



Chapter III

Topic Maps





Topic Maps

- ISO standard (ISO/IEC 13250) for an implementation-independent representation of knowledge about resources, their subjects and interrelationships
- topic maps consist of topics (concepts), associations (relationships) and occurrences (relevant information resources)
- as opposed to RDF that aims at machine-processable metadata, topic maps are used to structure knowledge for human readers, with an emphasis on the findability of information
- stem from glossaries, classification systems and thesauri, but provide more expressiveness
- can be used to develop ontologies which may be even mapped to RDF, but are not part of the semantic web effort of the W3C

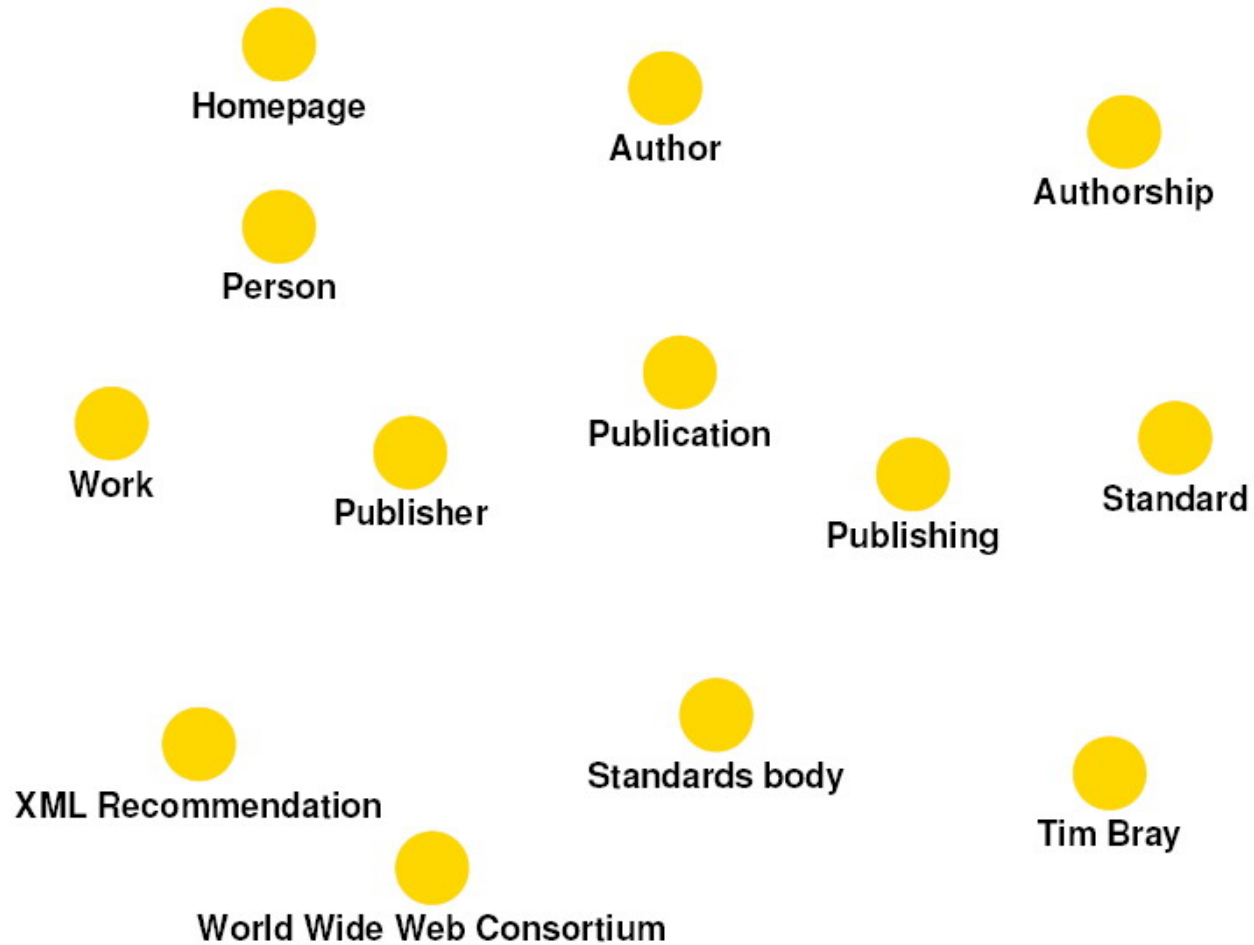


Fundamental Concepts

- topic -> fundamental entity in the context of the modeled knowledge domain
- topic name -> topic identifier (base name, display name and sort name)
- topic occurrence -> instances and roles (occurrence role type)
- public subject descriptor -> unique topic descriptor
- associations -> relationships between topics and their roles (association role)
- scope -> specifies the extent of the validity
- facet -> attribute-value-pair that describes a topic in more detail

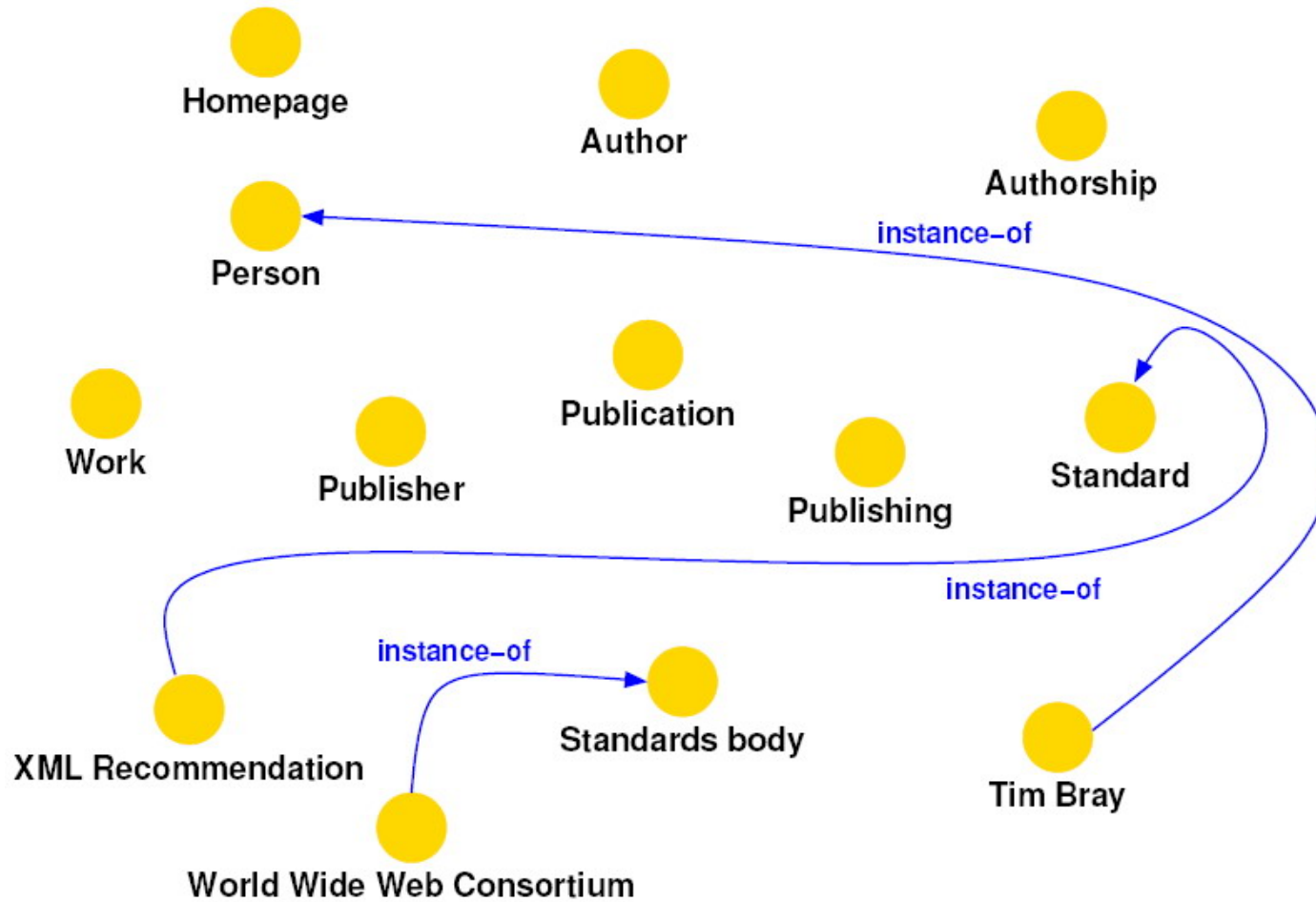


Topic Maps – Example (I)



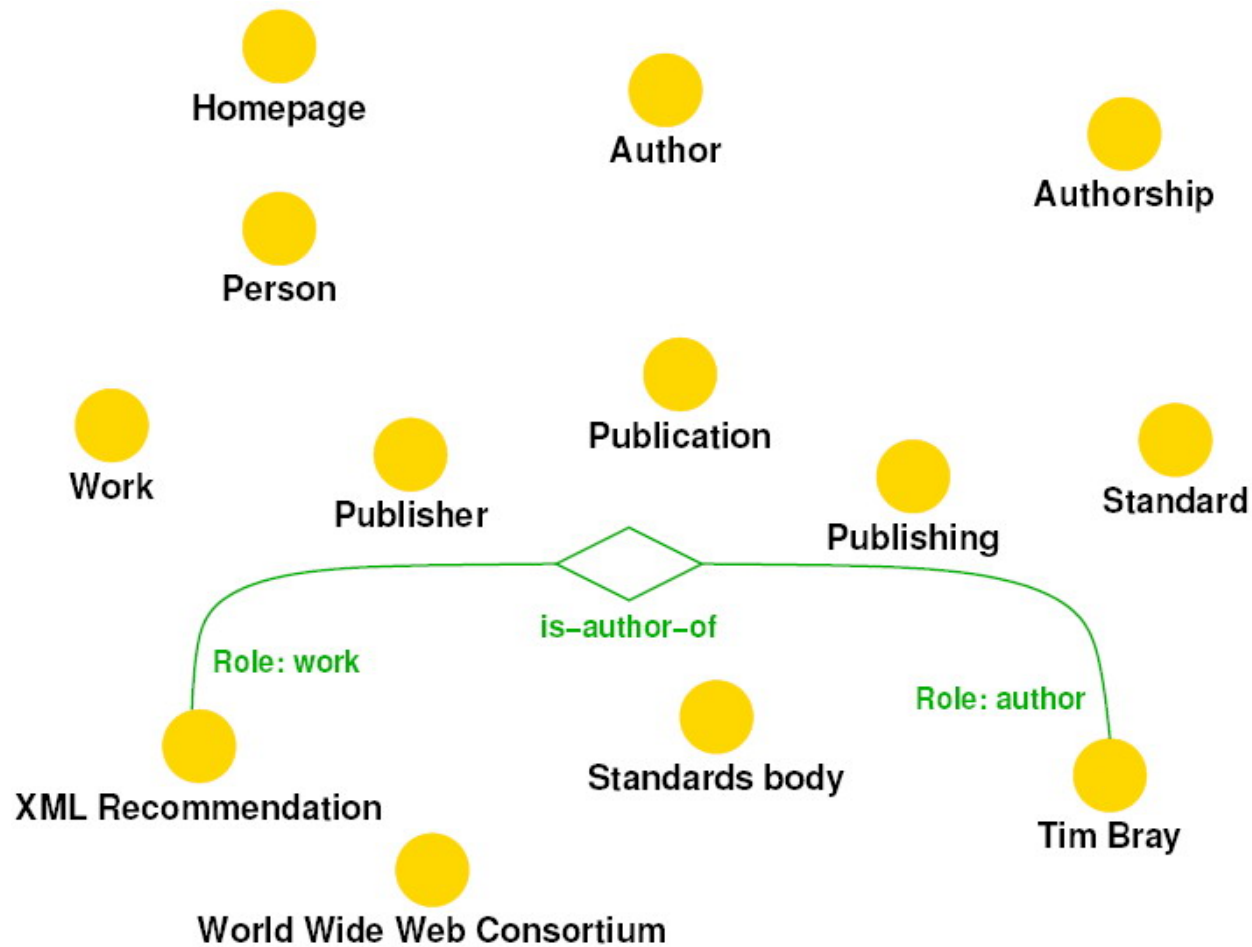


Topic Maps – Example (II)



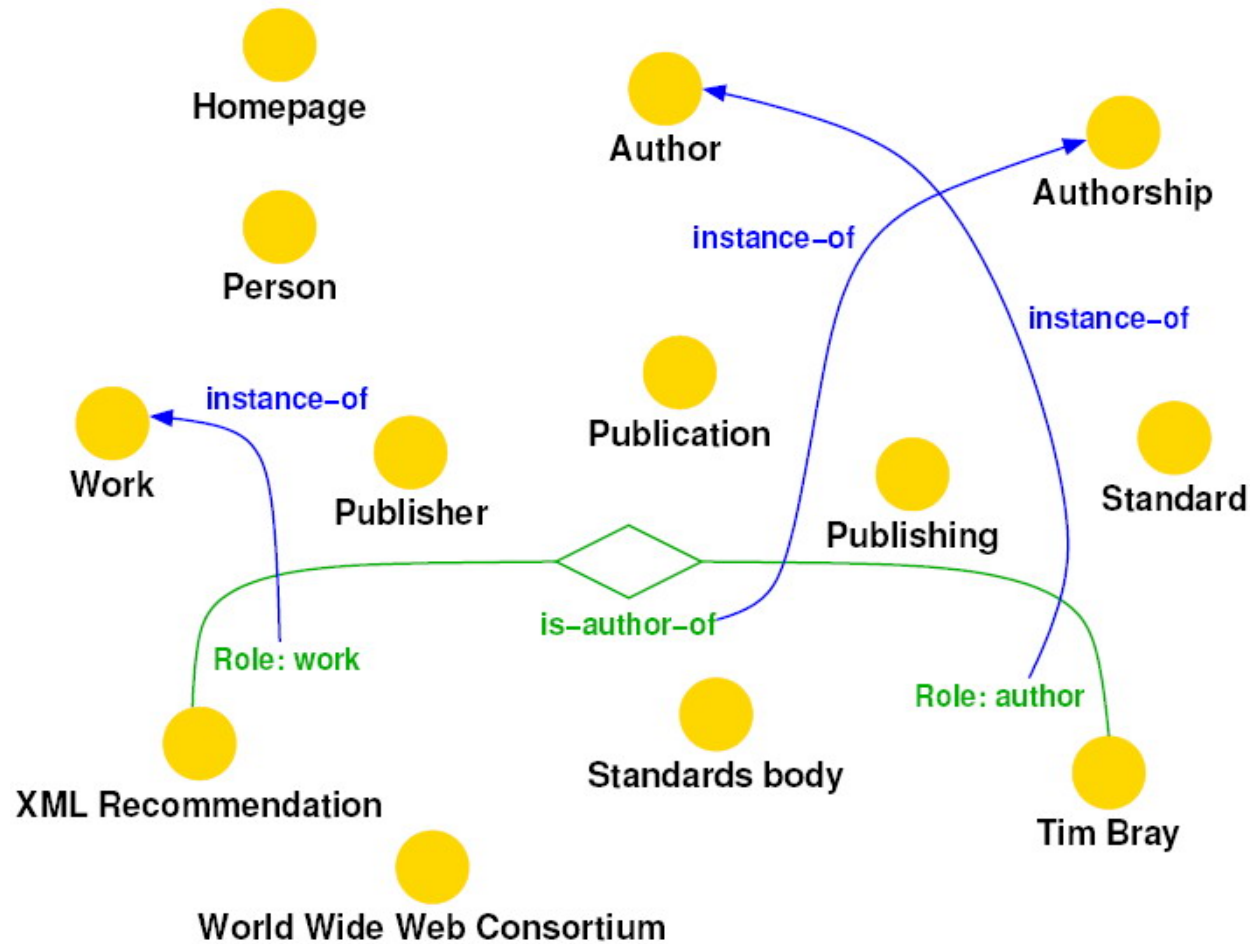


Topic Maps – Example (III)



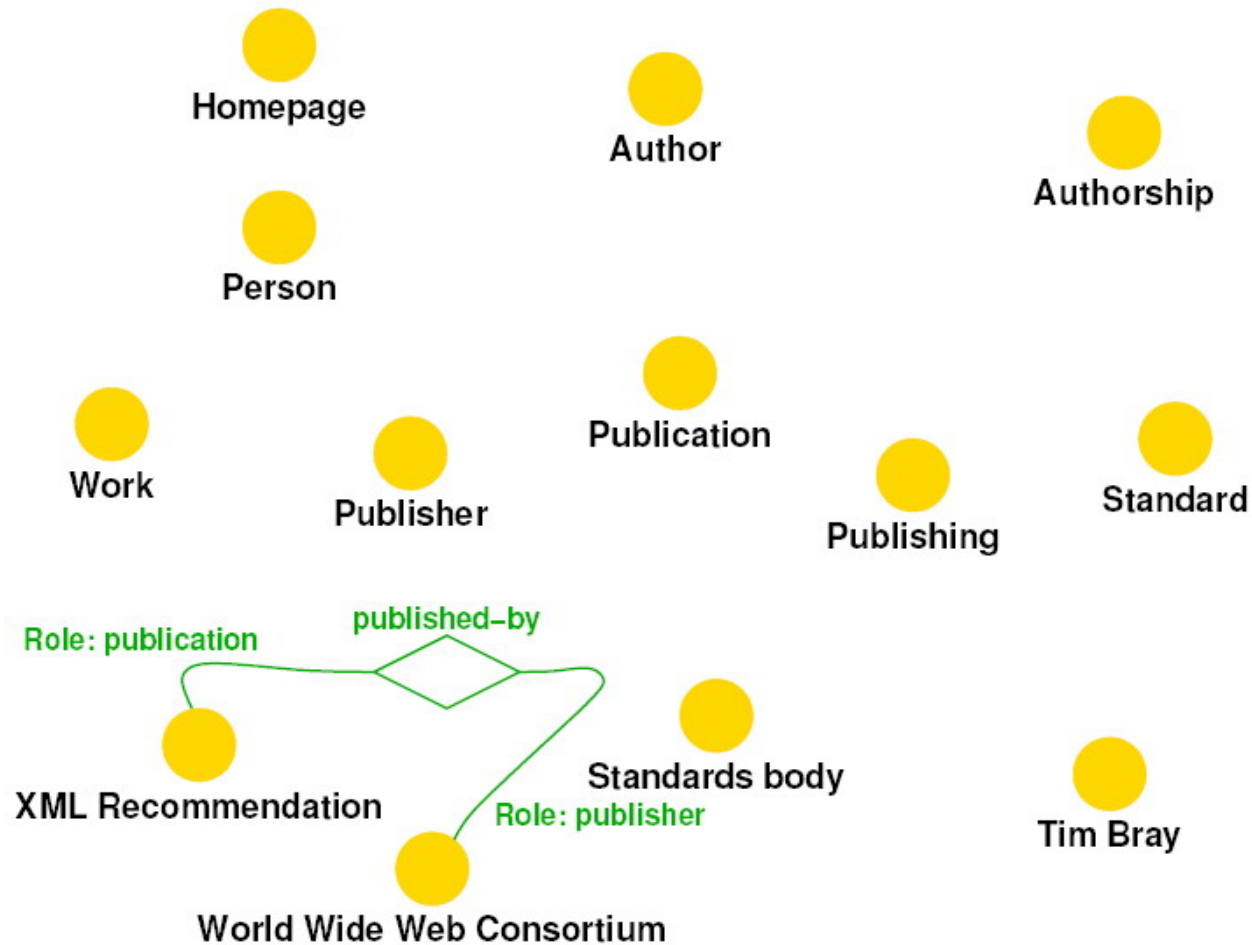


Topic Maps – Example (IV)



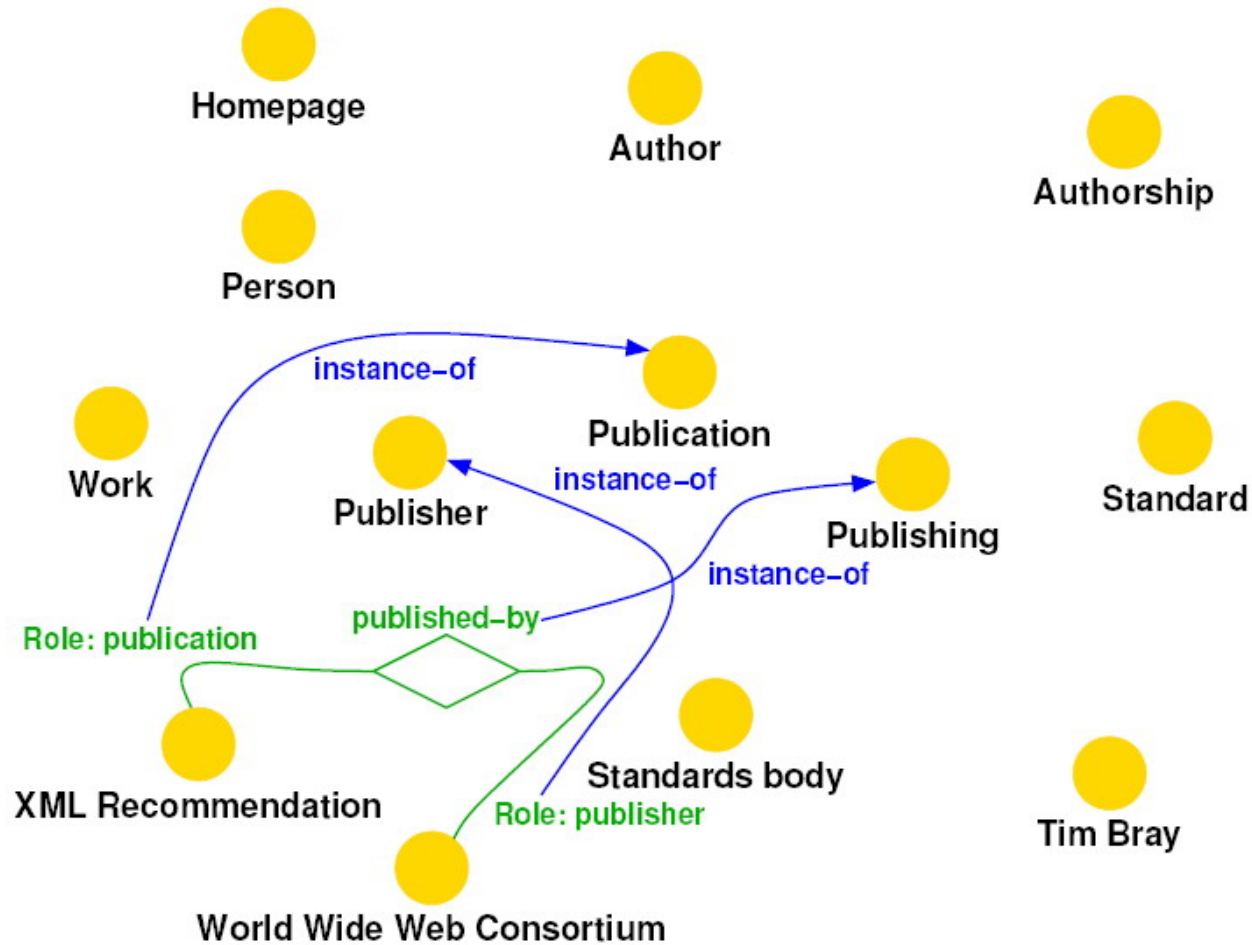


Topic Maps – Example (V)



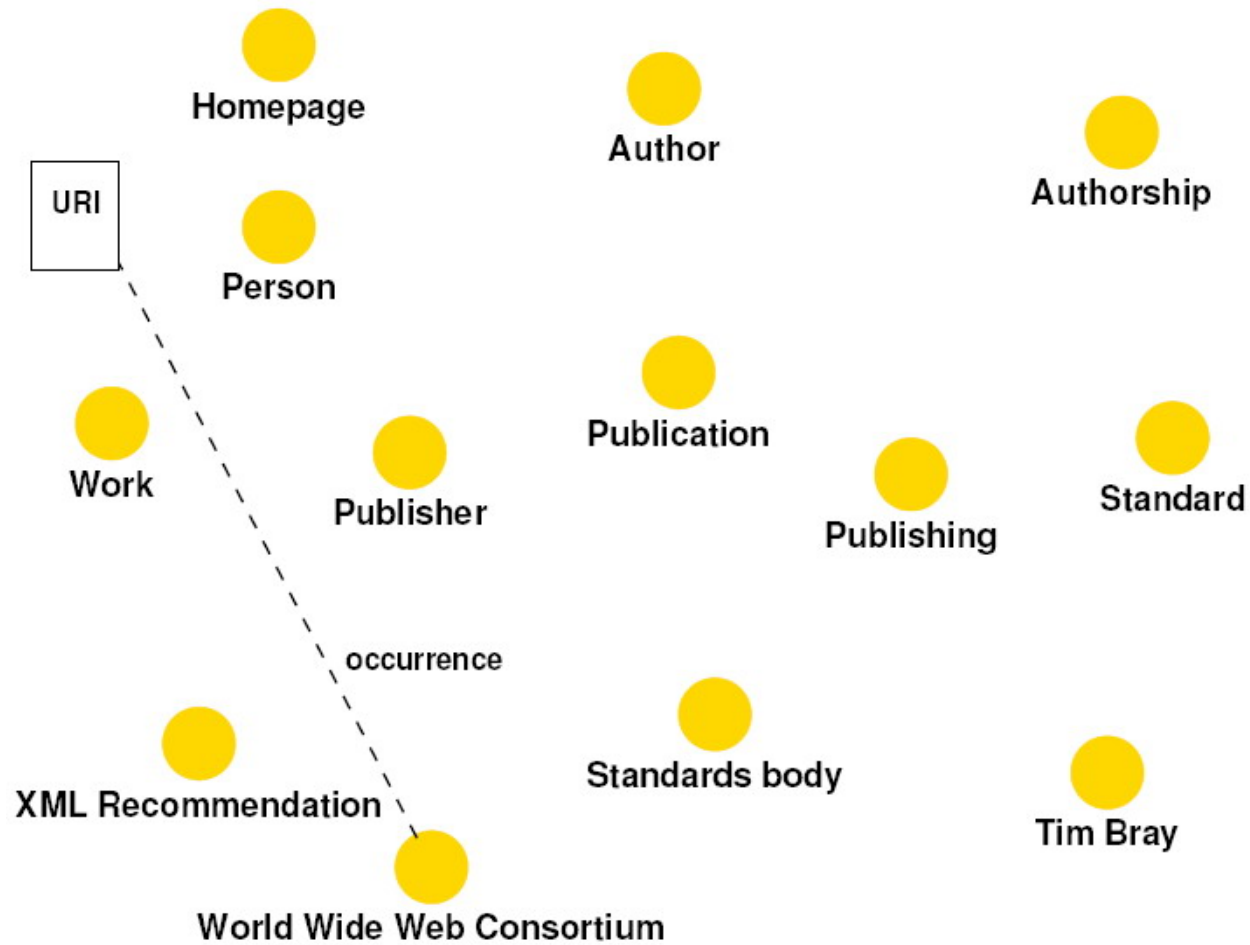


Topic Maps – Example (VI)



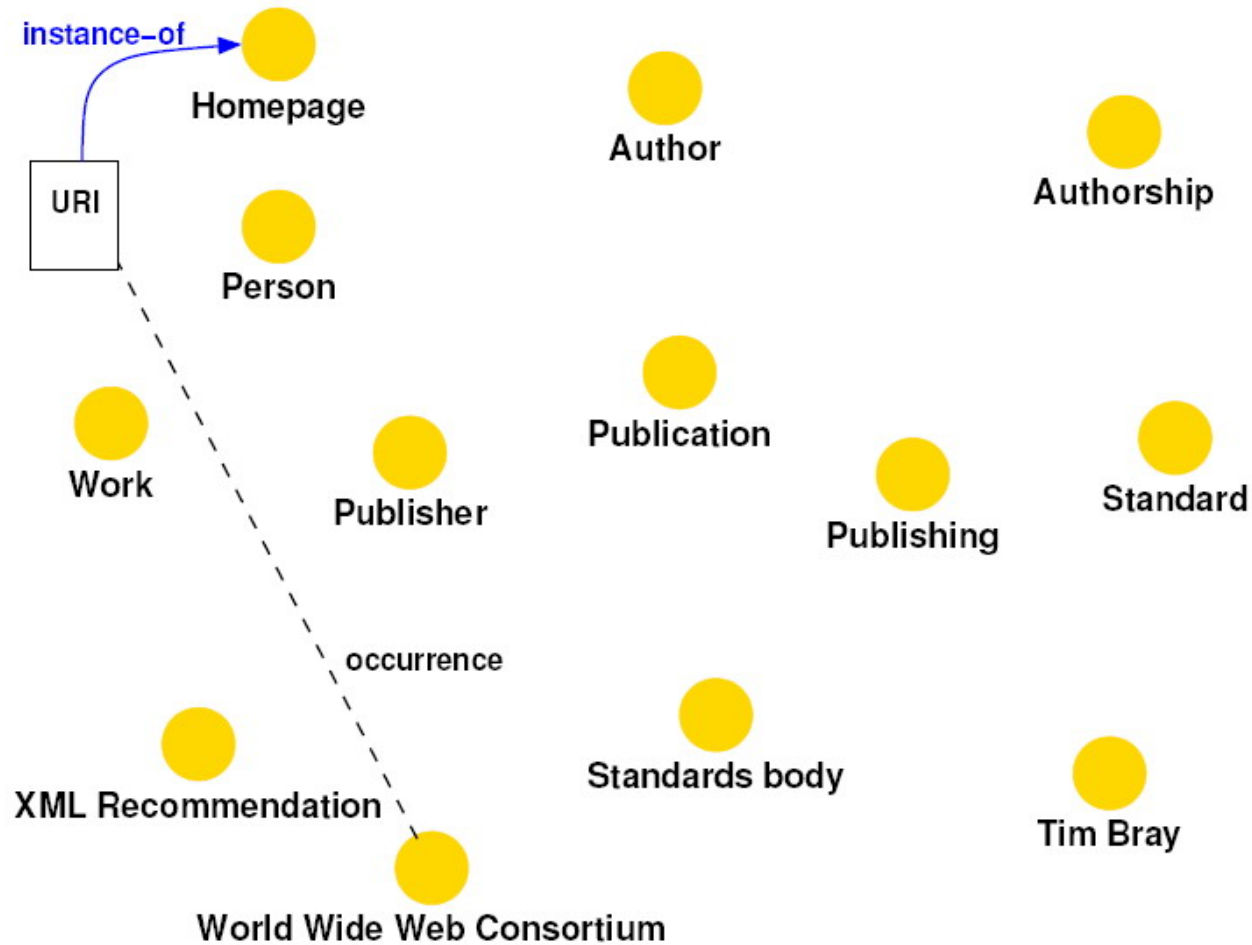


Topic Maps – Example (VII)





Topic Maps – Example (VIII)



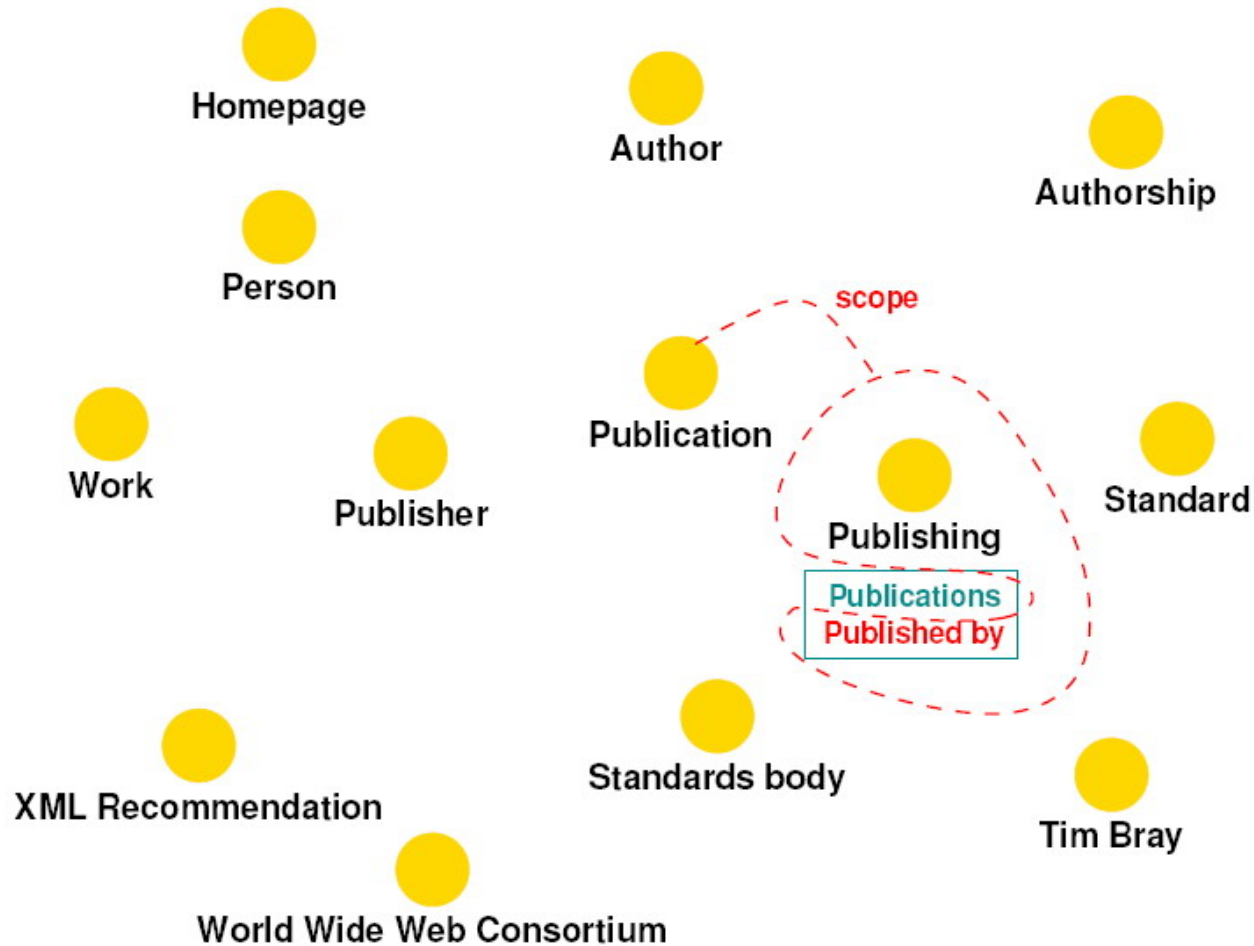


Topic Maps – Example (IX)



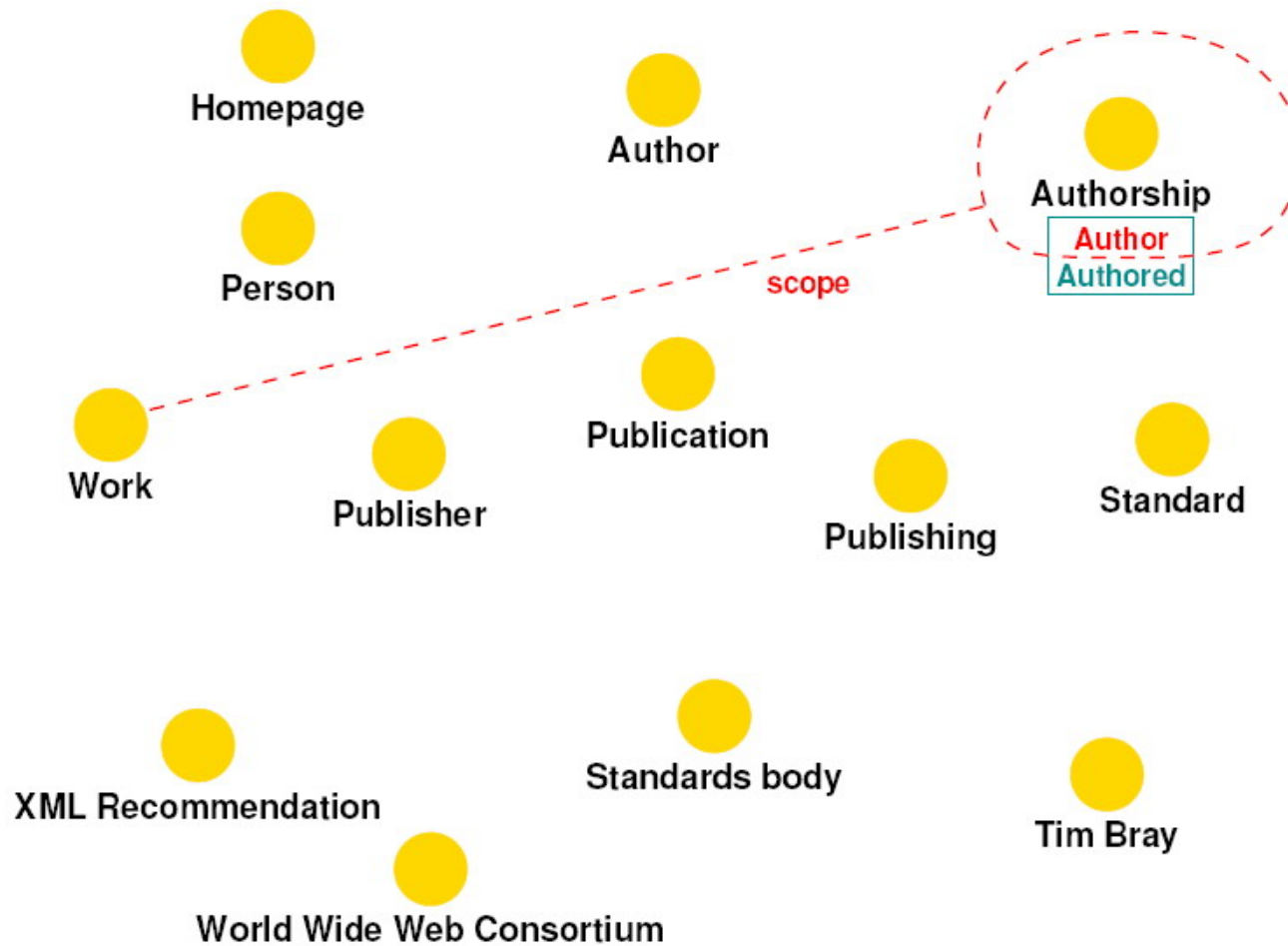


Topic Maps – Example (X)



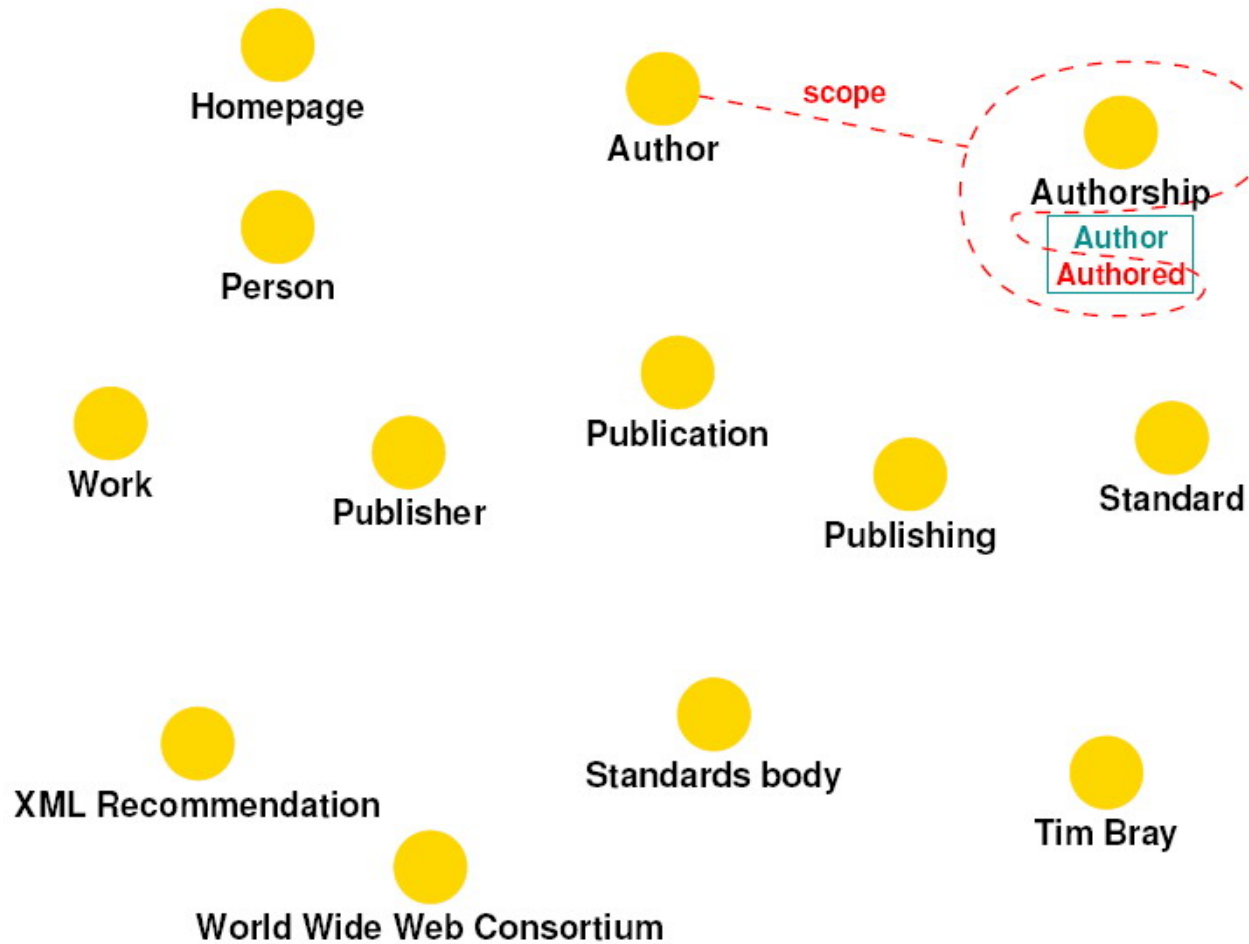


Topic Maps – Example (XI)





Topic Maps – Example (XII)





XTM – XML Topic Maps

- are an abstract model and XML grammar for the exchange of web-based topic maps created by the TopicMaps.Org Authoring Group (2001)
- design goals:
 - ease of use
 - support for a wide range of applications
 - standards compatible
 - ideally no optional features
 - short and concise specification
 - XTM documents shall be easy to create, read and understand



XTM Syntax Overview (I)

- **topicRef**: reference to a topic element
- **subjectIndicatorRef**: reference to a subject indicator
- **scope**: reference to topic(s) that comprise the scope
- **instanceOf**: points to a topic representing a class
- **topicMap**: topic map document element
- **topic**: topic element
- **subjectIdentity**: subject reified by topic
- **baseName**: base name of a topic
- **baseNameString**: base name string container
- **variant**: alternate forms of base name



XTM Syntax Overview (II)

- **variantName**: container for 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 resource
- **resourceData**: container for resource data
- **mergeMap**: merge with another topic map



XTM - topicRef

- Synopsis:
 - 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.
- Content Model:
 - <!ELEMENT topicRef EMPTY>
- Attributes:
 - <!ATTLIST topicRef
 - id ID #IMPLIED
 - xlink:type NMTOKEN #FIXED 'simple'
 - xlink:href CDATA #REQUIRED>
- Example:
 - <topicRef xlink:href="http://www.topicmaps.org/xtm/1.0/language.xtm#en"/>



XTM - subjectIndicatorRef

- Synopsis:
 - The <subjectIndicatorRef> element provides a URI reference to a resource that acts as a subject indicator.
- Content Model:
 - <!ELEMENT subjectIndicatorRef EMPTY>
- Attributes:
 - <!ATTLIST subjectIndicatorRef
id ID #IMPLIED
xlink:type NMTOKEN #FIXED 'simple'
xlink:href CDATA #REQUIRED>
- Example:
 - <subjectIndicatorRef
xlink:href="http://www.shakespeare.org/plays.html#hamlet"/>



XTM - scope

- Synopsis:
 - 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.
- Content Model:
 - `<!ELEMENT scope (topicRef | resourceRef | subjectIndicatorRef)+>`
- Attributes:
 - `<!ATTLIST scope`
`id ID #IMPLIED>`
- Example:
 - `<scope>`
`<topicRef xlink:href="#tragedy"/>`
`<topicRef xlink:href="#theatre"/>`
`</scope>`



XTM - instanceOf

- Synopsis:
 - The <instanceOf> element specifies the class to which its parent belongs, via a <topicRef> or <subjectIndicatorRef> child element.
- Content Model:
 - <!ELEMENT instanceOf (topicRef | subjectIndicatorRef) >
- Attributes:
 - <!ATTLIST instanceOf
id ID #IMPLIED>
- Example:
 - <topic id="hamlet">
 <instanceOf>
 <subjectIndicatorRef xlink:href="http://www.shakespeare.org/plays.html"/>
 </instanceOf>
</topic>



XTM – topicMap (I)

- Synopsis:
 - The <topicMap> element is the parent of all <topic>, <association>, and <mergeMap> elements in the topic map document.
- Content Model:
 - `<!ELEMENT topicMap (topic | association | mergeMap)*>`
- 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>



XTM – topicMap (II)

- Example:

```
- <?xml version="1.0"?>
  <!DOCTYPE topicMap
    PUBLIC "-//TopicMaps.Org//DTD XML Topic Map (XTM) 1.0//EN"
    "file:///usr/local/home/gromit/xml/xtm/xtm1.dtd">
  <topicMap xmlns='http://www.topicmaps.org/xtm/1.0/'
    xmlns:xlink='http://www.w3.org/1999/xlink'
    xml:base='http://www.shakespeare.org/hamlet/'>
    <!-- topics, associations, and merge map directives go here -->
  </topicMap>
```



XTM - topic

- Synopsis:
 - The <topic> element specifies the name and occurrence characteristics of a single topic.
- Content Model:
 - <!ELEMENT topic (instanceOf*, subjectIdentity?, (baseName | occurrence)*)>
- Attributes:
 - <!ATTLIST topic
 - id ID #REQUIRED>
- Example:
 - <topic id="hamlet">
 - <instanceOf>
 - <topicRef xlink:href="#play"/>
 - </instanceOf>
 - <!-- base names and occurrences go here -->
 - </topic>



XTM - subjectIdentity

- Synopsis:
 - The <subjectIdentity> element specifies the subject that is reified by a topic, via <resourceRef>, <subjectIndicatorRef>, and/or <topicRef> child elements.
- Content Model:
 - <!ELEMENT subjectIdentity (resourceRef?, (topicRef | subjectIndicatorRef)*)>
- Attributes:
 - <!ATTLIST subjectIdentity
id ID #IMPLIED>
- Example:
 - <topic id="dk">
 <subjectIdentity>
 <subjectIndicatorRef
 xlink:href="http://www.topicmaps.org/xtm/1.0/country.xtm#dk"/>
 </subjectIdentity>
</topic>



XTM - baseName

- Synopsis:
 - The <baseName> element specifies a topic name in form of a <baseNameString> child element.
- Content Model:
 - <!ELEMENT baseName (scope?, baseNameString, variant*)>
- Attributes:
 - <!ATTLIST baseName
id ID #IMPLIED>
- Example:

```
<topic id="shakespeare">  
  <baseName>  
    <baseNameString>William Shakespeare</baseNameString>  
  </baseName>  
</topic>
```



XTM – baseNameString (I)

- Synopsis:
 - The <baseNameString> element is a string that represents the base name of its ancestor <topic> parent.
- Content Model:
 - `<!ELEMENT baseNameString (#PCDATA)>`
- Attributes:
 - `<!ATTLIST baseNameString
id ID #IMPLIED>`



XTM – baseNameString (II)

- Example:

```
- <topic id="written-by">
  <baseName>
    <baseNameString>written by</baseNameString>
  </baseName>
  <baseName>
    <scope>
      <topicRef xlink:href="#author"/>
    </scope>
    <baseNameString>author of</baseNameString>
  </baseName>
</topic>
```



XTM – variant (I)

- Synopsis:
 - 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.
- Content Model:
 - `<!ELEMENT variant (parameters, variantName?, variant*)>`
- Attributes:
 - `<!ATTLIST variant`
`id ID #IMPLIED>`



XTM – variant (II)

- Example:
 - `<topic id="shakespeare">`
 - `<baseName>`
 - `<baseNameString>William Shakespeare</baseNameString>`
 - `<!-- form for sorting (sort name) -->`
 - `<variant>`
 - `<parameters>`
 - `<topicRef xlink:href="#sort"/>`
 - `</parameters>`
 - `<variantName>`
 - `<resourceData>shakespeare,william</resourceData>`
 - `</variantName>`
 - `</variant>`
 - `</baseName>`
 - `</topic>`



XTM - variantName

- Synopsis:
 - The <variantName> element provides the resource to be used as a variant of a base name.
- Content Model:
 - `<!ELEMENT variantName (resourceRef | resourceData)>`
- Attributes:
 - `<!ATTLIST variantName
id ID #IMPLIED>`
- Example:
 - `<variantName>
 <resourceData>shakespeare,william</resourceData>
</variantName>`



XTM – parameters (I)

- Synopsis:
 - 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.
- Content Model:
 - `<!ELEMENT parameters (topicRef | subjectIndicatorRef)+>`
- Attributes:
 - `<!ATTLIST parameters`
`id ID #IMPLIED>`



XTM – parameters (II)

- Example:
 - `<topic id="shakespeare">`
 - `<baseName>`
 - `<baseNameString>William Shakespeare</baseNameString>`
 - `<!-- form for sorting (sort name) -->`
 - `<variant>`
 - `<parameters>`
 - `<topicRef xlink:href="#sort"/>`
 - `</parameters>`
 - `<variantName>`
 - `<resourceData>shakespeare,william</resourceData>`
 - `</variantName>`
 - `</variant>`
 - `</baseName>`
 - `</topic>`



XTM – association (I)

- Synopsis:
 - The <association> element asserts a relationship among topics that play roles as members of the association.
- Content Model:
 - `<!ELEMENT association (instanceOf?, scope?, member+)>`
- Attributes:
 - `<!ATTLIST association id ID #IMPLIED>`



XTM – association (II)

- Example:

```
- <association id="will-wrote-hamlet">
  <instanceOf>
    <topicRef xlink:href="#written-by"/>
  </instanceOf>
  <member>
    <roleSpec><topicRef xlink:href="#author"/></roleSpec>
    <topicRef xlink:href="#shakespeare"/>
  </member>
  <member>
    <roleSpec><topicRef xlink:href="#work"/></roleSpec>
    <topicRef xlink:href="#hamlet"/>
  </member>
</association>
```



XTM - member

- **Synopsis:**
 - The <member> element specifies all topics that play a given role in an association. The <roleSpec> element specifies the role played by these topics.
- **Content Model:**
 - <!ELEMENT member (roleSpec?, (topicRef | resourceRef | subjectIndicatorRef)+)>
- **Attributes:**
 - <!ATTLIST member id ID #IMPLIED>
- **Example:**

```
<member>
  <roleSpec><topicRef xlink:href="#work"/></roleSpec>
  <topicRef xlink:href="#hamlet"/>
</member>
```



XTM - roleSpec

- Synopsis:
 - The `<roleSpec>` element specifies the role played by a member in an association.
- Content Model:
 - `<!ELEMENT roleSpec (topicRef | subjectIndicatorRef)>`
- Attributes:
 - `<!ATTLIST roleSpec
id ID #IMPLIED>`
- Example:
 - `<roleSpec>
 <topicRef xlink:href="#work"/>
</roleSpec>`



XTM – occurrence (I)

- Synopsis:
 - The <occurrence> element specifies a resource supplying information relevant to a topic.
- Content Model:
 - `<!ELEMENT occurrence (instanceOf?, scope?, (resourceRef | resourceData))>`
- Attributes:
 - `<!ATTLIST occurrence`
`id ID #IMPLIED>`



XTM – occurrence (II)

- Example:

```
- <topic id="hamlet">
  <occurrence id="hamlet-in-xml">
    <instanceOf>
      <topicRef xlink:href="#xml-version"/>
    </instanceOf>
    <resourceRef
      xlink:href="http://www.uwaterloo.ca/relander/XML/hamlet.xml"/>
    </occurrence>
  </topic>
```



XTM – resourceRef (I)

- Synopsis:
 - The <resourceRef> element provides a URI reference to a resource:
 - 1. as occurrences of topics (in <occurrence> elements)
 - 2. as addressable subjects (in <member>, <mergeMap>, <scope>, and <subjectIdentity> elements)
 - 3. as variant names of topics (in <variantName> elements)
- Content Model:
 - <!ELEMENT resourceRef EMPTY>
- Attributes:
 - <!ATTLIST resourceRef
 - id ID #IMPLIED
 - xlink:type NMTOKEN #FIXED 'simple'
 - xlink:href CDATA #REQUIRED>



XTM – resourceRef (II)

- Example:

```
- <occurrence id="hamlet-in-xml">
  <instanceOf>
    <topicRef xlink:href="#xml-version"/>
  </instanceOf>
  <resourceRef
xlink:href="http://www.uwaterloo.ca/relander/XML/hamlet.xml"/>
</occurrence>
```



XTM – resourceData (I)

- Synopsis:
 - 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.
- Content Model:
 - <!ELEMENT resourceData (#PCDATA)>
- Attributes:
 - <!ATTLIST resourceData
id ID #IMPLIED>



XTM – resourceData (II)

- Example:

- `<topic id="hamlet">`

- `<occurrence>`

- `<instanceOf>`

- `<topicRef xlink:href="#date-of-composition"/>`

- `</instanceOf>`

- `<resourceData>1600-01</resourceData>`

- `</occurrence>`

- `</topic>`



XTM – mergeMap (I)

- Synopsis:
 - A <mergeMap> element references an external <topicMap> element through an xlink:href attribute containing a URI. It is a directive to merge the containing topic map and the referenced topic map.
- Content Model:
 - <!ELEMENT mergeMap (topicRef | resourceRef | subjectIndicatorRef)*>
- Attributes:
 - <!ATTLIST mergeMap
 - id ID #IMPLIED
 - xlink:type NMTOKEN #FIXED 'simple'
 - xlink:href CDATA #REQUIRED>



XTM – mergeMap (II)

- Example:

```
- <mergeMap xlink:href="http://www.shakespeare.org/plays.xtm">
  <topicRef xlink:href="#shakespeare"/>
  <topicRef xlink:href="#drama"/>
</mergeMap>

<mergeMap xlink:href="http://www.shakespeare.org/biography.xtm">
  <resourceRef
xlink:href="http://www.shakespeare.org/biography.xtm"/>
</mergeMap>
```



Resources

- Geroimenko, V.; Chen, C. (2005): Visualizing the Semantic Web. XML-Based Internet and Information Visualization. Springer.
- XTM 1.0 specification
 - <http://topicmaps.org/xtm/index.html>
- XTM 2.0 draft
 - <http://www.isotopicmaps.org/sam/sam-xtm/>
- Topic Map Data Model
 - <http://www.isotopicmaps.org/sam/sam-model/>
- Topic Map Designer – free editor and graph viewer
 - <http://www.topicmap-design.com/>
- more tools
 - <http://topicmap.com/topicmap/tools.html>



Summary

- XML
 - basics (syntax, structure, well-formedness, entities, namespaces, notations)
 - DTDs
 - XML schema
 - CSS, data binding, DOM, XSL and XSLT
- Semantic Web
 - basics, meta data, classification systems, taxonomies, thesauri
 - RDF and RDFS (RDF graph, RDF syntax, classes, resources, properties, objects)
 - Dublin Core
 - XBRL
 - Ontologies, OWL (basics, sublanguages, vocabulary)
- Topic Maps and XTM (basics, vocabulary)