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Context Information Management (CIM); NGSI-LD Architecture Deployment Scenarios

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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

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Executive summary

The present document is intended to provide developers with supplement descriptions based on Next Generation Service Interface Linked Data (NGSI-LD) architectural considerations that are discussed in the NGSI-LD Application Programming Interface (API) specification. The aim is to give detailed statements for how to configure NGSI-LD systems and use the distributed operations of NGSI-LD API in various deployment scenarios using central, distributed, and federated architecture configurations.

Introduction

While ETSI GS CIM 009 [i.1] provides the distributed architectural concepts with distributed operations. However, it could be difficult to implement the specifications without further informative deliverables. The present document is intended to help readers how to configure NGSI-LD systems using a centralized, distributed, or federated architectures.

Each deployment scenario consists of the following:

- Service scenario
- System configuration with components (e.g. national disaster warning platform)
- NGSI-LD entity modelling (e.g. EarthquakeEvent)
- Request message of each distributed operation

1 Scope

The present document provides detailed statements for how to configure NGSI-LD system and use the distributed operations of NGSI-LD API in the centralized, distributed, and federated architectures. Those architectural considerations are described in ETSI GS CIM 009 [i.1].

The present document includes the following topics:

- NGSI-LD deployment scenarios and usage of NGSI-LD API operations using the centralized architecture.
- NGSI-LD deployment scenarios and usage of distributed operations of NGSI-LD API using the distributed architecture.
- NGSI-LD deployment scenarios and usage of distributed operations of NGSI-LD API using the federated architecture.

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.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

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 (V1.7.1): "Context Information Management (CIM); NGSI-LD API".

3 Definition of terms, symbols and abbreviations

3.1 Terms

Void.

3.2 Symbols

Void.

3.3 Abbreviations

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

API	Application Programming Interface
CSR	Context Source Registration
ID	IDentifier

NGSI-LD Next Generation Service Interfaces Linked Data
URI Uniform Resource Identifier

4 Overview

The present document supplements the architectural considerations of NGSI-LD API specification (see clause 4.3 in ETSI GS CIM 009 [i.1]). For this purpose, the present document provides deployment scenarios with NGSI-LD system configuration and examples.

Table 4-1 shows the relationship between the present document and NGSI-LD API specification.

Table 4-1: Relationship between the present document and NGSI-LD API specification

Deployment scenario	The present document	The NGSI-LD API specification ETSI GS CIM 009 [i.1]
Centralized architecture	Clause 5	Clause 4.3.2
Distributed architecture using exclusive mode	Clause 6	Clause 4.3.3 and 4.3.6
Distributed architecture using inclusive mode	Clause 6	Clause 4.3.3 and 4.3.6
Distributed architecture using redirect mode	Clause 6	Clause 4.3.3 and 4.3.6
Distributed architecture using auxiliary mode	Clause 6	Clause 4.3.3 and 4.3.6
Federated architecture	Clause 7	Clause 4.3.4 and 4.3.6

5 Deployment scenario #1 - centralized architecture

5.1 Introduction

The clause 5 describes an NGSI-LD API-based simple data production and consumption using the centralized architecture (see clause 4.3.2 in ETSI GS CIM 009 [i.1]).

5.2 NGSI-LD system configuration

Figure 5.2-1 shows an NGSI-LD system for simple data production and consumption using the centralized architecture.

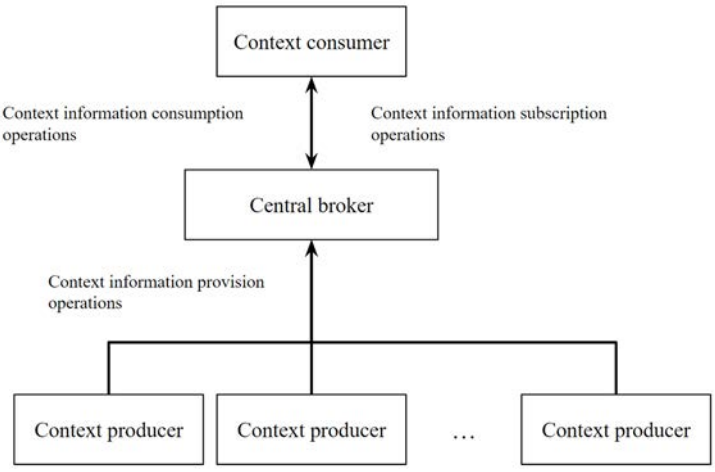

Figure 5.2-1: NGSI-LD system for simple data production and consumption using the centralized architecture

The definition of the central broker, context producer, and context consumer is specified in clause 3.1 of ETSI GS CIM 009 [i.1].

Context information provision operations are specified in clause 5.6 of ETSI GS CIM 009 [i.1].

Context information consumption operations are specified in clause 5.7 of ETSI GS CIM 009 [i.1].

Context information subscription operations are specified in clause 5.8 of ETSI GS CIM 009 [i.1].

5.3 Deployment scenario example - smart parking

5.3.1 Overview

A building has a number of parking spaces. For each parking space, a vehicle detection sensor is installed and connected to a smart parking server. Every time the vehicle detection sensor detects a vehicle in its parking space, it sends a detection event to the smart parking server.

Now, a building customer drives to the building and looks for available parking spaces using the smart parking application.

5.3.2 Service component mapping

Figure 5.3.2-1 shows a service component mapping to the NGSI-LD system.

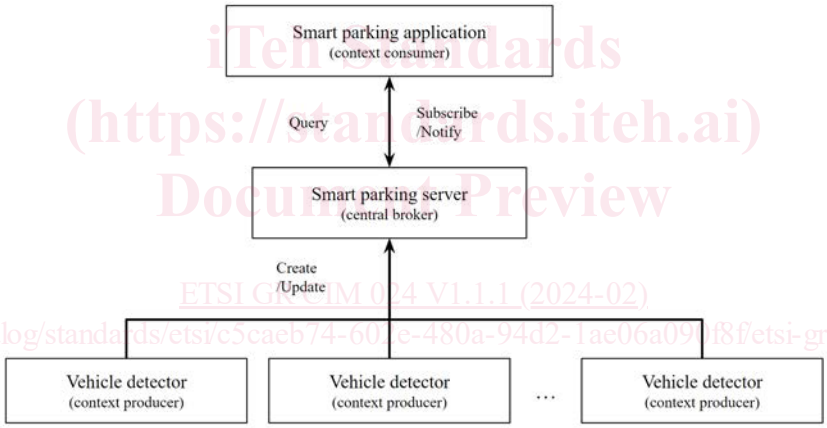

Figure 5.3.2-1: Service component mapping to the NGSI-LD system

Table 5.3.2-1 shows an example data model of the entity *VehicleDetector*. Each vehicle detector has its entity ID and their context information is persisted in the smart parking server.

Table 5.3.2-1: Example data model of entity *VehicleDetector*

Name	Type	Restriction	Cardinality	Description
id	URI		1	Entity identifier (ID) of vehicle detector
type	String	The value is equal to "http://example.org/ngsi-ld/VehicleDetector"	1	Entity type
name	String		1	Property for indicating a parking space
isDetected	Boolean		1	Property for indicating a vehicle is detected or not: • false: not detected • true: detected
location	GeoJSON		0..1	Property for location of the installation point for the vehicle detection sensor

5.3.3 Scenarios

5.3.3.1 Parking space availability retrieval

Figure 5.3.3.1-1 shows communication flows to get available parking spaces.

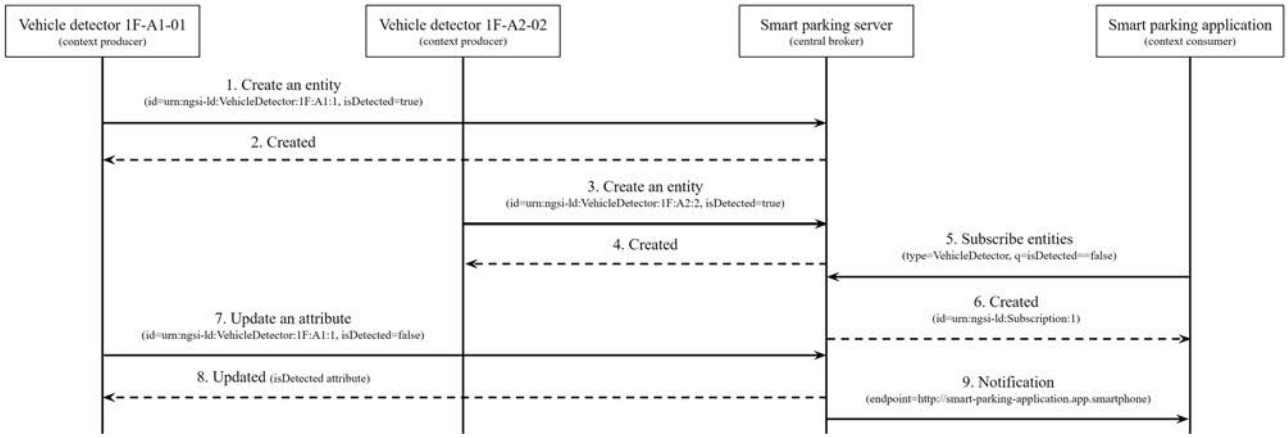

Figure 5.3.3.1-1: Communication flows to get available parking spaces

Each step is described as follows:

1) Vehicle detector 1F-A1-01 provisions its context information to the smart parking server.

   - The entity creation request (see clause 5.6.1 in ETSI GS CIM 009 [i.1]) includes the entity resource (see clause 5.2.4 in ETSI GS CIM 009 [i.1]):

```
{
  "id": "urn:ngsi-ld:VehicleDetector:1F:A1:1",
  "type": "VehicleDetector",
  "name": {
    "type": "Property",
    "value": "1F-A1-01"
  },
  "isDetected": {
    "type": "Property",
    "value": true,
    "observedAt": "2023-01-01T12:00:00Z"
  },
  "location": {
    "type": "GeoProperty",
    "value": {
      "type": "Point",
      "coordinates": [127.16019783463986, 37.40378558266181]
    }
  },
  "@context": [
    "http://example.org/ngsi-ld/latest/vehicle-detector.jsonld",
    "https://uri.etsi.org/ngsi-ld/v1/ngsi-ld-core-context-v1.7.jsonld"
  ]
}
```

2) Smart parking server sends back the successful response.

3) Vehicle detector 1F-A2-02 provisions its context information to smart parking server.

   - The entity creation request (see clause 5.6.1 in ETSI GS CIM 009 [i.1]) includes the entity resource (see clause 5.2.4 in ETSI GS CIM 009 [i.1]):

```
{
  "id": "urn:ngsi-ld:VehicleDetector:1F:A2:2",
  "type": "VehicleDetector",
  "name": {
    "type": "Property",
    "value": "1F-A2-02"
  },
```

```
  "isDetected": {
    "type": "Property",
    "value": true,
    "observedAt": "2023-01-01T12:00:00Z"
  },
  "location": {
    "type": "GeoProperty",
    "value": {
      "type": "Point",
      "coordinates": [127.16019783463986, 37.40378558266181]
    }
  },
  "@context": [
    "http://example.org/ngsi-ld/latest/vehicle-detector.jsonld",
    "https://uri.etsi.org/ngsi-ld/v1/ngsi-ld-core-context-v1.7.jsonld"
  ]
}
```

4) Smart parking server sends back the successful response.

5) Smart parking application subscribes for available parking spaces.

   - The subscription creation request (see clause 5.8.1 in ETSI GS CIM 009 [i.1]) includes the subscription resource (see clause 5.2.12 in ETSI GS CIM 009 [i.1]):

```
{
  "type": "Subscription",
  "entities": [
    {
      "type": "VehicleDetector"
    }
  ],
  "watchedAttributes": ["name", "isDetected"],
  "q": "isDetected==false",
  "notification": {
    "attributes": ["name", "isDetected"],
    "endpoint": "http://smart-parking-application.app.smartphone"
  },
  "@context": [
    "http://example.org/ngsi-ld/latest/vehicle-detector.jsonld",
    "https://uri.etsi.org/ngsi-ld/v1/ngsi-ld-core-context-v1.7.jsonld"
  ]
}
```


6) Smart parking server creates subscription resource and responds with the successful response.

7) Vehicle detector 1F-A1-01 detects a vacancy for its parking space and updates vacancy information to smart parking server.

   - The partial attribute update request (see clause 5.6.4 in ETSI GS CIM 009 [i.1]) for the entity "urn:ngsi-ld:VehicleDetector:1F:A1:1" is as follows:

```
{
  "isDetected": false
}
```

8) Smart parking server updates the attributes for the entity resource and responds with the successful response.

9) Smart parking server checks if there is one or more subscription(s) match with the event in step 8, , then the server notifies to notification endpoint of the subscription.

   - There is one subscription that is created in the step 5, according to the notification behaviour (see clause 5.8.6 in ETSI GS CIM 009 [i.1]), smart parking server notifies to smart parking application with the following notification resource (see clause 5.3.1 in ETSI GS CIM 009 [i.1]):

```
{
  "id": "urn:ngsi-ld:Notification:1",
  "type": "Notification",
  "subscriptionId": "urn:ngsi-ld:Subscription:1",
  "notifiedAt": "2023-01-01T14:00:00Z",
  "data": [
    {
      "id": "urn:ngsi-ld:VehicleDetector:1F:A1:1",
      "type": "VehicleDetector",
```

```
      "name": {
        "type": "Property",
        "value": "1F-A1-01"
      },
      "isDetected": {
        "type": "Property",
        "value": false,
        "observedAt": "2023-01-01T14:00:00Z"
      },
      "@context": [
        "http://example.org/ngsi-ld/latest/vehicle-detector.jsonld",
        "https://uri.etsi.org/ngsi-ld/v1/ngsi-ld-core-context-v1.7.jsonld"
      ]
    }
  ],
  "@context": [
    "https://uri.etsi.org/ngsi-ld/v1/ngsi-ld-core-context-v1.7.jsonld"
  ]
}
```


6 Deployment scenario #2 - distributed architecture

6.1 Introduction

The clause 6 describes an NGSI-LD API-based interactions using the distributed architecture (see clause 4.3.3 in ETSI GS CIM 009 [i.1]).

6.2 NGSI-LD system configuration

Figure 6.2-1 shows an NGSI-LD system using the distributed architecture.

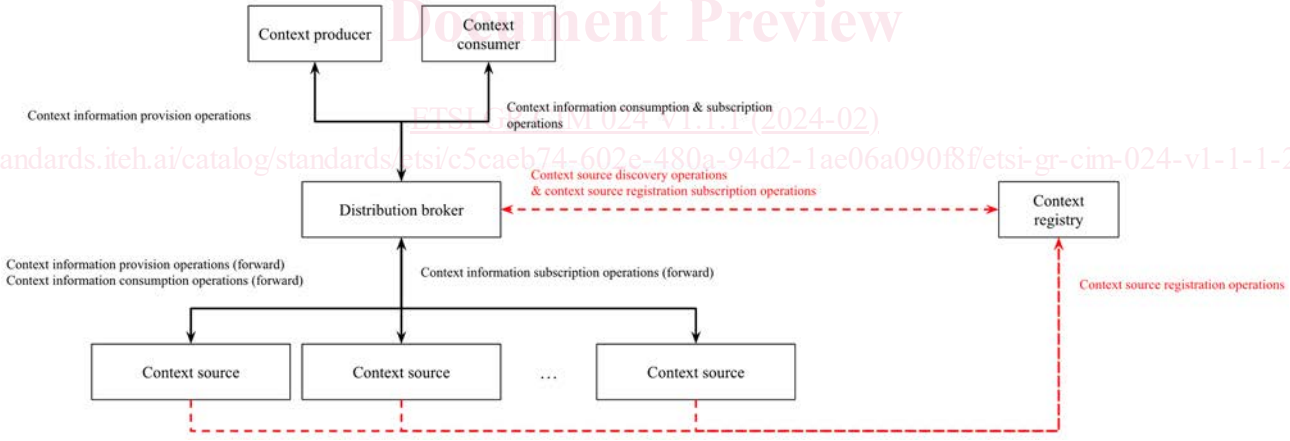

Figure 6.2-1: NGSI-LD system using the distributed architecture

The definition of the distribution broker, context producer, context consumer, context source, and context registry are specified in clause 3.1 of ETSI GS CIM 009 [i.1].

Context information provision operations are specified in clause 5.6 of ETSI GS CIM 009 [i.1].

Context information consumption operations are specified in clause 5.7 of ETSI GS CIM 009 [i.1].

Context information subscription operations are specified in clause 5.8 of ETSI GS CIM 009 [i.1].

Context source registration operations are specified in clause 5.9 of ETSI GS CIM 009 [i.1].

Context source discovery operations are specified in clause 5.10 of ETSI GS CIM 009 [i.1].

Context source registration subscription operations are specified in clause 5.11 of ETSI GS CIM 009 [i.1].