ETSI GR CIM 030 V1.1.1 (2023-12)

Context Information Management (CIM); Validation of NGSI-LD test Platform and Examples of uses

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Reference
DGR/CIM-0030

Keywords
data interoperability, data models, data sharing,
NGSI-LD, PCTR, testing

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Sous-Préfecture de Grasse (06) N° w061004871

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Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) cross-cutting Context Information Management (CIM).

Modal verbs terminology

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1 Scope

The present document provides the case study about validation of NGSI-LD test platform and describe data interoperability in point of NGSI-LD interface. The case study describes how to develop the NGSI-LD interface and data model test platform. At the conclusion, the present document describe how the NGSI-LD test platform can be used for data interoperability in Smart city.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI GS CIM 009 (V1.6.1): "cross-cutting Context Information Management (CIM); NGSI-LD API".

[i.2] ETSI GS CIM 012 (V1.1.1): "Context Information Management (CIM); NGSI-LD Test Suite Structure".

[i.3] ETSI GS CIM 013: "Context Information Management (CIM); NGSI-LD Test Purposes Descriptions".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

Data Model: model representing the structure of data stored and managed in a data hub, indicating the abstract model required during the access and processing of data

Data Model schema: specification that defines the data model utilized in a Data Hub, outlining the overall specifications for structuring and constraining data in order to objectify and load it into a database for utilization

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

API	Application Process Interface
ATS	Abstract Test Suite
BI	Invalid Behaviour tests
BV	Behaviour Valid tests
CCTV	Closed-Circuit Television
CPS	Cyber Physical System
GS1	Global Standard one
ICS	Implementation Conformance Statement
ID	Identity or Identifier
IUT	Implementation Under Test
IXIT	Implementation eXtra Information for Test
JSON	JavaScript Object Notation
KETI	Korea Electronics Technology Institution
NGSI-LD	Next Generation Service Interfaces Linked Data
QR	Quick Response code
RFID	Radio Frequency Identification
SUT	System - Under Test
TC	Test Case
TP	Test Purpose
TTA	Telecommunications Technology Association (South Korea)
URI	Unified Resource Identifier
URL	Uniform Ressource Locator

4 NGSI-LD Interface Test Validation

4.1 Introduction

Korea Electronics Technology Institute (KETI) developed a Data Hub by adopting ETSI GS CIM 009 [i.1]. Moreover, ETSI CIM developed a test framework and test suite that can test the NGSI-LD standard conformance and released a develop version of the test suite. The test suite is a development version and in order to apply it to the test equipment, it is necessary to secure the validity of the test operation, additional implementation, and validation of the implementation. This session introduces the process of establishing the test system such as the test scope, test equipment, and test environment, focusing on the interface functions supported by the Data Hub.

4.2 Test Environment

4.2.1 Implementation Under Test (IUT)

The smart city Data Hub divides logical functions into its modules and connects with each internal module or external service through the NGSI-LD interface to send request and responses to operations. Among the modules of the Data Hub, its core module stores smart city data based on the NGSI-LD information model and exchanges data between internal modules and external systems through the NGSI-LD interface. In this session, the data core module responsible for core functions in the Data Hub was defined as an IUT, and the interface conformance test was performed by adopting ETSI GS CIM 009 [i.1] and test framework. The Data core module includes a Context Broker supporting NGSI-LD interface and the Context Broker has a data structure based on the NGSI-LD information model. The Context Broker performs data modelling through context-based definitions of common terms.

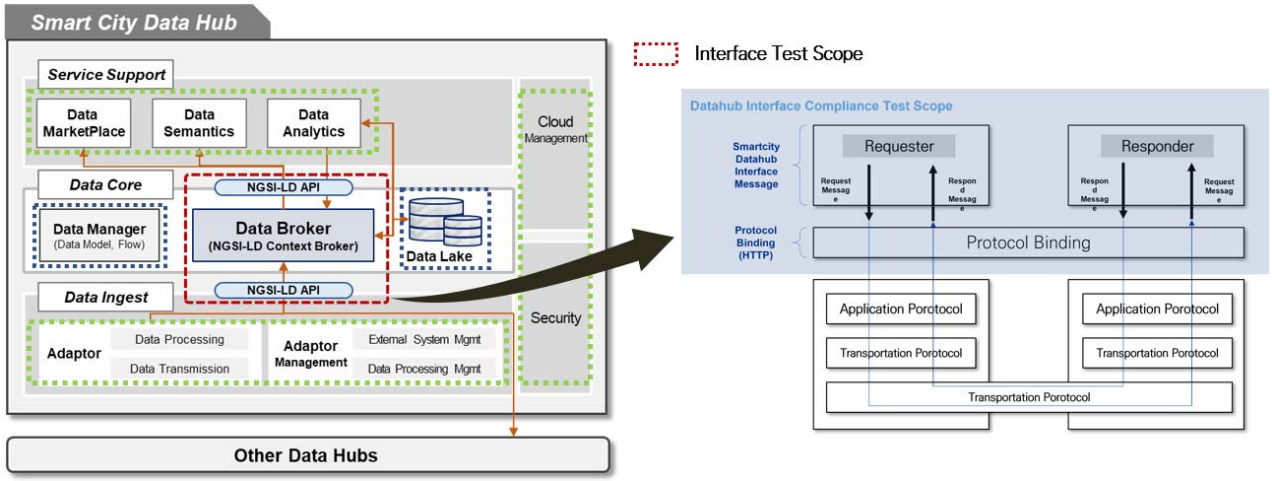

Figure 4.2.1-1: IUT system architecture for NGSI-LD interface test

4.2.2 Test Equipment

In order to set up Data Hub NGSI-LD interface conformance test, test equipment was developed based on technical specifications if required. The test equipment developed by complying with the standards defined by ETSI GS CIM 009 [i.1] and test framework has test procedures and criteria for each test case. The test equipment requests Create, retrieve, update, delete, and subscription operations for the data stored by the IUT, and the IUT returns a response message to the test equipment in response to the requested operation.

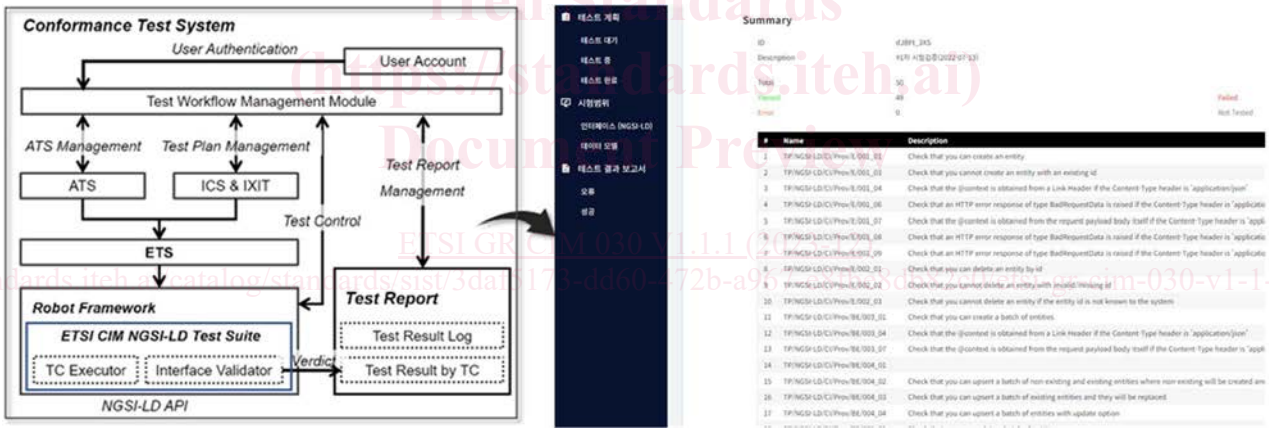

Figure 4.2.2-1: NGSI-LD Interface Test equipment

For the development of the test equipment, test cases were derived according to the interface functions supported by the Data Hub and the test suite was applied at the source code level. Figure 4.2.2-1 shows the system architecture and user interface of test equipment. The test equipment performs test planning, test execution, and test result reporting functions through the test manager and presents a PASS or Fail decision for test results for each test case in connection with the test suite of ETSI CIM. ETSI CIM's test suite runs in the robot framework environment, which is a test automation framework, and performs keyword-based test procedures. After that, it compares and analyses the response data returned from the IUT with the expected data to determine the test result.

4.2.3 Test Environment

The Data Hub NGSI-LD interface conformance test equipment serves as a requester that sends a message to the Data Hub under test according to the interface operation for each resource and the Data Hub operates as a responder. In addition, test equipment plays the role of context producer that provides resources to the context broker of Data Hub and context consumer that consumes resources.

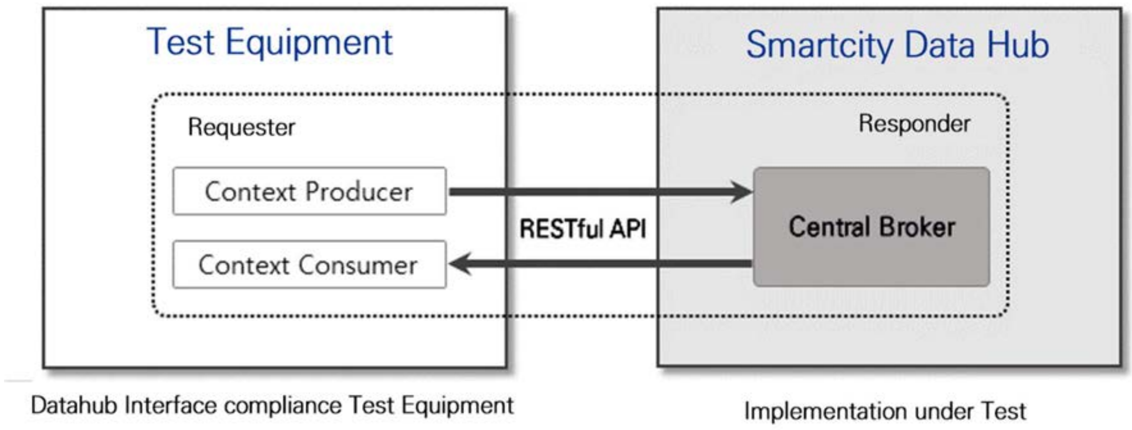

Figure 4.2.3-1: NGSI-LD interface test environment

4.2.4 Test case

For the Data Hub NGSI-LD interface test, figure 4.2.4-1 shows the test cases structure of ETSI GS CIM 012 [i.2] interface test. The test cases were classified according to the common service functions and resources of the IUT. Common service functions are divided into Provision and Consumption and each service function is divided into subtest groups according to the target resource.

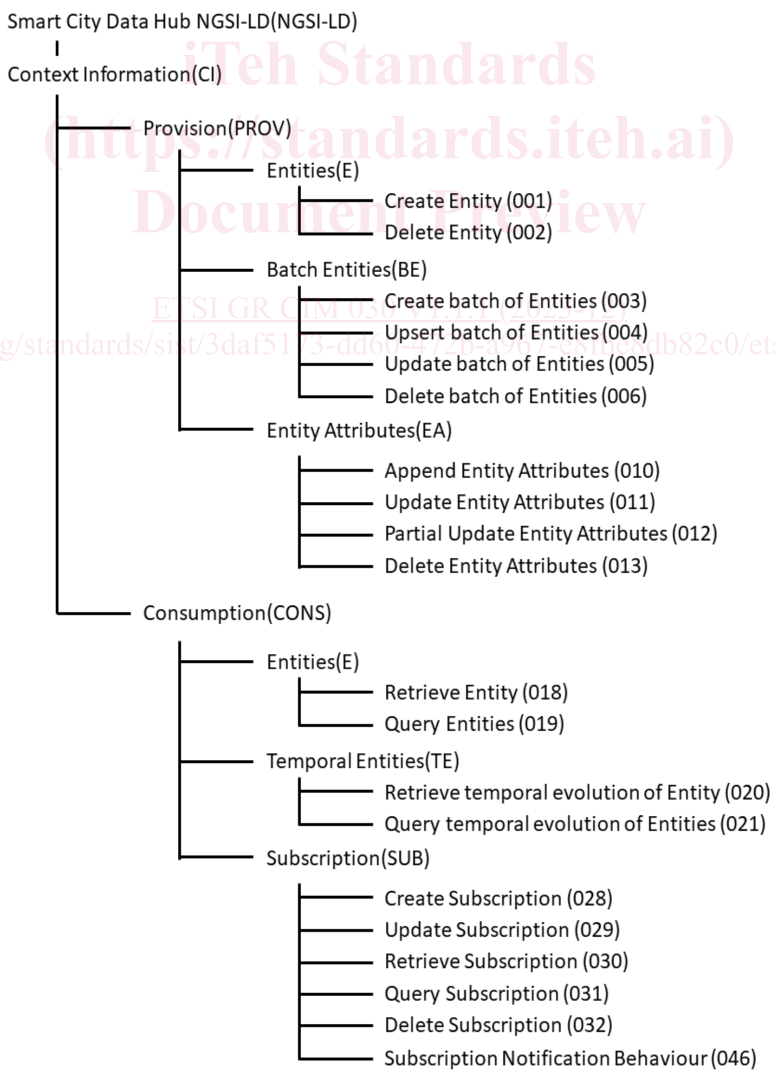

Figure 4.2.4-1: Test case structure for NGSI-LD interface

4.3 Update history about NGSI-LD interface test code

4.3.1 Introduction

TTA and KETI cooperated in the development of a Data Hub through an R&D project of the Republic of Korea. The role of TTA in this project was to develop a test system of the Data Hub's conformance to ETSI GS CIM 009 [i.1] and conduct tests to ensure the reliability of the Data Hub developed by KETI. To fulfil its role, TTA developed a test system as described above. As the purpose of developing the test system was to verify the conformance of the Data Hub to ETSI GS CIM 009 [i.1], as explained above, the NGSI-LD functions applied by the Data Hub were confirmed in advance to establish the test system.

Since the Data Hub did not apply all NGSI-LD functions, the test cases had to be designed according to the NGSI-LD functions supported by the Data Hub. Then, the test code of the test cases was downloaded from ETSI CIM git, and the code was validated to enhance the reliability of the test system. The Data Hub's NGSI-LD interface test system was developed through this process. However, the validation had the following limitations. First, the test code of test suite was a development version and not the official one. There are still some test cases which is not developed yet according to ETSI GS CIM 013 [i.3]. Therefore, using an incomplete test suite was the only way to establish the test system of the Data Hub.

In order to test the NGSI-LD interface of Data Hub, TTA developed the undeveloped test cases and updated the incorrect ones which were not run according to the standard. Second, there was a time limit on completing the test cases design for the NGSI-LD interface test. Due to the development speed of the Data Hub and the nature of R&D in Korea, there was a deadline for establishing the test system. Instead of reviewing all of the test cases distributed by ETSI CIM, the test cases for the functions supported by the Data Hub were selected, and TTA validated the test cases. Third, the test cases were designed around the functions supported by the Data Hub because the purpose of establishing the test system was to verify the conformance of the Data Hub. Therefore, TTA considered only the NGSI-LD function of the Data Hub for the test system and did not validate the other test cases. Regardless of the limitations above, validation of the NGSI-LD test code contributed to increasing the reliability of test suite.

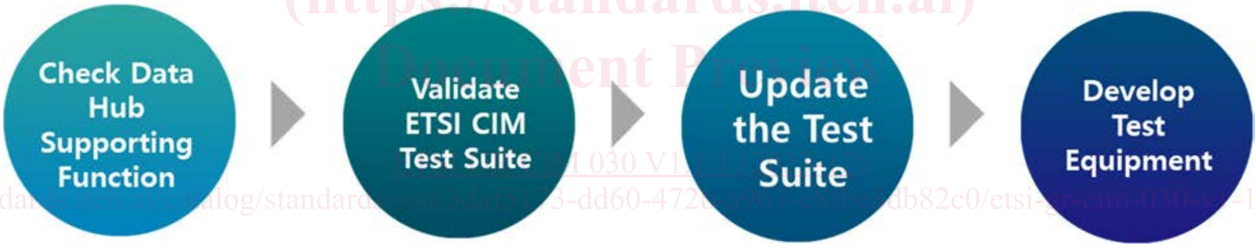

Figure 4.3.1-1: Process for validation of NGSI-LD interface test equipment

4.3.2 Test cases Design

The test cases distributed by ETSI CIM consist of 277 cases. As described above, 76 test cases that can be used for the test were selected among the NGSI-LD functions supported by the Data Hub.

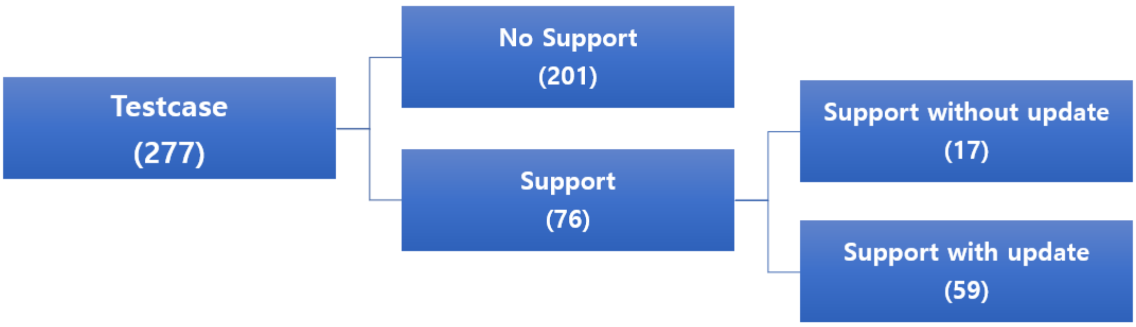

Figure 4.3.2-1: Supported Test cases of NGSI-LD Test Suite

4.3.3 Validation

It is necessary to install the Test Suite in the test equipment and check whether the test equipment operates correctly based on the test standards. This series of verification processes is called validation, and the Data Hub was used to validate the test equipment. Two validations are performed, and test standards are carefully reviewed to ensure that the Data Hub and test equipment operate correctly according to the Standards. At the same time, the scope of test verification is confirmed by checking whether the Data Hub supports the interface's operation for each test cases.

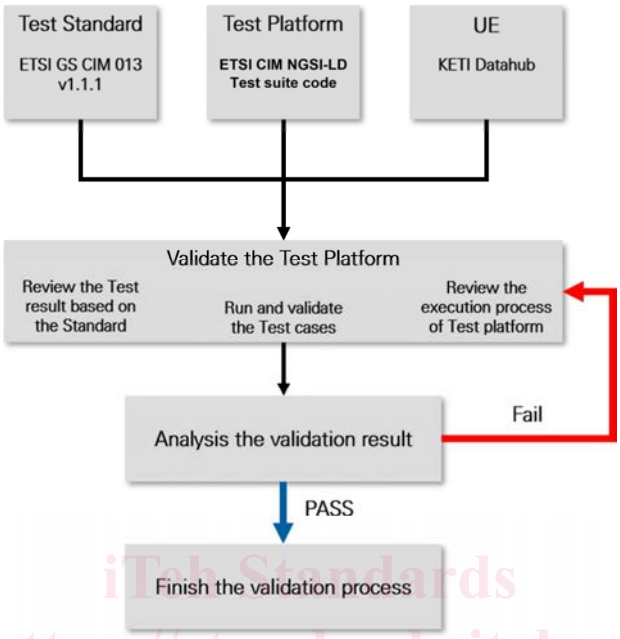

Figure 4.3.3-1: Validation Process of NGSI-LD Test Suite

4.3.4 Validation Result

As shown in table 4.3.4-1, a total of 41 detailed test cases passed the first validation, and a total of 73 test cases passed the second validation. TTA conducted two NGSI-LD interface conformance tests on Data Hub using the test equipment. Some of the test cases that failed in the first validation were corrected and supplemented. The correction and supplementation history are described in clause 4.3.5. Secondary validation was conducted for the corrected and supplemented test cases, and the validation result was derived based on the results. Through the validation process, it was confirmed that the Data Hub supports interface operations for a total of 73 test cases, and the scope of the interface conformance test was determined based on ETSI GS CIM 009 test framework using the validation results.