International Conference on Dublin Core and Metadata Applications

Tutorial 2: Dublin Core – Key Concepts

Pete Johnston, Eduserv Foundation
mailto:pete.johnston@eduserv.org.uk

What I'm going to talk about

- A conceptual model for Dublin Core metadata
  - DCMI Abstract Model (DCAM)
- The relationship of this model to another conceptual model for metadata
  - RDF Model
- (Briefly) How to represent instances of the DCAM conceptual model in concrete syntaxes
  - "Encoding Guidelines"

- N.B. May gloss over some of the detail!

What I'm not going to talk about

- The use of any specific sets of metadata terms
  - DCMI vocabularies or other metadata vocabularies
- Declaring/defining metadata terms
- "Simple Dublin Core" or "Qualified Dublin Core"
- Dublin Core Application Profiles

Why DCAM? Dublin Core in c2003

- Metadata vocabularies
  - … but what is a DC “element”?
- Syntax independence & encoding guidelines
  - … but what are we “encoding”?
- Grammatical Principles (including “1-to-1 rule”)
  - … fairly informal
- “Simple” and “Qualified” DC
  - … vocabularies?
  - … formats? (e.g. oai_dc)
  - … constraints on use of vocabularies? On which vocabularies?
- DC application profiles
  - … “(re)using” terms? But what “terms” can we “(re)use”?
- Relationship between DC & Resource Description Framework

The DCMI Abstract Model (DCAM)

DCMI Abstract Model

- Work by DCMI Architecture WG from mid-2003, initiated by Andy Powell
- Second Version, DCMI Recommendation, 2007-06-04
  - http://dublincore.org/documents/2007/06/04/abstract-model/
- Describes
  - Components and constructs that make up an information structure ("DC description set")
  - How that information structure is to be interpreted
- Made up of three related "information models"
  - Resource model
  - Description set model
  - Vocabulary model

DCMI Abstract Model

- DCAM describes DC description set…
- … but does **not** describe how to represent DC description set in concrete form
  - DCMI-defined “Encoding guidelines”
  - Formats defined by others, e.g. Eprints DC-XML

- DCAM specifies use of various **types** of metadata term…
- …but does **not** specify the use of any fixed set of terms
  - DCMI-owned metadata vocabularies
  - Vocabularies owned/defined by other agencies

DCAM Resource Model

- The “view of the world” on which DC metadata is based
- Concerned with description of **resources**
  - digital objects, physical objects, imaginary things, concepts…
  - anything of interest can be a resource
- When describing a resource we make assertions about its relationships with other resources
  - DCAM views world in terms of binary relationships
  - “Resource X is-related-in-some-way-to Resource Y”
    “Resource Y is-related-in-some-way-to Resource Z”
- DCAM uses the terminology
  - **Described resource**
  - **Property** = type of relationship
  - **Value** = other resource

Literals and “non-literals”

- The world of resources is further divided into
  - Literals (“Strings”)
    - “self-contained”
    - appear directly in DC metadata
    - “terminals” in DC metadata
    - can not be further “described”
  - Other “non-literal” resources (“Things”)
    - referred to in DC metadata
    - can be further described
      - in your metadata or in someone else’s metadata elsewhere
- “Things” can be described, “strings” can’t

Literals and “non-literals”

- So, the designer of a DC application has to
  - Construct (or adopt) a model of the part of the world of interest
  - Types of resource, types of relationship between resources
- And they have to decide
  - Do I model this as a “Thing” - because
    - I need to describe it?
    - Or allow others to describe it?
    - Or take advantage of fact that others have described it?
  - Do I model this as a “String” (literal) – because
    - it is “self describing”?
    - I don’t need to describe it?
    - Or allow others to describe it?
    - Or make use of others’ descriptions of it?
- **Choice depends on requirements of application**

Relational Model

uri	title	author	publisher	pub date
http://dublincore.org/documents/2007/06/04/abstract-model/	DCMI Abstract Model	Andy Powell	DCMI	2007-06-04
http://www.w3.org/TR/2004/REC-rdf-concepts-20040210/	RDF Concepts & Abstract Syntax	Graham Klyne	W3C	2004-02-10

Relational Model

- Each row represents a resource being described

uri	title	author	publisher	pub date
http://dublincore.org/documents/2007/06/04/abstract-model/	DCMI Abstract Model	Andy Powell	DCMI	2007-06-04
http://www.w3.org/TR/2004/REC-rdf-concepts-20040210/	RDF Concepts & Abstract Syntax	Graham Klyne	W3C	2004-02-10

Relational Model

- Each column represents an attribute of those resources

uri	title	author	publisher	pub date
http://dublincore.org/documents/2007/06/04/abstract-model/	DCMI Abstract Model	Andy Powell	DCMI	2007-06-04
http://www.w3.org/TR/2004/REC-rdf-concepts-20040210/	RDF Concepts & Abstract Syntax	Graham Klyne	W3C	2004-02-10

Relational Model

- Intersection gives value of attribute for resource described

uri	title	author	publisher	pub date
http://dublincore.org/documents/2007/06/04/abstract-model/	DCMI Abstract Model	Andy Powell	DCMI	2007-06-04
http://www.w3.org/TR/2004/REC-rdf-concepts-20040210/	RDF Concepts & Abstract Syntax	Graham Klyne	W3C	2004-02-10

From DCAM perspective

- Each attribute for resource described = Property + Value

Described Resource	Property	Value
Document (Thing)	has-title	“RDF Concepts & Abstract Syntax” (String)

Relational Model

- More attributes of document?

uri	title	author	publisher	pub date
http://dublincore.org/documents/2007/06/04/abstract-model/	DCMI Abstract Model	Andy Powell	DCMI	2007-06-04
http://www.w3.org/TR/2004/REC-rdf-concepts-20040210/	RDF Concepts & Abstract Syntax	Graham Klyne	W3C	2004-02-10

From DCAM perspective

- More attributes? Additional Properties + Values

Described Resource	Property	Value
Document (Thing)	has-title	“RDF Concepts & Abstract Syntax” (String)
Document (Thing)	has-author	“Graham Klyne” (String)
Document (Thing)	has-publisher	“W3C” (String)

Relational Model

uri	title	author	pub id	pub date
http://dublincore.org/documents/2007/06/04/abstract-model/	DCMI Abstract Model	Andy Powell	000001	2007-06-04
http://www.w3.org/TR/2004/REC-rdf-concepts-20040210/	RDF Concepts & Abstract Syntax	Graham Klyne	000002	2004-02-10

- Attributes of document & attributes of agent?

pub id	short name	full name	location	…
000001	DCMI	Dublin Core Metadata Initiative	Singapore	…
000002	W3C	World Wide Web Consortium	Boston, MA, USA	…

From DCAM perspective

- Two described resources, one is also a value

Described Resource	Property	Value
Document (Thing)	has-title	"RDF Concepts & Abstract Syntax" (String)
Document (Thing)	has-author	Agent (Thing)
Document (Thing)	has-publisher	"W3C" (String)

Described Resource	Property	Value
Agent (Thing)	has-short-name	"W3C"
Agent (Thing)	has-name	"World Wide Web Consortium"

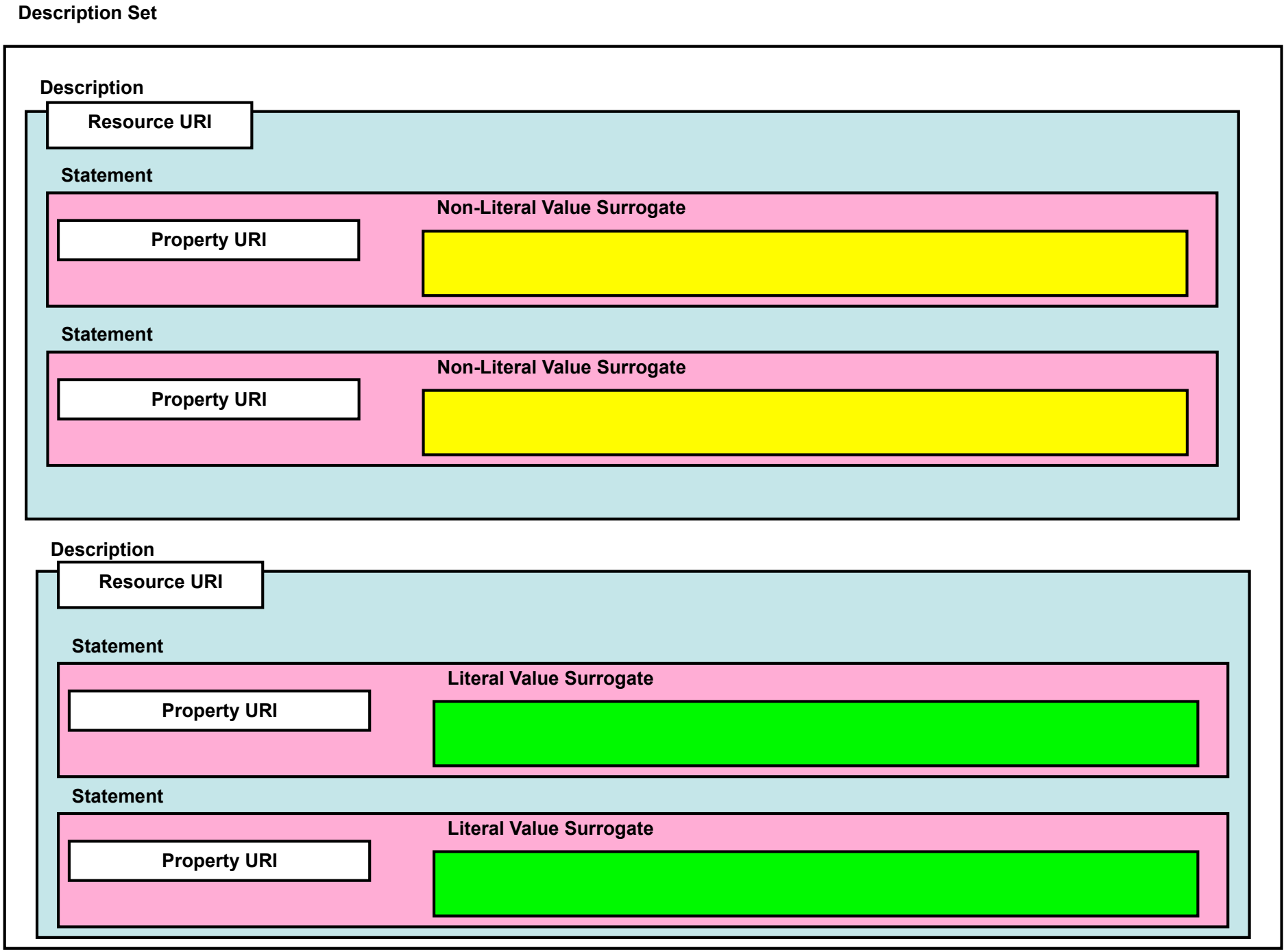
DCAM Description Set Model

- The structure of “DC metadata”
- Uses URIs to refer to resources described & to metadata terms

- a *description set* is made up of one or more *descriptions*, each of which describes one *resource*
- a *description* is made up of
  - zero or one *described resource URI*
    - **identifies** *described resource*
  - one or more *statements*
- a *statement* is made up of
  - exactly one *property URI*
    - **identifies** *property*
  - exactly one *value surrogate*
- a *value surrogate* is either a *literal value surrogate* or a *non-literal value surrogate*

e.g. http://dublincore.org/documents/2007/06/04/abstract-model/

e.g. http://purl.org/dc/terms/subject


Description Set
Description
Resource URI
Statement
Non-Literal Value Surrogate
Property URI
Statement
Non-Literal Value Surrogate
Property URI
Description
Resource URI
Statement
Literal Value Surrogate
Property URI
Statement
Literal Value Surrogate
Property URI

DCAM Description Set Model

- a *literal value surrogate* is made up of
  - exactly one *value string*
    - **encodes** *value*
- a *non-literal value surrogate* is made up of
  - zero or one *value URIs*
    - **identifies** *value*
  - zero or one *vocabulary encoding scheme URI*
    - **identifies** a set of which the *value* is a member
  - zero or more *value strings*
    - **represents** *value*
- a *value string* is either a *plain value string* or a *typed value string*
  - a *plain value string* may have an associated *value string language*
  - a *typed value string* is associated with a *syntax encoding scheme URI*
- Vocabulary Encoding Scheme
  - A named set to which a “Thing” belongs
- Syntax Encoding Scheme
  - A named set of rules for the “interpretation” of a set of “Strings”

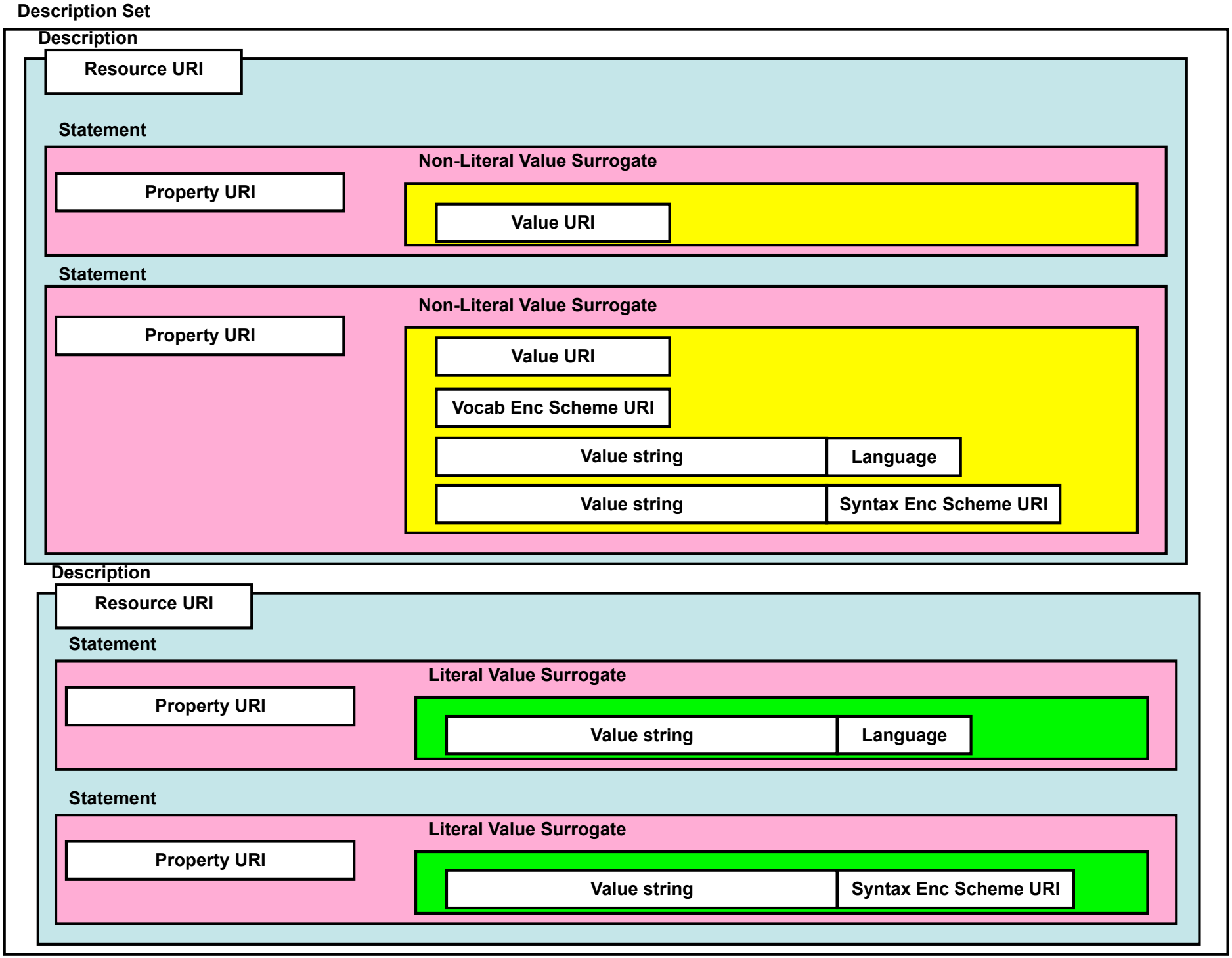
e.g. “DCMI Abstract Model”

e.g. http://www.w3.org/TR/2004/REC-rdf-concepts-20040210/

e.g. http://purl.org/dc/terms/LCSH

e.g. “metadata”

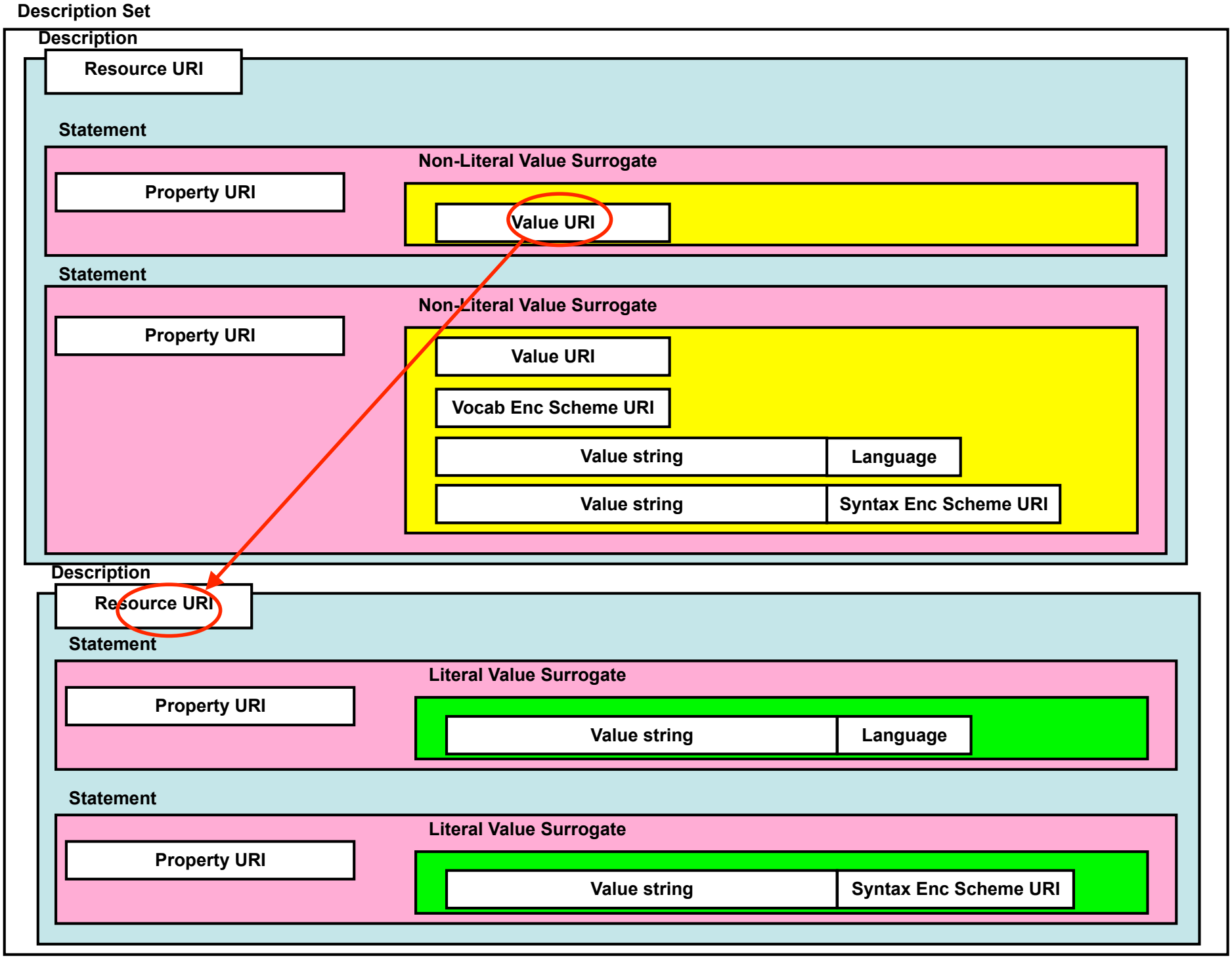
e.g. “métadonnées”


Description Set
Description
Resource URI
Statement
Property URI
Non-Literal Value Surrogate
Value URI
Statement
Property URI
Non-Literal Value Surrogate
Value URI
Vocab Enc Scheme URI
Value string
Language
Value string
Syntax Enc Scheme URI
Description
Resource URI
Statement
Property URI
Literal Value Surrogate
Value string
Language
Statement
Property URI
Literal Value Surrogate
Value string
Syntax Enc Scheme URI

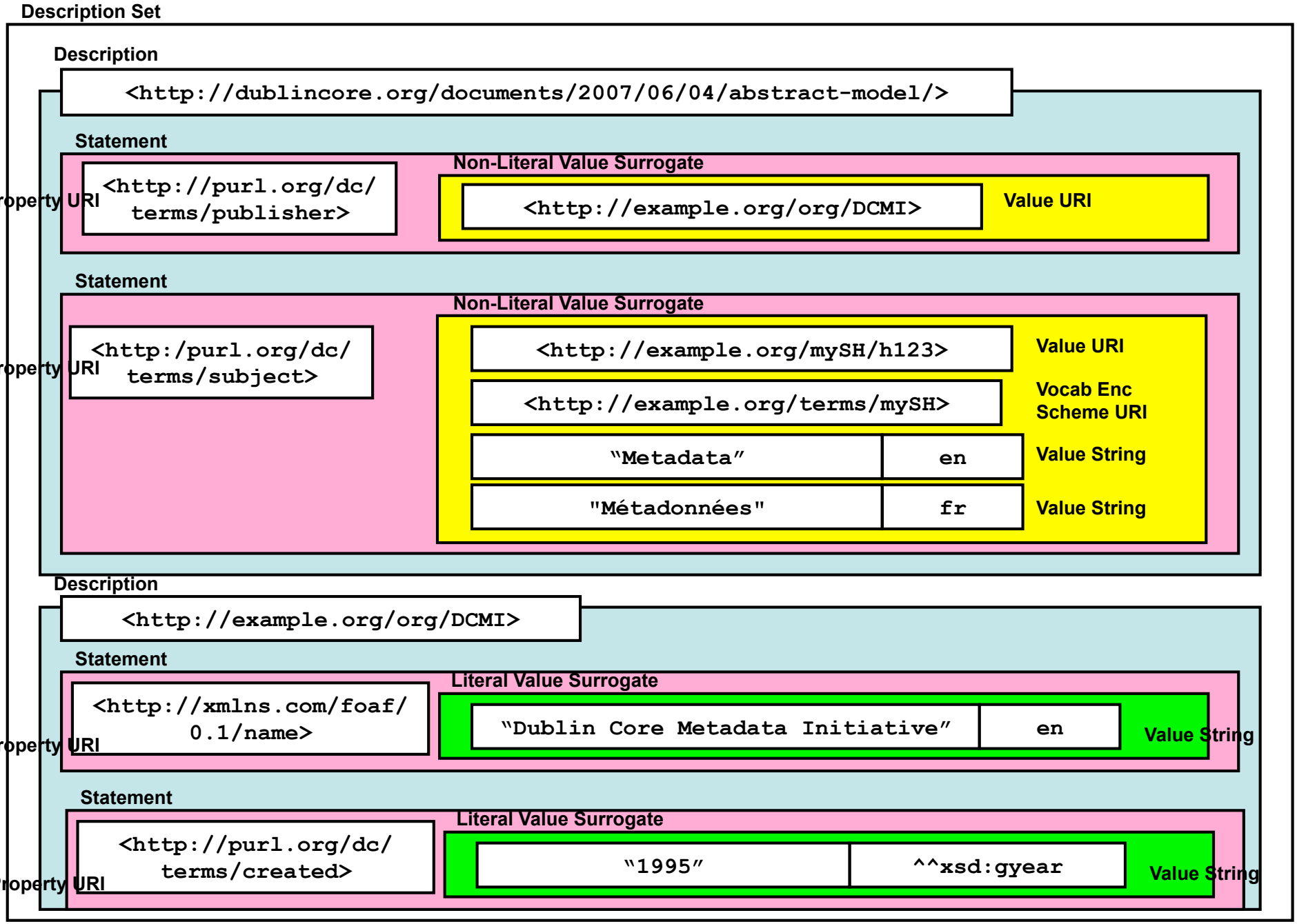
DCAM Description Set Model

- a *non-literal value* may be described by another *description*

- Remember the document and publisher example


Description Set
Description
Resource URI
Statement
Property URI
Non-Literal Value Surrogate
Value URI
Statement
Property URI
Non-Literal Value Surrogate
Value URI
Vocab Enc Scheme URI
Value string
Language
Value string
Syntax Enc Scheme URI
Description
Resource URI
Statement
Property URI
Literal Value Surrogate
Value string
Language
Statement
Property URI
Literal Value Surrogate
Value string
Syntax Enc Scheme URI

Example: Description of document, description of publisher



DCAM Vocabulary Model

1. Specifies **the types of term** used in DC metadata
   - Properties
   - Classes
   - Vocabulary Encoding Schemes
   - Syntax Encoding Schemes
2. Defines some **relationship types** that can exist between terms
   - between properties
     - Property P is subProperty Of Property Q
   - between properties and classes
     - Property P has Range Class C
     - Property P has Domain Class D
   - between classes
     - Class C is subclass of Class D
3. Provides **rules for drawing logical conclusions** based on these relationship types

Summary: key DCAM concepts

- Think in terms of simple relationships between two resources
- Resources & metadata terms identified by URIs
- Literal ("String") v Non-literal ("Thing")
  - "Things" can be described; "strings" can't"
- Use of description set structure
  - Description set
  - One **or more** Descriptions
  - One **or more** Statements
- Value surrogate
  - Literal value surrogate = simple structure
  - Non-literal value surrogate = more complex structure
    - Non-literal value as member of Vocabulary Encoding Scheme
    - Non-literal value represented by multiple Value Strings

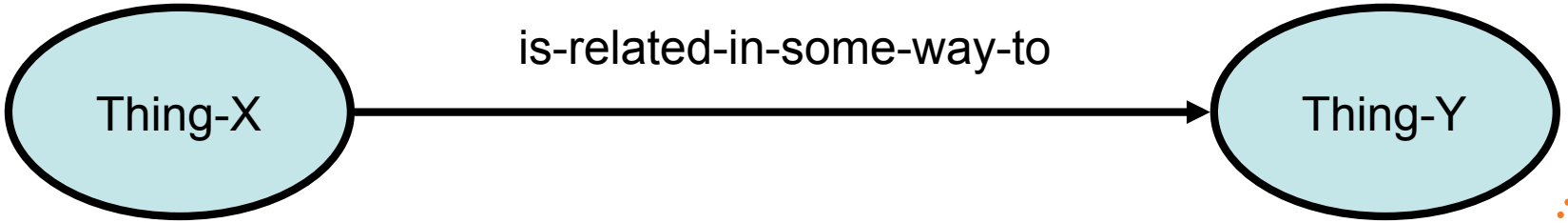
Summary: key DCAM concepts

- DCAM specifies use of defined **types** of terms
  - Property
  - Class
  - Vocabulary Encoding Scheme
  - Syntax Encoding Scheme
- DCAM doesn't require use of any specific set of terms
  - a description set might use **no** DCMI-owned metadata terms
- DCAM doesn't specify use of any particular combinations of terms

The DCMI Abstract Model & the Resource Description Framework (RDF)

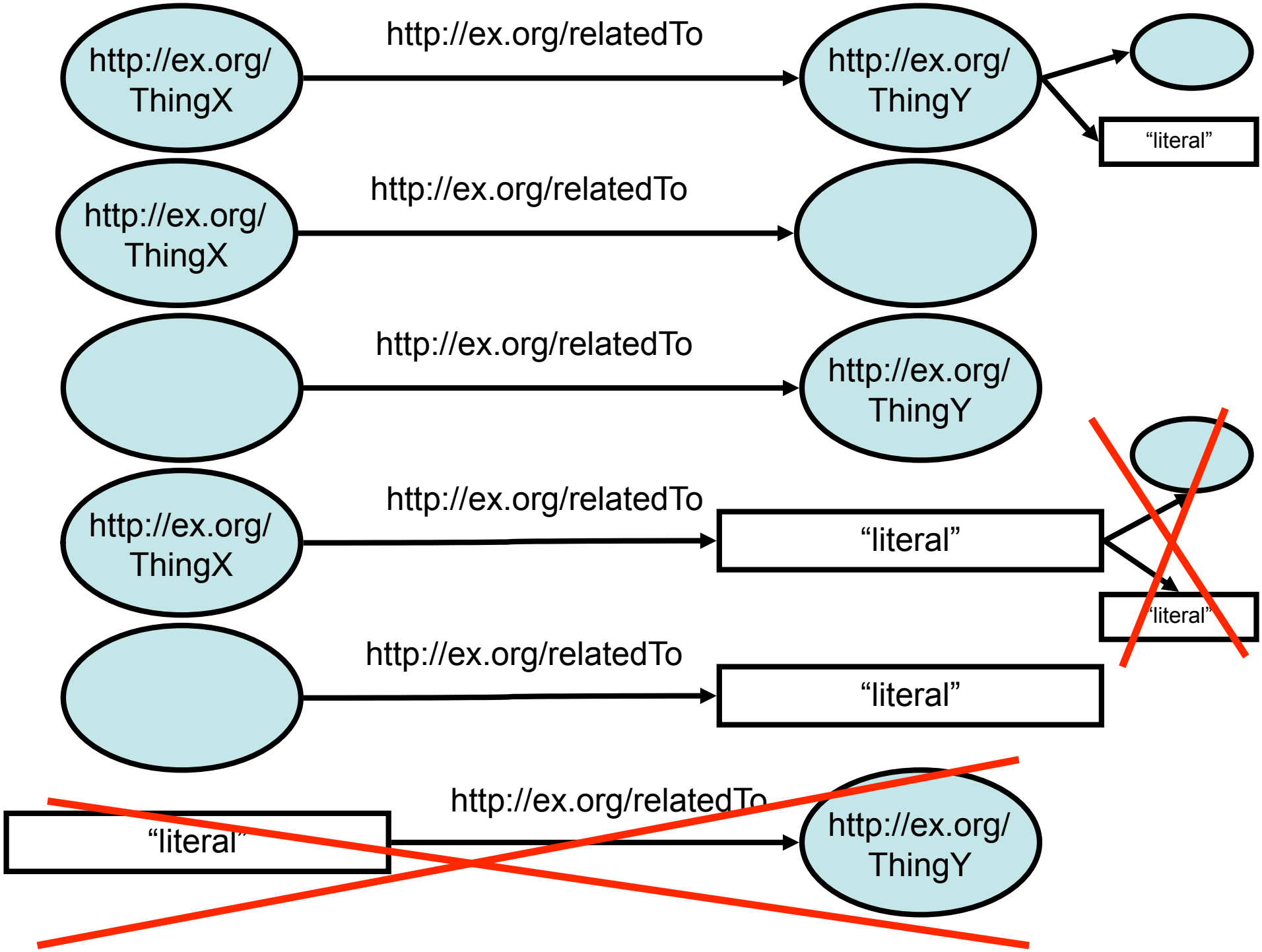
Resource Description Framework (RDF)

- Set of specifications from W3C
- A simple conceptual model...
- ...for making assertions about relationships between resources
  - "Thing-X is-related-in-some-way-to Thing-Y"
- Types of relationship are *properties*
- Assertions made in the form of *triples*
  - Subject, Predicate, Object
- Sets of triples often represented as node-arc-node patterns (*graphs*)



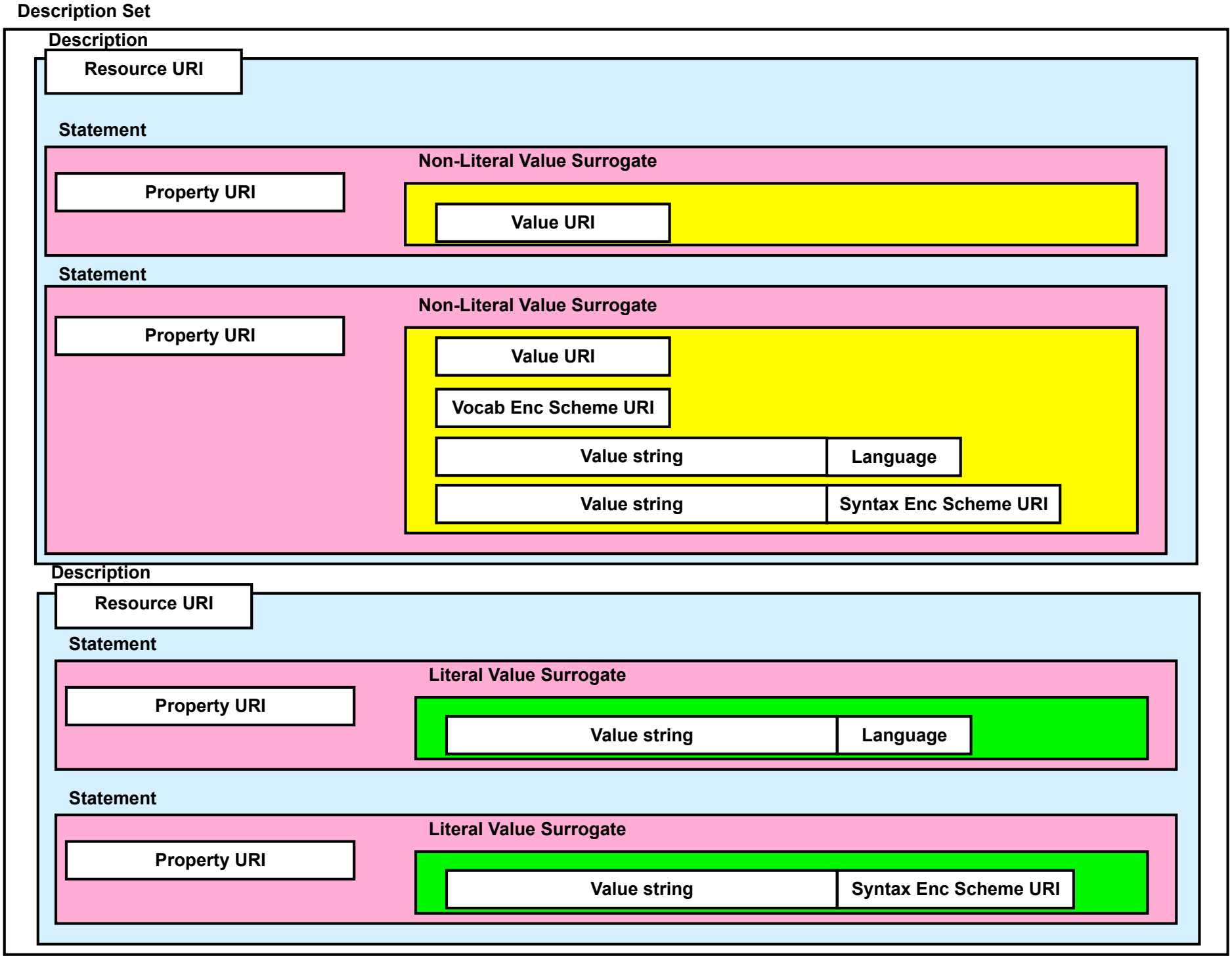
Resource Description Framework (RDF)

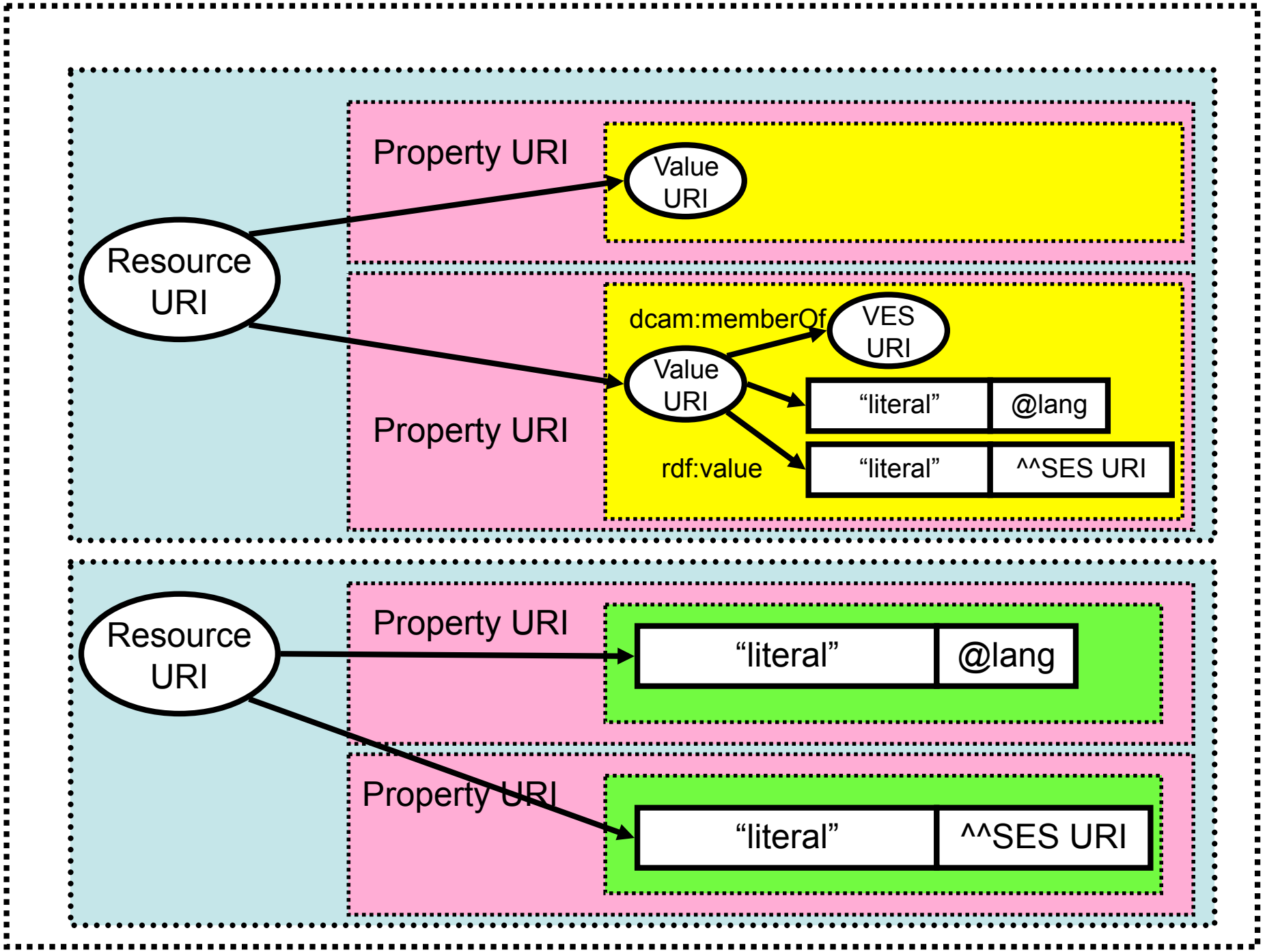
- RDF designed for use on Web
- Global context, global naming: URIs
  - URIs as names for things described (subject, object)
  - URIs as names of relationships between things (predicate)
- Also allows for
  - “unnamed” things: “blank nodes” (subject, object)
  - “literals” = text strings (object only)
- RDF defines rules
  - for merging sets of triples
    - e.g. for “joining together” your “descriptions” and my “descriptions” of the same set of resources
  - for drawing logical conclusions from some triples


http://ex.org/ThingX
http://ex.org/relatedTo
http://ex.org/ThingY
"literal"
http://ex.org/ThingX
http://ex.org/relatedTo
http://ex.org/relatedTo
http://ex.org/ThingY
http://ex.org/ThingX
http://ex.org/relatedTo
"literal"
"literal"
http://ex.org/relatedTo
"literal"
http://ex.org/relatedTo
http://ex.org/ThingY

DCAM & RDF

- A history of co-evolution
- DCAM grounded in concepts of RDF
  - assertions of binary relationships between resources, use of URIs
  - DCAM Vocabulary Model is RDF Schema
  - (rather informally!) shares RDF Semantics
  - basis for merging, inferencing
- DCAM doesn't explicitly use "description model" of RDF (triple, graph)
- But description set can be seen as "specialised view" of RDF graph
  - adds some additional constructs
- Mapping provided by "Expressing DC metadata using RDF", DCMI Recommendation, 2008-01-14
- **In using the DCAM, you are also using RDF**
- **Dublin Core terms can be used in RDF without using DCAM**


Description Set
Description
Resource URI
Statement
Property URI
Non-Literal Value Surrogate
Value URI
Statement
Property URI
Non-Literal Value Surrogate
Value URI
Vocab Enc Scheme URI
Value string
Language
Value string
Syntax Enc Scheme URI
Description
Resource URI
Statement
Property URI
Literal Value Surrogate
Value string
Language
Statement
Property URI
Literal Value Surrogate
Value string
Syntax Enc Scheme URI

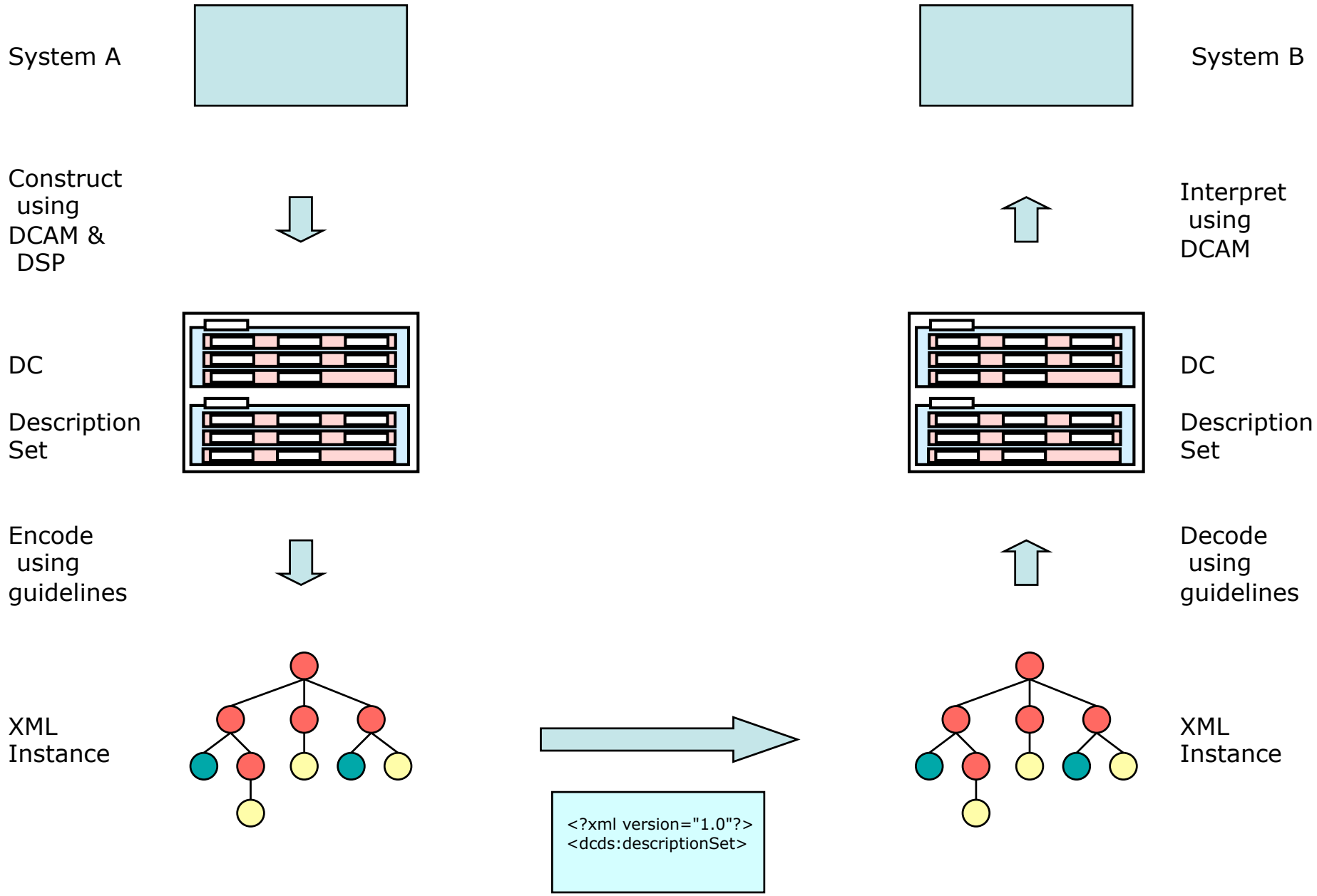

Property URI
Value URI
Resource URI
dcam:memberOf
VES URI
Value URI
"literal"
@lang
Property URI
rdf:value
"literal"
^^SES URI
Resource URI
Property URI
"literal"
@lang
Property URI
"literal"
^^SES URI

Encoding Dublin Core metadata

"Encoding" Dublin Core metadata

- DCAM description set model is syntax-independent
- For transfer between applications, description sets must be encoded as digital objects (records)
- "Encoding Guidelines" describe
  - how abstract information structure is **serialised/encoded** using a **metadata format**
  - how instances of a metadata format are **decoded/interpreted** in terms of abstract information structure
- Provider and consumer need shared rules for encoding/decoding
- DCAM description set as "interface"; concrete syntax as implementation

- **N.B. This is just a very quick overview of DCAM-based encoding guidelines currently provided by DCMI**


System A
System B
Construct using DCAM & DSP
Interpret using DCAM
DC
Description Set
DC
Description Set
Encode using guidelines
Decode using guidelines
XML Instance
XML Instance
<?xml version="1.0"?>
<dcds:descriptionSet>

"Encoding" Dublin Core metadata

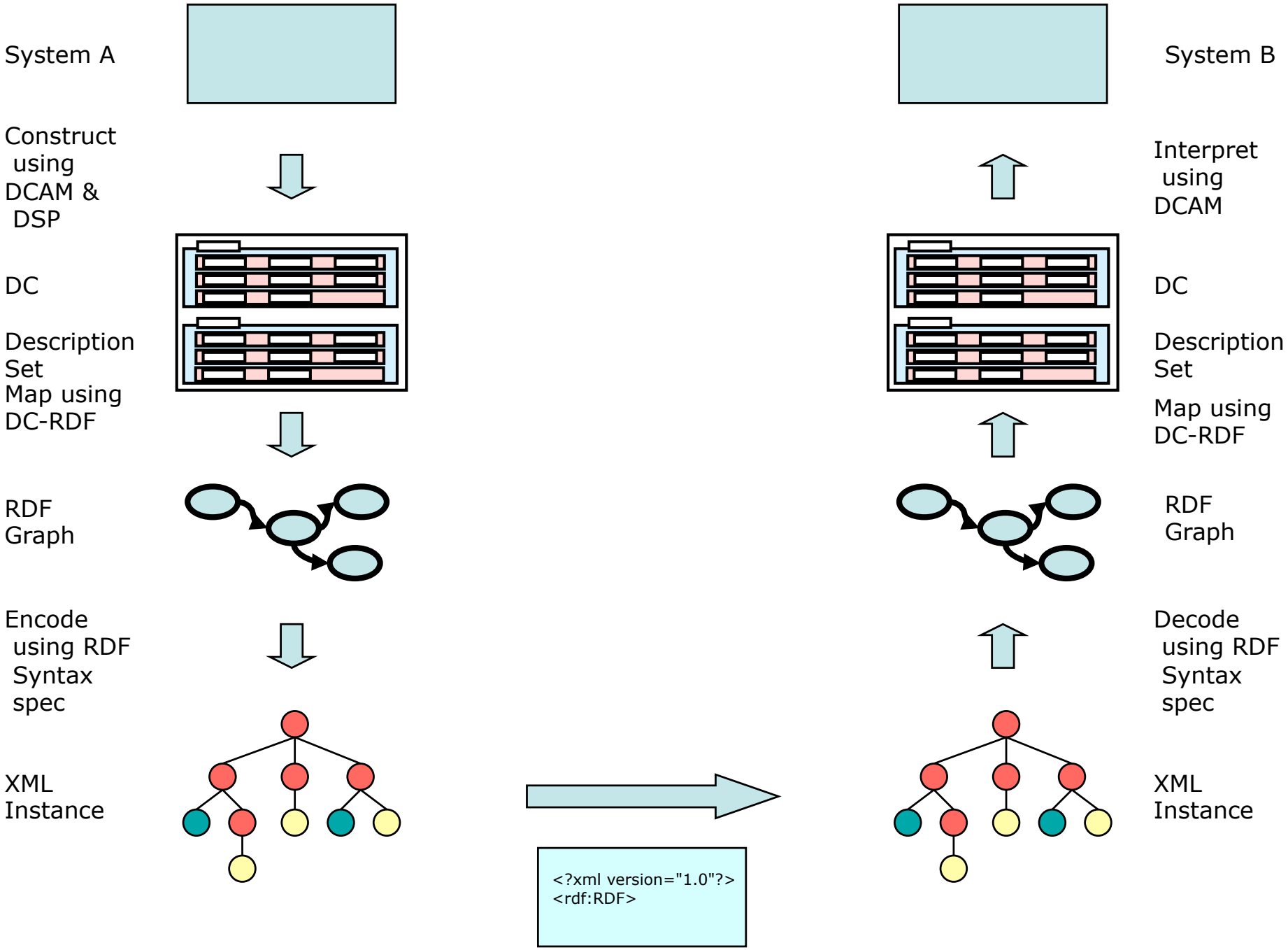
- Multiple syntaxes available
  - Defined by DCMI
  - Defined by other parties
- Different syntaxes may be appropriate for different contexts
- "Encoding guidelines" specify
  - what subset of DCAM description model supported
  - how each supported feature of DCAM encoded as syntactic constructs
  - how syntactic constructs interpreted as DCAM features
- Terms are always referred to using URIs
  - Some syntaxes provide abbreviation mechanisms

"Encoding" Dublin Core metadata

- Warning!
- Some of current DCMI "Encoding Guidelines" specs
  - Pre-date development of DCAM
  - Use earlier, simpler "DC abstract models"
  - Not compatible with RDF model
  - Not compatible with DCAM description set model
- Updating of specs currently (Sep 2008) in progress

DC-RDF

- RDF itself is conceptual model
  - Multiple concrete syntaxes available for RDF
    - RDF/XML, N3, Turtle, RDFa etc
- "Expressing DC metadata using RDF", DCMI Recommendation, 2008-01-14
  - http://dublincore.org/documents/2008/01/14/dc-rdf/
  - Uses RDF abstract syntax
  - Supports full DCAM description model
  - Any concrete syntax for RDF can be used for DC metadata
- DC-RDF is stable, complete


System A
Construct using DCAM & DSP
DC
Description Set
Map using DC-RDF
RDF Graph
Encode using RDF Syntax spec
XML Instance
<?xml version="1.0"?>
<rdf:RDF>
System B
Interpret using DCAM
DC
Description Set
Map using DC-RDF
RDF Graph
Decode using RDF Syntax spec
XML Instance

```
<?xml version="1.0" encoding="UTF-8" ?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:dcterms="http://purl.org/dc/terms/"
         xmlns:dcam="http://purl.org/dc/dcam/"
         xmlns:foaf="http://xmlns.com/foaf/0.1/" >

 <rdf:Description
     rdf:about="http://dublincore.org/documents/2007/06/04/abstract-model/">
  <dcterms:publisher rdf:resource="http://example.org/org/DCMI" />
  <dcterms:subject>
   <rdf:Description rdf:about="http://example.org/mySH/h123" >
    <dcam:memberOf  rdf:resource="http://example.org/terms/mySH" />
    <rdf:value xml:lang= "en">Metadata</rdf:value>
    <rdf:value xml:lang= "fr">Métadonnées</rdf:value>
   </rdf:Description>
  </dcterms:subject>
 </rdf:Description>

 <rdf:Description rdf:about="http://example.org/org/DCMI">
   <foaf:name xml:lang= "en">Dublin Core Metadata Initiative</foaf:name>
   <dcterms:created
       rdf:datatype="http://www.w3.org/2001/XMLSchema#gyear">1995</dcterms:created
    >
  </rdf:Description>

</rdf:RDF>
```

DC-HTML

- "Expressing DC metadata using HTML/XHTML meta and link elements", DCMI Recommendation, 2008-08-04
  - http://dublincore.org/documents/2008/08/04/dc-html/
  - Supports subset of DCAM description model
  - DC metadata in HTML document describes that document
    - or at least document of which HTML page is representation
  - An HTML meta-data profile
  - GRDDL Profile Transformation to generate RDF/XML
- DC-HTML is stable, complete

DC-HTML

- Supports subset of description set model
  - One description
  - For non-literal value surrogate
    - Maximum of one value string
    - Value string must be plain value string
    - Value URI must be provided
    - Vocabulary encoding scheme URI not supported
- **Do** use the X/HTML profile attribute
- “Namespacing” using link/@rel=“schema.XX”
  - **Don’t** use “composite name” convention (dcterms.description.abstract)
- Statements w literal value surrogates, use <meta>
- Statements w non-literal value surrogates, use <link>

```
<?xml version="1.0" encoding="UTF-8" ?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
     "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
  <head profile="http://dublincore.org/documents/2008/08/04/dc-html/">
    <title>DCMI Abstract Model</title>
   <base href="http://dublincore.org/documents/2007/06/04/abstract-model/" />
    <link rel="schema.DCTERMS" href="http://purl.org/dc/terms/" />
    <link rel="DCTERMS.subject" href="http://example.org/terms/mySH/h123"
          xml:lang="en" title="Metadata" />
    <link rel="DCTERMS.publisher" href="http://example.org/org/DCMI" />
  </head>
  <body>
  </body>
</html>
```

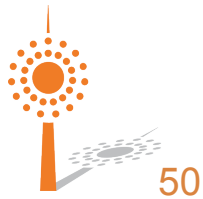
DC-DS-XML

- "Expressing DC Description Sets using XML (DC-DS-XML)", Proposed Recommendation, 2008-09-01
  - http://dublincore.org/documents/2008/09/01/dc-ds-xml/
  - Supports full DCAM description model
  - "TRiX"-like
    - uses XML element names and XML attribute names corresponding to the names of the components of the description set
    - Instance data as XML element content and XML attribute values
    - URIs represented in full
  - Verbose, but easily processable
  - W3C XML Schema, RELAX NG Schema
  - GRDDL Namespace Transformation to generate RDF/XML
- DC-DS-XML is still liable to change

```
<?xml version="1.0" encoding="UTF-8" ?>
<dcds:descriptionSet xmlns:dcds="http://purl.org/dc/xmlns/2008/09/01/dc-ds-xml/">

 <dcds:description
     dcds:resourceURI="http://dublincore.org/pages/home">

  <dcds:statement
     dcds:propertyURI="http://purl.org/dc/terms/publisher“
     dcds:valueURI="http://example.org/org/DCMI" />
 <dcds:statement
    dcds:propertyURI="http://purl.org/dc/terms/subject"
    dcds:vesURI="http://example.org/terms/mySH"
    dcds:valueURI="http://example.org/mySH/h123">
    <dcds:valueString xml:lang= "en">Metadata</dcds:valueString>
    <dcds:valueString xml:lang= "fr">Métadonnées</dcds:valueString>
  </dcds:statement>

 </dcds:description>

 <dcds:description
     dcds:resourceURI="http://example.org/org/DCMI">

  <dcds:statement dcds:propertyURI="http://xmlns.com/foaf/0.1/name">
    <dcds:literalValueString xml:lang=“en”>Dublin Core Metadata Initiative</dcds:literalValueString>
  </dcds:statement>
  <dcds:statement dcds:propertyURI="http://purl.org/dc/terms/created">
    <dcds:literalValueString
        dcds:sesURI="http://www.w3.org/2001/XMLSchema#gyear">1995</dcds:literalValueString>
  </dcds:statement>
 </dcds:description>
</dcds:descriptionSet>
```

DC metadata in XML

- DCMI Archtecture Forum currently gathering requirements for other XML format(s)
  - e.g. use of schema validation to implement structural constraints of Description Set Profile



Summary: key points re encoding guidelines

- DCAM defines a conceptual model
- "Encoding guidelines" specify how to encode instances of that conceptual model
- Current DCMI specifications being updated
- DCAM conceptual model builds on/maps to RDF conceptual model
  - Several syntaxes exist for encoding RDF model
  - So any RDF syntax can also be used
- Some work ongoing!

Summary

Summary

- DCMI Abstract Model provides conceptual model for DC metadata
  - What is “DC metadata”?
  - What is the thing which is being “encoded”?
- “Encoding guidelines” define how to represent in concrete syntaxes
- DCAM model based on the RDF model
  - DC description set as “specialised view” of RDF graph
  - Use of DCAM description set implies use of RDF
  - DCAM Vocabulary Model = RDF Schema
- But N.B. DC metadata terms may be used in RDF graphs **without** use of description set concept
  - Different “levels” of “using Dublin Core”

Acknowledgements

- Thanks to Tom Baker, Mikael Nilsson & Andy Powell for comments and suggestions
- The relational database comparison draws on an example used in a presentation on RDF by Ian Davis (Talis)
  - http://research.talis.com/2005/rdf-intro/

International Conference on Dublin Core and Metadata Applications

Tutorial 2: Dublin Core – Key Concepts

Pete Johnston, Eduserv Foundation
mailto:pete.johnston@eduserv.org.uk