

# Extended information of Semantic Definition Format (SDF) for Digital Twin

[draft-lee-asdf-digital-twin-00](#)

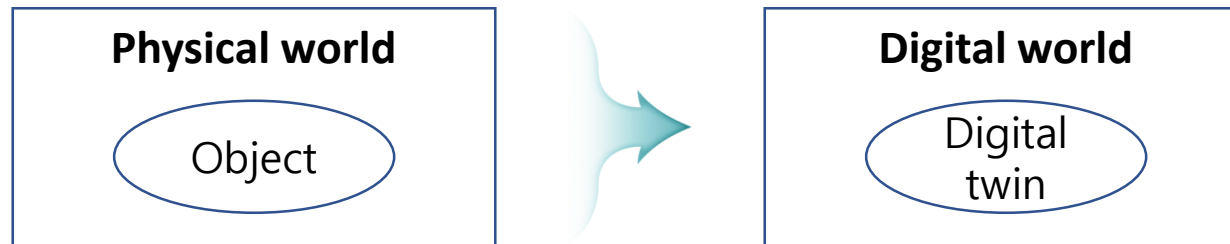
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# Background

- The Semantic Definition Format (SDF) is a format to describe Things.
  - We want to use SDF to represent “Things(objects)” as “digital twins”.
  - Or, we want to represent objects represented in SDF as digital twins.
  - Currently, as far as we know, there is no location information for objects in the SDF.
  - Therefore, we propose adding location information to SDF.

# Location information

- Location
    - One of the key information for specifying objects as digital twins.
    - The roles and properties for the object are dependent on its location.
- ⇒ “sdfLocation” is needed to represent “objects” in the right place in the digital world.



# Information attributes for objects

- The table 1 shows the template used to describe “objects”.
  - The table is taken from ISO 23247-3, “Digital twin framework for manufacturing — Part 3: Digital representation of manufacturing elements”.
  - The 8 kinds of objects are represented using the table.
    - ✓ Personnel, equipment
    - ✓ Material, process
    - ✓ Facility, environment
    - ✓ Product, supporting document
  - This framework can be used for almost all industries by defining objects that are used and needed in each industry domain.

Information attribute	Description	Mandatory (M) Optional (O)
Identifier	A value that conforms to ISO 8000-115 used to uniquely identify an OME in a specific enterprise, e.g.: <ul style="list-style-type: none"> <li>— UUID</li> <li>— URL</li> <li>— URN</li> <li>— OID (ITU-T X.680 and ISO/IEC 8824-1)</li> <li>— domain-specific ID</li> <li>— ISO 29002 series or URI unique ID (used in AAS)</li> </ul>	Mandatory
Characteristics	A typical or noticeable feature of an OME, e.g.: <ul style="list-style-type: none"> <li>— IEC 62264-2 (B2MML)</li> <li>— eCl@ss</li> <li>— ISO 13584-42 (PLIB)</li> <li>— IEC 61360 (CDD)</li> </ul>	Optional depending on the purpose of the use cases
Schedule	Time information bound to a manufacturing process, e.g.: <ul style="list-style-type: none"> <li>— ISO 8601 series</li> <li>— start/stop</li> </ul>	
Status	A condition of an OME involved in a manufacturing process, e.g.: <ul style="list-style-type: none"> <li>— VDMA 24582</li> </ul>	
Location	Geographical or relative location information of an OME, e.g.: <ul style="list-style-type: none"> <li>— GPS coordinates</li> <li>— postal address</li> <li>— ISO 6709</li> <li>— relative location</li> </ul>	
Report	Description of activities done by or onto an OME, e.g.: <ul style="list-style-type: none"> <li>— QIF</li> <li>— MTConnect</li> </ul>	
Relationship	Connection information between two or more OMEs, e.g. IEC 62264-2	

# Information attributes for personnel

- The table 2 shows the examples of information attributes for personnel.
- The location information is as follows:
  - GPS coordinates
  - postal address
  - ISO 6709
  - relative location

Attribute	Description	Examples
Identifier	A value that conforms to ISO 8000-115 used to uniquely identify the person in a specific enterprise, e.g.: <ul style="list-style-type: none"> <li>— employee ID</li> <li>— UUID</li> <li>— URL</li> <li>— URN</li> <li>— OID (ITU-T X.680 and ISO/IEC 8824-1)</li> <li>— domain-specific ID</li> <li>— ISO 29002 series or URI unique ID (used in AAS)</li> </ul>	<ul style="list-style-type: none"> <li>— employee ID: 11223</li> <li>— UUID: b2287ac5-9572-4e58-88e5-2ba446c630d7</li> </ul>
Characteristics	Personal properties including skill level, classification, e.g.: <ul style="list-style-type: none"> <li>— IEC 62264-2               <ul style="list-style-type: none"> <li>— skill level                   <ul style="list-style-type: none"> <li>— 1: master</li> <li>— 2: journeyman</li> <li>— 3: apprentice</li> </ul> </li> <li>— classification                   <ul style="list-style-type: none"> <li>— 1: researcher</li> <li>— 2: administrator</li> <li>— 3: technician</li> <li>— 4: driver</li> </ul> </li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>— IEC 62264-2               <ul style="list-style-type: none"> <li>— skill level: 2</li> <li>— classification: 3</li> </ul> </li> </ul>
Schedule	A personal working schedule, e.g.: <ul style="list-style-type: none"> <li>— ISO 8601 series</li> <li>— working</li> <li>— day-off</li> </ul>	<ul style="list-style-type: none"> <li>— 2019-05-14-working-0800-1700</li> </ul>
Status	A current working status	<ul style="list-style-type: none"> <li>— 2019-05-14-onbreak-1500-1530</li> </ul>
Location	location information of a person, e.g.: <ul style="list-style-type: none"> <li>— GPS coordinates</li> <li>— postal address</li> <li>— ISO 6709</li> <li>— relative location</li> </ul>	<ul style="list-style-type: none"> <li>— Operator #1: WorkUnit #3 and 50 cm away from Robot #2.</li> </ul>
Report	An activity report of a person	<ul style="list-style-type: none"> <li>— 2019-05-14-8 h of work</li> </ul>
Relationship	Information regarding collaborations among personnel and other OMEs	<ul style="list-style-type: none"> <li>— Operator #1 is the supervisor of operator #2.</li> <li>— WorkUnit #3 must have at least 4 persons for safety reasons.</li> <li>— Operator #1 and Operator #2 are working in the WorkUnit #3.</li> <li>— Operator #1 and Operator #2 are 70 cm away from Machine #2.</li> </ul>

# Information attributes for equipment

- The table shows the examples of information attributes for equipment.
- The location information is as follows:
  - GPS coordinates
  - postal address
  - ISO 6709
  - relative location

Attribute	Description	Examples
Identifier	A value that conforms to ISO 8000-115 used to uniquely identify the equipment in a specific enterprise, e.g.: <ul style="list-style-type: none"><li>— UUID</li><li>— asset ID</li></ul>	<ul style="list-style-type: none"><li>— UUID: e88561dc-2401-4f9a-961c-e90e6424b1dd</li><li>— asset ID: dtm-200327-11</li></ul>
Characteristics	Functionalities, features of the equipment, e.g.: <ul style="list-style-type: none"><li>— milling</li><li>— turning</li><li>— grinding</li><li>— pressing</li></ul>	milling
Schedule	A plan for carrying out manufacturing activities, e.g. Monday to Friday first shift	Maintenance for Machine #1 is scheduled on every Sunday.
Status	A current state of the equipment, e.g.: <ul style="list-style-type: none"><li>— on/off</li><li>— working/breakdown</li><li>— energy usage (unit: kWh)</li><li>— temperature (unit: °C, °F)</li><li>— noise level (unit: dB)</li></ul>	<ul style="list-style-type: none"><li>— on</li><li>— energy usage: 10kWh</li><li>— temperature: 25 °C</li></ul>
Location	Location information of the equipment, e.g.: <ul style="list-style-type: none"><li>— GPS coordinates</li><li>— postal address</li><li>— ISO 6709</li><li>— relative location</li></ul>	<ul style="list-style-type: none"><li>— Relative location</li><li>— Machine #2: Work Unit #2 in Room #3</li></ul>
Report	An activity report of the equipment engaged in manufacturing, maintenance, etc.	<ul style="list-style-type: none"><li>— May 14<sup>th</sup>, 2019 9 AM to 6 PM: Regular Maintenance</li><li>— May 14<sup>th</sup>, 2019 11 AM: Machine #1 reports high temperature.</li></ul>
Relationship	Relationship information between the equipment and other OMEs	<ul style="list-style-type: none"><li>— Machine #1 operates with Material #2.</li><li>— Machine #1 is operated in WorkCenter #5.</li></ul>

# Purpose of this draft

- We propose to
  - specify the extension information of the SDF to represent the **location** information of the object as a digital twin.

Quality	Type	Required	Description
locationType	string	yes	What kind of location these definitions have
target	string	no	Target model for the location
description	string	no	Description of the location
label	string	no	Short text describing the location
property	object	no	Additional properties for this location
\$comment	string	no	Additional comments for implementors

Table 1: Qualities of sdfLocation

# A template and example of sdfLocation

```
"namespace": {
  "exont": "https://example.com/locationOntology
  "saref": "https://saref.etsi.org/core/v3.1.1/"
},
sdfObject: {
  "Humidity": {
    "description": "Example Humidity object",
    "sdfProperty": {
      ...
    },
    "sdfLocation": {
      "postalAddr": {
        "locationType": "exont:postal-addr",
        "target": "saref:PostalAddress",
        "description": "address of object",
        "label": "postcode"
      }
    }
  }
  ...
}
```

```
sdfObject: {
  "example-object": {
    "description": "example object",
    "sdfProperty": {
      ...
    },
    "sdfLocation": {
      "postalAddr": {
        "locationType": "exont:postal-addr",
        "target": "saref:PostalAddress",
        "description": "Postal address of a company", "218 Gajeong-
ro ...",
        "label": "34129",
        "property": "company address"
      }
    }
  }
  ...
}
```



# Conclusion and future plans

- Add sdfLocation to SDF model
- Provide more information to represent an object as digital twin

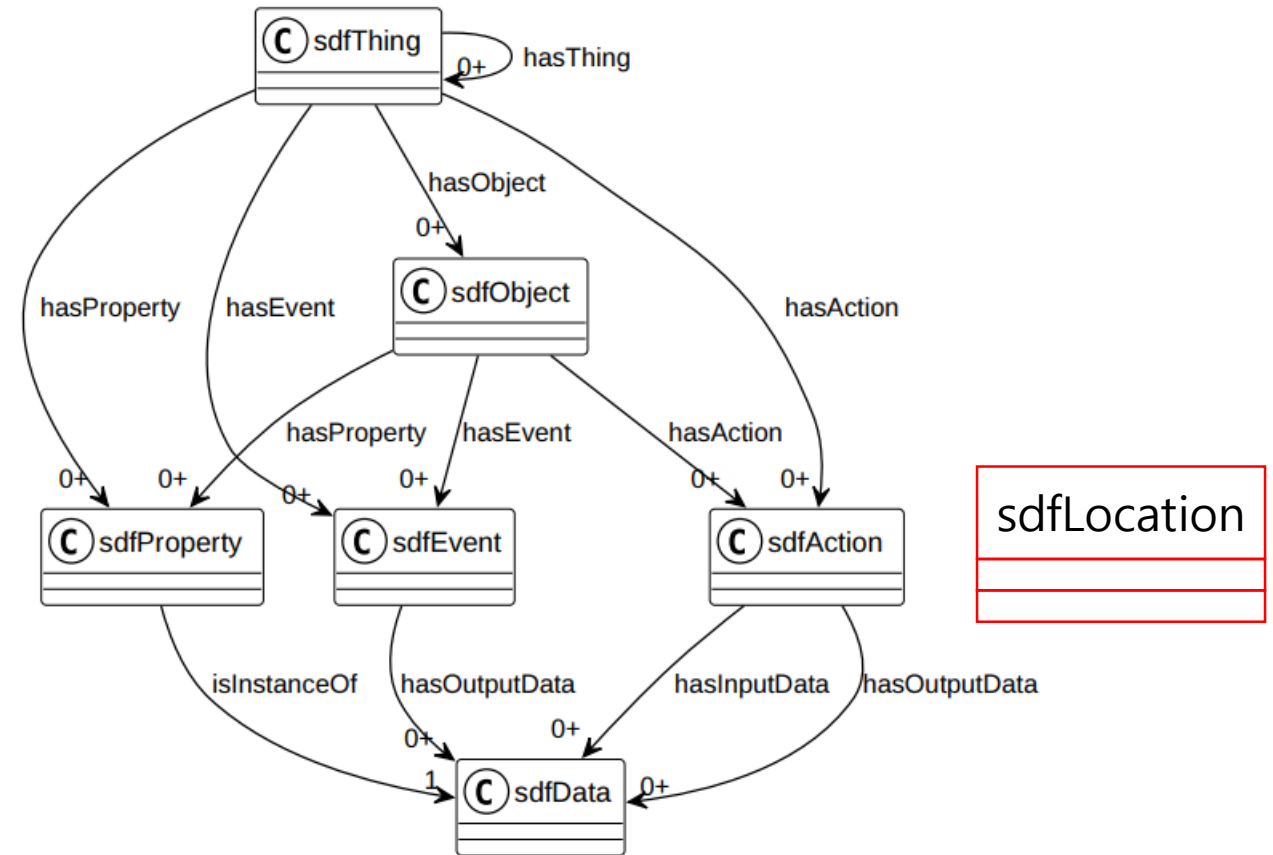


Figure 2: Main classes used in SDF models

[Source: Figure 2 in draft-ietf-asdf-sdf-16]