The XTM Syntax

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1 Terminology

The terminology used to describe XTM documents is defined in the body of this specification. The terms defined in this section are used in building those definitions.

addressable information resource

> An information resource whose identity is computable (that is, a computer system can retrieve the resource and make deterministic comparisons between it, and some other resource, to establish their identity or difference). In this specification, the term *resource* is used synonymously with *addressable information resource* unless otherwise stated.

addressable subject

> An **addressable information resource**, considered as a subject in and of itself, and not considered in terms of what an author meant by it. The identity of an addressable subject is by definition directly computable. (Cf. **non-addressable subject**.)

association

1. A relationship between topics asserted by an `<association>` element.
2. An `<association>` element.

association type

1. One of the classes of **association**.
2. The class of association specified by an `<association>` element's `<instanceOf>` child element. An association may belong to only one class.
3. A topic whose **subject** is a class of association.

base name

1. A child element (<baseName>) of a <topic> element.
2. A name characteristic of a topic that is provided by the content of a <baseNameString> element. Base names must be unique within a given scope (cf. **topic naming constraint**).

See also **variant name**.

characteristic

See **topic characteristic**.

consistent topic map

A **topic map** in which there is one topic per subject and no further opportunities for merging or duplicate suppression.

member

1. A child element (<member>) of an <association> element.
2. A set of topics that play a particular **role** in an **association**.

merging

1. The process of merging two topic maps, either as a result of explicit <mergeMap> directives, or for any application-specific reasons.
2. The process of merging two topics.

non-addressable subject

A **subject** that exists outside the bounds of the computer system and whose identity is therefore not computable. The identity of a non-addressable subject may only be established indirectly, for example through the use of a **subject indicator**.

occurrence

1. A child element (<occurrence>) of a <topic> element.
2. A **topic occurrence**.

occurrence type

1. One of the classes of **topic occurrence**.
2. The class of topic occurrence specified by an <occurrence> element's <instanceOf> child element. An occurrence may belong to only one class.
3. A topic whose **subject** is a class of topic occurrence.

parameters

1. A child element (<parameters>) of a <variant> element.
2. Information, in the form of a set of topics, that expresses the appropriate processing context for a **variant name**.

processed topic map

The collection of **topics**, **associations**, and **scopes** which have been processed by the XTM processing application.

processing requirements

The requirements on processing performed by a conforming XTM processor.

published subject indicator

A **subject indicator** that is published and maintained at an advertised address for the purpose of facilitating topic map interchange and mergeability.

reification

The act of creating a topic. When anything is reified it becomes the subject of the topic thus created; to reify something is therefore to create a topic of which that thing is the subject. Reification of a subject allows topic characteristics to be assigned to the topic that reifies it: In other words, it makes it possible to **discourse** about that subject within the terms of the topic map paradigm.

resource

See **addressable information resource**.

role

The role that a topic plays as a member of an association; the nature of its involvement in that association.

scope

1. The extent of the validity of a **topic characteristic assignment.** The context in which a name or an occurrence is assigned to a given topic, and the context in which topics are related through associations.
2. The set of topics specified via a `<scope>` element.

See also **unconstrained scope**.

This specification places no constraints on how applications interpret scope.

subject

1. Anything that can be spoken about or conceived of by a human being. In the most generic sense, a subject is anything whatsoever, regardless of whether it exists or has any other specific characteristics, about which anything whatsoever may be asserted by any means whatsoever.
2. Anything on which the author of a topic map chooses to discourse.
3. Anything that is reified by a **topic** in a topic map; the organizing principle of a topic. Humans are the ultimate authorities for determining the subjects of topics.

See also **subject identity**, **subject indicator**.

subject identity

1. The `<subjectIdentity>` child of a `<topic>` element.
2. That which makes two **subjects** identical, or distinguishes one subject from another. The determination of subject identity is aided, and may be automated, by the use of **published subject indicators**.
3. A criterion for merging topics.

subject indicator

A **resource** that is intended by the topic map author to provide a positive, unambiguous indication of the identity of a **subject**. There are three ways of indicating a subject in a topic map:

1. Pointing via a `<topicRef>` element to a `<topic>` element that shares the same subject;
2. Pointing via a `<subjectIndicatorRef>` element to a resource that **indicates** the subject;
3. Pointing via a `<resourceRef>` element to a resource that **is** the subject.

The subject indicated by a subject indicator may be either **non-addressable** or **addressable**. (Note that in case 3, the subject is necessarily addressable, since it is a resource.)

topic

1. A **resource** that acts as a proxy for some **subject**; the topic map system's representation of that subject. The relationship between a topic and its subject is defined to be one of **reification**. Reification of a subject allows **topic characteristics** to be assigned to the topic that reifies it.
2. A `<topic>` element.

topic characteristic

One of the following:

1. a topic name,
2. a topic occurrence, or
3. a role played by a topic in an association

A topic's names, occurrences, and roles played in associations are collectively known as its characteristics.

See also **topic name**, **topic occurrence**, and **role**.

topic characteristic assignment

The act of asserting that a given topic has a particular characteristic. Such assertions are deemed to be valid within a certain **scope**.

topic map

1. A collection of **topics**, **associations**, and **scopes** that may exist in one of two forms:
   (a) a serialized interchange format (e.g. as a topic map document expressed in XTM syntax), or
   (b) some application-internal form.
2. The document element (`<topicMap>`) of a topic map document expressed using XTM syntax.

topic map document

A document that contains one or more topic maps that conform to this specification. It may be serialized for the purpose of storage or interchange in a syntax governed by this or some other specification.

topic map node

An object (in the system's internal representation of a topic map) that represents a **topic**, **association**, or **scope**.

topic name

1. A **base name** characteristic of a topic (including that base name's **variants**).
2. *(Informally)* The string of characters specified as a name of a topic using a `<baseNameString>` element.

topic naming constraint

The constraint, imposed by the topic map paradigm, that any topics having the same base name in the same scope implicitly refer to the same subject and therefore should be merged.

topic occurence

A resource containing information that is specified as relevant to a given subject. In order to be expressed in an XTM topic map, such a resource must either

1. be addressable via a URI using a `<resourceRef>` element, or
2. be capable of being placed inline as a `<resourceData>` element.

topic type

1. One of the classes of **topic**.
2. A class of topic specified by an `<instanceOf>` child of a `<topic>` element. A topic may belong to more than one class.
3. A topic whose **subject** is a class of topic.

unconstrained scope

The absence of a specified **scope** in the assignment of a **topic characteristic**.

variant

See **variant name**

variant name

An alternative form of a base name, optimized for a particular computational purpose, such as sorting or display.

XTM document

topic map document that is expressed in the syntax defined by this specification.

2 The XTM Syntax Documentation

2.1 Introduction to XTM Syntax

All the element types defined in the XTM DTD are documented in this section. We now present a complete list with all the XTM's element types:

- `<topicRef>`: Reference to a Topic element
- `<subjectIndicatorRef>`: Reference to a Subject Indicator
- `<scope>`: Reference to Topic(s) that comprises the Scope
- `<instanceOf>`: Points to a Topic representing class
- `<topic>`: Topic Map document element
- `<topicMap>`: Topic element
- `<subjectIdentity>`: Subject reified by Topic
- `<baseName>`: Base Name of a Topic
- `<baseNameString>`: Base Name String container
- `<variant>`: Alternate forms of Base Name
- `<variantName>`: Container of Variant Name
- `<parameters>`: Processing context for Variant
- `<association>`: Topic Association
- `<member>`: Member in Topic Association
- `<roleSpec>`: Points to a Topic serving as an Association Role
- `<occurrence>`: Resources regarded as an Occurrence
- `<resourceRef>`: Reference to a Ressource
- `<resourceData>`: Container for Resource data
- `<mergeMap>`: Merge with another Topic Map

2.2 References to Topics and Subject Indicators

2.2.1 `<topicRef>` Element

The `<topicRef>` element provides a URI reference to a topic. The target of a `<topicRef>` link must resolve to a `<topic>` element child of a `<topicMap>` document that conforms to this XTM specification. The target `<topic>` need not be in the document entity of origin.

`<topicRef>` are identical to `<subjectIndicatorRef>`s, except for the additional constraint that they must point to `<topic>` elements.

Occurs in: `<instanceOf>`, `<member>`, `<mergeMap>`, `<parameters>`, `<roleSpec>`, `<scope>`, `<subjectIdentity>`.

Content Model

```
<!ELEMENT topicRef EMPTY>
```

The <topicRef> element has no content.

Attributes

```
<!AttLIST topicRef
          id ID #IMPLIED
          xlink:type NMTOKEN #FIXED "simple"
          xlink:href CDATA #REQUIRED
>
```

The <topicRef> element has the following attributes:

id	unique identifier for element
xlink:type	identifies this as an XLink simple link type
xlink:href	supplies the URI reference for this link .

2.2.2 <subjectIndicatorRef> Element

The <subjectIndicatorRef> element provides a URI reference to a resource that acts as a subject indicator.

Occurs in: <instanceOf>, <member>, <mergeMap>, <parameters>, <roleSpec>, <scope>, <subjectIdentity>.

Content Model

```
<!ELEMENT subjectIndicatorRef EMPTY>
```

The <subjectIndicatorRef> element has no content.

Attributes

```
<!AttLIST subjectIndicatorRef
          id ID #IMPLIED
          xlink:type NMTOKEN #FIXED "simple"
          xlink:href CDATA #REQUIRED
>
```

The <subjectIndicatorRef> element has the following attributes:

id	unique identifier for element
xlink:type	identifies this as an XLink simple link type
xlink:href	supplies the URI reference for this link .

2.2.3 The VDM-SL Specification

These two elements are identical, so they can be gathered in the same struture:

$$
\begin{aligned}
Reference1 :: \; & id : [ID] \\
& type : TypeRef1 \\
& attr : Attributes
\end{aligned}
$$

$$ID = \text{token};$$

$$TypeRef1 = \textsc{topicRef} \mid \textsc{subjectIndicatorRef};$$

$$\begin{aligned} Attributes :: xlinkType &: [Simple] \\ xlinkHref &: ID \end{aligned}$$

$$Simple = \textsc{simple};$$

2.3 Scope and Context

2.3.1 `<scope>` Element

The `<scope>` element consists of one or more `<topicRef>`, `<resourceRef>` or `<subjectIndicatorRef>` elements. The union of the subjects corresponding to these elements specifies the context in which the assignment of the topic characteristic is considered to be valid.

A declaration of a topic characteristic is valid only within a scope. When a topic characteristic declaration does not specify a scope, it is valid in the **unconstrained scope**.

Occurs in: `<baseName>`, `<occurrence>`, `<association>`.

Content Model

```
<!ELEMENT scope (topicRef | resourceRef | subjectIndicatorRef)+>
```

- Each repeatable `<topicRef>` child element references a `<topic>` element ("scoping topic") whose subject contributes to the scope.
- Each repeatable `<resourceRef>` child element references a resource that contributes to the scope.
- Each repeatable `<subjectIndicatorRef>` child element references a resource that indicates the identity of the subject that contributes to the scope.

Attributes

```
<!AttLIST scope
          id ID #IMPLIED
>
```

The `<scope>` element has the following attribute:

id unique identifier for element

2.3.2 The VDM-SL Specification

$$
\begin{aligned}
&\mathit{Scope} :: \mathit{id} : [\mathit{ID}] \\
&\qquad\quad \mathit{refs} : \mathit{Reference}\text{-set} \\
&\mathsf{inv}\ \mathit{scope} \triangleq \mathsf{card}\,(\mathit{scope}.\mathit{refs}) \geq 1;
\end{aligned}
$$

The `Reference` element is an extension of the `Reference1` element:

$$
\begin{aligned}
&\mathit{Reference} :: \mathit{id} : [\mathit{ID}] \\
&\qquad\qquad\quad \mathit{type} : \mathit{TypeRef} \\
&\qquad\qquad\quad \mathit{attr} : \mathit{Attributes}
\end{aligned}
$$

$$
\mathit{TypeRef} = \text{TOPICREF} \mid \text{RESOURCEREF} \mid \text{SUBJECTINDICATORREF};
$$

2.4 Classes and Instances

2.4.1 `<instanceOf>` Element

The `<instanceOf>` element specifies the class to which its parent belongs, via a `<topicRef>` or `<subjectIndicatorRef>` child element.

For the constraints on the usage of `<instanceOf>`, see the description of the element types that can be its parent:`<topic>`, `<occurrence>`, and `<association>`.

Occurs in: `<topic>`, `<occurrence>`, `<association>`.

Content Model

```
<!ELEMENT instanceOf (topicRef | subjectIndicatorRef)>
```

- The `<topicRef>` child element references a `<topic>` element that reifies a class of subject.
- The `<subjectIndicatorRef>` child element references a resource that indicates the identity of a class of subject.

Attributes

```
<!AttLIST instanceOf
          id ID #IMPLIED
>
```

The `<instanceOf>` element has the following attribute:

id unique identifier for element

2.4.2 The VDM-SL Specification

$$
\begin{aligned}
&\mathit{InstanceOf} :: \mathit{id} : [\mathit{ID}] \\
&\qquad\qquad\qquad \mathit{ref} : \mathit{Reference} \\
&\mathsf{inv}\ \mathit{inst} \triangleq \mathit{inst}.\mathit{ref}.\mathit{type} \in \{\text{TOPICREF}, \text{SUBJECTINDICATORREF}\};
\end{aligned}
$$

2.5 The Topic Map

2.5.1 `<topicMap>` Element

The `<topicMap>` element is the parent of all `<topic>`, `<association>`, and `<mergeMap>` elements in the topic map document.

The `<topicMap>` element is the root element from which topic map syntactical recognition is performed. The `<topicMap>` element can be the root of a document containing only a topic map (i.e. when it is the document element), or it can be the root of a subtree inside an XML document containing other information than the topic map itself. In the latter case, only the subtree starting with the element `<topicMap>` is taken into account for topic map syntactical recognition and conformance.

Content Model

```
<!ELEMENT topicMap (topic | association | mergeMap)*>
```

- Each optional and repeatable `<topic>` child element reifies a single subject.
- Each optional and repeatable `<association>` child element specifies a relationship among topics.
- Each optional and repeatable `<mergeMap>` child element causes its parent topic map to be merged with another topic map.

Attributes

```
<!AttLIST topicMap
          id ID #IMPLIED
          xmlns CDATA #FIXED "http://www.topicmaps.org/xtm/1.0/"
          xmlns:xlink CDATA #FIXED "http://www.w3.org/1999/xlink"
          xml:base CDATA #IMPLIED
>
```

The `<topicMap>` element has the following attributes:

id	unique identifier for element
xmlns	namespace identifier for default XML namespace
xmlns:xlink	namespace identifier for XLink namespace
xml:base	reference to document base URI

2.5.2 The VDM-SL Specification

$$
\begin{array}{l}
\mathit{TopicMap} :: \mathit{id} : [\mathit{ID}] \\
\qquad\qquad\quad \mathit{nodes} : \mathit{TMNode}\text{-set} \\
\qquad\qquad\quad \mathit{attributes} : \mathit{TMAttributes} \\
\text{inv } \mathit{tm} \triangleq \\
\quad (\text{let mk-}(\mathit{tc}, \mathit{ti}, \mathit{ai}) = \mathit{collectIDs}\,(\mathit{tm.nodes}), \\
\qquad \mathit{args} = \mathit{assocArgs}\,(\mathit{tm.nodes}) \text{ in} \\
\quad\; (\mathit{ti} \subseteq \mathit{tc}) \wedge \\
\quad\; (\mathit{ai} \subseteq \mathit{tc}) \wedge \\
\quad\; (\mathit{args} \subseteq \mathit{tc})) \wedge \\
\quad (\text{let } \mathit{allt} = \mathit{allTopics}\,(\mathit{tm.nodes}), \\
\qquad \mathit{alltr} = \mathit{allTopicRef}\,(\mathit{tm.nodes}) \text{ in} \\
\quad\; \mathit{alltr} \subseteq \mathit{allt});
\end{array}
$$

$$TMNode = Topic \mid Association \mid MergeMap;$$

$$\begin{aligned} TMAttributes ::\ & xtmNS : XTM \\ & xlinkNS : XLINK \\ & base : String \end{aligned}$$

$$\begin{aligned} XTM &= \text{TOPICMAPS}; \\ XLINK &= \text{XLINK}; \\ String &= \mathsf{char}^{+}; \end{aligned}$$

2.6 Topics and Subjects

2.6.1 `<topic>` Element

The `<topic>` element specifies the name and occurrence characteristics of a single topic. It has a single unique identifier, and the ability to state the class(es) of which it is an instance and the identity of the subject that it reifies.

By definition, a topic reifies only one subject. Every topic is intended to be organized around exactly one subject, even if that subject is only implicitly defined. During XTM processing, topics with identical subjects will be merged according to the rules specified in chapter XTM Processing Requirements.

However, a topic map *document* may contain multiple topic elements that reify the same subject. After processing there will only be one topic for each subject; its characteristics will be the union of the characteristics of all topics that reified that subject.

The class(es) of which the topic is an instance are indicated via the `<instanceOf>` child element(s), each of which addresses either a topic or a subject indicator. If no `<instanceOf>` children are present, the class of the topic defaults to the class defined by the **topic published subject**.

A `<topic>` element specifies zero or more names and zero or more occurrences that are relevant to its subject. Names are declared by means of `<baseName>` child elements. Occurrences are specified by means of `<occurrence>` child elements.

Occurs in: `<topicMap>`.

Content Model

```
<!ELEMENT topic (instanceOf*, subjectIdentity?, (baseName | occurrence)*)>
```

- Each optional and repeatable `<instanceOf>` child element specifies a class of which this topic is an instance.
- The optional `<subjectIdentity>` child element specifies the subject identity of this topic.
- Each optional and repeatable `<baseName>` child element specifies a name characteristic of this topic.
- Each optional and repeatable `<occurrence>` child element specifies information resources that are relevant to this topic.

Attributes

```
<!ATTLIST topic
          id ID #REQUIRED
>
```

The <topic> element has the following attribute:

id unique identifier for element

2.6.2 <subjectIdentity> Element

The <subjectIdentity> element specifies the subject that is reified by a topic, via <resourceRef>, <subjectIndicatorRef>, and/or <topicRef> child elements.

When a topic has an addressable subject, the subject can be addressed directly via a <resourceRef> element. In that case, it is the resource itself which is considered the subject of the topic, not what the resource means or indicates. There can be only one such resource per topic.

Resources may also be subject *indicators*, as opposed to subjects in and of themselves. Resources are used to indicate subjects via <subjectIndicatorRef> elements, of which there may be more than one per topic.

A topic may also indicate that it has the same subject as another topic by addressing that topic via a <topicRef> element. There may be multiple such elements, each of which causes topic merging to occur.

Occurs in: <topic>

Content Model

```
<!ELEMENT subjectIdentity (resourceRef?, (topicRef | subjectIndicatorRef)*)>
```

- The optional <resourceRef> element references an *addressable subject*
- Each optional and repeatable <topicRef> child element references a <topic> element that shares the same subject.
- Each optional and repeatable <subjectIndicatorRef> child element references a subject indicator.

Attributes

```
<!ATTLIST subjectIdentity
          id ID #IMPLIED
>
```

The <subjectIdentity> element has the following attribute:

id unique identifier for element

2.6.3 The VDM-SL Specification

$$
\begin{aligned}
\mathit{Topic} :: \ & \mathit{id} : \mathit{ID} \\
& \mathit{instanceOf} : \mathit{InstanceOf}\text{-set} \\
& \mathit{subjectIdentity} : [\mathit{SubjectIdentity}] \\
& \mathit{characteristics} : \mathit{Characteristic}\text{-set}
\end{aligned}
$$

$$\mathit{Characteristic} = \mathit{BaseName} \mid \mathit{Occurrence};$$

$$
\begin{aligned}
& \mathit{SubjectIdentity} :: \mathit{id} : [\mathit{ID}] \\
& \qquad\qquad\qquad\quad \mathit{ref} : \mathit{Reference}\text{-set} \\
& \text{inv } \mathit{subIdent} \triangleq \mathit{countResource}\,(\mathit{subIdent}.\mathit{ref}) \leq 1;
\end{aligned}
$$

2.7 Topic Names

2.7.1 `<baseName>` Element

The `<baseName>` element specifies a topic name. A topic name is represented by one string: the content of the `<baseNameString>` child of `<baseName>`. The context within which the assignment of a name to a topic is valid may be expressed using a `<scope>` child element. If none such is present, the scope is unconstrained and the name is always valid. A topic may have multiple base names in the same and/or multiple scopes.

Natural language discrimination between base names may be specified by a child `<scope>` element.

Base names are subject to the **topic naming constraint** that two topics with the same base name in the same scope implicitly reify the same subject and should therefore be merged.

Alternate forms of the topic name, optimized for computational purposes like sorting, searching, and display, are specified by `<variant>` elements.

Occurs in: `<topic>`

Content Model

```
<!ELEMENT baseName (scope?, baseNameString, variant*)>
```

- The optional `<scope>` child element specifies the context in which this base name is valid.
- The single mandatory `<baseNameString>` child element provides the string that is the base name of the topic.
- The optional and repeatable `<variant>` child element provides alternate forms of the base name.

Attributes

```
<!ATTLIST baseName
          id ID #IMPLIED
>
```

The `<baseName>` element has the following attribute:

id unique identifier for element

2.7.2 <baseNameString> Element

The <baseNameString> element is a string that represents the base name of its ancestor <topic> parent.

Occurs in: <baseName>.

Content Model

```
<!ELEMENT baseNameString (#PCDATA)>
```

The <baseNameString> element contains #PCDATA; it may only contain character data.

Attributes

```
<!ATTLIST baseNameString
          id ID #IMPLIED
>
```

The <baseNameString> element has the following attribute:

id unique identifier for element

2.7.3 <variant> Element

The <variant> element is an alternate form of a topic's base name appropriate for a processing context specified by the variant's <parameters> child element. Among these contexts may be sorting and display.

Each <variantName> child element in the recursive structure provides a single alternate form of the base name; the processing context in which this form is considered to be appropriate is defined by the union of all the parameters at this and higher levels of the recursive structure.

Occurs in: <baseName>.

Content Model

```
<!ELEMENT variant (parameters, variantName?, variant*)>
```

- The single mandatory <parameters> child element specifies an additional processing context for its parent <variant> element.
- The optional <variantName> child element provides an alternate form of the base name.
- Each optional and repeatable <variant> child element specifies additional parameters and variant names, within the context of the parameters declared by its parent <variant> element.

Attributes

```
<!ATTLIST variant
          id ID #IMPLIED
>
```

The <variant> element has the following attribute:

id unique identifier for element

2.7.4 <variantName> Element

The <variantName> element provides the resource to be used as a variant of a base name. The resource may be referenced by a <resourceRef> element, or may be included directly as a <resourceData> element.

Occurs in: <variant>

Content Model

```
<!ELEMENT variantName (resourceRef | resourceData)>
```

- The <resourceRef> child element references a resource that supplies the variant name.
- The <resourceData> child element *is* the resource that supplies the variant name.

Attributes

```
<!ATTLIST variantName
          id ID #IMPLIED
>
```

The <variantName> element has the following attribute:

id unique identifier for element

2.7.5 <parameters> Element

The <parameters> element consists of one or more <topicRef> or <subjectIndicatorRef> elements. The union of the subjects corresponding to these elements specifies an additional processing context in which variant names in the variant's subtree are considered to be appropriate.

Occurs in: <variant>

Content Model

```
<!ELEMENT parameters (topicRef | subjectIndicatorRef)+>
```

- The repeatable <topicRef> child element references a topic element that indicates the processing context of the parent <variant> element.
- The repeatable <subjectIndicatorRef> element references a resource that indicates the processing context of the parent <variant> element.

Attributes

```
<!ATTLIST parameters
          id ID #IMPLIED
>
```

The <parameters> element has the following attribute:

id unique identifier for element

2.7.6 The VDM-SL Specification

$$
\begin{aligned}
BaseName :: \; & id : [ID] \\
& scope : [Scope] \\
& baseNameString : BaseNameString \\
& variants : Variant\text{-set}
\end{aligned}
$$

$$
\begin{aligned}
BaseNameString :: \; & id : [ID] \\
& name : String
\end{aligned}
$$

$$
\begin{aligned}
Variant :: \; & id : [ID] \\
& subjects : Parameter\text{-set} \\
& variantName : [VariantName] \\
& variants : Variant\text{-set}
\end{aligned}
$$
$$
\text{inv } vrnt \triangleq \text{card } (vrnt.subjects) \geq 1;
$$

$$
\begin{aligned}
VariantName :: \; & id : [ID] \\
& resource : ResourceType
\end{aligned}
$$

$$
\begin{aligned}
ResourceType :: \; & id : [ID] \\
& res : (Reference \mid ResourceData)
\end{aligned}
$$
$$
\begin{aligned}
&\text{inv } rt \triangleq \text{cases } rt.res : \\
&\qquad \text{mk-}Reference\,(\text{-}, type, \text{-}) \to type = \text{RESOURCEREF} \\
&\quad \text{end;}
\end{aligned}
$$

$$
\begin{aligned}
Parameter :: \; & id : [ID] \\
& ref : Reference
\end{aligned}
$$
$$
\text{inv } prmt \triangleq prmt.ref.type \in \{\text{TOPICREF}, \text{SUBJECTINDICATORREF}\};
$$

2.8 Associations and Members

2.8.1 `<association>` Element

The `<association>` element asserts a relationship among topics that play roles as members of the association.

The class to which an `<association>` belongs is specified by an `<instanceOf>` child element. If no such element is present, the association's class defaults to the *association published subject*.

The context within which the assertion made by the association is valid may be expressed using a `<scope>` child element. If none such is present, the scope is unconstrained and the association is always valid.

Occurs in: `<topicMap>`

Content Model

```
<!ELEMENT association (instanceOf?, scope?, member+)>
```

- The optional <instanceOf> child element specifies the class to which this association belongs.
- The optional <scope> child element specifies the context in which the assertion made by the association is valid.
- The mandatory and repeatable <member> element specifies the topics that play roles in the association.

Attributes

```
<!ATTLIST association
          id ID #IMPLIED
>
```

The <association> element has the following attribute:

id unique identifier for element

2.8.2 <member> Element

The <member> element specifies all topics that play a given role in an association. The <roleSpec> element specifies the role played by these topics.

Occurs in: <association>

Content Model

```
<!ELEMENT member (roleSpec?, (topicRef | resourceRef | subjectIndicatorRef)*)>
```

- The optional <roleSpec> child element specifies the role played in this association by this member.
- Each repeatable <topicRef> child element references a topic that plays the specified role.
- Each repeatable <resourceRef> child element references a resource that plays the specified role.
- Each repeatable <subjectIndicatorRef> element references a subject indicator for a subject that plays the specified role.

Attributes

```
<!ATTLIST member
          id ID #IMPLIED
>
```

The <member> element has the following attribute:

id unique identifier for element

2.8.3 <roleSpec> Element

The <roleSpec> element specifies the role played by a member in an association.

Occurs in: <roleSpec>

Content Model

```
<!ELEMENT roleSpec (topicRef | subjectIndicatorRef)>
```

- The <topicRef> child element references a topic that reifies a role in an association.
- The <subjectIndicatorRef> child element references a subject indicator for a role in an association.

Attributes

```
<!ATTLIST roleSpec
          id ID #IMPLIED
>
```

The <roleSpec> element has the following attribute:

id unique identifier for element

2.8.4 The VDM-SL Specification

$$
\begin{aligned}
&\mathit{Association} :: \mathit{id} : [\mathit{ID}] \\
&\qquad\qquad\quad \mathit{instanceOf} : [\mathit{InstanceOf}] \\
&\qquad\qquad\quad \mathit{scope} : [\mathit{Scope}] \\
&\qquad\qquad\quad \mathit{members} : \mathit{Member}\text{-set} \\
&\text{inv } \mathit{assoc} \triangleq \text{card } (\mathit{assoc.members}) \geq 1;
\end{aligned}
$$

$$
\begin{aligned}
&\mathit{Member} :: \mathit{id} : [\mathit{ID}] \\
&\qquad\qquad \mathit{roleSpec} : [\mathit{RoleSpec}] \\
&\qquad\qquad \mathit{refs} : \mathit{Reference}\text{-set}
\end{aligned}
$$

$$
\begin{aligned}
&\mathit{RoleSpec} :: \mathit{id} : [\mathit{ID}] \\
&\qquad\qquad\; \mathit{ref} : \mathit{Reference} \\
&\text{inv } \mathit{rSpec} \triangleq \mathit{rSpec.ref.type} \in \{\textsc{TopicRef}, \textsc{SubjectIndicatorRef}\};
\end{aligned}
$$

2.9 Occurrences and Resources

2.9.1 <occurrence> Element

The <occurrence> element specifies a resource supplying information relevant to a topic.

The class of which the occurrence is an instance is indicated via the <instanceOf> child element. If no such element is present, the occurrence type defaults to the class defined by the *occurrence published subject*.

The context within which the occurrence is valid may be expressed using a <scope> child element. If none such is present, the scope is unconstrained and the occurrence is always valid.

Occurs in: <topic>

Content Model

```
<!ELEMENT occurrence (instanceOf?, scope?, (resourceRef | resourceData))>
```

- The optional <instanceOf> child element specifies the class of which the topic occurrence is an instance.
- The optional <scope> child element specifies the context in which the resource is relevant to the topic.

- The <resourceRef> child element references a resource that is an occurrence of the topic.
- The <resourceData> child element *is* the resource that is an occurrence of the topic.

Attributes

```
<!ATTLIST occurrence
          id ID #IMPLIED
>
```

The <occurrence> element has the following attribute:

id unique identifier for element

2.9.2 <resourceRef> Element

The <resourceRef> element provides a URI reference to a resource.

Resource may be referenced for one of the following reasons:

1. as occurrences of topics (in <occurrence> elements)
2. as addressable subjects (in <member>, <mergeMap>, <scope>, and <subjectIdentity> elements), and
3. as variants names of topics (in variantName elements).

Occurs in: <member>, <mergeMap>, <scope>, <subjectIdentity>, variantName.

Content Model

```
<!ELEMENT resourceRef EMPTY>
```

The <resourceRef> element has no content.

Attributes

```
<!ATTLIST resourceRef
          id ID #IMPLIED
          xlink:type NMTOKEN #FIXED "simple"
          xlink:href CDATA #REQUIRED
>
```

The <resourceRef> element has the following attributes:

id unique identifier for element
xlink:type identifies this as an XLink simple link type
xlink:href supplies the URI reference for this link.

2.9.3 `<resourceData>` Element

The `<resourceData>` element contains information in the form of character data that may be:

1. an occurrence of a topic, or
2. a variant form of a base name

Occurs in: `<occurrence>`, `variantName`.

Content Model

```
<!ELEMENT resourceData (#PCDATA)>
```

The `<resourceData>` element is declared `#PCDATA`, meaning that it may only contain character data.

Attributes

```
<!ATTLIST resourceRef
          id ID #IMPLIED
>
```

The `<resourceRef>` element has the following attribute:

id unique identifier for element

2.9.4 The VDM-SL Specification

$$\begin{aligned} Occurrence :: \ & id : [ID] \\ & instanceOf : [InstanceOf] \\ & scope : [Scope] \\ & resources : ResourceType \end{aligned}$$

The `ResourceRef` element has been defined above.

$$\begin{aligned} ResourceData :: \ & id : [ID] \\ & data : String \end{aligned}$$

2.10 Merge

2.10.1 `<mergeMap>` Element

A `<mergeMap>` element references an external `<topicMap>` element through an `xlink:href` attribute containing a URI.

The children of `<mergeMap>` indicate topics that are to be added to the scopes of all characteristics originating in the referenced topic map. (The reason for modifying the scopes of the merged characteristics may be to prevent topics from merging on account of the topic naming constraint, or to distinguish between characteristics on the basis of their topic map of origin.)

Occurs in: `<topicMap>`

Content Model

```
<!ELEMENT mergeMap (topicRef | resourceRef | subjectIndicatorRef)*>
```

- The optional and repeatable `<topicRef>` child element references a topic whose subject is to be added to the scope of all characteristics originating in the referenced topic map.
- The optional and repeatable `<resourceRef>` child element references an addressable subject that is to be added to the scope of all characteristics originating in the referenced topic map.
- The optional and repeatable `<subjectIndicatorRef>` child element references a subject indicator whose subject is to be added to the scope of all characteristics originating in the referenced topic map.

Attributes

```
<!ATTLIST mergeMap
          id ID #IMPLIED
          xlink:type NMTOKEN #FIXED "simple"
          xlink:href CDATA #REQUIRED
>
```

The `mergeMap` elements has the following attributes:

id	unique identifier for element
xlink:type	identifies this as an XLink simple link type
xlink:href	supplies the URI reference for this link. This is a reference to a topic map to be merged with this one at Graph creation time.

2.10.2 The VDM-SL Specification

$$
\begin{aligned}
&\mathit{MergeMap} :: \mathit{id} : [\mathit{ID}] \\
&\qquad\qquad \mathit{references} : \mathit{Reference}\text{-set} \\
&\qquad\qquad \mathit{attributes} : \mathit{Attributes}
\end{aligned}
$$

2.11 Used functions

2.11.1 Function *countResource*

Specification:

$$
\begin{aligned}
&\mathit{countResource} : \mathit{Reference}\text{-set} \rightarrow \mathbb{Z} \\
&\mathit{countResource}\,(f) \triangleq \\
&\quad \text{if } f = \{\} \\
&\quad \text{then } 0 \\
&\quad \text{else let } r \in f \text{ in} \\
&\qquad\quad \text{if } r.\mathit{type} = \textsc{ResourceRef} \\
&\qquad\quad \text{then } 1 + \mathit{countResource}\,(f \setminus \{r\}) \\
&\qquad\quad \text{else } \mathit{countResource}\,(f \setminus \{r\});
\end{aligned}
$$

Description:

Counts the occurrences of the element `resourceRef`.

Calls:

Standard VDM-SL only

2.11.2 Function $collectIDs$

Specification:

$$
\begin{array}{l}
collectIDs : TMNode\text{-set} \rightarrow ID\text{-set} \times ID\text{-set} \times ID\text{-set} \\
collectIDs\,(nodes) \triangleq \\
\quad collectIDsAc\,(nodes, \{\}, \{\}, \{\});
\end{array}
$$

Description:

Collects the identifiers of:

1. *topics which are classes*
2. *topics which are instances*
3. *associations which are instances*

present in the Topic Map.

Calls:

$collectIDsAc$

2.11.3 Function $collectIDsAc$

Specification:

$$
\begin{array}{l}
collectIDsAc : TMNode\text{-set} \times ID\text{-set} \times ID\text{-set} \times ID\text{-set} \rightarrow \\
\qquad\qquad\qquad ID\text{-set} \times ID\text{-set} \times ID\text{-set} \\
collectIDsAc\,(nodes, tc, ti, ai) \triangleq \\
\quad \text{let } elem \in nodes \text{ in} \\
\quad \text{cases } elem : \\
\qquad \text{mk-}Topic\,(\text{-}, \text{-}, \text{-}, \text{-}) \rightarrow \\
\qquad\quad \text{if } elem.instanceOf = \{\} \\
\qquad\quad \text{then } collectIDsAc\,(nodes \setminus \{elem\}, \\
\qquad\qquad\qquad \{elem.id\} \cup tc, \\
\qquad\qquad\qquad ti, ai) \\
\qquad\quad \text{else } collectIDsAc\,(nodes \setminus \{elem\}, tc, \\
\qquad\qquad\qquad tr\text{-}in\text{-}Instances\,(elem.instanceOf) \cup ti, \\
\qquad\qquad\qquad ai), \\
\qquad \text{mk-}Association\,(\text{-}, \text{-}, \text{-}, \text{-}) \rightarrow \\
\qquad\quad \text{if } elem.instanceOf = \text{nil} \\
\qquad\quad \text{then } collectIDsAc\,(nodes \setminus \{elem\}, \\
\qquad\qquad\qquad tc, ti, ai) \\
\qquad\quad \text{else } collectIDsAc\,(nodes \setminus \{elem\}, \\
\qquad\qquad\qquad tc, ti, \\
\qquad\qquad\qquad \{myClass\,(elem.instanceOf)\} \cup ai), \\
\qquad \text{others} \rightarrow collectIDsAc\,(nodes \setminus \{elem\}, tc, ti, ai) \\
\quad \text{end;}
\end{array}
$$

Description:

Auxiliar function of $collectIDs$*.*

Calls:

$tr_i n_I nstances$, $myClass$

2.11.4 Function $tr_i n_I nstances$

Specification:

$$
\begin{array}{l}
\mathit{tr\text{-}in\text{-}Instances} : \mathit{InstanceOf}\text{-set} \rightarrow \mathit{ID}\text{-set} \\
\mathit{tr\text{-}in\text{-}Instances}\,(f) \;\triangleq \\
\quad \text{if } f = \{\} \\
\quad \text{then } \{\} \\
\quad \text{else let } i \in f \text{ in} \\
\qquad\quad \{\mathit{myClass}\,(i)\} \cup \\
\qquad\quad (\mathit{tr\text{-}in\text{-}Instances}\,(f \setminus \{i\}));
\end{array}
$$

Description:

Auxiliar function of collectIDsAc

Calls:

Standard VDM-SL only

2.11.5 Function $myClass$

Specification:

$$
\begin{array}{l}
\mathit{myClass} : \mathit{InstanceOf} \rightarrow \mathit{ID} \\
\mathit{myClass}\,(i) \;\triangleq \\
\quad \text{cases } i.\mathit{ref}.\mathit{type} : \\
\qquad \text{TOPICREF} \rightarrow i.\mathit{ref}.\mathit{attr}.\mathit{xlinkHref} \\
\quad \text{end};
\end{array}
$$

Description:

No description?

Calls:

Standard VDM-SL only

2.11.6 Function $assocArgs$

Specification:

$assocArgs$: $TMNode$-set $\rightarrow$ ID-set
$assocArgs\ (s) \triangleq$
  if $s = \{\}$
  then $\{\}$
  else let $t \in s$ in
    cases t :
      mk-$Topic$ (-, -, -, -) $\rightarrow$
        if $t.instanceOf = \{\}$
        then $collectBN\ (t.characteristics, \{\}) \cup$
          $assocArgs\ (s \setminus \{t\})$
        else $assocArgs\ (s \setminus \{t\})$
    end;

Description:

Collects the identifiers of the topics envolved in some association definition.

Calls:

Standard VDM-SL only

2.11.7 Function $collectBN$

Specification:

$collectBN$: $Characteristic$-set $\times$ ID-set $\rightarrow$ ID-set
$collectBN\ (s, id) \triangleq$
  if $s = \{\}$
  then id
  else let $c \in s$ in
    cases c :
      mk-$BaseName$ (-, -, -, -) $\rightarrow$
        if $c.scope =$ nil
        then $collectBN\ (s \setminus \{c\}, id)$
        else $collectBN\ (s \setminus \{c\},$
          $tr\text{-}in\text{-}References\ (c.scope.refs) \cup$
          $id)$
    end;

Description:

¡topicRef¿ nos baseNames

Calls:

$tr_i n_R eferences$

2.11.8 Function $tr_i n_R eferences$

Specification:

$tr\text{-}in\text{-}References$: $Reference$-set → ID-set
$tr\text{-}in\text{-}References\,(s)\ \triangleq$
  if $s = \{\}$
  then $\{\}$
  else let $r \in s$ in
    cases $r.type$:
      TOPICREF →
        $\{r.attr.xlinkHref\} \cup$
        $tr\text{-}in\text{-}References\,(s \setminus \{r\})$,
      others → $tr\text{-}in\text{-}References\,(s \setminus \{r\})$
    end;

Description:

os topicRef nas references

Calls:

Standard VDM-SL only

2.11.9 Function $allTopics$

Specification:

$allTopics$: $TMNode$-set → ID-set
$allTopics\,(nodes)\ \triangleq$
  let $elem \in nodes$ in
  cases $elem$:
    mk-$Topic$ (-, -, -, -) → $\{elem.id\} \cup (allTopics\,(nodes \setminus \{elem\}))$,
    others → $allTopics\,(nodes \setminus \{elem\})$
  end;

Description:

Calculates all topics identifiers.

Calls:

Standard VDM-SL only

2.11.10 Collecting all href:xlink of the Topic Map

2.11.11 Function $allTopicRef$

Specification:

$allTopicRef : TMNode\text{-set} \rightarrow ID\text{-set}$
$allTopicRef\,(nodes) \triangleq$
  if $nodes = \{\}$
  then $\{\}$
  else let mk- $(t, a, m) = split\,(nodes, \{\}, \{\}, \{\})$,
      $tr1 = tr\text{-}in\text{-}Topic\,(t)$,
      $tr2 = tr\text{-}in\text{-}Assoc\,(a)$,
      $tr3 = tr\text{-}in\text{-}MergeMap\,(m)$ in
    $tr1 \cup tr2 \cup tr3$;

Description:

No description?

Calls:

Standard VDM-SL only

2.11.12 Function *split*

Specification:

$split : TMNode\text{-set} \times Topic\text{-set} \times Association\text{-set} \times MergeMap\text{-set} \rightarrow$
  $Topic\text{-set} \times Association\text{-set} \times MergeMap\text{-set}$
$split\,(nodes, b1, b2, b3) \triangleq$
  let $x \in nodes$ in
  cases x :
    mk-$Topic$ (-, -, -, -) $\rightarrow split\,(nodes \setminus \{x\}, b1 \cup \{x\}, b2, b3)$,
    mk-$Association$ (-, -, -, -) $\rightarrow split\,(nodes \setminus \{x\}, b1, b2 \cup \{x\}, b3)$,
    mk-$MergeMap$ (-, -, -) $\rightarrow split\,(nodes \setminus \{x\}, b1, b2, b3 \cup \{x\})$
  end;

Description:

separa em "sacos" os vários tipos de nodo do TM

Calls:

Standard VDM-SL only

2.11.13 Function $tr_i n_T opic$

Specification:

$tr\text{-}in\text{-}Topic : Topic\text{-set} \rightarrow ID\text{-set}$
$tr\text{-}in\text{-}Topic\,(s) \triangleq$
  if $s = \{\}$
  then $\{\}$
  else let $t \in s$ in
    $topicAux\,(t) \cup (tr\text{-}in\text{-}Topic\,(s \setminus \{t\}))$;

Description:

¡topicRef¿ in topic's child elements.

Calls:

$topicAux$

2.11.14 Function $topicAux$

Specification:

$topicAux : Topic \rightarrow ID\text{-set}$
$topicAux\,(t) \triangleq$
  let $i = tr\text{-}in\text{-}Instances\,(t.instanceOf)$,
    $s = tr\text{-}in\text{-}References\,(t.subjectIdentity.ref)$,
    $c = tr\text{-}in\text{-}Characteristic\,(t.characteristics)$ in
  $(i \cup s \cup c)$;

Description:

Auxiliar function of $tr_i n_T opic$

Calls:

$tr_i n_I nstances$,$tr_i n_R eferences$,$tr_i n_C haracteristics$

2.11.15 Function $tr_i n_A ssoc$

Specification:

$tr\text{-}in\text{-}Assoc : Association\text{-set} \rightarrow ID\text{-set}$
$tr\text{-}in\text{-}Assoc\,(s) \triangleq$
  if $s = \{\}$
  then $\{\}$
  else let $t \in s$ in
    $assocAux\,(t) \cup tr\text{-}in\text{-}Assoc\,(s \setminus \{t\})$;

Description:

¡topicRef¿ in association's child elements.

Calls:

Standard VDM-SL only

2.11.16 Function $topicAux$

Specification:

$$
\begin{array}{l}
assocAux : Association \to ID\text{-set} \\
assocAux\,(t) \triangleq \\
\quad \mathsf{let}\ i = \mathsf{if}\ t.instanceOf = \mathsf{nil} \\
\qquad\qquad \mathsf{then}\ \{\} \\
\qquad\qquad \mathsf{else}\ \{myClass\,(t.instanceOf)\}, \\
\qquad s = \mathsf{if}\ t.scope = \mathsf{nil} \\
\qquad\qquad \mathsf{then}\ \{\} \\
\qquad\qquad \mathsf{else}\ tr\text{-}in\text{-}References\,(t.scope.refs), \\
\qquad m = tr\text{-}in\text{-}Members\,(t.members)\ \mathsf{in} \\
\quad i \cup s \cup m;
\end{array}
$$

Description:

Auxiliar function of $tr_i n_A ssoc$

Calls:

$myClass, tr_i n_R eferences, tr_i n_M embers$

2.11.17 Function $tr_i n_M ergeMap$

Specification:

$$
\begin{array}{l}
tr\text{-}in\text{-}MergeMap : MergeMap\text{-set} \to ID\text{-set} \\
tr\text{-}in\text{-}MergeMap\,(s) \triangleq \\
\quad \mathsf{if}\ s = \{\} \\
\quad \mathsf{then}\ \{\} \\
\quad \mathsf{else\ let}\ t \in s\ \mathsf{in} \\
\qquad tr\text{-}in\text{-}References\,(t.references) \cup \\
\qquad tr\text{-}in\text{-}MergeMap\,(s \setminus \{t\});
\end{array}
$$

Description:

No description?

Calls:

Standard VDM-SL only

2.11.18 Function $tr_i n_C haracteristic$

Specification:

$tr\text{-}in\text{-}Characteristic : Characteristic\text{-}\mathsf{set} \rightarrow ID\text{-}\mathsf{set}$
$tr\text{-}in\text{-}Characteristic\,(s) \triangleq$
  if $s = \{\}$
  then $\{\}$
  else let $x \in s$ in
    cases x :
      mk-$BaseName$ (-, -, -, -) $\rightarrow$
        $tr\text{-}in\text{-}bName\,(x) \cup$
        $tr\text{-}in\text{-}Characteristic\,(s \setminus \{x\})$,
      mk-$Occurrence$ (-, -, -, -) $\rightarrow$
        $tr\text{-}in\text{-}Occur\,(x) \cup$
        $tr\text{-}in\text{-}Characteristic\,(s \setminus \{x\})$
    end;

Description:

tr em Characteristic

Calls:

$tr_i n_b Name$, $tr_i n_O ccurrence$

2.11.19 Function $tr_i n_M embers$

Specification:

$tr\text{-}in\text{-}Members : Member\text{-}\mathsf{set} \rightarrow ID\text{-}\mathsf{set}$
$tr\text{-}in\text{-}Members\,(s) \triangleq$
  if $s = \{\}$
  then $\{\}$
  else let $x \in s$ in
    $membersAux\,(x) \cup tr\text{-}in\text{-}Members\,(s \setminus \{x\})$;

Description:

¡topicRef¿ in members

Calls:

$membersAux$

2.11.20 Function $membersAux$

Specification:

$membersAux : Member \rightarrow ID\text{-}\mathsf{set}$
$membersAux\,(m) \triangleq$
  let $rS = tr\text{-}in\text{-}References\,(\{m.roleSpec.ref\})$,
    $r = tr\text{-}in\text{-}References\,(m.refs)$ in
  $rS \cup r$;

Description:

Auxiliar function of $tr_in_Members$

Calls:

$tr_in_References$

2.11.21 Function tr_in_bName

Specification:

$tr\text{-}in\text{-}bName : BaseName \rightarrow ID\text{-}\mathsf{set}$
$tr\text{-}in\text{-}bName\,(b) \triangleq$
$\quad \mathsf{let}\ s = \mathsf{if}\ b.scope = \mathsf{nil}$
$\qquad\qquad \mathsf{then}\ \{\}$
$\qquad\qquad \mathsf{else}\ tr\text{-}in\text{-}References\,(b.scope.refs),$
$\qquad v = tr\text{-}in\text{-}Variants\,(b.variants)\ \mathsf{in}$
$\quad s \cup v;$

Description:

¡topicRef¿ in base names.

Calls:

$tr_in_References$, $tr_in_Variants$

2.11.22 Function tr_in_Occur

Specification:

$tr\text{-}in\text{-}Occur : Occurrence \rightarrow ID\text{-}\mathsf{set}$
$tr\text{-}in\text{-}Occur\,(o) \triangleq$
$\quad \mathsf{let}\ i = \mathsf{if}\ o.instanceOf = \mathsf{nil}$
$\qquad\qquad \mathsf{then}\ \{\}$
$\qquad\qquad \mathsf{else}\ \{myClass\,(o.instanceOf)\},$
$\qquad s = \mathsf{if}\ o.scope = \mathsf{nil}$
$\qquad\qquad \mathsf{then}\ \{\}$
$\qquad\qquad \mathsf{else}\ tr\text{-}in\text{-}References\,(o.scope.refs)\ \mathsf{in}$
$\quad i \cup s;$

Description:

¡topicRef¿ in Occurrence

Calls:

$myClass$,$tr_in_References$

2.11.23 Function $tr_i n_V ariants$

Specification:

$tr\text{-}in\text{-}Variants : Variant\text{-set} \to ID\text{-set}$
$tr\text{-}in\text{-}Variants\,(s) \triangleq$
  if $s = \{\}$
  then $\{\}$
  else let $v \in s$ in
    $variantsAux\,(v) \cup tr\text{-}in\text{-}Variants\,(s \setminus \{v\})$;

Description:

No description?

Calls:

Standard VDM-SL only

2.11.24 Function $variantsAux$

Specification:

$variantsAux : Variant \to ID\text{-set}$
$variantsAux\,(v) \triangleq$
  let $s = tr\text{-}in\text{-}Parameters\,(v.subjects)$,
    $v1 = tr\text{-}in\text{-}Variants\,(v.variants)$ in
  $s \cup v1$;

Description:

No description?

Calls:

Standard VDM-SL only

2.11.25 Function $tr_i n_P arameters$

Specification:

$tr\text{-}in\text{-}Parameters : Parameter\text{-set} \to ID\text{-set}$
$tr\text{-}in\text{-}Parameters\,(s) \triangleq$
  if $s = \{\}$
  then $\{\}$
  else let $p \in s$ in
    $tr\text{-}in\text{-}References\,(\{p.ref\}) \cup tr\text{-}in\text{-}Parameters\,(s \setminus \{p\})$

Description:

No description?

Calls:

Standard VDM-SL only

2.12 Values

```
values
    si1 = mk-SubjectIdentity (nil ,
                             {mk-Reference (nil ,
                                            SUBJECTINDICATORREF,
                                            mk-Attributes (SIMPLE, mk-token ("first")))});
    c1 = {mk-BaseName (nil , nil ,
                       mk-BaseNameString (nil , "gEPL"),
                       {})};
    topic1 = mk-Topic (mk-token ("firstTopic"), {}, si1, c1);
    r211 = mk-Reference (nil ,
                         TOPICREF,
                         mk-Attributes (SIMPLE,
                                        mk-token ("estudante")));
    i21 = mk-InstanceOf (nil , r211);
    r221 = mk-Reference (nil ,
                         TOPICREF,
                         mk-Attributes (SIMPLE,
                                        mk-token ("professor")));
    i22 = mk-InstanceOf (nil , r221);
    i2 = {i21, i22};
    bn21 = mk-BaseNameString (nil , "Giovani R Librelotto");
    bn2 = mk-BaseName (nil , nil , bn21, {});
    oc2i1r1 = mk-Reference (nil ,
                            TOPICREF,
                            mk-Attributes (SIMPLE,
                                           mk-token ("website")));
    oc2i1 = mk-InstanceOf (nil , oc2i1r1);
    oc2r1r1 = mk-Reference (nil ,
                            RESOURCEREF,
                            mk-Attributes (SIMPLE,
                                           mk-token ("http : //alfa.di.uminho.pt/~grl")));
    oc2r1 = mk-ResourceType (nil , oc2r1r1);
    oc2 = mk-Occurrence (nil , oc2i1, nil , oc2r1);
    c2 = {bn2, oc2};
    topic2 = mk-Topic (mk-token ("grl"), i2, nil , c2);
    i3r1 = mk-Reference (nil ,
                         TOPICREF,
                         mk-Attributes (SIMPLE,
                                        mk-token ("estudante")));
    i3 = {mk-InstanceOf (nil , i3r1)};
    bn3 = mk-BaseName (nil , mk-BaseNameString (nil , "Gustavo V Arnold"));
    oc3i1 = mk-InstanceOf (nil );
    oc3r1 = mk-Reference (nil ,
                          RESOURCEREF,
                          mk-Attributes (SIMPLE,
                                         mk-token ("http : //alfa.di.uminho.pt/~gva")));
    oc3 = mk-Occurrence (nil , oc3i1, nil , oc3r1)
```

A The XML Topic Map DTD

B The VDM-SL Specification

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