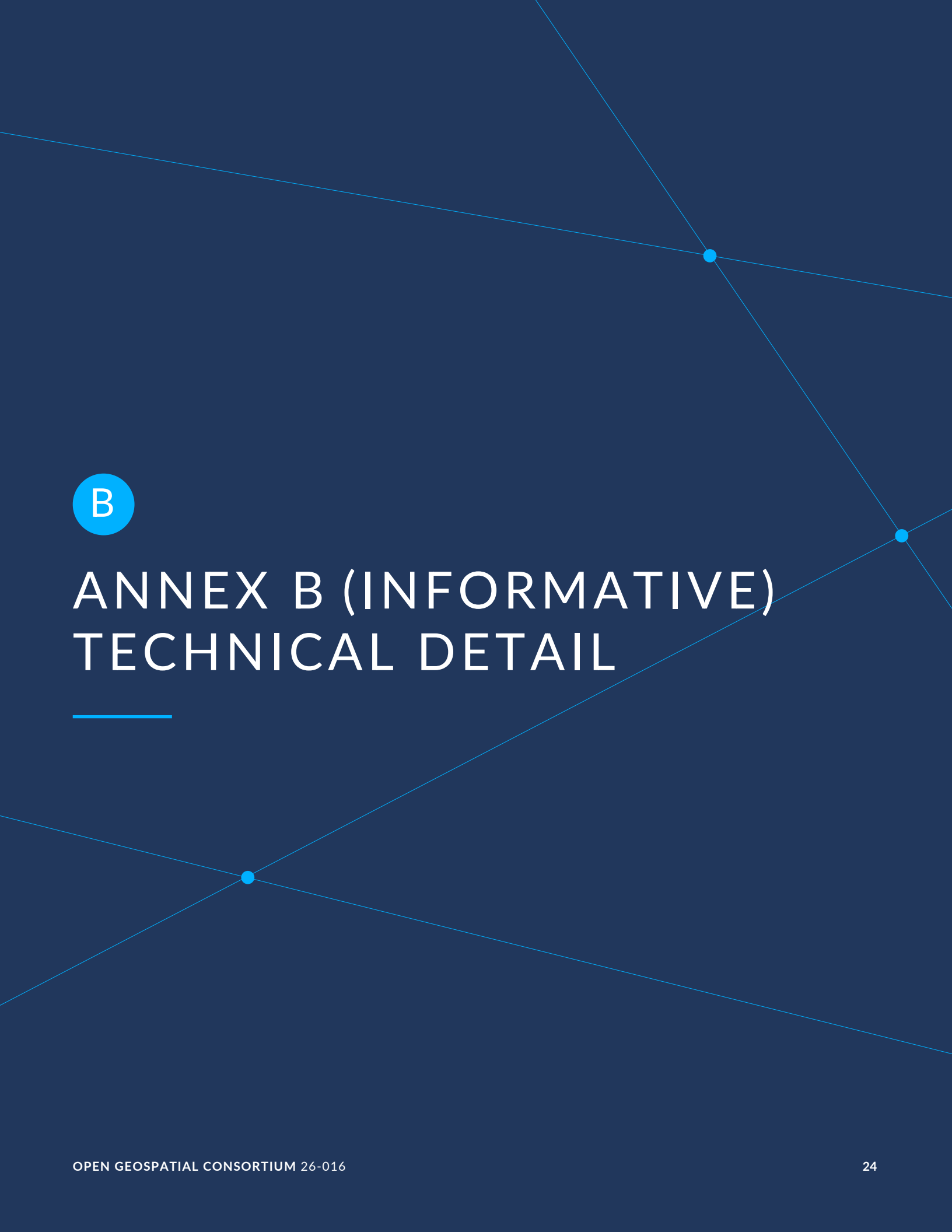


ANNEX A

(NORMATIVE)

ABBREVIATIONS/ACRONYMS

ATS	Abstract Test Suite
ETS	Executable Test Suite
GIMI	GEOINT Imagery Media for Intelligence, Surveillance, and Reconnaissance



B

ANNEX B (INFORMATIVE) TECHNICAL DETAIL

ANNEX B

(INFORMATIVE)

TECHNICAL DETAIL

B.1. Sample Configuration file

This section presents a sample configuration file, typically named `config.xml`.

```
<?xml version="1.0" encoding="UTF-8"?>
<config>
  <scripts>
    <organization>
      <name>OGC</name>
      <standard>
        <name>GIMI</name>
        <version>
          <name>1.0</name>
          <suite>
            <namespace-uri>http://www.opengis.net/cite/gimi-1</namespace-
uri>
              <prefix>tns</prefix>
              <local-name>ets-gimi-1-0.2-SNAPSHOT</local-name>
              <title>ets-gimi-1 Conformance Test Suite</title>
              <description>Tests for compliance to the GIMI Standard.</
description>
                <BasicConformanceClasses>
                  <conformanceClass>Core</conformanceClass>
                </BasicConformanceClasses>
              </suite>
              <revision>
                <name>0.2-SNAPSHOT</name>
                <status>Final</status>
                <sources>
                  <source>gimi-1/1.0/ctl</source>
                </sources>
                <webdir>gimi-1/1.0/site</webdir>
              </revision>
            </version>
          </standard>
        </organization>
      </scripts>
    </config>
```

Listing B.1

B.2. Sample Input Properties file

This section presents a sample input properties file, typically named `test-run-props.xml`.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
<properties version="1.0">
  <comment>Sample test run arguments</comment>
  <entry key="iut">file:///path/sample-image.heif</entry>
</properties>
```

Listing B.2