

TERN Ontology Specification

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Status: Draft - while the document is in draft, sections of the document may contain placeholders such as **TBA** and **TBD**.

1. Metadata

| | |
|-----------------------------------|---|
| IRI | https://w3id.org/tern/profiles/tern/specification |
| Title | TERN Ontology Specification |
| Definition | This document lists the normative requirements for data aiming to conform to the TERN Ontology. It is to be used as the authoritative, human-readable list of individual requirements from which profile artefacts such as validators are derived from. |
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2. Preamble

2.1. Abstract

The TERN Ontology Specification addresses the data exchange and data representation problems with integrating or exchanging heterogeneous ecological field survey data. The specification uses the PROF vocabulary to express itself as a profile of multiple internationally-recognised Semantic Web standards and establishes links to informative resources and controlled vocabularies necessary to use the specification.

For many years, the scientific ecological community and industry partners collected rich and insightful data about the land and ecosystems by performing field surveys. Unfortunately, the state of the collected data was often unusable for prompt nationwide reporting and data analysis due to incompatible data storage solutions between non-standardised relational databases, spreadsheets and PDF documents. Without spending further time and money to extract, transform and integrate the data, much of the data's richness and usefulness is lost.

The solution to this problem of an ever-growing set of heterogeneous data is to use existing standards defined by the W3C and follow the Linked Data set of principles. By building a specification based on existing web standards, the richness of the ecological field survey data can now be integrated and queried as one large graph of data on the World Wide Web.

The TERN Ontology Specification is a profile of W3C's SOSA, SSN and PROV ontologies. It uses these ontologies to describe observations and samplings as kinds of activities on a field survey trip and provides associations of these activities to persons and organisations. The TERN Ontology Specification also uses community-based standards such as OGC's GeoSPARQL to associate spatial features or geometries to things within a field survey trip and QUDT's Units vocabulary for associating units of measure to results of observations. The TERN Ontology Specification also provides a vast set of TERN-created ecology-based and ecology-related controlled vocabularies to describe observable properties, feature types, instruments and protocol methods. Lastly, the TERN Ontology introduces Site and Site Visit classes to represent survey trips performed on ad-hoc or permanent plots and uses the Attribute class to represent auxiliary information.

2.2. Normative Status

This specification is normative for the TERN Ontology.

2.3. Normative references

2.4. Terms and definitions

2.5. Conventions

2.5.1. Symbols and abbreviated terms

2.5.2. Namespaces

2.5.3. Placeholder IRIs

2.5.4. RDF serializations

3. TERN Ontology Specification

This specification defines the classes and properties of the TERN Ontology and the set of requirements that data validators will use to ensure conformance. This specification also details how data providers should use related ontologies and controlled vocabularies to represent their ecological field survey data. Annex A lists these parts in more detail.

3.1. Scope

The TERN Ontology Specification provides a standardised way to exchange and represent ecological field survey data by providing classes, properties and controlled vocabularies that characterise

terrestrial data. Although the upper ontologies such as SOSA and SSN can theoretically apply to any domain, the TERN Ontology Specification focuses on representing data collected during opportunistic and plot-based field surveys and provides mechanisms for doing so.

Lastly, the TERN Ontology Specification is not concerned with validating data according to specific field survey collection protocols and instead is concerned with validating the structure of the data. Data custodians can create a profile of the TERN Ontology Specification and extend it by providing validation and requirements according to their field survey protocol's data collection methodologies.

3.2. Standard Parts

This specification is one of many resources that make up the TERN Ontology Profile Standard and expresses its structure using the Profiles Vocabulary [PROF]. Each resource in the profile is assigned a role from the [Resource Roles vocabulary](#).

Other resources in the TERN Ontology profile include:

| | TERN Ontology - conceptual information model |
|--------------------|---|
| Description | An overview of the core concepts of the TERN Ontology. |
| Artifcat | https://linkeddata.tern.org.au/information-models/tern-ontology/conceptual-information-model |
| Role | role:guidance |

| | TERN Ontology - cookbook |
|--------------------|---|
| Description | A cookbook of patterns on representing ecological things with the TERN Ontology. |
| Artifcat | https://linkeddata.tern.org.au/information-models/tern-ontology/cookbook |
| Role | role:guidance |

| | TERN Ontology - classes, properties and shape constraints |
|--------------------|---|
| Description | A web-based viewer of the TERN Ontology classes, properties and their shape constraints. |
| Artifcat | https://linkeddata.tern.org.au/viewers/tern-ontology |
| Role | role:constraints |

| | TERN Ontology - specification |
|--------------------|---|
| Description | TERN Ontology specification (<i>this document</i>) |
| Artifcat | https://linkeddata.tern.org.au/information-models/tern-ontology/specification |
| Role | role:specification |

| | TERN Ontology - validator |
|--------------------|-------------------------------------|
| Description | SHACL shapes for the TERN Ontology. |

| | |
|-----------------|---|
| | TERN Ontology - validator |
| Artifcat | https://w3id.org/tern/shapes/tern.ttl |
| Role | role:validator |

| | |
|--------------------|---|
| | TERN Ontology vocabulary - feature types |
| Description | Feature types controlled vocabulary to describe SOSA-based features of interest. |
| Artifcat | http://linked.data.gov.au/def/tern-cv/68af3d25-c801-4089-afff-cf701e2bd61d |
| Role | role:vocabulary |

| | |
|--------------------|---|
| | TERN Ontology vocabulary - observable properties |
| Description | Observable properties controlled vocabulary to describe SOSA-based observations. |
| Artifcat | http://linked.data.gov.au/def/tern-cv/5699eca7-9ef0-47a6-bcfb-9306e0e2b85e |
| Role | role:vocabulary |

| | |
|--------------------|---|
| | TERN Ontology vocabulary - attributes |
| Description | Attributes controlled vocabulary to describe facts about any entity. |
| Artifcat | http://linked.data.gov.au/def/tern-cv/dd085299-ae86-4371-ae15-61dfa432f924 |
| Role | role:vocabulary |

| | |
|--------------------|---|
| | TERN Ontology vocabulary - units of measure |
| Description | Unit of measure controlled vocabulary by QUDT |
| Artifcat | http://qudt.org/vocab/unit/ |
| Role | role:vocabulary |

| | |
|--------------------|---|
| | TERN Ontology vocabulary - instrument types |
| Description | Instrument types controlled vocabulary to describe the types of instruments used in observations and sampling acts. |
| Artifcat | http://linked.data.gov.au/def/tern-cv/a3088b5c-622d-4e25-8a75-4c4961b0dfe8 |
| Role | role:vocabulary |

| | |
|--------------------|---|
| | TERN Ontology vocabulary - site types |
| Description | Site types controlled vocabulary to describe the types of ecological survey sites. |
| Artifcat | http://linked.data.gov.au/def/tern-cv/74aa68d3-28fd-468d-8ff5-7e791d9f7159 |
| Role | role:vocabulary |

| | |
|--------------------|---|
| | TERN Ontology vocabulary - CI Role Code |
| Description | CI Role Code controlled vocabulary to describe the roles available to the TERN Ontology concepts. |
| Artifcat | http://def.isotc211.org/iso19115/-1/2018/CitationAndResponsiblePartyInformation/code/CI_RoleCode |
| Role | role:vocabulary |

3.3. Conformance

Requirements define the rules and constraints that validators will use to validate data for conformance.

Each requirement will be assigned a subset of the status types defined by the [Registry ontology](#).

| Status type | Icon | Definition |
|--------------|------|--|
| experimental | ○ | An entry that has been accepted into the register temporarily and may be subject to change or withdrawal. |
| stable | ☑ | An entry that is seen as having a reasonable measure of stability, may be used to mark the full adoption of a previously 'experimental' entry. |

4. Core

This section establishes the core requirements class and provides definitions and usage examples.

4.1. Classes

4.1.1. Class: tern:Attribute

| Property | Value |
|------------|---|
| IRI | tern:Attribute |
| Status | stable ☑ |
| Label | Attribute |
| Definition | A property-value pair to capture attributes of an individual where observations are not suitable. |
| Scope note | Follows a similar modelling pattern to schema:PropertyValue . |

4.1.1.1. Property: dcterms:type

| Property | Value |
|-----------|---|
| IRI | dcterms:type |
| Shape IRI | https://w3id.org/tern/shapes/tern/dcterms-type |

| Property | Value |
|-----------------|---|
| Status | stable ☑ |
| Label | type |
| Definition | Useful to capture the proximate class type in situations when <code>rdfs:subClassOf</code> entailment is enabled and <code>rdf:type</code> is not suitable. |
| Scope note | |
| Implementation | The value of <code>dcterms:type</code> <i>MUST</i> be an IRI. |
| Cardinality | |
| Node kind | sh:IRI |
| Class type | |
| Expected values | |

4.1.1.2. Property: tern:attribute

| Property | Value |
|-----------------|--|
| IRI | tern:attribute |
| Shape IRI | https://w3id.org/tern/shapes/tern/tern-attribute |
| Status | stable ☑ |
| Label | attribute |
| Definition | The identifier of the attribute concept. Attribute concepts are usually described with SKOS controlled vocabularies. TERN manages a list of attributes . |
| Scope note | |
| Implementation | There <i>MUST</i> exist exactly 1 <code>tern:attribute</code> property with an IRI value. |
| Cardinality | Exactly 1 |
| Node kind | sh:IRI |
| Class type | |
| Expected values | |

4.1.1.3. Property: tern:hasSimpleValue

| Property | Value |
|------------|---|
| IRI | tern:hasSimpleValue |
| Shape IRI | https://w3id.org/tern/shapes/tern/tern-hasSimpleValue |
| Status | stable ☑ |
| Label | has simple value |
| Definition | The direct link to the IRI or RDF literal value. The simple value <i>MUST</i> be the same value captured in <code>rdf:value</code> of the <code>tern:Value</code> instance. |

| Property | Value |
|-----------------|--|
| Scope note | |
| Implementation | There <i>MUST</i> exist exactly 1 <code>tern:hasSimpleValue</code> with an IRI or literal value. |
| Cardinality | Exactly 1 |
| Node kind | <code>sh:IRIOrLiteral</code> |
| Class type | |
| Expected values | |

4.1.1.4. Property: `tern:hasValue`

| Property | Value |
|-----------------|--|
| IRI | <code>tern:hasValue</code> |
| Shape IRI | https://w3id.org/tern/shapes/tern/tern-hasValue |
| Status | <code>stable</code> ☑ |
| Label | has value |
| Definition | A link to a [tern:Value](https://w3id.org/tern/ontologies/tern/Value) instance which encapsulates the value of this Attribute. |
| Scope note | |
| Implementation | There <i>MUST</i> exist exactly 1 <code>tern:hasValue</code> with an IRI value. |
| Cardinality | Exactly 1 |
| Node kind | <code>sh:IRI</code> |
| Class type | <code>tern:Value</code> |
| Expected values | |

4.1.1.5. Property: `tern:isAttributeOf`

| Property | Value |
|----------------|--|
| IRI | <code>tern:isAttributeOf</code> |
| Shape IRI | https://w3id.org/tern/shapes/tern/tern-isAttributeOf |
| Status | <code>stable</code> ☑ |
| Label | is attribute of |
| Definition | A link to the individual which this attribute and its value is applied to. Inverse property of [tern:hasAttribute](https://w3id.org/tern/ontologies/tern/hasAttribute). |
| Scope note | |
| Implementation | The value of <code>tern:isAttributeOf</code> <i>MUST</i> be an IRI value. |
| Cardinality | |

| Property | Value |
|-----------------|--------|
| Node kind | sh:IRI |
| Class type | |
| Expected values | |

4.1.1.6. Property: void:inDataset

| Property | Value |
|-----------------|---|
| IRI | void:inDataset |
| Shape IRI | https://w3id.org/tern/shapes/tern/void-inDataset |
| Status | stable ☑ |
| Label | in dataset |
| Definition | A link to the RDF payload's metadata which this resource was a part of. |
| Scope note | |
| Implementation | There <i>MUST</i> exist exactly 1 void:inDataset property with an IRI value to a tern:RDFDataset. |
| Cardinality | Exactly 1 |
| Node kind | sh:IRI |
| Class type | tern:RDFDataset |
| Expected values | |

4.1.1.7. tern:Attribute example

Annotate the volume of the soil ring using tern:Attribute.

```


<urn:example:soil-ring> a tern:Sampler ;
    rdfs:label "soil ring" ;
    ssn:implements <urn:example:method:soil-ring> ;
    tern:systemType <http://linked.data.gov.au/def/tern-cv/24c81cc3-4d68-45a0-91a2-051af25dfb94> ;
    tern:hasAttribute <urn:example:Attribute:1>
.

<urn:example:Attribute:1> a tern:Attribute ;
    rdfs:label "volume of soil ring" ;
    tern:attribute <http://linked.data.gov.au/def/tern-cv/039f87e5-ffd9-4676-b126-c74844d2e095> ;
    tern:hasSimpleValue 209.35 ;
    tern:hasValue [
        a tern:Float ;
        rdf:value 209.35 ;
        tern:unit <http://qudt.org/vocab/unit/CentiM3> ;
    ] ;
.


```

4.2. External Classes

4.2.1. Class: prov:Association

| Property | Value |
|------------|--|
| IRI | prov:Association |
| Status | stable  |
| Label | Association |
| Definition | An activity association is an assignment of responsibility to an agent for an activity, indicating that the agent had a role in the activity. It further allows for a plan to be specified, which is the plan intended by the agent to achieve some goals in the context of this activity. |
| Scope note | Associate an agent to an activity (tern:Sampling , tern:Observation) with a role from ISO 19115-1's CI Role Code . |

4.2.1.1. Property: prov:agent

| Property | Value |
|-----------|---|
| IRI | prov:agent |
| Shape IRI | https://w3id.org/tern/shapes/tern/Association-agent |
| Status | stable  |
| Label | agent |

| Property | Value |
|-----------------|--|
| Definition | An agent is something that bears some form of responsibility for an activity taking place, for the existence of an entity, or for another agent's activity. |
| Scope note | |
| Implementation | A prov:Association <i>MUST</i> have exactly 1 prov:agent predicate where the value node is an IRI of an individual with the type prov:Agent . |
| Cardinality | Exactly 1 |
| Node kind | sh:IRI |
| Class type | prov:Agent |
| Expected values | |

4.2.1.2. Property: prov:hadPlan

| Property | Value |
|-----------------|---|
| IRI | prov:hadPlan |
| Shape IRI | https://w3id.org/tern/shapes/tern/Association-hadPlan |
| Status | stable ☑ |
| Label | had plan |
| Definition | A plan is an entity that represents a set of actions or steps intended by one or more agents to achieve some goals. |
| Scope note | Associate a plan to the agent which they use for their role in some activity. This may or may not be the same as the procedure of a tern:Sampling or a tern:Observation depending on the role of the agent. |
| Implementation | A prov:Association <i>MAY</i> have some prov:hadPlan predicate where the value node is an IRI. |
| Cardinality | |
| Node kind | sh:IRI |
| Class type | |
| Expected values | |

4.2.1.3. Property: prov:hadRole

| Property | Value |
|-----------|---|
| IRI | prov:hadRole |
| Shape IRI | https://w3id.org/tern/shapes/tern/Association-hadRole |
| Status | stable ☑ |
| Label | had role |

| Property | Value |
|-----------------|---|
| Definition | prov:hadRole references the Role (i.e. the function of an entity with respect to an activity), in the context of an instantaneous usage, generation, association, start, and end. |
| Scope note | |
| Implementation | A prov:Association <i>MUST</i> have exactly 1 prov:hadRole predicate where the value node is an IRI of a controlled concept from ISO 19115-1's CI Role Code . |
| Cardinality | Exactly 1 |
| Node kind | sh:IRI |
| Class type | |
| Expected values | <ul style="list-style-type: none"> - author - co author - collaborator - contributor - custodian - distributor - editor - funder - mediator - originator - owner - point of contact - principal investigator - processor - publisher - resource provider - rights holder - sponsor - stakeholder - user |

4.2.1.4. prov:Association example

The RDF example below illustrates how to:

- associate a **schema:Person** to an instance of **tern:Sampling** activity with the role *principal investigator*
- associate an **schema:Organization** to a **tern:MaterialSample** with the role *custodian*.

```

<org-1>
  a schema:Organization ;
  schema:name "Org 1" ;
  .

<person-1>

```

```

    a schema:Person ;
    schema:name "Person 1" ;
    schema:affiliation <org-1> ;
.

<site-visit>
  a tern:SiteVisit ;
  prov:startedAtTime "2015-03-22T13:00:00+00:00"^^xsd:dateTime ;
  tern:hasSite <...> ;
  prov:wasAssociatedWith <person-1> ;
  prov:qualifiedAssociation [
    a prov:Association ;
    prov:agent <person-1> ;
    prov:hadRole <http://def.isotc211.org/iso19115/-
1/2014/CitationAndResponsiblePartyInformation/code/CI_RoleCode/principalInvestigator>
;
  ] ;
.

<sampling-1>
  a tern:Sampling ;
  ... ;
  tern:hasSiteVisit <site-visit> ;
  prov:wasAssociatedWith <person-1> ;
  prov:qualifiedAssociation [
    a prov:Association ;
    prov:agent <person-1> ;
    prov:hadRole <http://def.isotc211.org/iso19115/-
1/2014/CitationAndResponsiblePartyInformation/code/CI_RoleCode/resourceProvider> ;
  ] ;
  sosa:hasResult <soil-sample-1> ;
.

<soil-sample-1>
  a tern:MaterialSample ;
  ... ;
  sosa:isResultOf <sampling-1> ;
  prov:wasAttributedTo <org-1> ;
  prov:qualifiedAttribution [
    a prov:Attribution ;
    prov:agent <org-1> ;
    prov:hadRole <http://def.isotc211.org/iso19115/-
1/2014/CitationAndResponsiblePartyInformation/code/CI_RoleCode/custodian> ;
  ]
.

```

4.2.2. Class: time:Instant

| Property | Value |
|----------------|--|
| IRI | <code>time:Instant</code> |
| Status | stable ☑ |
| Label | Instant |
| Definition | A temporal entity with zero extent or duration. |
| Implementation | One or more of [<code>time:inXSDDate</code> , <code>time:inXSDDateTimeStamp</code> , <code>time:inXSDgYear</code> , <code>time:inXSDgYearMonth</code> , <code>time:inTimePosition</code> , and <code>time:inDateTime</code>] <i>MUST</i> be present. |
| Scope note | |

4.2.2.1. Property: `time:inDateTime`


| Property | Value |
|-----------------|---|
| IRI | <code>time:inDateTime</code> |
| Shape IRI | https://w3id.org/tern/shapes/tern/time-Instant-inDateTime |
| Status | stable ☑ |
| Label | in date-time |
| Definition | Position of an instant, expressed using a structured description. |
| Scope note | |
| Implementation | Value <i>MUST</i> be a literal with the datatype <code>xsd:dateTime</code> . Maximum of one value is allowed for this property. |
| Cardinality | Maximum 1 |
| Node kind | <code>sh:Literal</code> |
| Class type | <code>xsd:dateTime</code> |
| Expected values | |

4.2.2.2. Property: `time:inTimePosition`


| Property | Value |
|----------------|--|
| IRI | <code>time:inTimePosition</code> |
| Shape IRI | https://w3id.org/tern/shapes/tern/time-inTimePosition |
| Status | stable ☑ |
| Label | in time position |
| Definition | Position of a time instant expressed as a <code>TimePosition</code> . |
| Scope note | |
| Implementation | Value <i>MUST</i> be an instance of <code>time:TimePosition</code> . Maximum of one value is allowed for this property. The value node <i>MUST</i> be a blank node or IRI. |
| Cardinality | Maximum 1 |

| Property | Value |
|-----------------|--------------------------------|
| Node kind | <code>sh:BlankNodeOrIRI</code> |
| Class type | <code>time:TimePosition</code> |
| Expected values | |


4.2.2.3. Property: `time:inXSDDate`

| Property | Value |
|-----------------|---|
| IRI | <code>time:inXSDDate</code> |
| Shape IRI | https://w3id.org/tern/shapes/tern/time-inXSDDate |
| Status | <code>stable</code>  |
| Label | in XSD date |
| Definition | Position of an instant, expressed using <code>xsd:date</code> . |
| Scope note | |
| Implementation | Value <i>MUST</i> be a literal with the datatype <code>xsd:date</code> . Maximum of one value is allowed for this property. |
| Cardinality | Maximum 1 |
| Node kind | <code>sh:Literal</code> |
| Class type | <code>xsd:date</code> |
| Expected values | |


4.2.2.4. Property: `time:inXSDDateTimeStamp`

| Property | Value |
|-----------------|--|
| IRI | <code>time:inXSDDateTimeStamp</code> |
| Shape IRI | https://w3id.org/tern/shapes/tern/time-inXSDDateTimeStamp |
| Status | <code>stable</code>  |
| Label | in XSD date-time-stamp |
| Definition | Position of an instant, expressed using <code>xsd:dateTimeStamp</code> . |
| Scope note | |
| Implementation | Value <i>MUST</i> be a literal with the datatype <code>xsd:dateTimeStamp</code> . Maximum of one value is allowed for this property. |
| Cardinality | Maximum 1 |
| Node kind | <code>sh:Literal</code> |
| Class type | <code>xsd:dateTimeStamp</code> |
| Expected values | |

4.2.2.5. Property: time:inXSDgYear

| Property | Value |
|-----------------|--|
| IRI | <code>time:inXSDgYear</code> |
| Shape IRI | https://w3id.org/tern/shapes/tern/time-inXSDgYear |
| Status | stable  |
| Label | in XSD g-year |
| Definition | Position of an instant, expressed using <code>xsd:gYear</code> . |
| Scope note | |
| Implementation | Value <i>MUST</i> be a literal with the datatype <code>xsd:gYear</code> . Maximum of one value is allowed for this property. |
| Cardinality | Maximum 1 |
| Node kind | <code>sh:Literal</code> |
| Class type | <code>xsd:gYear</code> |
| Expected values | |

4.2.2.6. Property: time:inXSDgYearMonth

| Property | Value |
|-----------------|---|
| IRI | <code>time:inXSDgYearMonth</code> |
| Shape IRI | https://w3id.org/tern/shapes/tern/time-inXSDgYearMonth |
| Status | stable  |
| Label | in XSD g-year-month |
| Definition | Position of an instant, expressed using <code>xsd:gYearMonth</code> . |
| Scope note | |
| Implementation | Value <i>MUST</i> be a literal with the datatype <code>xsd:gYearMonth</code> . Maximum of one value is allowed for this property. |
| Cardinality | Maximum 1 |
| Node kind | <code>sh:Literal</code> |
| Class type | <code>xsd:gYearMonth</code> |
| Expected values | |

5. References

[PROF]

The Profiles Vocabulary, Nicholas J Car; Rob Atkinson. 18 December 2019. W3C Working Group Note. URL: <https://www.w3.org/TR/dx-prof/>

[vocab-ssn]

Semantic Sensor Network Ontology. Armin Haller; Krzysztof Janowicz; Simon Cox; Danh Le Phuoc; Kerry Taylor; Maxime Lefrançois. 19 October 2017. W3C Recommendation. URL: <https://www.w3.org/TR/vocab-ssn/>

Annex A: Specification Parts



This Annex is normative.

TBD.