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Semantic Definition Format (SDF) for Data and Interactions of Things: Compact Notation

Abstract

The Semantic Definition Format (SDF) is a format for domain experts to use in the creation and maintenance of data and interaction models in the Internet of Things. It was created as a common language for use in the development of the One Data Model liaison organization (OneDM) definitions. Tools convert this format to database formats and other serializations as needed.

The SDF format is mainly intended for interchange between machine generation and machine processing. However, there often is a need for humans to look at and edit SDF models.

Similar to the way Relax-NG as defined in ISO/IEC 19757-2 has an XML format and a compact format (Annex C), this specification defines a compact format to go along SDF's JSON format.

The present version of this document is mostly a proof of concept, but was deemed useful to obtain initial feedback on the approach taken.

Contributing

Recent versions of this document are available at its GitHub repository <https://github.com/cabo/sdfc> -- this also provides an issue tracker as well as a way to supply "pull requests".

General discussion of this SDF Internet-Draft happens on the mailing list of the IETF ASDF Working Group, asdf@ietf.org (subscribe at <https://www.ietf.org/mailman/listinfo/asdf>).

The IETF Note Well applies (<https://www.ietf.org/about/note-well/>).

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1. Introduction

The Semantic Definition Format (SDF) is a format for domain experts to use in the creation and maintenance of data and interaction models in the Internet of Things. It was created as a common language for use in the development of the One Data Model liaison organization (OneDM) definitions. Tools convert this format to database formats and other serializations as needed.

The SDF format is mainly intended for interchange between machine generation and machine processing. However, there often is a need for humans to look at and edit SDF models.

Similar to the way Relax-NG as defined in ISO/IEC 19757-2 has an XML format and a compact format (Annex C), this specification defines a compact format to go along SDF's JSON format.

The present version of this document is mostly a proof of concept, but was deemed useful to obtain initial feedback on the approach taken.

(References: [[I-D.ietf-asdf-sdf](#)], [[RELAXNG](#)].)

The intention is to be able to bidirectionally translate between compact and JSON form, without appreciable semantic losses. This will allow viewing SDF in compact form, apply edits if needed, and then continuing processing it in JSON form. As a limitation of this approach, it will be difficult to always recreate the order of map entries (members of JSON objects) in the JSON form; this order is essentially arbitrary as maps (JSON objects) in JSON are unordered. (In the long run, it may be useful to define a canonical order in the SDF specification or here.)

An initial prototype of a converter from compact form to JSON form was constructed during the ASDF/WISHI hackathon preceding IETF110. A more complete, bidirectionally operating version of this tool is planned for release soon.

2. Overview

The SDF compact format is a YAML file [[YAML](#)]; a good part of the work needed for a compact representation is already done by the increased user-friendliness of YAML over JSON.

In addition, all the sections defined with named<...> in the CDDL definition of SDF have been compacted into map entries with space-separated keys, giving the kind first and the name next. This saves the need for another level of hierarchy and reminds the reader of the kind of item being specified.

The map key description is replaced by :, which also is rendered in the most compact form possible in YAML.

The dataqualities readable, writable, and observable, together with optionality, are compressed into a four-character map key: The first three are translated into rwo when set (default in SDF) and into --- when not set. The fourth character is ? for optional and ! for required.

The value of this abbreviated key is a CDDL [[RFC8610](#)] rendition of the attributes defined in the jsonschema production in [Appendix A](#) of [[I-D.ietf-asdf-sdf](#)]. To further reduce noise, a top-level array production in the CDDL can be represented as an array in the YAML (i.e., does not require additional quotes).

2.1. Example Definition

This is an SDF-compact version of a slightly modified copy of the sdfobject-cadence.sdf.json model found at the time of writing in OneDM's SDF playground. (This example was chosen more or less randomly; better examples can probably be found. The modification is the addition of a unit quality.)

info:

```
copyright: Copyright 2018-2019 Open Connectivity Foundation, Inc. All rights reserved.
version: '2019-06-11'
title: Cadence
license: https://github.com/one-data-model/oneDM/blob/master/LICENSE
```

object cadence:

```
:: This Resource describes the cadence, which is the number of
   revolutions of crank per minute when cyclists pedal the
   pedals. The unit, which is the default unit, is rpm. The cadence
   Property is a read-only value that is provided by the
   server. When range (from "oic. r. baseresource") is omitted the
   default is 0 to +MAXFLOAT.
```

property cadence:

```
r-o!: integer .ge 0
unit: 1/min
:: This Property describes the rate at which a cyclist is pedalling/turning
   the pedals.
```

property range:

```
r-o?: [2*2 integer]
:: The valid range for the Property in the Resource as an integer.
   The first value in the array is the minimum value, the second value in the
   array is the maximum value.
```

property step:

```
r-o?: integer
:: Step value across the defined range when the range is an integer. This
   is the increment for valid values across the range; so if range is 0..10
   and step is 2 then valid values are 0,2,4,6,8,10.
```

The result of automatically converting this YAML file using the prototype sdfc tool back into the JSON form of SDF is given in [Appendix A](#). Except for the unit addition, it is semantically identical to the sdfobject-cadence.sdf.json. Differences are visible

in the order of map entries (members in JSON objects); a future version of the sdfc tool could attempt to preserve more of this order, even though it does not carry semantics.

3. References

3.1. Normative References

[I-D.ietf-asdf-sdf] Koster, M. and C. Bormann, "Semantic Definition Format (SDF) for Data and Interactions of Things", Work in Progress, Internet-Draft, draft-ietf-asdf-sdf-07, 12 July 2021, <<https://www.ietf.org/archive/id/draft-ietf-asdf-sdf-07.txt>>.

[RFC8610] Birkholz, H., Vigano, C., and C. Bormann, "Concise Data Definition Language (CDDL): A Notational Convention to Express Concise Binary Object Representation (CBOR) and JSON Data Structures", RFC 8610, DOI 10.17487/RFC8610, June 2019, <<https://www.rfc-editor.org/info/rfc8610>>.

3.2. Informative References

[RELAXNG] ISO/IEC, "Information technology – Document Schema Definition Language (DSDL) – Part 2: Regular-grammar-based validation – RELAX NG", ISO/IEC 19757-2, 15 December 2008.

[YAML] Ben-Kiki, O., Evans, C., and I.d. Net, "YAML Ain't Markup Language (YAML[TM]) Version 1.2", 3rd Edition, October 2009, <<http://www.yaml.org/spec/1.2/spec.html>>.

Appendix A. Example in SDF JSON format

```
{
  "info": {
    "title": "Cadence",
    "license": "https://github.com/one-data-model/oneDM/blob/master/LICENSE",
    "version": "2019-06-11",
    "copyright": "Copyright 2018-2019 Open Connectivity Foundation, Inc. All rights reserved"
  },
  "sdfObject": {
    "cadence": {
      "description": "This Resource describes the cadence, which is the number of revolutions",
      "sdfProperty": {
        "step": {
          "type": "integer",
          "writable": false,
          "description": "Step value across the defined range when the range is an integer."
        },
        "range": {
          "type": "array",
          "items": {
            "type": "integer"
          },
          "maxItems": 2,
          "minItems": 2,
          "writable": false,
          "description": "The valid range for the Property in the Resource as an integer. The"
        },
        "cadence": {
          "type": "integer",
          "minimum": 0,
          "writable": false,
          "description": "This Property describes the rate at which a cyclist is pedalling/tu"
        }
      }
    },
    "sdfRequired": [
      "#/sdfObject/cadence/sdfProperty/cadence"
    ]
  }
}
```

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