

Recommendation

ITU-T Y.4704 (03/2024)

SERIES Y: Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities

Internet of things and smart cities and communities –
Management, control and performance

Internet of things device management application programming interface Representational State Transfer specification

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Recommendation ITU-T Y.4704

Internet of things device management application programming interface Representational State Transfer specification

Summary

Recommendation ITU-T Y.4704 specifies the Representational State Transfer (REST) application programming interface (API) for the management of any Internet of things (IoT) Device. It includes the model definition as well as all available operations.

History*

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Recommendation ITU-T Y.4704

Internet of things device management application programming interface Representational State Transfer specification

1 Scope

This Recommendation presents a strong framework for management of Internet of things (IoT) devices leveraging existing globally adopted and publicly available TM Forum (TMF) open application programming interfaces (Open APIs). The business case for IoT requires that IoT platforms are highly scalable and interoperable supporting many different types of devices. This Recommendation demonstrates how an existing organization's information technology state can be reused to manage IoT devices through their lifecycles with the inclusion of a single new Open API Device Agent for the encapsulation of IoT device data enabling the management of many different IoT protocols, for example Message Queuing Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), etc. MQTT is a lightweight, publish-subscribe based messaging protocol designed for resource-constrained devices and where low-bandwidth, high latency is important.

Constrained Application Protocol (CoAP) is a specialized Internet application protocol for constrained devices. It enables constrained devices to communicate with the wider internet.

NOTE – This Recommendation is technically aligned with TMF 908 IoT Agent and Device Component Suite API Specification v1.0.1 [b-TMF 908].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T X.733] Recommendation ITU-T X.733 (1992) | ISO/IEC ISO/IEC 10164-4:1992, *Information technology – Open Systems Interconnection – Systems Management: Alarm reporting function*.

[3GPP TS 32.111-2] 3GPP TS 32.111-2 V10.1.0 (201103). Release 10, *Fault Management; Part 2: Alarm Integration Reference Point (IRP): Information Service (IS)*.

3 Definitions

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

6LoWPAN	IPv6 over Low-Power Wireless Personal Area Networks
API	Application Programming Interface
CoAP	Constrained Application Protocol
EMS	Element Management System
GeoJSON	Geographic JavaScript Object Notation



Documents

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Document Sharing Hub

ID	Identifier
IoT	Internet of Things
MQTT	Message Queuing Telemetry Transport
MSISDN	Mobile Station International Subscriber Directory Number
NGSI	Next Generation Service Interface
REST	Representational State Transfer
RFSS	Radio Frequency Sub-System
OSS	Operations Support System
UDG	User Datagram Protocol (UDP) Datagram
URI	Uniform Resource Identifier

5 Conventions

5.1 Support of polymorphism and extension patterns

Support of polymorphic collections and types and schema-based extension is provided by means of a list of generic meta-attributes that are described below. Polymorphism in collections occurs when entities inherit from base entities, for instance a `BillingAccount` and `SettlementAccount` inheriting properties from the abstract `Account` entity.

The `@type` attribute provides a way to represent the actual class type of an entity. For example, within a list of `Account` instances some may be instances of `BillingAccount` where other could be instances of `SettlementAccount`. The `@type` gives this information. All resources and sub-resources of this application programming interface (API) have `@type` attributes that can be provided when this is useful.

The `@referredType` can be used within reference entities (like for instance an `AccountRef` object) to explicitly denote the actual entity type of the referred class. Notice that in reference entities the `@type`, when used, denotes the class type of the reference itself, such as `BillingAccountRef` or `SettlementAccountRef`, and not the class type of the referred object. However, since reference classes are rarely sub-classed, `@type` is generally not useful in reference objects.

The `@schemaLocation` property can be used in resources to allow specifying user-defined properties of an Entity or to specify the expected *characteristics* of an entity.

The `@baseType` attribute gives a way to provide explicitly the base of class of a given resource that has been extended.

6 Resource model

This API uses the GeoLocation Datamodel defined as follows:

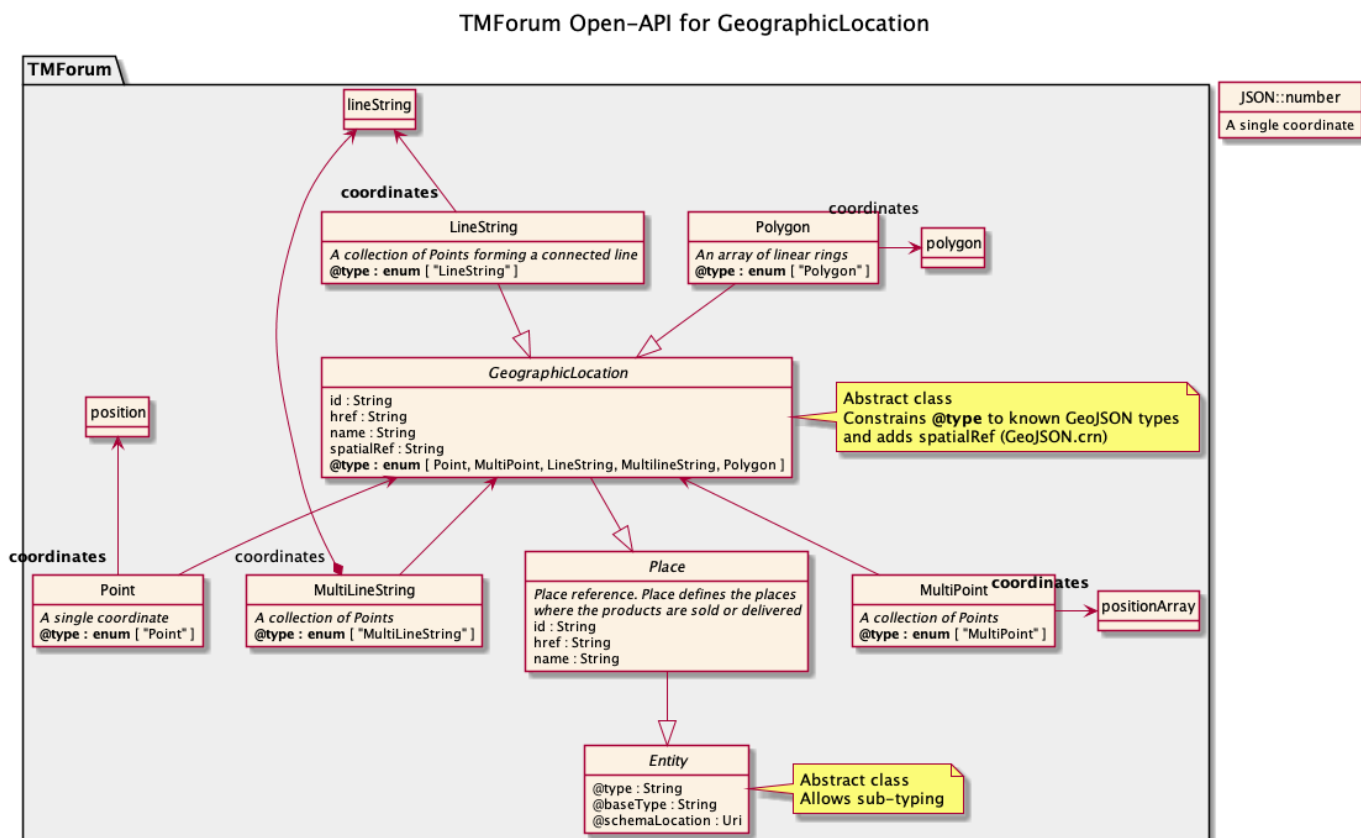


Figure 1 – TM Forum Open API for geographic location

6.1 Managed Entity and Task Resource Models

6.1.1 IoT device resource

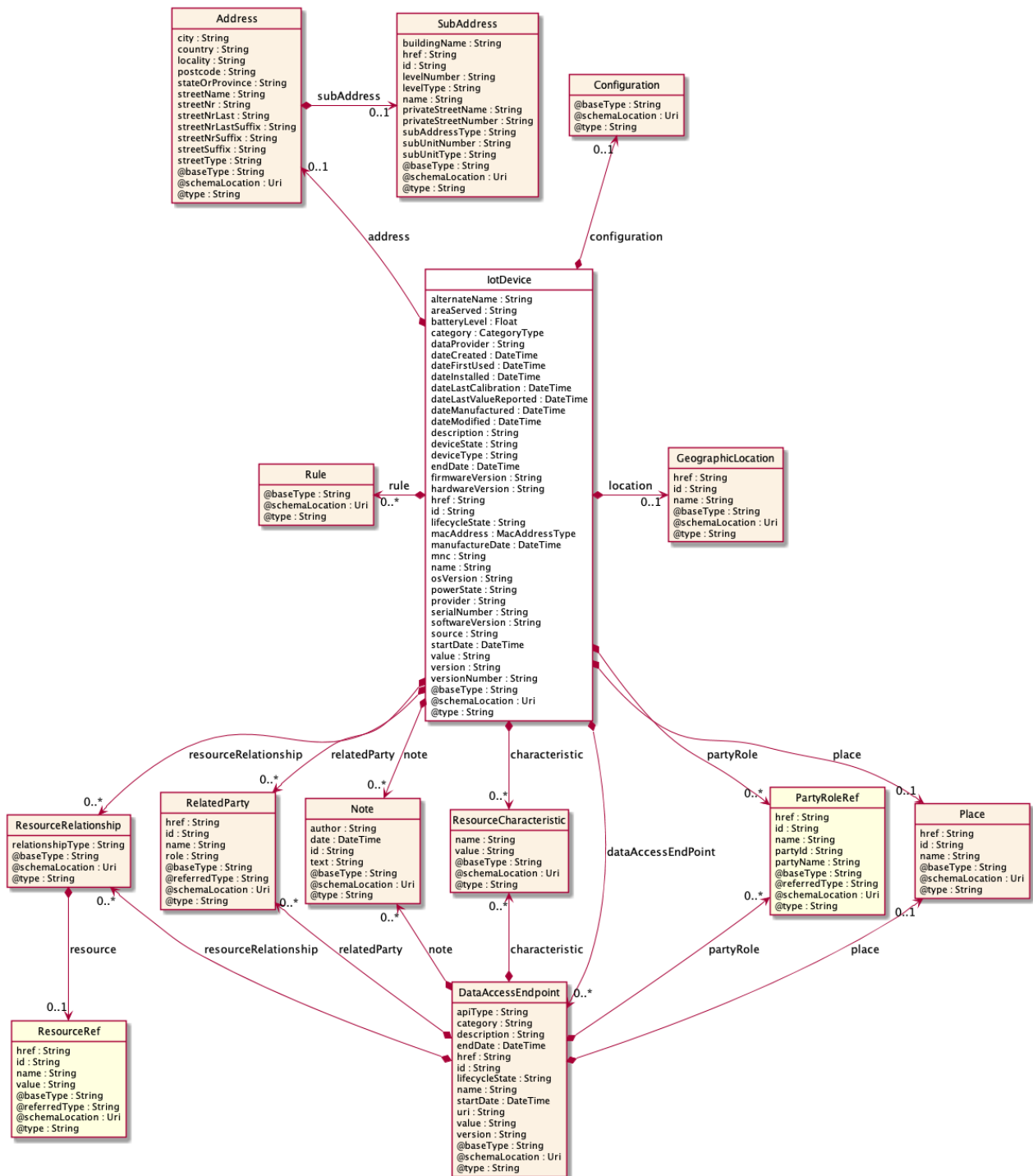


Figure 2 – Managed entity and task resource model, schematic

Field descriptions

IotDevice fields

batteryLevel	A float.
dateFirstUsed	A date time (DateTime).
dateInstalled	A date time (DateTime).
dateLastCalibration	A date time (DateTime).
dateLastValueReported	A date time (DateTime).
dateManufactured	A date time (DateTime).
deviceState	A string.
deviceType	A string. NGSI Entity type.
firmwareVersion	A string.
hardwareVersion	A string.
mnc	A string.
osVersion	A string.
provider	A string.
serialNumber	A string. This is a string that represents a manufacturer-allocated number used to identify different instances of the same hardware item. The ModelNumber and PartNumber attributes are used to identify different types of hardware items. This is a REQUIRED attribute.
softwareVersion	A string.
value	A string.
alternateName	A string.
dataProvider	A string.
dateCreated	A date time (DateTime).
dateModified	A date time (DateTime).
description	A string. free-text description of the resource.
name	A string. A string used to give a name to the resource.
source	A string.
areaServed	A string.
category	A list of category types (CategoryType [1..*]).
description	A string. free-text description of the resource.
endDate	A date time (DateTime). A date time(DateTime). The date till the resource is effective.
href	A string. The URI for the object itself.
id	A string. Identifier of an instance of the resource. Required to be unique within the resource type. Used in URIs as the identifier for specific instances of a type.
lifecycleState	A string. The life cycle state of the resource.

manufactureDate	A date time (DateTime). This is a string attribute that defines the date of manufacture of this item in the fixed format "dd/mm/yyyy". This is an optional attribute.
name	A string. A string used to give a name to the resource.
powerState	A string. This defines the current power status of the hardware item. Values include: 0: Unknown 1: Not Applicable 2: No Power Applied 3: Full Power Applied 4: Power Save - Normal 5: Power Save - Degraded 6: Power Save - Standby 7: Power Save - Critical 8: Power Save - Low Power Mode 9: Power Save - Unknown 10: Power Cycle 11: Power Warning 12: Power Off.
serialNumber	A string. This is a string that represents a manufacturer-allocated number used to identify different instances of the same hardware item. The ModelNumber and PartNumber attributes are used to identify different types of hardware items. This is a REQUIRED attribute.
startDate	A date time (DateTime). A date time (DateTime). The date from which the resource is effective.
version	A string. A field that identifies the specific version of an instance of a resource.
versionNumber	A string. This is a string that identifies the version of this object. This is an optional attribute.
category	A list of category types (CategoryType [1..*]).
dataAccessEndPoint	A list of data access endpoints (DataAccessEndpoint [*]). This is the endpoint exposed by the IoT Device to authorized users.
location	A geographic location (GeographicLocation). A GeographicLocation is a pure-virtual super-class to the GeoJSON-aligned geometries of Point (addresses and locations), MultiPoint, LineString (streets, highways and boundaries), MultiLineString and Polygon (countries, provinces, tracts of land). Use the @type attribute to specify which of these is being specified by the geometry attribute.
configuration	A configuration (Configuration).
macAddress	A list of mac address types (MacAddressType [*]).
rule	A list of rules (Rule [*]).
address	An address (Address). Structured textual way of describing how to find a Property in an urban area (country properties are often defined differently). Note: Address corresponds to SID UrbanPropertyAddress.

location	A geographic location (GeographicLocation). A GeographicLocation is a pure-virtual super-class to the GeoJSON-aligned geometries of Point (addresses and locations), MultiPoint, LineString (streets, highways and boundaries), MultiLineString and Polygon (countries, provinces, tracts of land). Use the @type attribute to specify which of these is being specified by the geometry attribute.
characteristic	A list of resource characteristics (ResourceCharacteristic [*]).
note	A list of notes (Note [*]). Extra information about a given entity.
partyRole	A list of party role references (PartyRoleRef [*]). A party role represents the part played by a party in a given context.
place	A place (Place). Place reference. Place defines the places where the products are sold or delivered.
relatedParty	A list of related parties (RelatedParty [*]). Related Entity reference. A related party defines party or party role linked to a specific entity.
resourceRelationship	A list of resource relationships (ResourceRelationship [*]). Describes links between resources.

Address sub-resource

Structured textual way of describing how to find a Property in an urban area (country properties are often defined differently).

NOTE – Address corresponds to SID UrbanPropertyAddress.

city	A string. City that the address is in.
country	A string. Country that the address is in.
locality	A string. "An area of defined or undefined boundaries within a local authority or other legislatively defined area, usually rural or semi-rural in nature." [ANZLIC-STREET], or a suburb "a bounded locality within a city, town or shire principally of urban character " [ANZLICSTREET].
postcode	A string. descriptor for a postal delivery area, used to speed and simplify the delivery of mail (also known as zipcode).
stateOrProvince	A string. the State or Province that the address is in.
streetName	A string. Name of the street or other street type.
streetNr	A string. Number identifying a specific property on a public street. It may be combined with streetNrLast for ranged addresses.
streetNrLast	A string. Last number in a range of street numbers allocated to a property.
streetNrLastSuffix	A string. Last street number suffix for a ranged address.
streetNrSuffix	A string. the first street number suffix.
streetSuffix	A string. A modifier denoting a relative direction.
streetType	A string. alley, avenue, boulevard, brae, crescent, drive, highway, lane, terrace, parade, place, tarn, way, wharf.
subAddress	A sub address (SubAddress). Within a property in an urban area, may refer to a building, building cluster, or a floor of a multistory building.

DataAccessEndpoint sub-resource

This is the endpoint exposed by the IoT Device to authorized users.

category	A string. Category of the concrete resource, such as: Gold, Silver for MSISDN concrete resource.
description	A string. Free-text description of the resource.
endDate	A date time (DateTime). The date till the resource is effective.
href	A string. The URI for the object itself.
id	A string. Identifier of an instance of the resource. Required to be unique within the resource type. Used in URIs as the identifier for specific instances of a type.
lifecycleState	A string. The life cycle state of the resource.
name	A string. A string used to give a name to the resource.
startDate	A date time (DateTime). A date time (DateTime). The date from which the resource is effective.
value	A string. The value of the logical resource, such as: 0044746712345 for an MSISDN.
version	A string. A field that identifies the specific version of an instance of a resource.
apiType	A string.
uri	A string. URI for using the data access API.
characteristic	A list of resource characteristics (ResourceCharacteristic [*]).
note	A list of notes (Note [*]). Extra information about a given entity.
partyRole	A list of party role references (PartyRoleRef [*]). A party role represents the part played by a party in a given context.
place	A place (Place). Place reference. Place defines the places where the products are sold or delivered.
relatedParty	A list of related parties (RelatedParty [*]). Related Entity reference. A related party defines party or party role linked to a specific entity.
resourceRelationship	A list of resource relationships (ResourceRelationship [*]). Describes links between resources.

GeographicLocation sub-resource

A GeographicLocation is a pure-virtual super-class to the GeoJSON-aligned geometries of Point (addresses and locations), MultiPoint, LineString (streets, highways and boundaries), MultiLineString and Polygon (countries, provinces, tracts of land). Use the @type attribute to specify which of these is being specified by the geometry attribute.

href	A string. An URI used to access to the geographic location resource.
id	A string. Unique identifier of the geographic location.
name	A string. A user-friendly name for the place, such as [Paris Store], [London Store], [Main Home].

MacAddressType sub-resource

MacAddressType A string.

Note sub-resource

Extra information about a given entity.

author A string. Author of the note.
date A date time (DateTime). Date of the note.
id A string. Identifier of the note within its containing entity (may or may not be globally unique, depending on provider implementation).
text A string. Text of the note.

Place sub-resource

Place reference. Place defines the places where the products are sold or delivered.

href A string. Unique reference of the place.
id A string. Unique identifier of the place.
name A string. A user-friendly name for the place, such as [Paris Store], [London Store], [Main Home].

RelatedParty sub-resource

Related Entity reference. A related party defines party or party role linked to a specific entity.

@referredType A string. The actual type of the target instance when needed for disambiguation.
href A string. Reference of the related entity.
id A string. Unique identifier of a related entity.
name A string. Name of the related entity.
role A string. Role played by the related party.

ResourceCharacteristic sub-resource

name A string. name of the characteristic.
value A string. value of the characteristic.

ResourceRelationship sub-resource

Describes links between resources.

relationshipType A string. Semantic of the relationship.
resource A resource reference (ResourceRef). A reference to the resource.

SubAddress sub-resource

Representation of a SubAddress.

It is used for addressing within a property in an urban area (country properties are often defined differently). It may refer to a building, a building cluster, or a floor of a multistory building.

buildingName A string. Allows for buildings that have well-known names.
href A string.

id	A string. Unique ID for this SubAddress.
levelNumber	A string. Used where a level type may be repeated e.g., BASEMENT 1, BASEMENT 2.
levelType	A string. Describes level types within a building.
name	A string. Name of the subAddress to identify it with a meaningful identification.
privateStreetName	A string. Private streets internal to a property (e.g., a university) may have internal names that are not recorded by the land title office.
privateStreetNumber	A string. Private streets numbers internal to a private street.
subAddressType	A string. The type of subaddress: it can be a subunit or a private street.
subUnitNumber	A string. The discriminator of the subunit, often just a simple number e.g., FLAT 5, may also be a range.
subUnitType	A string. The type of subunit, such as BERTH, FLAT, PIER, SUITE, SHOP, TOWER, UNIT, WHARF.

PartyRoleRef relationship

Party role reference. A party role represents the part played by a party in a given context.

@referredType	A string. The actual type of the target instance when needed for disambiguation.
href	A string. Reference of the product.
id	A string. Unique identifier of the product.
name	A string. The name of the referred party role.
partyId	A string. The identifier of the engaged party that is linked to the PartyRole object.
partyName	A string. The name of the engaged party that is linked to the PartyRole object.

ResourceRef relationship

@referredType	A string. The actual type of the target instance when needed for disambiguation.
href	A string. Reference of the related entity.
id	A string. Unique identifier of a related entity.
name	A string. Name of the resource.
value	A string. The resource value that can be used to identify a resource with a public key (e.g.: a tel nr, an msisdn).

Json representation example

The following is an example json representation of an 'IotDevice' resource object

```
{
  "dateFirstUsed": "2019-05-13T00:00",
  "dateInstalled": "2019-05-13T00:00",
  "dateLastCalibration": "2019-05-13T00:00",
  "dateLastValueReported": "2019-05-13T00:00",
  "dateManufactured": "2019-05-13T00:00",

```

```

"deviceState": "ok",
"deviceType": "Temperature",
"firmwareVersion": "1.0.0",
"hardwareVersion": "1.0.0",
"mnc": "01",
"osVersion": "1.0.0",
"provider": "Mandat International",
"serialNumber": "12345",
"softwareVersion": "1.0.0",
"value": "0041227744222",
"alternateName": "CoAP temperature sensor 3",
"dataProvider": "https://www.mandint.org",
"dateCreated": "2019-05-13T00:00",
"dateModified": "2019-05-13T00:00",
"description": "This is a temperature sensor using CoAP and 6LoWPAN.",
"name": "temp_3",
"source": "coap://[2001:41e0:6002:1800:0:0:0:3]:61616/temp ",
"areaServed": "Switzerland ",
"category": "Gold ",
"endDate ": "2019-05-13T00:00",
"href ": "https://host:port/tmf-api/iotDevice/v1/iotDevice/temp_3",
"lifecycleState": "InService",
"manufactureDate": "2019-05-13T00:00",
"powerState": "3",
"startDate": "2019-05-13T00:00",
"version": "1.0",
"versionNumber": "1.0.0",
"dataAccessEndPoint": {
  "category": "Gold",
  "description": "This is a temperature sensor using CoAP and 6LoWPAN.",
  "endDate": "2019-05-13T00:00",
  "href": "https://host:port/tmf-api/iotDevice/v1/iotDevice/temp_3",
  "id": "3",
  "lifecycleState": "InService",
  "name": "temp_3",
  "startDate": "2019-05-03T00:00",
  "value": "0041227744222",
  "version": "1.0",
  "apiType": "NGSI",
  "uri": "https://host:port/tmf-api/iotDevice/v1/iotDevice/temp_3/dataAccessEndpoint/3"
},
"batteryLevel": 1.0,
"configuration": {
  "timeout": 5,
  "reportingPeriod ": 300
},
"macAddress": [
  "02:00:00:00:00:03"
],
"$id": "Device.schema.json",
"address": {
  "addressLocality": "Geneva",
  "postalCode": "1209",
  "streetAddress": "Chemin du Champ-Baron 3"
},
"location": {
  "attrName": "position",
  "coords": {
    "type": "Point",
    "coordinates": [
      46.223064,
      6.1305982
    ]
  }
}

```

```

    }
  },
  "characteristic": [
    {
      "name": "accuracy",
      "value": "1.0"
    }
  ],
  "note": [
    {
      "author": "Cedric Crettaz",
      "date": "2019-05-13T00:00",
      "id": "txt001",
      "text": "This is a CoAP temperature sensor."
    }
  ],
  "partyRole": [
    {
      "@referredType": "temperatureSensor",
      "href": "https://www.mandint.org/temperatureSensor",
      "id": "CoapTempSensor",
      "name": "Mandat International",
      "partyId": "MI",
      "partyName": "Mandat International"
    }
  ],
  "place": {
    "href": "Chemin du Champ-Baron 3",
    "id": "1209",
    "name": "Geneva Office"
  },
  "relatedParty": [
    {
      "@referredType": "temperatureSensor",
      "href": "https://www.mandint.org/temperatureSensor",
      "id": "CoapTempSensor",
      "name": "Mandat International",
      "role": "vendor"
    }
  ],
  "resourceRelationship": [
    {
      "@Type": "IotAgent",
      "href": "https://www.mandint.org/iotAgent",
      "id": "MI",
      "name": "UDG",
      "value": "0041227744222"
    }
  ],
  "iotAgent": [
    {
      "name": "UDG",
      "objectId": "udgmi",
      "href": "https://www.mandint.org/iotAgent",
      "@referredType": "IotAgent",
      "dataAccessEndPoint": {
        "category": "Gold",
        "description": "This is a temperature sensor using CoAP and 6LoWPAN.",
        "endDate": "2019-05-13T00:00",
        "href": "https://host:port/tmf-api/iotDevice/v1/iotDevice/temp_3",
        "id": "3",
        "lifecycleState": "InService",
        "name": "temp_3",

```

```

    "startDate": "2019-05-03T00:00",
    "value": "0041227744222",
    "version": "1.0",
    "apiType": "NGSI",
    "uri": "https://host:port/tmf-api/iotDevice/v1/iotDevice/temp_3/dataAccessEndpoint/3"
  }
}
]
}

```

Data access endpoint resource

This is the endpoint exposed by the IoT Device to authorized users.

Resource model

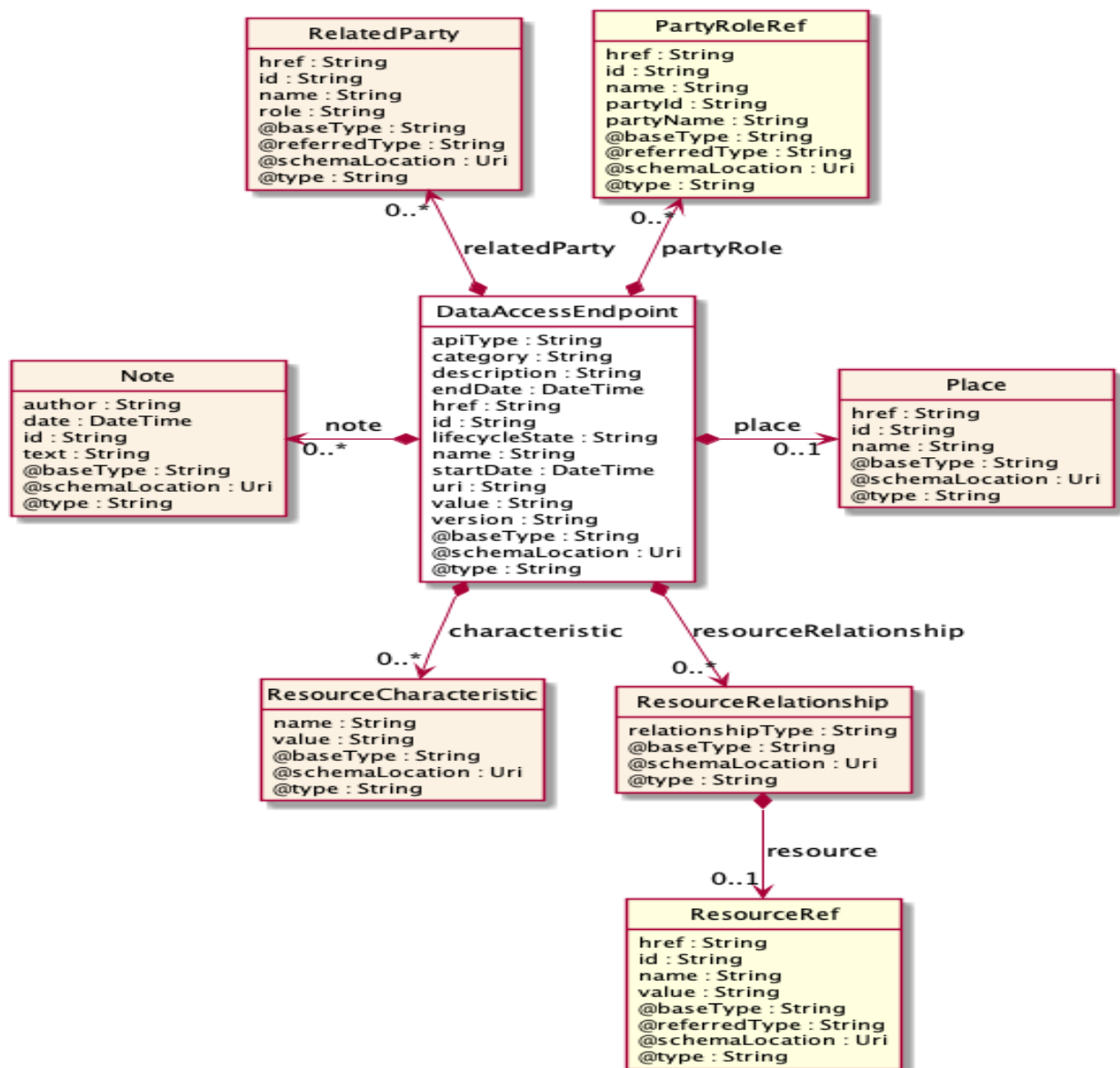


Figure 3 – Data access endpoint resource model, schematic

Field descriptions

DataAccessEndpoint fields

category	A string. Category of the concrete resource, such as: Gold, Silver for MSISDN concrete resource.
description	A string. Free-text description of the resource.
endDate	A date time (DateTime). The date till the resource is effective.
href	A string. The URI for the object itself.
id	A string. Identifier of an instance of the resource. Required to be unique within the resource type. Used in URIs as the identifier for specific instances of a type.
lifecycleState	A string. The life cycle state of the resource.
name	A string. A string used to give a name to the resource.
startDate	A date time (DateTime). A date time (DateTime). The date from which the resource is effective.
value	A string. The value of the logical resource, such as: 0044746712345 for an MSISDN.
version	A string. A field that identifies the specific version of an instance of a resource.
apiType	A string.
uri	A string. URI for using the data access API.
characteristic	A list of resource characteristics (ResourceCharacteristic [*]).
note	A list of notes (Note [*]). Extra information about a given entity.
partyRole	A list of party role references (PartyRoleRef [*]). A party role represents the part played by a party in a given context.
place	A place (Place). Place reference. Place defines the places where the products are sold or delivered.
relatedParty	A list of related parties (RelatedParty [*]). Related Entity reference. A related party defines party or party role linked to a specific entity.
resourceRelationship	A list of resource relationships (ResourceRelationship [*]). Describes links between resources.

Note sub-resource

Extra information about a given entity.

author	A string. Author of the note.
date	A date time (DateTime). Date of the note.
id	A string. Identifier of the note within its containing entity (may or may not be globally unique, depending on provider implementation).
text	A string. Text of the note.

Place sub-resource

Place reference. Place defines the places where the products are sold or delivered.

href	A string. Unique reference of the place.
id	A string. Unique identifier of the place.
name	A string. A user-friendly name for the place, such as [Paris Store], [London Store], [Main Home].

RelatedParty sub-resource

Related Entity reference. A related party defines party or party role linked to a specific entity.

@referredType	A string. The actual type of the target instance when needed for disambiguation.
href	A string. Reference of the related entity.
id	A string. Unique identifier of a related entity.
name	A string. Name of the related entity.
role	A string. Role played by the related party.

ResourceCharacteristic sub-resource

name	A string. name of the characteristic.
value	A string. value of the characteristic.

ResourceRelationship sub-resource

Describes links between resources.

relationshipType	A string. Semantic of the relationship.
resource	A resource reference (ResourceRef). A reference to the resource.

PartyRoleRef relationship

Party role reference. A party role represents the part played by a party in a given context.

@referredType	A string. The actual type of the target instance when needed for disambiguation.
href	A string. Reference of the product.
id	A string. Unique identifier of the product.
name	A string. The name of the referred party role.
partyId	A string. The identifier of the engaged party that is linked to the PartyRole object.
partyName	A string. The name of the engaged party that is linked to the PartyRole object.

ResourceRef relationship

@referredType	A string. The actual type of the target instance when needed for disambiguation.
href	A string. Reference of the related entity.
id	A string. Unique identifier of a related entity.
name	A string. Name of the resource.
value	A string. The resource value that can be used to identify a resource with a public key (e.g.,: a tel nr, an msisdn).

Json representation example

The following is an example json representation of a 'DataAccessEndpoint' resource object

```
{
  "category": "Gold",
  "description": "This is a temperature sensor using CoAP and 6LoWPAN.",
  "endDate": "2019-05-13T00:00",
  "href": "https://host:port/tmf-api/iotDevice/v1/iotDevice/temp_3",
  "id": "3",
  "lifecycleState": "InService",
  "name": "temp_3",
  "startDate": "2019-05-03T00:00",
  "value": "0041227744222",
  "version": "1.0",
  "apiType": "NGSI",
  "uri": "https://host:port/tmf-api/iotDevice/v1/iotDevice/temp_3/dataAccessEndpoint/3"
}
```

6.1.2 Iot Device Specification resource

Resource model

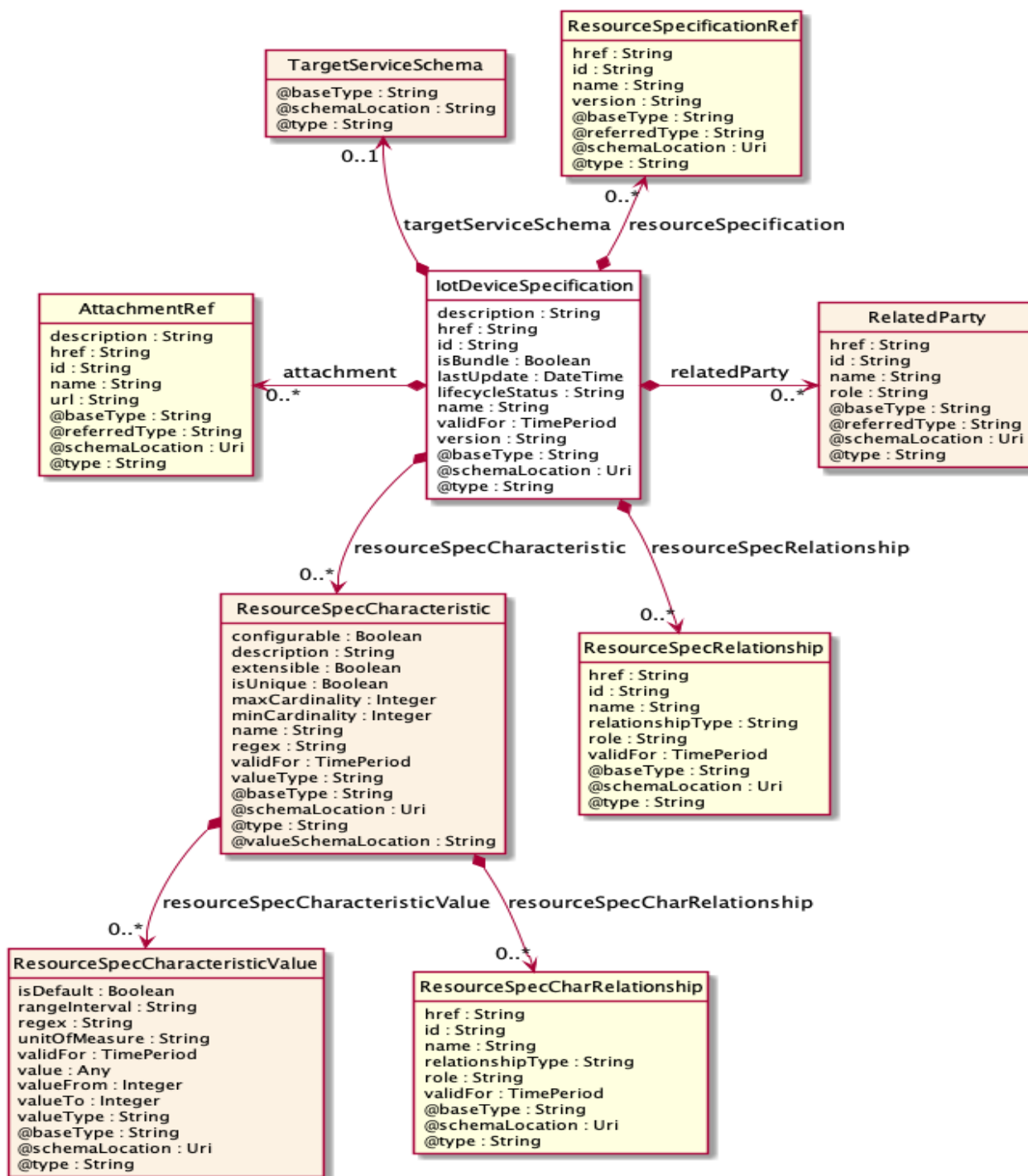


Figure 4 – IoT Device Specification Resource Model, Schematic

Field descriptions

IoTDeviceSpecification fields

description	A string. A narrative that explains in detail what the service specification is.
href	A string. Reference of the service specification.
id	A string. Unique identifier of the service specification.
isBundle	A boolean. isBundle determines whether a ServiceSpecification represents a single ServiceSpecification (false), or a bundle of ServiceSpecification (true).
lastUpdate	A date time (DateTime). Date and time of the last update of the service specification.
lifecycleStatus	A string. Used to indicate the current lifecycle status of the service specification.
name	A string. Name of the service specification.
version	A string. Service specification version.
attachment	A list of attachment references (AttachmentRef [*]). A list of attachments (Attachment [*]). Complements the description of the specification through video, pictures...
relatedParty	A list of related parties (RelatedParty [*]). A list of related party references (RelatedParty [*]). A related party defines party or party role linked to a specific entity.
resourceSpecCharacteristic	A list of resource spec characteristics (ResourceSpecCharacteristic [*]). A list of service spec characteristics (ServiceSpecCharacteristic [*]). This class represents the key features of this service specification.
resourceSpecRelationship	A list of resource spec relationships (ResourceSpecRelationship [*]). A list of resource specifications related to this specification, e.g., migration, substitution, dependency or exclusivity relationship.
resourceSpecification	A list of resource specification references (ResourceSpecificationRef [*]). A list of resource specification references (ResourceSpecificationRef [*]). The ResourceSpecification is required for a service specification with type ResourceFacingServiceSpecification (RFSS).
targetServiceSchema	A target service schema (TargetServiceSchema). A target service schema reference (TargetServiceSchemaRef). The reference object to the schema and type of target service which is described by service specification.
validFor	A time period. The period for which the service specification is valid.

RelatedParty sub-resource

Related Entity reference. A related party defines party or party role linked to a specific entity.

@referredType	A string. The actual type of the target instance when needed for disambiguation.
---------------	--

href	A string. Reference of the related entity.
id	A string. Unique identifier of a related entity.
name	A string. Name of the related entity.
role	A string. Role played by the related party.

ResourceSpecCharRelationship sub-resource

An aggregation, migration, substitution, dependency or exclusivity relationship between/among resourceSpecCharacteristics.

href	A string. Hyperlink reference to the target specification.
id	A string. Unique identifier of the target specification.
name	A string. Name of the target characteristic.
relationshipType	A string. Type of relationship such as aggregation, migration, substitution, dependency, exclusivity.
role	A string. The association role for this service specification.
validFor	A time period. The period for which the serviceSpecCharRelationship is valid.

ResourceSpecCharacteristic sub-resource

This class represents the key features of this service specification. For example, bandwidth is a characteristic of many different types of services; if bandwidth is a relevant characteristic (e.g., from the point-of-view of a Customer obtaining this Service via a Product) then bandwidth would be a ServiceSpecCharacteristic for that particular Service.

@valueSchemaLocation	A string. This (optional) field provides a link to the schema describing the value type.
configurable	A boolean. If true, the Boolean indicates that the serviceSpecCharacteristic is configurable.
description	A string. A narrative that explains in detail what the serviceSpecCharacteristic is.
extensible	A boolean. An indicator that specifies that the values for the characteristic can be extended by adding new values when instantiating a characteristic for an Entity.
isUnique	A boolean. An indicator that specifies if a value is unique for the specification. Possible values are; "unique while value is in effect" and "unique whether value is in effect or not".
maxCardinality	An integer. The maximum number of instances a CharacteristicValue can take on. For example, zero to five phone numbers in a group calling plan, where five is the value for the maxCardinality.
minCardinality	An integer. The minimum number of instances a CharacteristicValue can take on. For example, zero to five phone numbers in a group calling plan, where zero is the value for the minCardinality.