# Archetype Modeling Language

Presentation to SHN/CIMI Joint Working Group

# Outline

- OMG,  UML, and UML Profiles
- AML – Purpose and Goals
- AML Submission overview
- State of current submission
- Questions and next steps

# OMG, UML, AND UML PROFILES

# Object Management Group (OMG)

- Standards *consortium*
- Home to UML and Model Driven Architecture (MDA)
- "No Shelf-ware" policy – standards must be accompanied by implementations
- Platform Technical Committes – architecture, tools, middleware
- Domain Technical Commitees – "vertical" domains (Healthcare, Manufacturing, Robotics, Space, …)

# UML

A standard for representing and exchanging *models*

- A model *of* models (a "metamodel")
  - "Class", "Property", "Generalization", "Association"
- Representation for elements (An *instance* of a "Class" is represented as a box with separate slots…"
- Model of model exchange

# Model of “Class”

### 11.4.2 Abstract Syntax

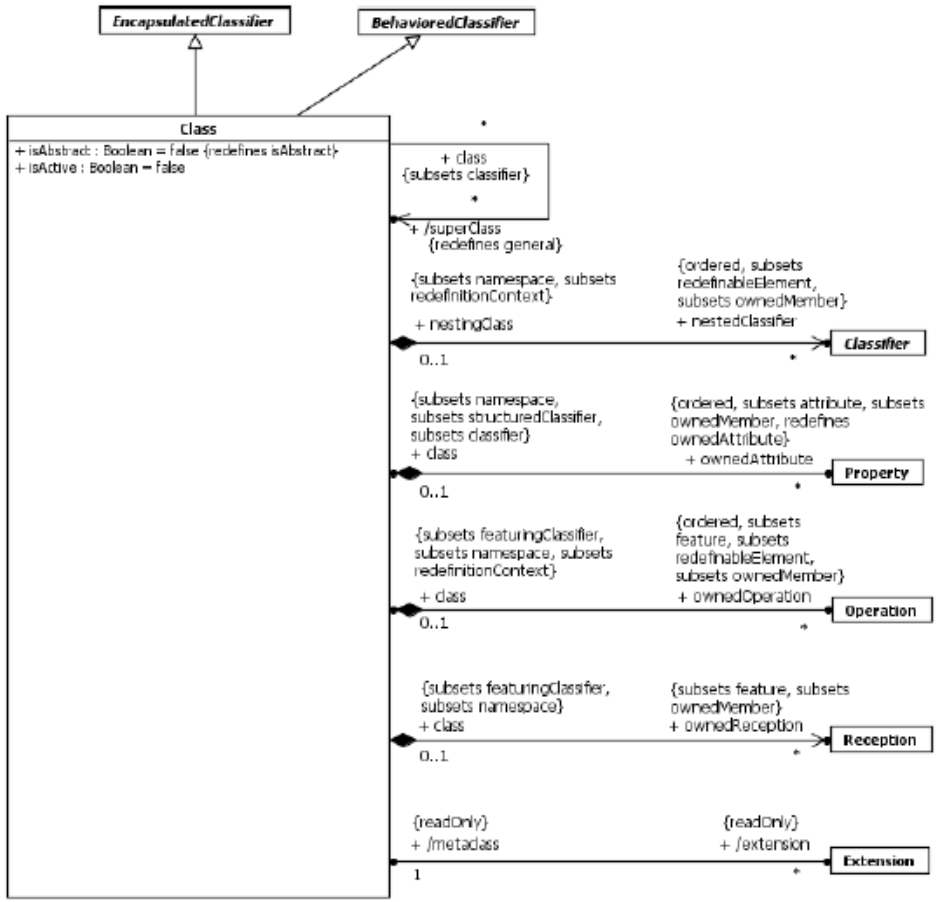



**Figure 11.15 Classes**

# Representation of “Class”

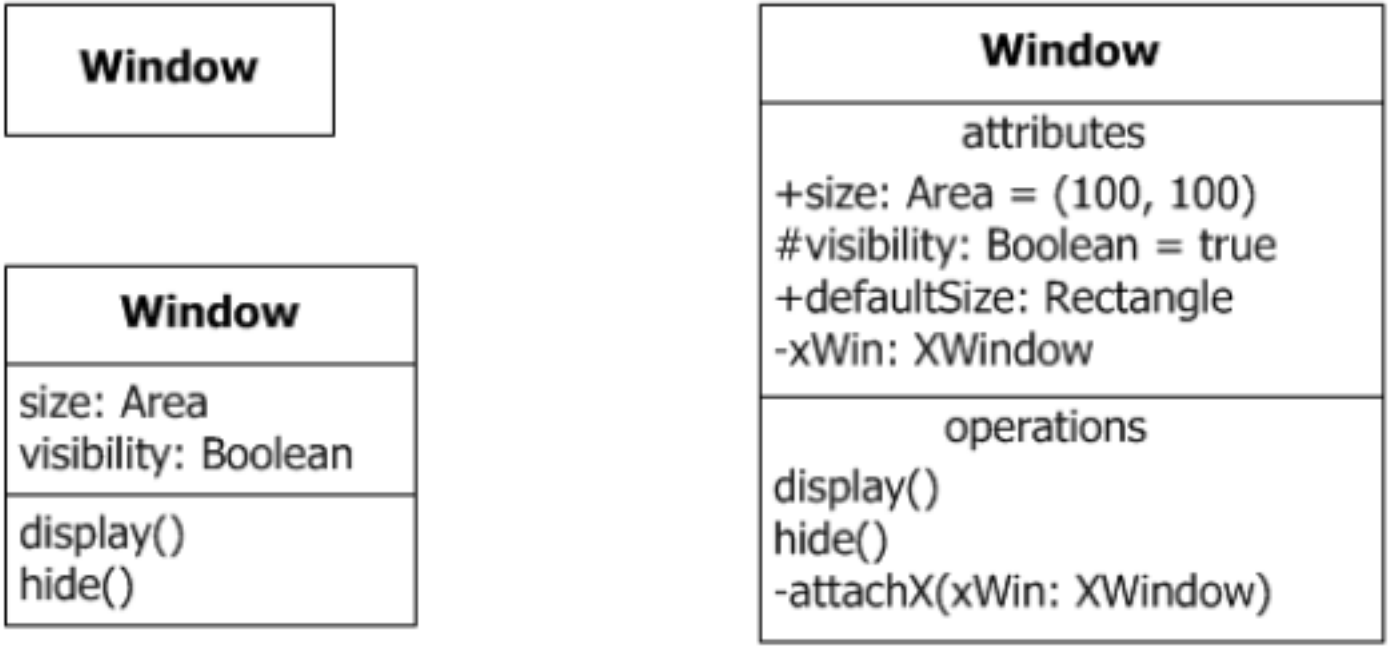
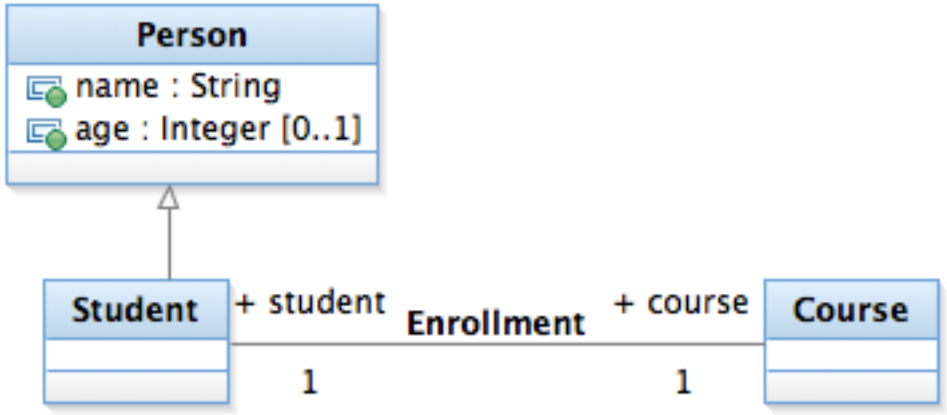


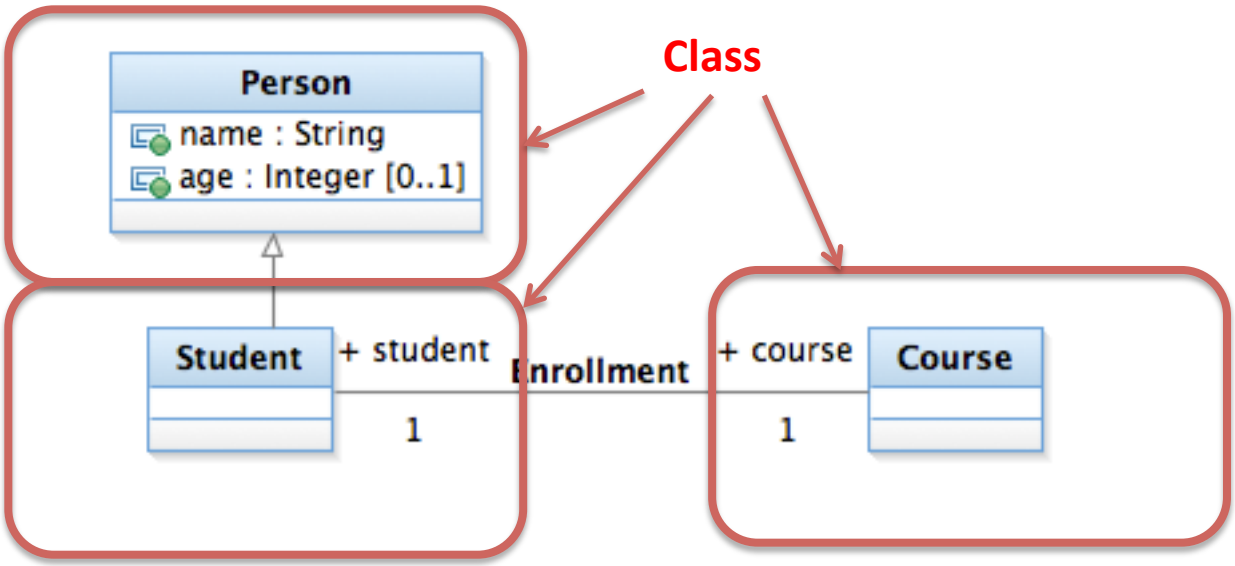

**Figure 11.16 Class notation variants**

Figure 11.17 shows the visibility grouping option (see 9.2.4) applied to the attribu
Window.

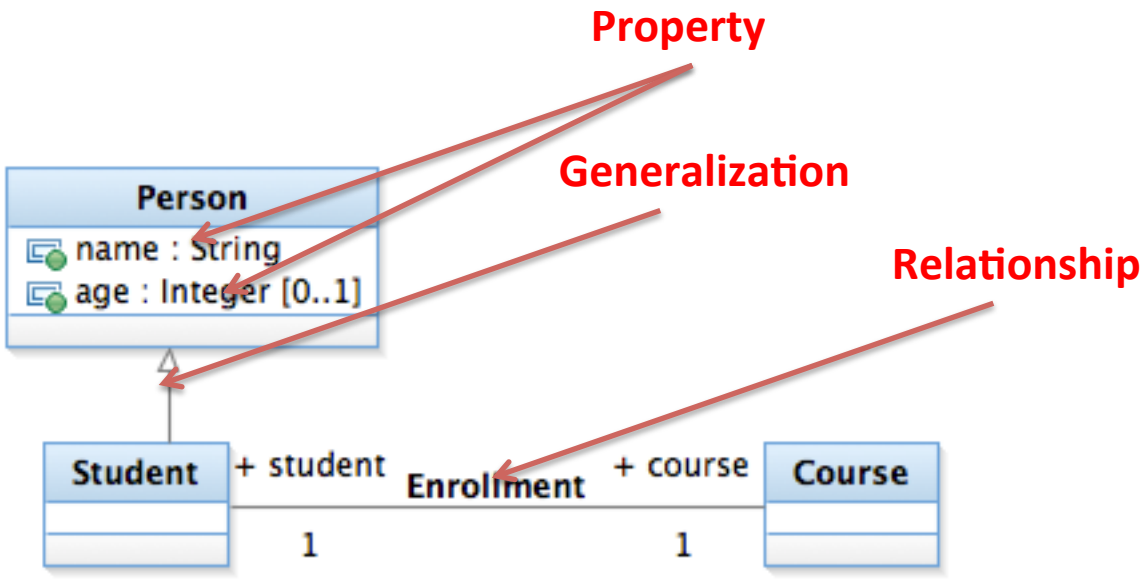
# UML Model *Instance*



# UML Model *Instance*



# *Instances*


Property
Generalization
Relationship
Person
name : String
age : Integer [0..1]
Student
+ student
Enrollment
+ course
Course
1
1

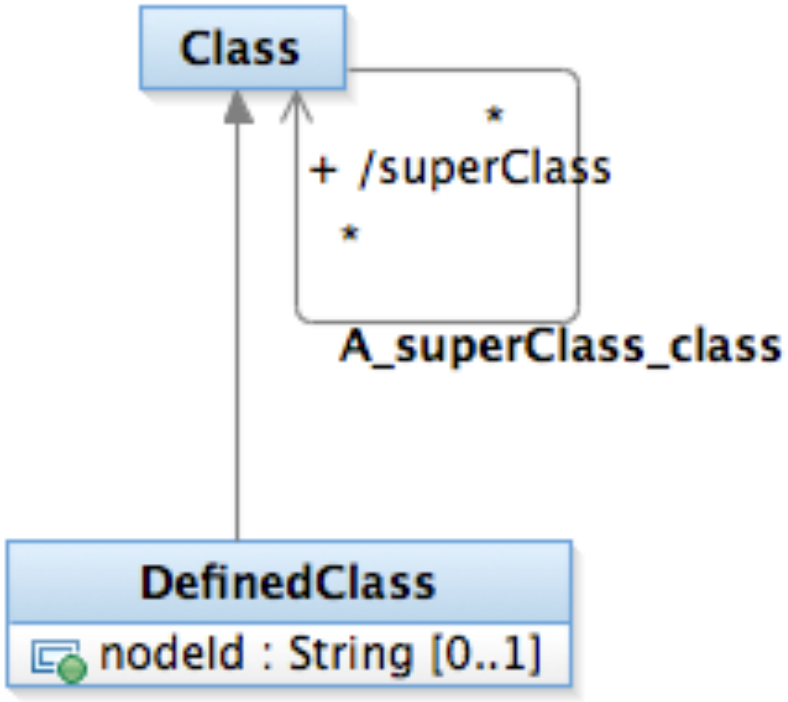
# Model Interchange

```
<?xml version="1.0" encoding="UTF-8"?>
<uml:Package xmi:version="2.1" xmlns:xmi="http://schema.omg.org/spec/XMI/2.1"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:ecore="http://www.eclipse.org/emf/2002/Ecore"
  xmlns:uml="http://schema.omg.org/spec/UML/2.2"
  xsi:schemaLocation="http://schema.omg.org/spec/UML/2.2 http://www.eclipse.org/uml2/3.0.0/UML"
  xmi:id="_PCoU8J_YEeO0_ccVLTZGDA" name="UML Sample">
  <packageImport xmi:type="uml:PackageImport" xmi:id="_PCoU85_YEeO0_ccVLTZGDA">
    <importedPackage xmi:type="uml:Model" href="pathmap://UML_LIBRARIES/UMLPrimitiveTypes.library.uml#_0"/>
  </packageImport>
  <packagedElement xmi:type="uml:Package" xmi:id="_VdF28J_YEeO0_ccVLTZGDA" name="PersonPackage">
    <packagedElement xmi:type="uml:Class" xmi:id="_Ydyn0J_YEeO0_ccVLTZGDA" name="Student">
      <generalization xmi:type="uml:Generalization" xmi:id="_B1-w0KABEeO0_ccVLTZGDA" general="_8ML2wKAAEeO0_ccVLTZGDA"/>
      <ownedAttribute xmi:type="uml:Property" xmi:id="_hWMXkKC3EeO0_ccVLTZGDA" name="course" visibility="public"
        type="_uapgsJ_YEeO0_ccVLTZGDA" association="_hWLJcKC3EeO0_ccVLTZGDA">
        <upperValue xmi:type="uml:LiteralUnlimitedNatural" xmi:id="_hWNlsaC3EeO0_ccVLTZGDA" value="*"/>
        <lowerValue xmi:type="uml:LiteralInteger" xmi:id="_hWNlsKC3EeO0_ccVLTZGDA"/>
      </ownedAttribute>
```

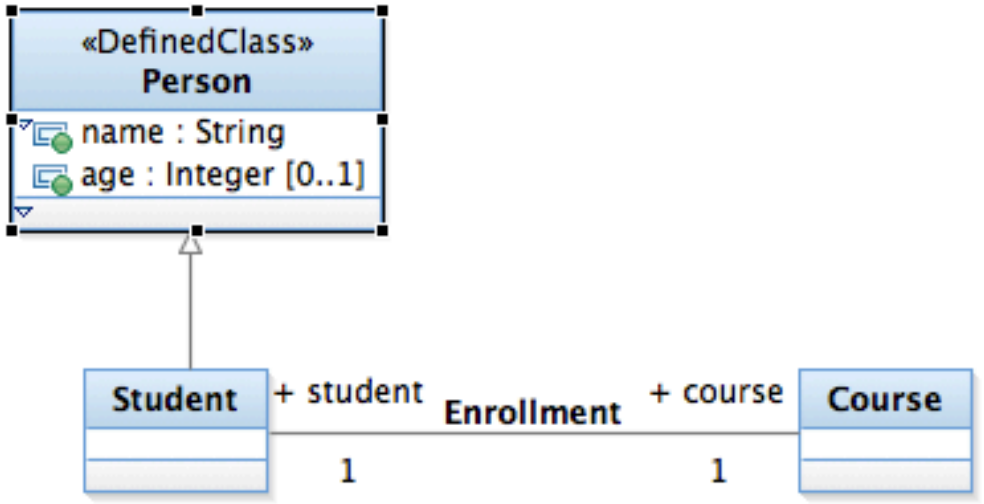
# UML

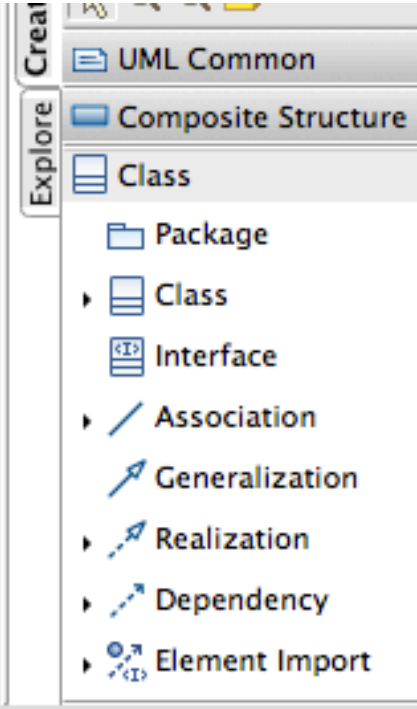
- Good at general, “extensible” models
- NOT so good at “constraint” models
- *Extensible* – elements the metamodel itself can be extended as a “Profile”

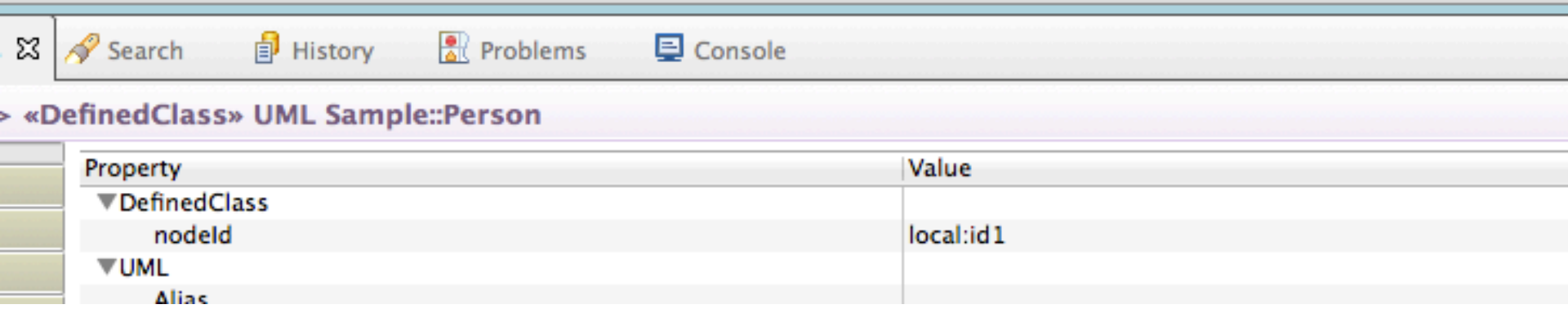
# Extension

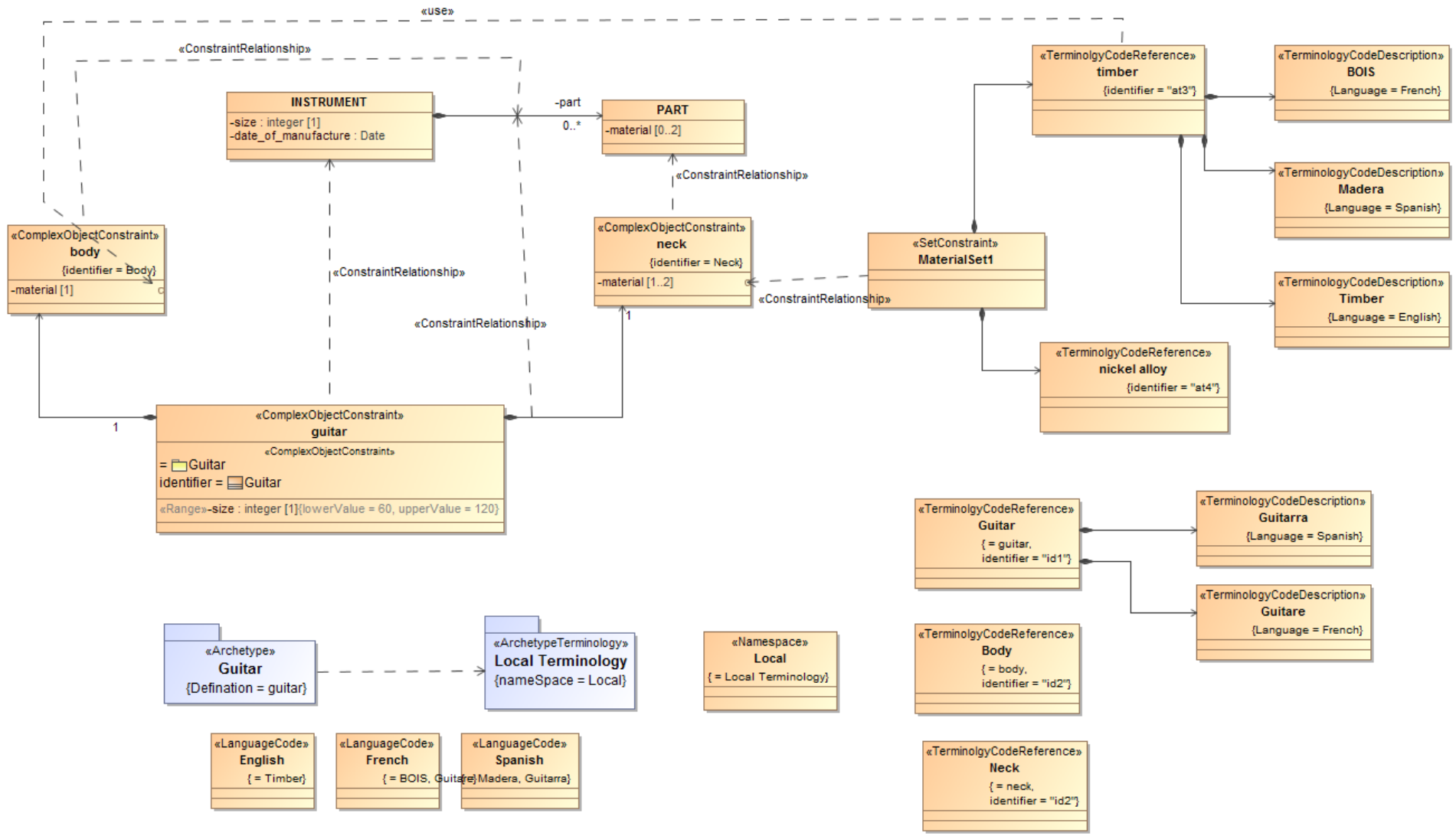

Class
*
+ /superClass
*
A_superClass_class
DefinedClass
nodeId : String [0..1]

# Using a Profile




«use»
«ConstraintRelationship»
INSTRUMENT
-size : integer [1]
-date_of_manufacture : Date
-part
0..*
PART
-material [0..2]
«ConstraintRelationship»
«ComplexObjectConstraint»
body
{identifier = Body}
-material [1]
«ConstraintRelationship»
«ConstraintRelationship»
«ComplexObjectConstraint»
neck
{identifier = Neck}
-material [1..2]
«ConstraintRelationship»
«SetConstraint»
MaterialSet1
«TerminolgyCodeReference»
timber
{identifier = "at3"}
«TerminologyCodeDescription»
BOIS
{Language = French}
«TerminologyCodeDescription»
Madera
{Language = Spanish}
«TerminologyCodeDescription»
Timber
{Language = English}
«TerminolgyCodeReference»
nickel alloy
{identifier = "at4"}
1
1
«ComplexObjectConstraint»
guitar
«ComplexObjectConstraint»
= Guitar
identifier = Guitar
«Range»-size : integer [1]{lowerValue = 60, upperValue = 120}
«TerminolgyCodeReference»
Guitar
{ = guitar,
identifier = "id1"}
«TerminologyCodeDescription»
Guitarra
{Language = Spanish}
«TerminologyCodeDescription»
Guitare
{Language = French}
«Archetype»
Guitar
{Defination = guitar}
«ArchetypeTerminology»
Local Terminology
{nameSpace = Local}
«Namespace»
Local
{ = Local Terminology}
«TerminolgyCodeReference»
Body
{ = body,
identifier = "id2"}
«LanguageCode»
English
{ = Timber}
«LanguageCode»
French
{ = BOIS, Guitare}
«LanguageCode»
Spanish
{ = Madera, Guitarra}
«TerminolgyCodeReference»
Neck
{ = neck,
identifier = "id2"}

# Profile

- Collections of Stereotypes, Metaclasses
- Semantics of the above
- Suggestions for representation and use

The (or “A”) GOAL is to have UML model vendors incorporate profiles as first class items into their tools…

# OMG STANDARDS PROCESS

# OMG RFP Process

Members Only

1) TC issues RFP – requirements document
2) Organizations submit responses
    1) Initial submission – draft responses shown, discussed.
    2) Final submission – (typically) one harmonized fesponse
3) Response(s) are balloted

Public

4) Accepted response becomes a Beta Specification / Finalization Task Force formed
5) FTF report submitted and Beta Specification becomes a final specification.

# AML PURPOSE AND GOALS

# Archetype Modeling Language RFC (AML)

***Goal:***

***"Create a standard for modeling Archetype Models (AMs) using UML, to support the representation of Clinical Information Modeling Initiative (CIMI) artifacts in UML. "***

# AML Profiles
# Profiles Called for in RFP

- **Reference Model Profile(RMP)** - enable the specification of reference models, upon which archetypes can be based
- **Constraint Model Profile(CMP)** - support the specification of constraints on a given reference model, to enable the development of archetypes, including Clinical Information Models (CIMs)
- **Terminology Binding Profile (TBP)** - support the binding of information models to terminology, with optional support for binding to CTS2.

# AML Profiles

## Additional Profiles Described in Submission

- **Rules Profile** – define a common constraint profile, compatible with a subset of OMG Object Constraint Language (OCL) and covering ADL Rules..
- **Metadata Profile** – description and state of model artifacts. Who, what, why, where, when…

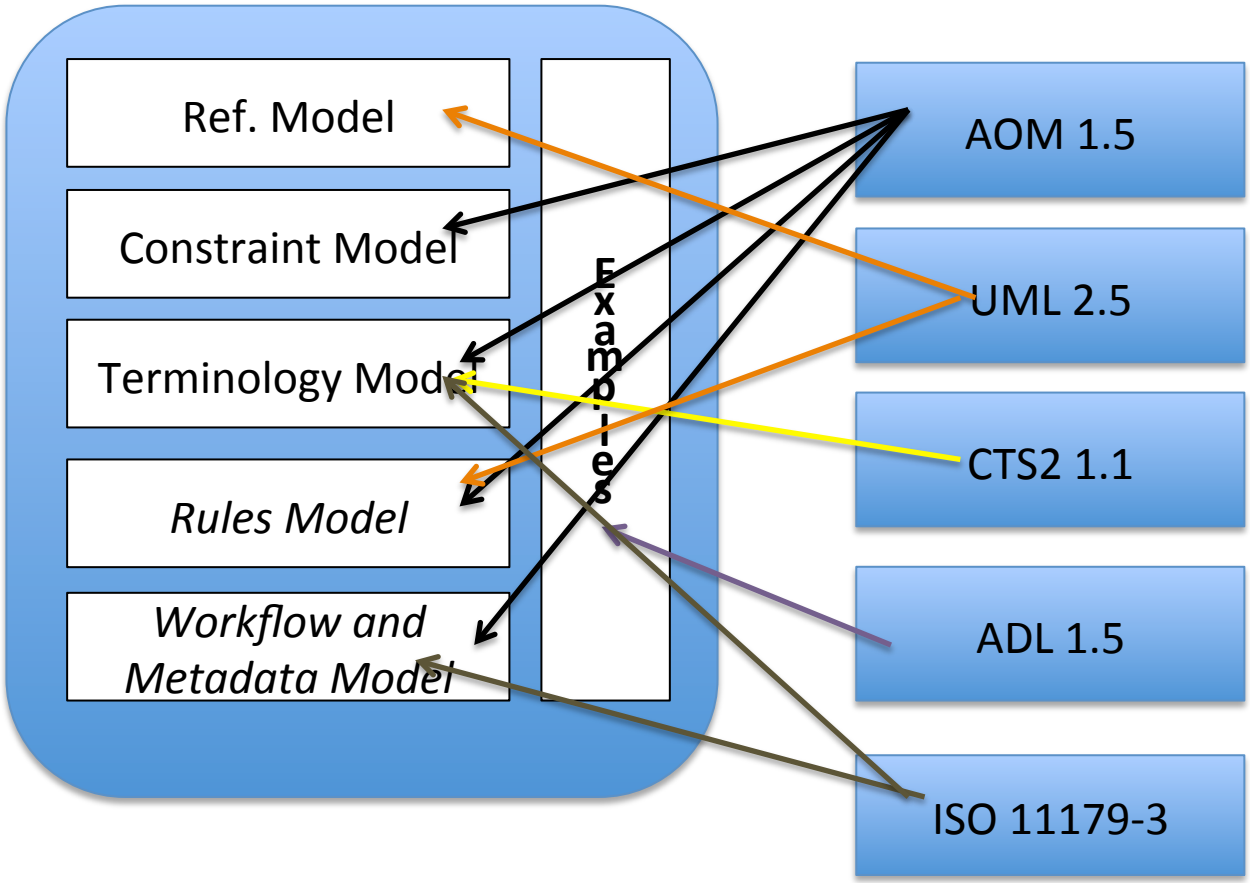
# Initial Submission

- Addresses **reference model**, **constraint model** and **terminology binding profile**
- (so far) leaves Rules (OCL) and metadata out of scope
  - Rules is is a not-insigificant task
  - Metadata is generic (Dave Carlson has been doing useful work wrt. 11179)

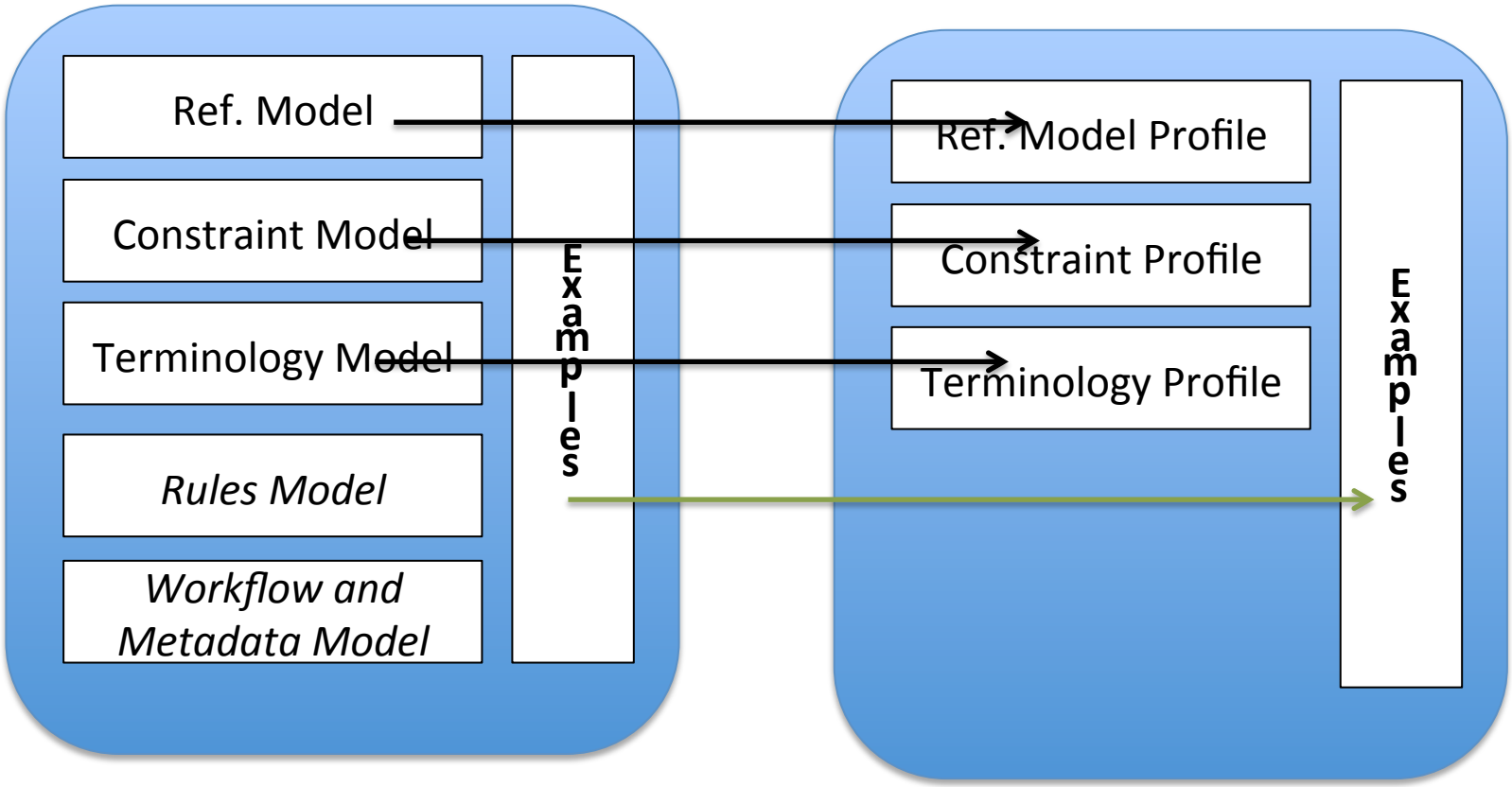
# AML Submission

- Boilerplate (Chapters 1-7)
- Metamodel – (Chapter 8) *what* we are trying to do
- Profiles – (Chapter 9…) *how* we do it (profiles)

# AML Submission Metadata Model



# AML Submission Profiles



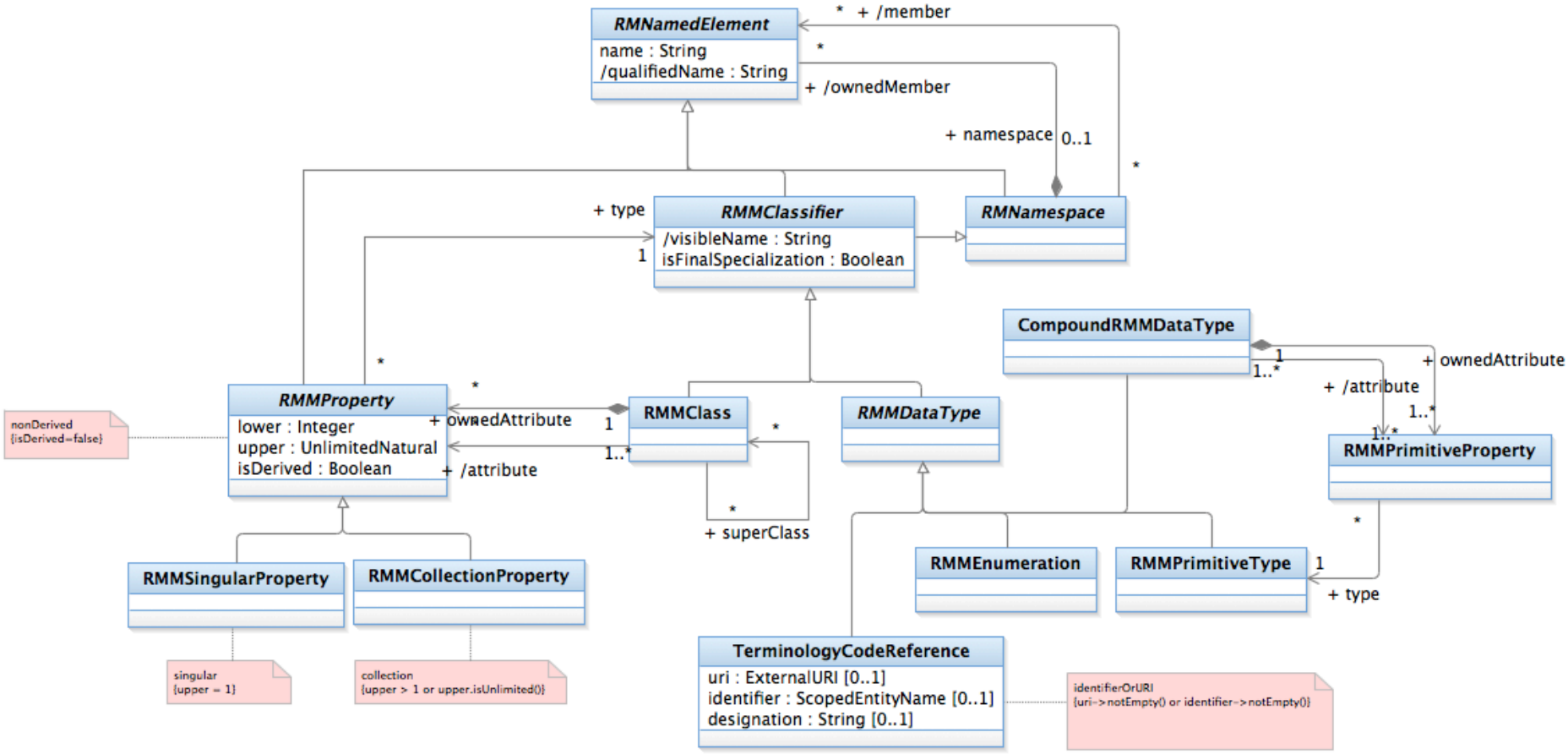
# AML SUBMISSION OVERVIEW

# REFERENCE MODEL METAMODEL

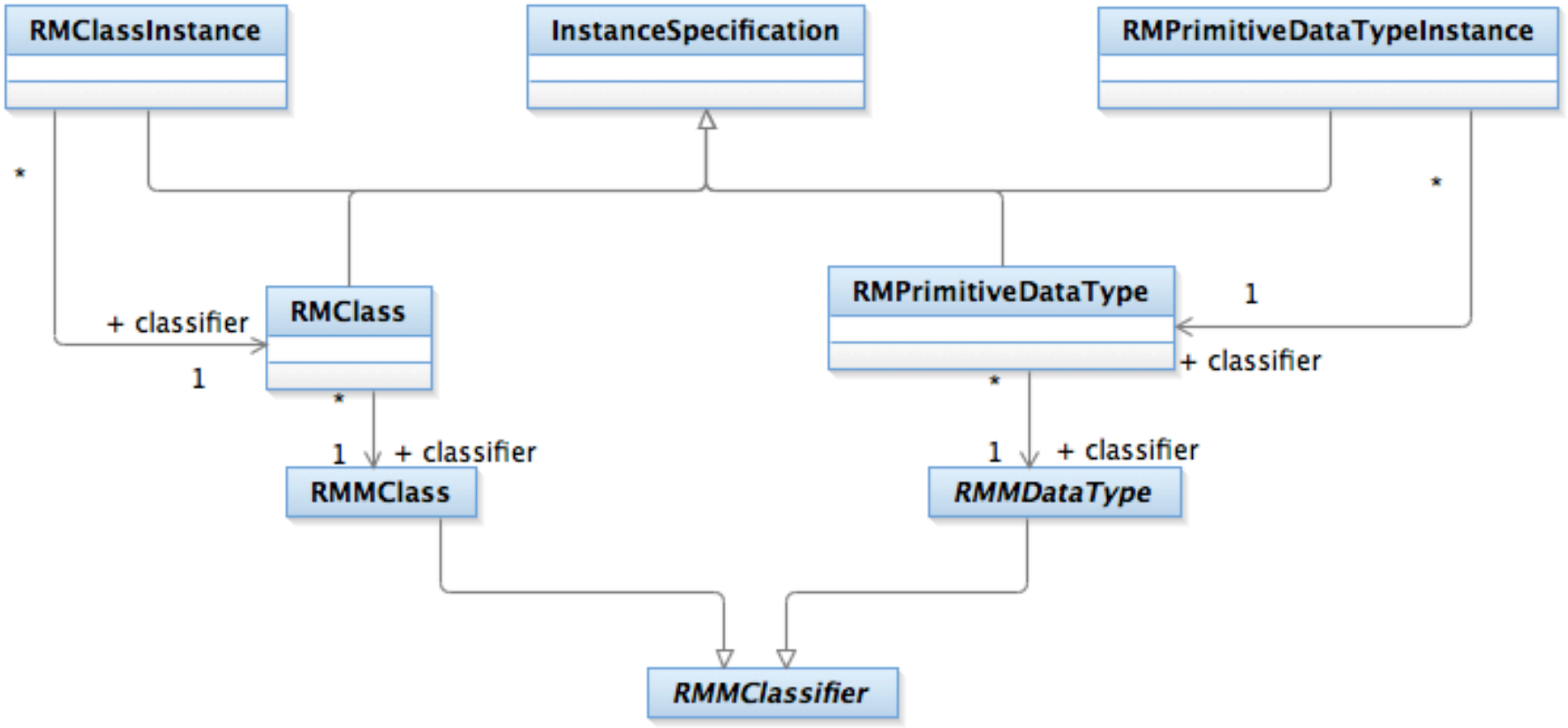
# Reference Model Metamodel

- Identify the subset of UML that will be recognized by AML
  - Class
  - Property (SingularProperty / CollectionProperty
  - DataType (UML Sense)
    - Enumeration
    - PrimitiveType
    - TerminologyCodeReferend
  - Namespace / Package

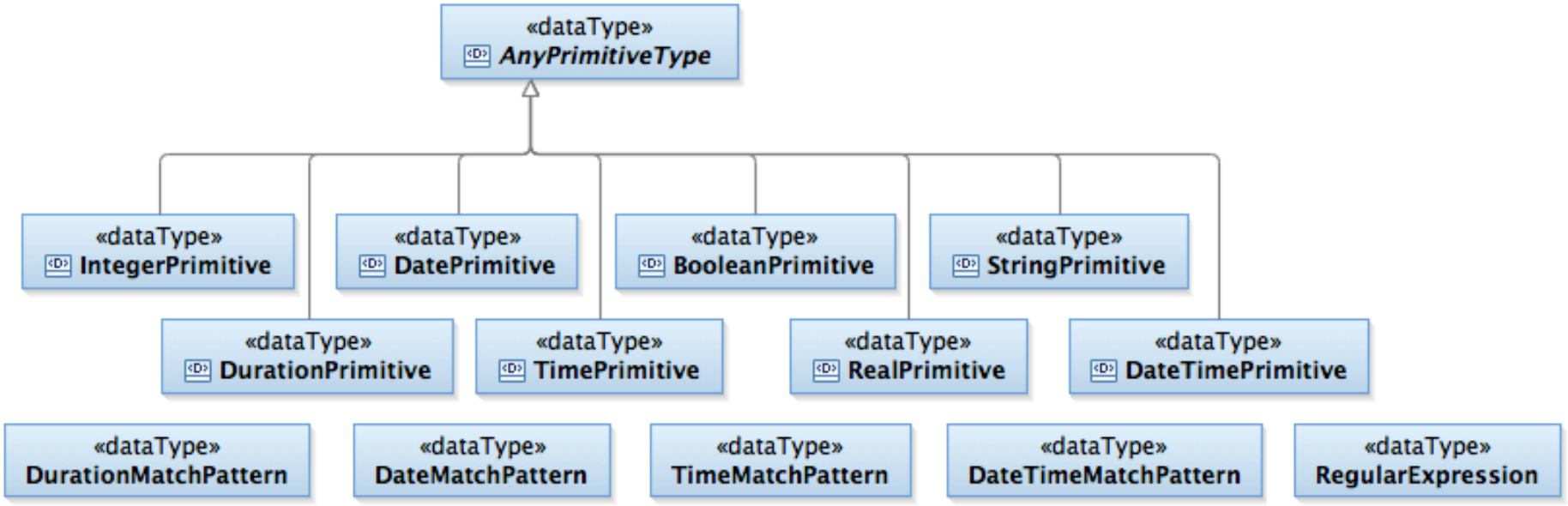
# Reference Metamodel



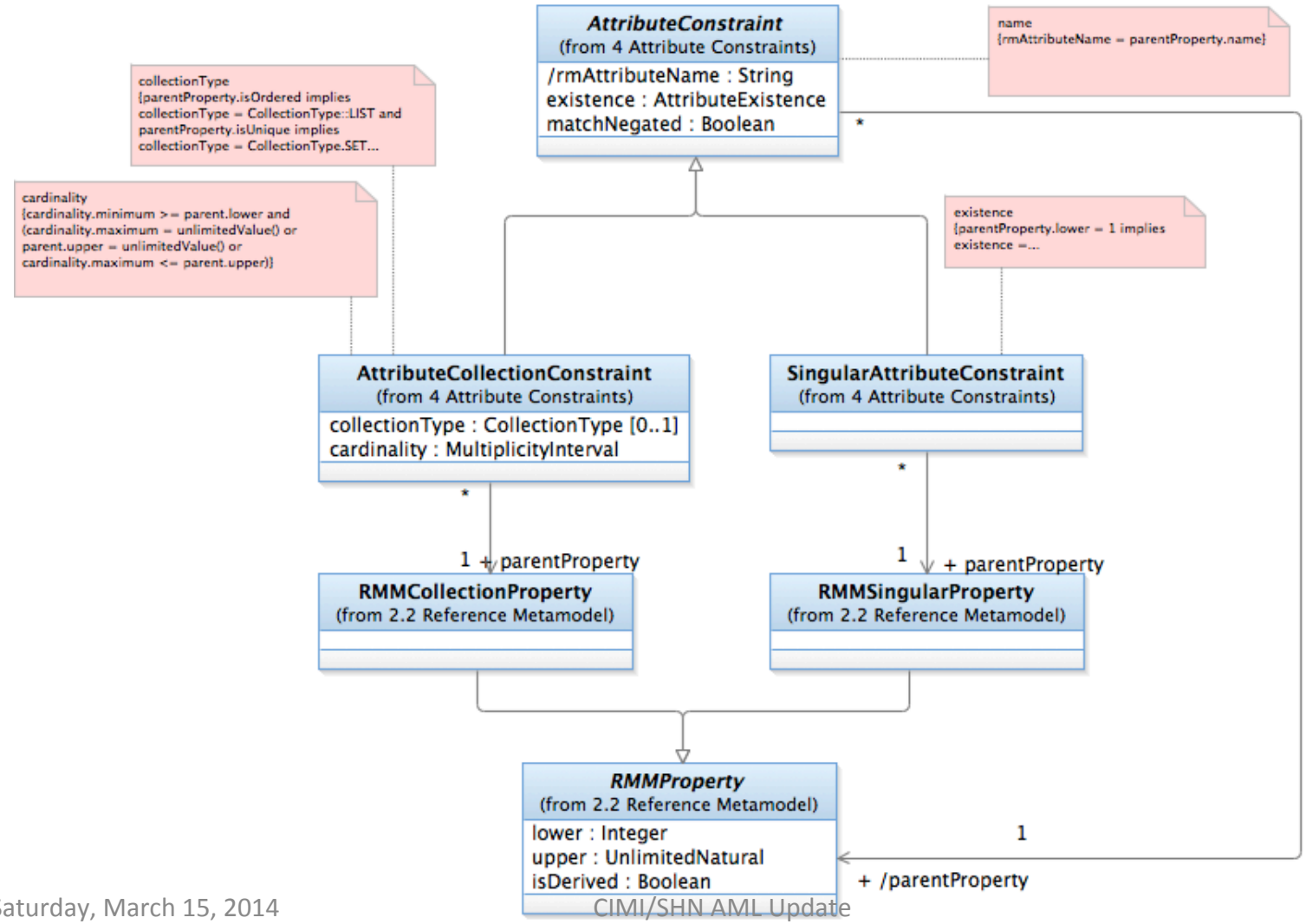
# Instance Specifications
## (Default Value / Assumed Value / Primitive types)



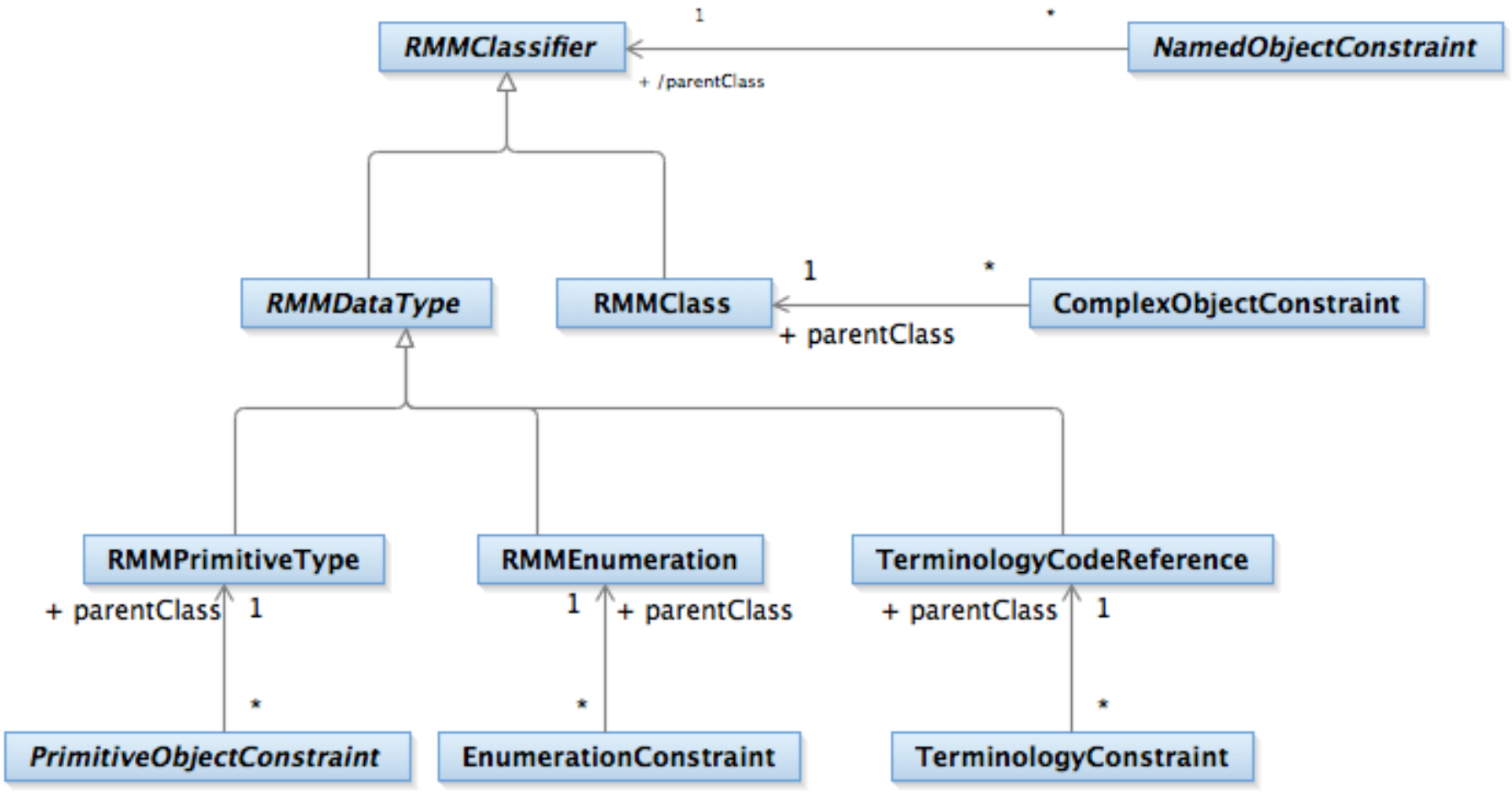
# Primitive Types



# Attribute to Constraints



# Class to Constraints



# Reference Metamodel

- Complete UML can be used for Reference Model
- Metamodel describes subset that can be addressed by AML
- Issues:
  - Templates – used in UML, but very painful to use
  - OCL
    - Need to work with OMG for latest subset
    - Need to understand implications wrt AOM and other systems

# CONSTRAINT METAMODEL

# Constraint Metamodel

- Based on (“latest”) AOM 1.5
- (Some) reverse engineering of ‘what’ from ‘how’
- Formal relationship to Reference Metamodel

# AOM 1.5 Archetype

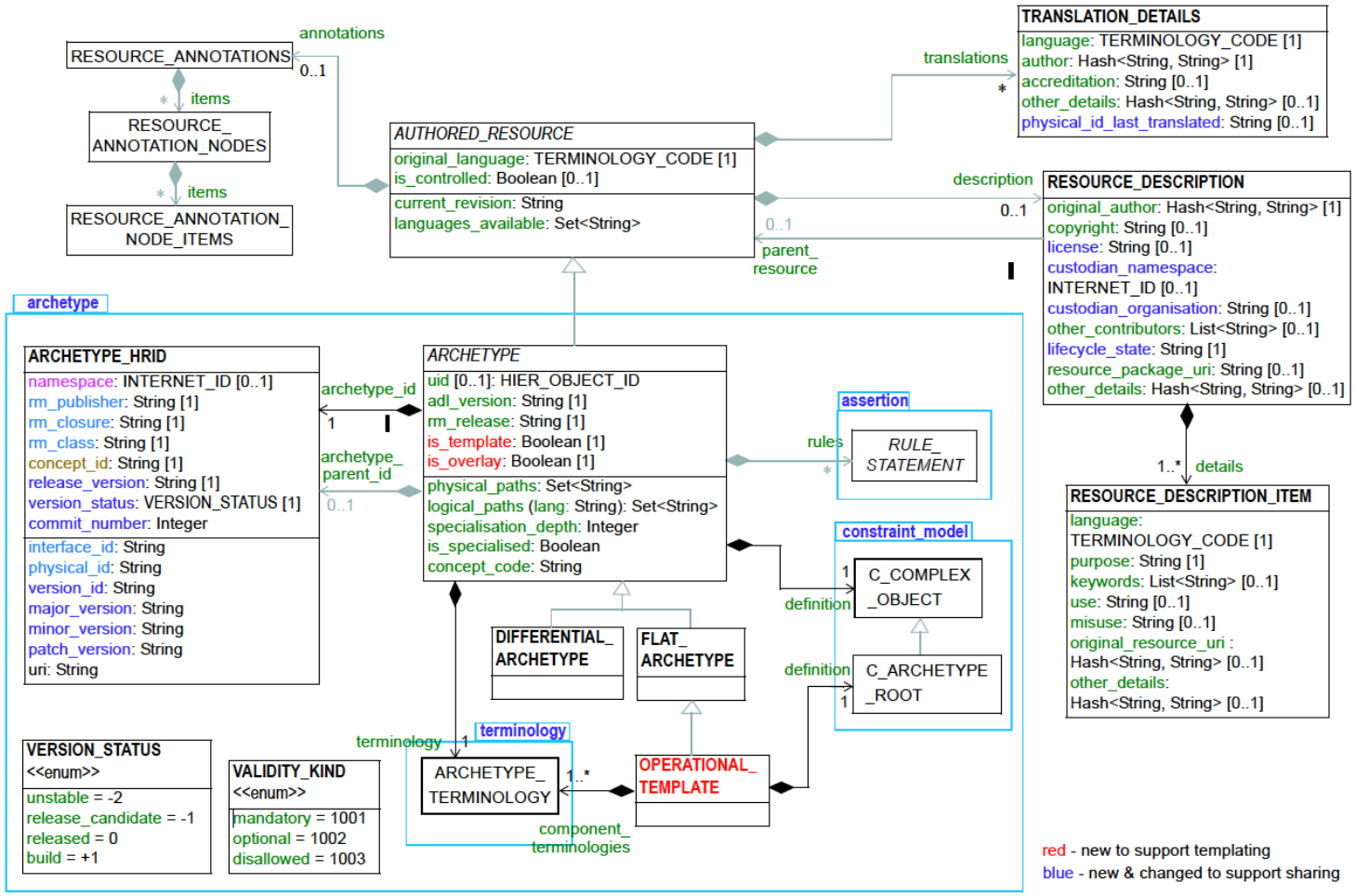



**FIGURE 7** openehr.am.archetype Package

# AOM 1.5 Archetype Metadata and Workflow

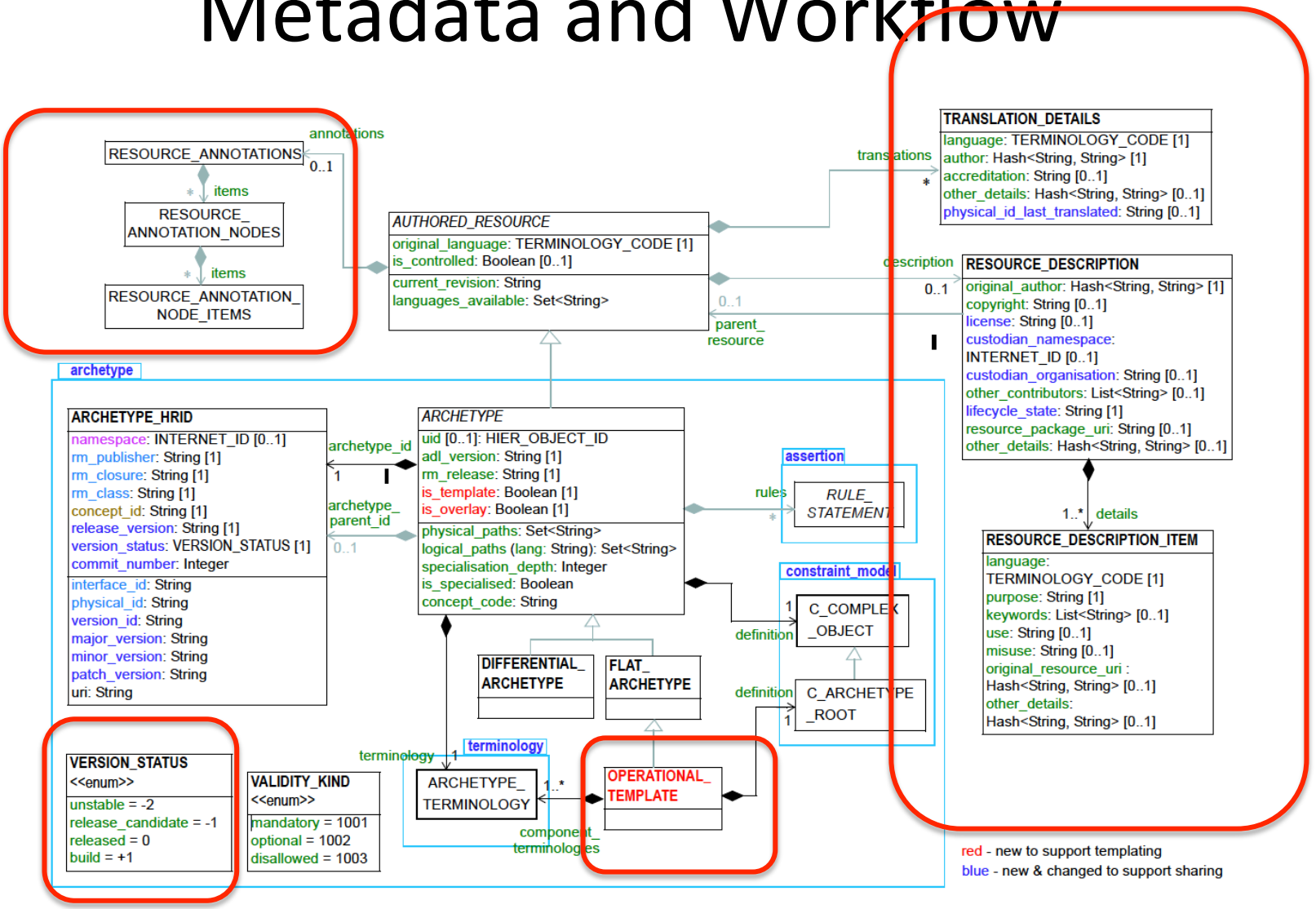



FIGURE 7 openehr.am.archetype Package

# AOM 1.5 Archetype "How"

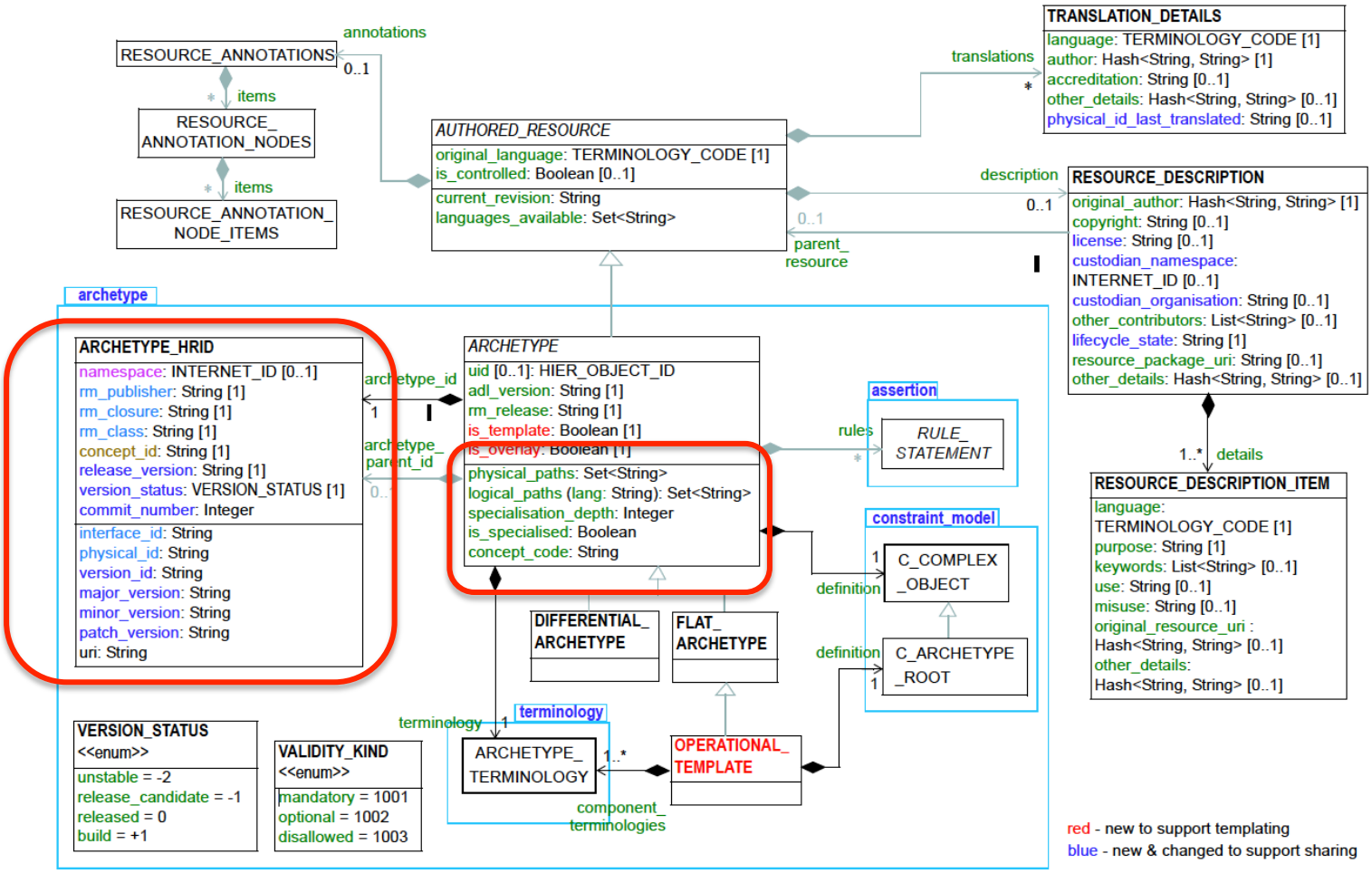
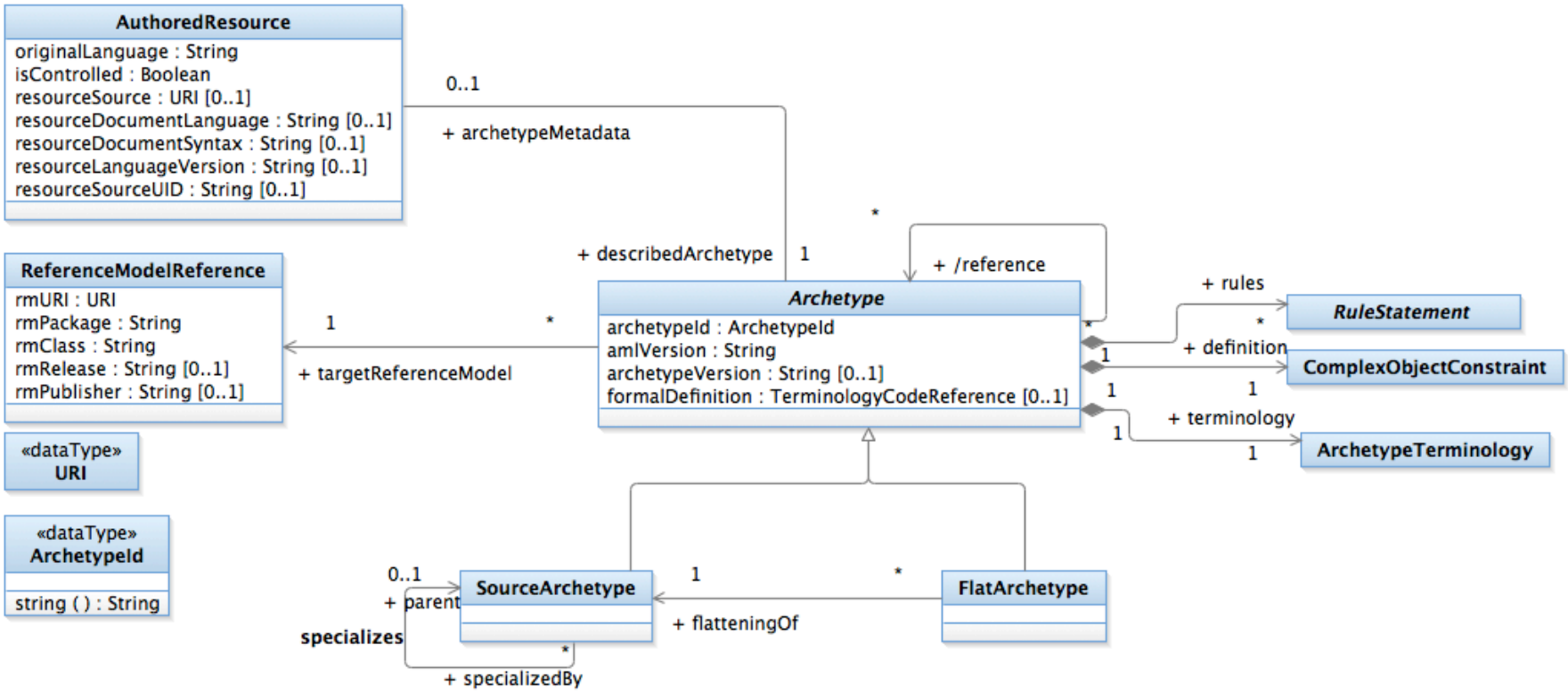



**FIGURE 7** openehr.am.archetype Package

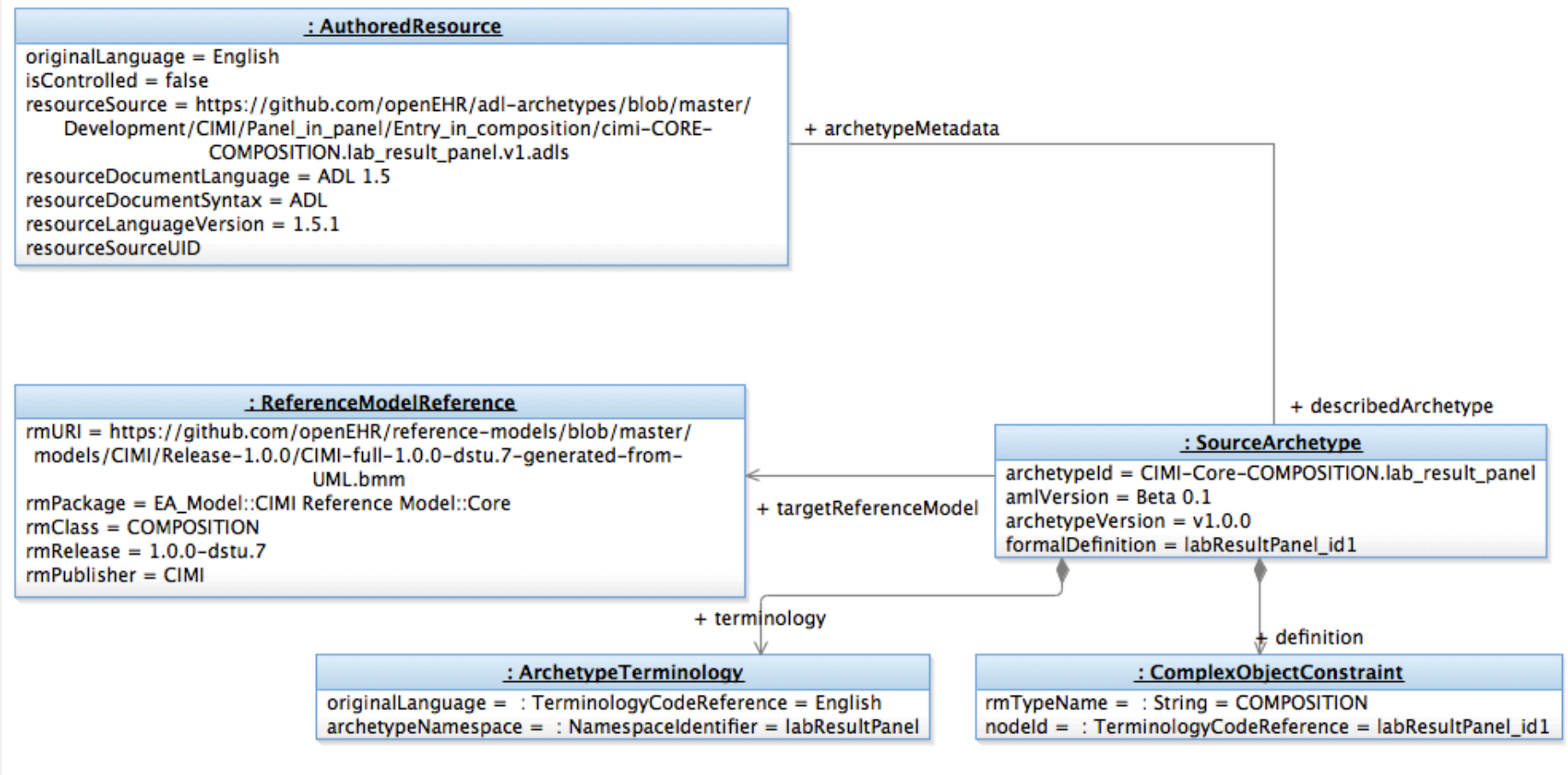
# AML 1.5 Archetype



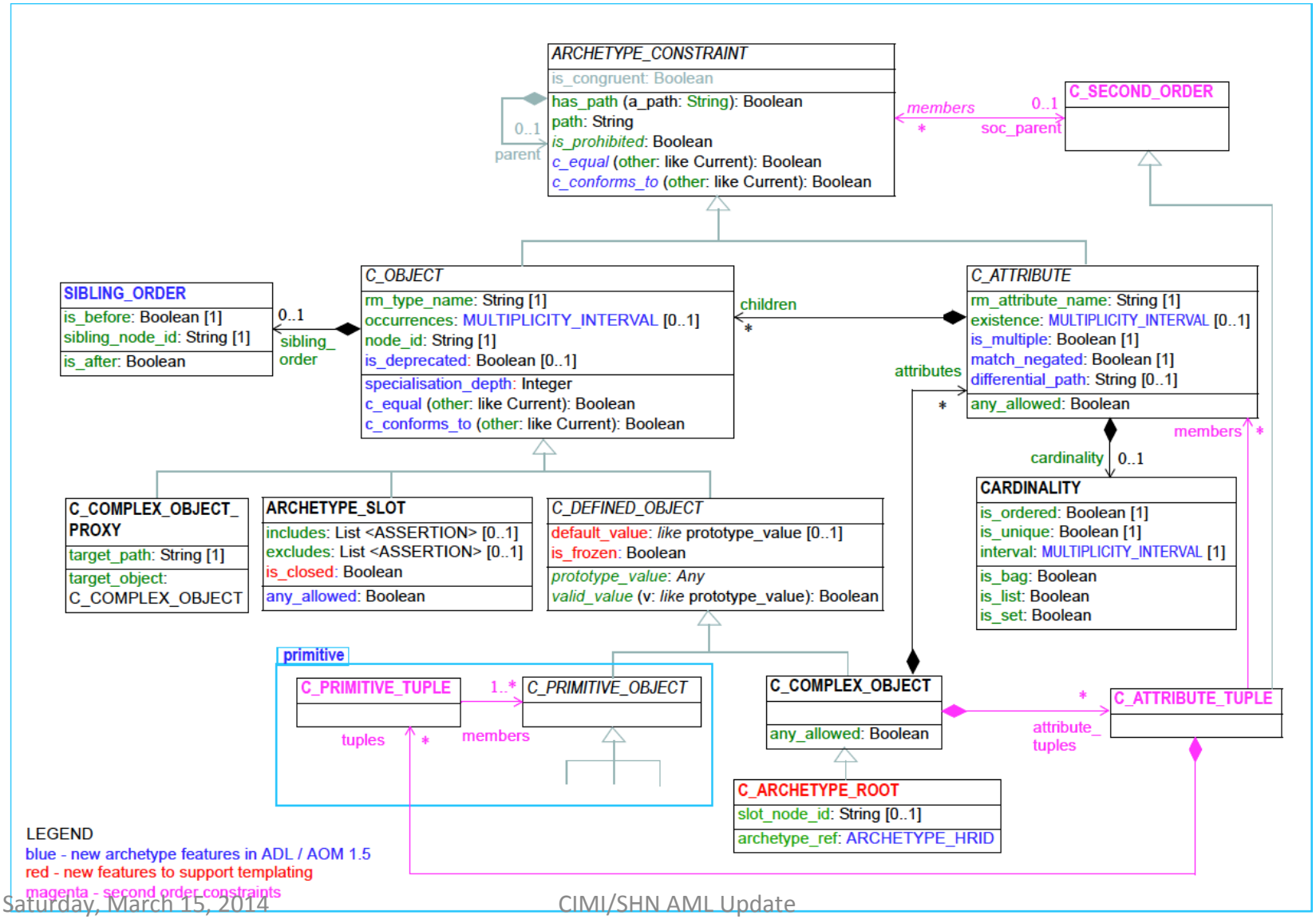
# ADL Example

```
archetype (adl_version=1.5.1)
    CIMI-Core-COMPOSITION.lab_result_panel.v1.0.0

language
    original_language = <[ISO_639-1::en]>

description
    original_author = <
        ["name"] = <"Thomas Beale">
        ["organisation"] = <"CIMI">
        ["email"] = <"thomas.beale@oceaninformatics.com">
        ["date"] = <"10/02/2014">
    >
    details = <
        ["en"] = <
            language = <[ISO_639-1::en]>
            purpose = <"CIMI Compund Entry that has slots for 'atomic' Entries">
            copyright = <"© 2014 CIMI">
        >
    >
    lifecycle_state = <"unmanaged">

definition
    COMPOSITION[id1] matches {  -- Multi-level panel
        participation matches {
```

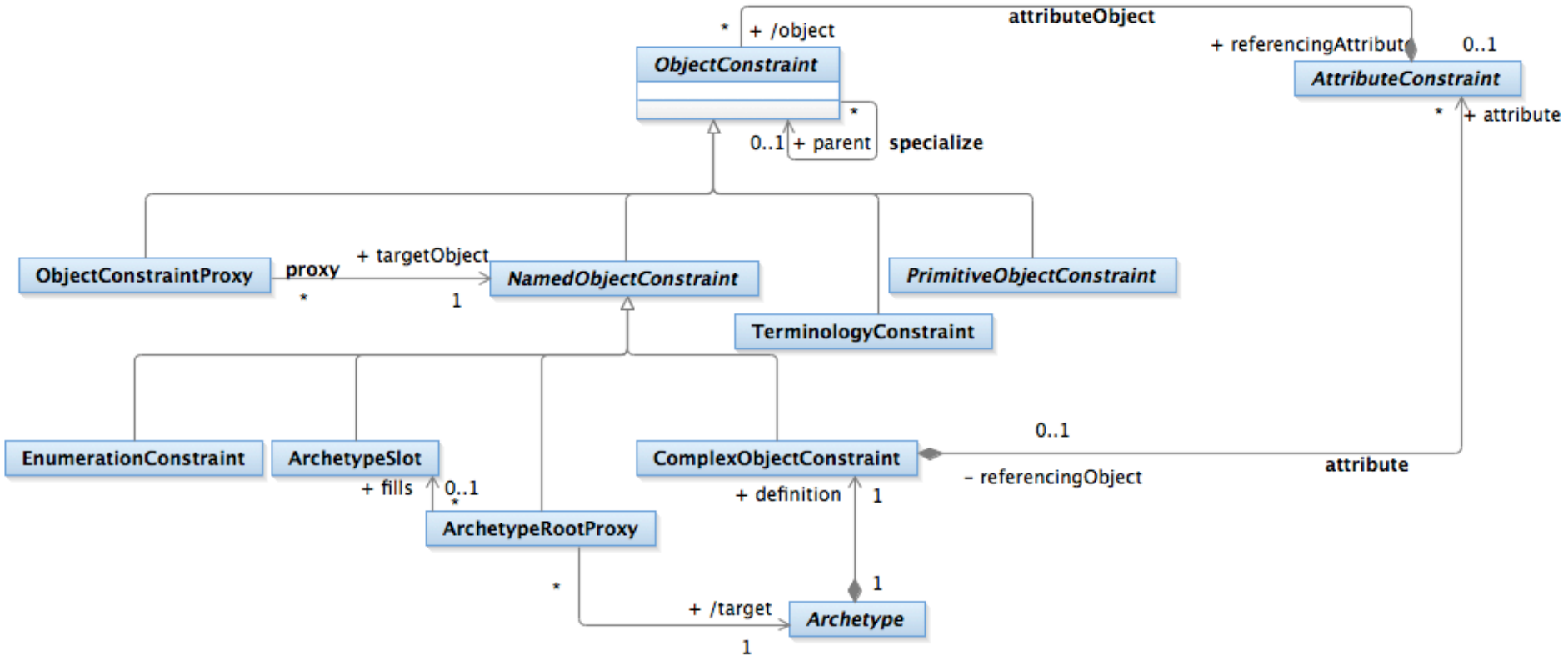
# ADL Metamodel Instance



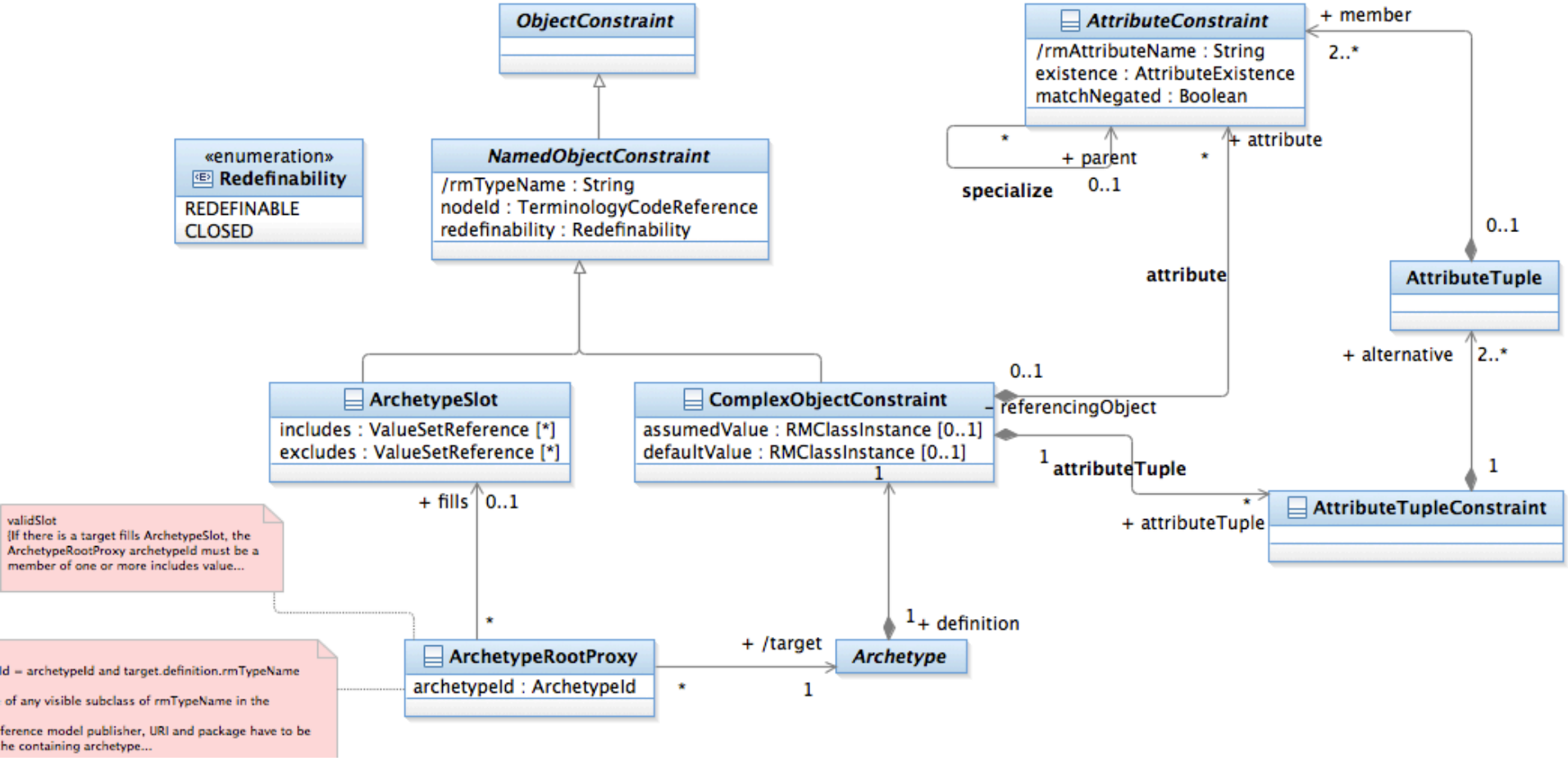
# AOM 1.5 Constraints



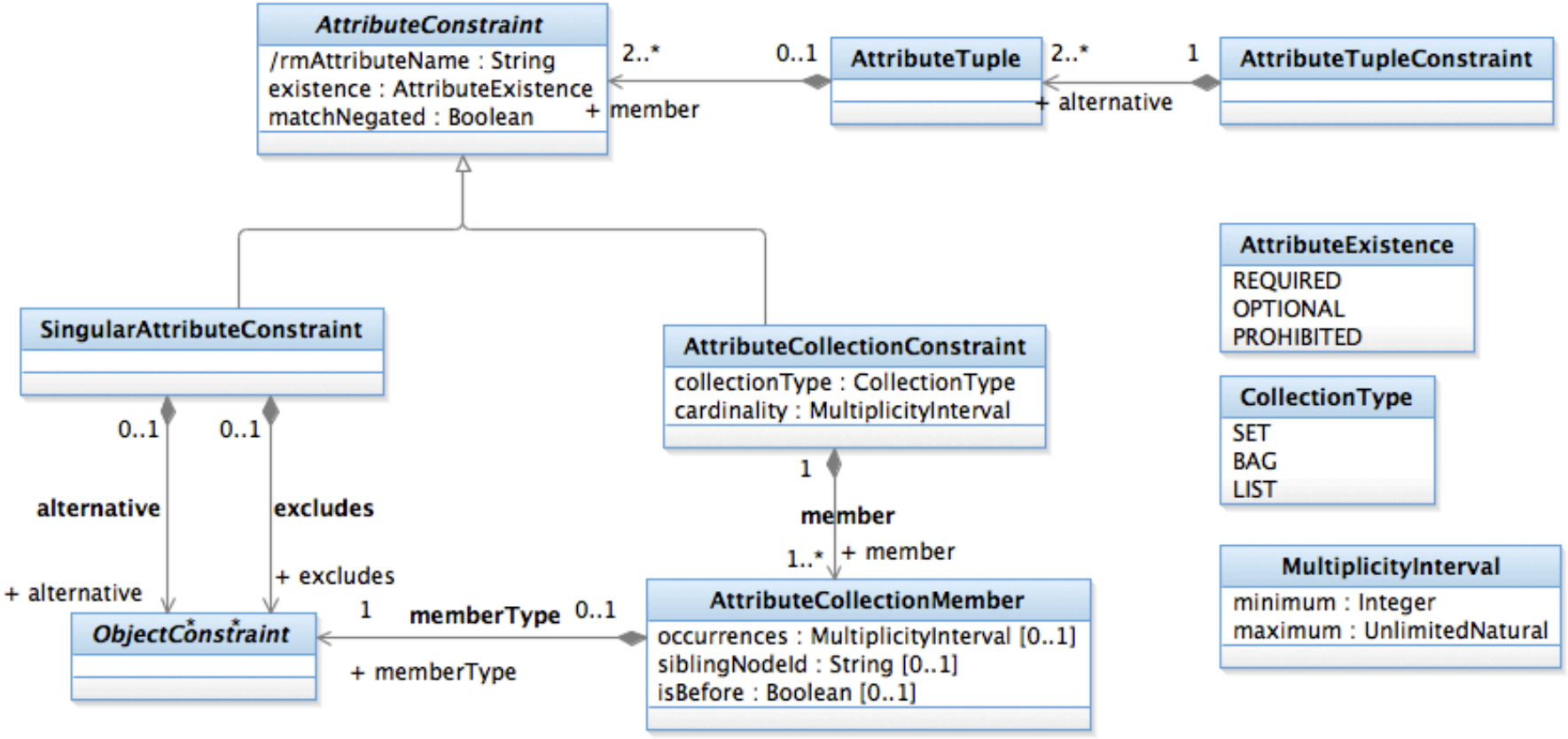
# Object Constraints



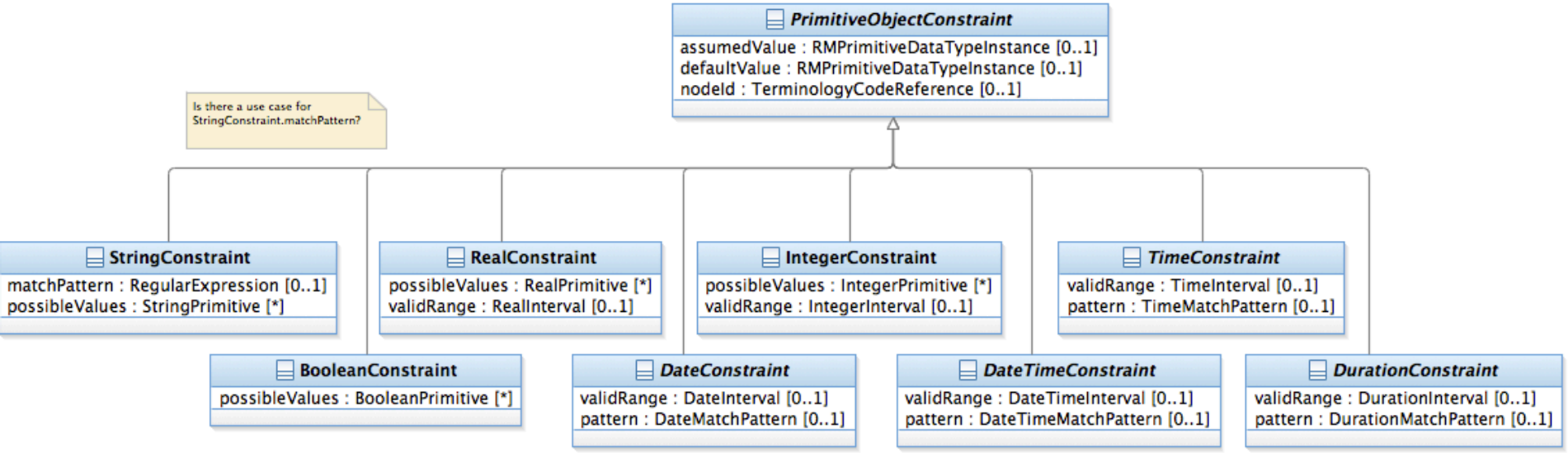
# Named Object Constraints



# Attribute Constraints



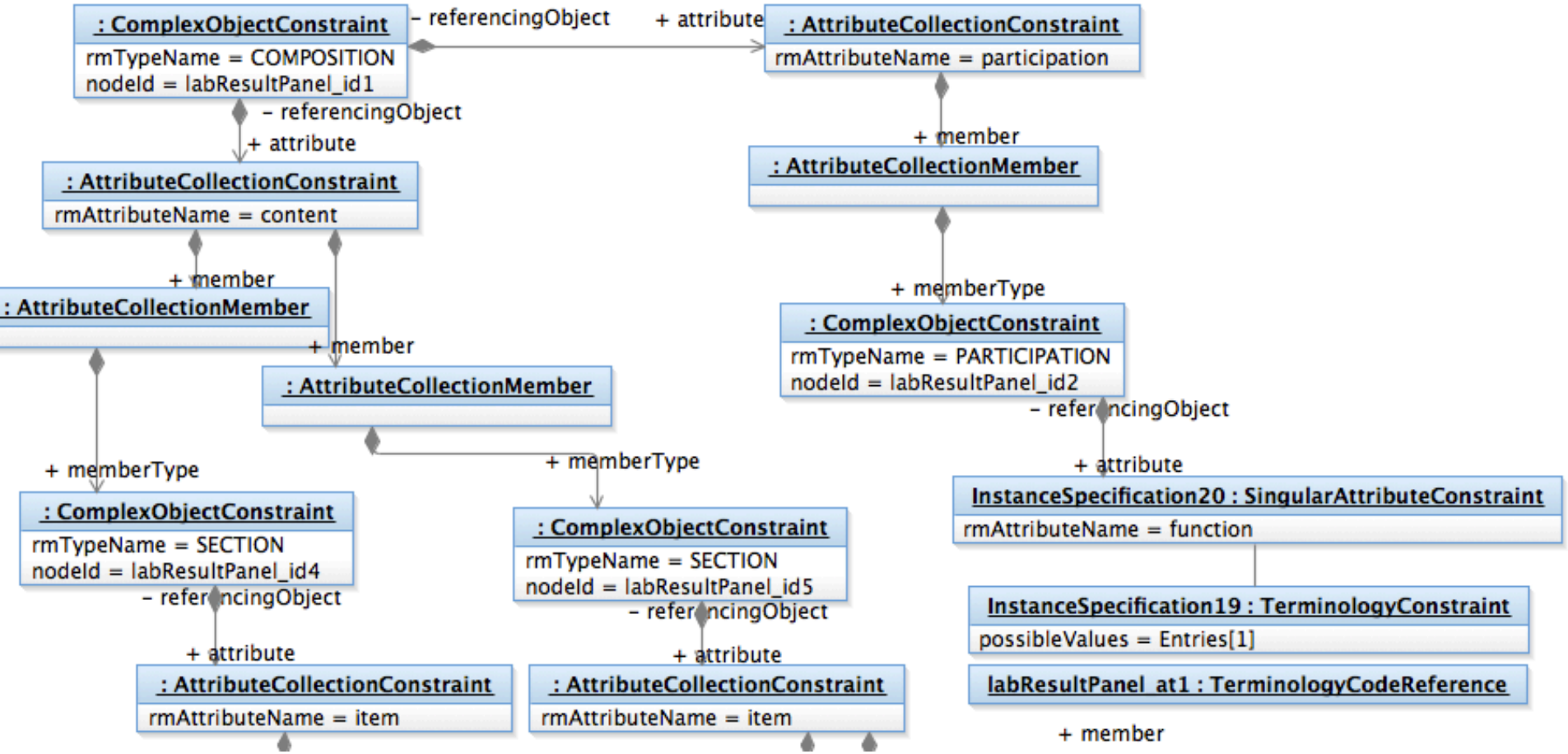
# Primitive Constraints



# Example

```
definition
    COMPOSITION[id1] matches {   -- Multi-level panel
        participation matches {
            PARTICIPATION[id2] matches { -- Panel Subject
                function matches {[at1]}
            }
        }
        content matches {
            SECTION[id4] matches {     -- Panel context
                item matches {
                    use_archetype ENTRY[CIMI-Core-ENTRY.panel_context.v1.0.0] occurrences
matches {1}
                }
            }
            SECTION[id5] matches {     -- Level 1 Panel items
                item matches {
                    allow_archetype ENTRY[id6] occurrences matches {0..*} matches {    -- Level 1
Panel item
                        include
                            archetype_id/value matches {/CIMI-Core-ENTRY\..*\.v1.*/}
                    }
                    SECTION[id7] matches {     -- Level 2 Panel items
```

# Example


: ComplexObjectConstraint
rmTypeName = COMPOSITION
nodeId = labResultPanel_id1
- referencingObject
+ attribute
: AttributeCollectionConstraint
rmAttributeName = participation
+ member
: AttributeCollectionMember
+ memberType
: ComplexObjectConstraint
rmTypeName = PARTICIPATION
nodeId = labResultPanel_id2
- referencingObject
+ attribute
InstanceSpecification20 : SingularAttributeConstraint
rmAttributeName = function
InstanceSpecification19 : TerminologyConstraint
possibleValues = Entries[1]
labResultPanel_at1 : TerminologyCodeReference
+ member
- referencingObject
+ attribute
: AttributeCollectionConstraint
rmAttributeName = content
+ member
: AttributeCollectionMember
+ memberType
: ComplexObjectConstraint
rmTypeName = SECTION
nodeId = labResultPanel_id4
- referencingObject
+ attribute
: AttributeCollectionConstraint
rmAttributeName = item
+ member
: AttributeCollectionMember
+ memberType
: ComplexObjectConstraint
rmTypeName = SECTION
nodeId = labResultPanel_id5
- referencingObject
+ attribute
: AttributeCollectionConstraint
rmAttributeName = item

# Examples

- Take pretty much every sample in ADL 1.5
- Represent in metamodel
  - Provides examples, documentation
  - Provides proof of mode
  - (Indirectly) provides mapping to ADL 1.5 and, indirectly AOM
- Metamodel → Profile
- (Re-) represent examples in profile
  - Same results as above

# TERMINOLOGY BINDING METAMODEL

# Approach

Archetypes Use Terminology as:

- (Object) Node Identifiers (!)
- Permissible values
  - Small sets (Enumerations)
  - Internal formal sets (Value sets)
  - External sets (Defined value sets)

# AOM 1.5

- Identifies where terminology is used in an archetype (‘binding’)
- Describes an ADL terminology (ontology) instance
  - Names, definitions, maps, sets
- Defines an API to access ADL (and any?) terminology?

# AOM Terminology Model

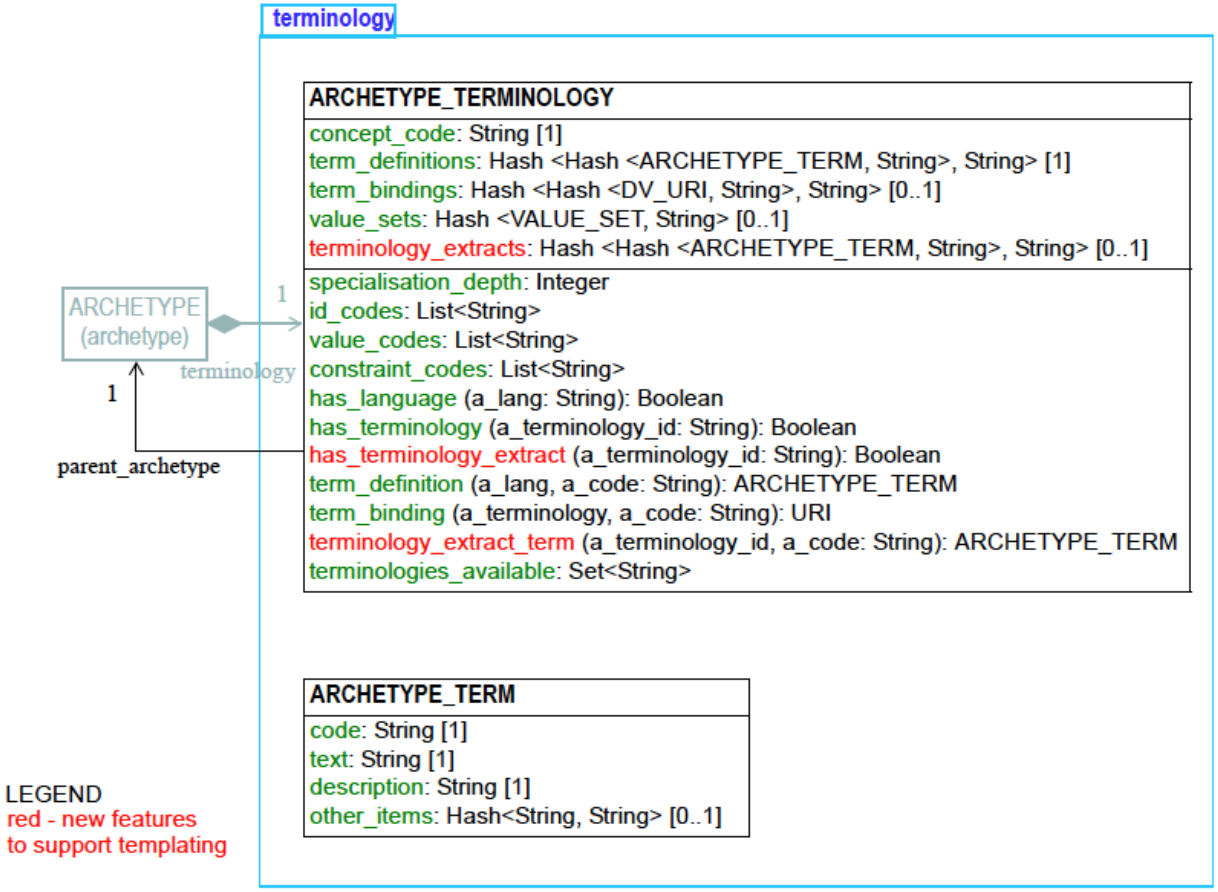



**FIGURE 20** openehr.am.archetype.terminology Package

# AOM Terminology Model

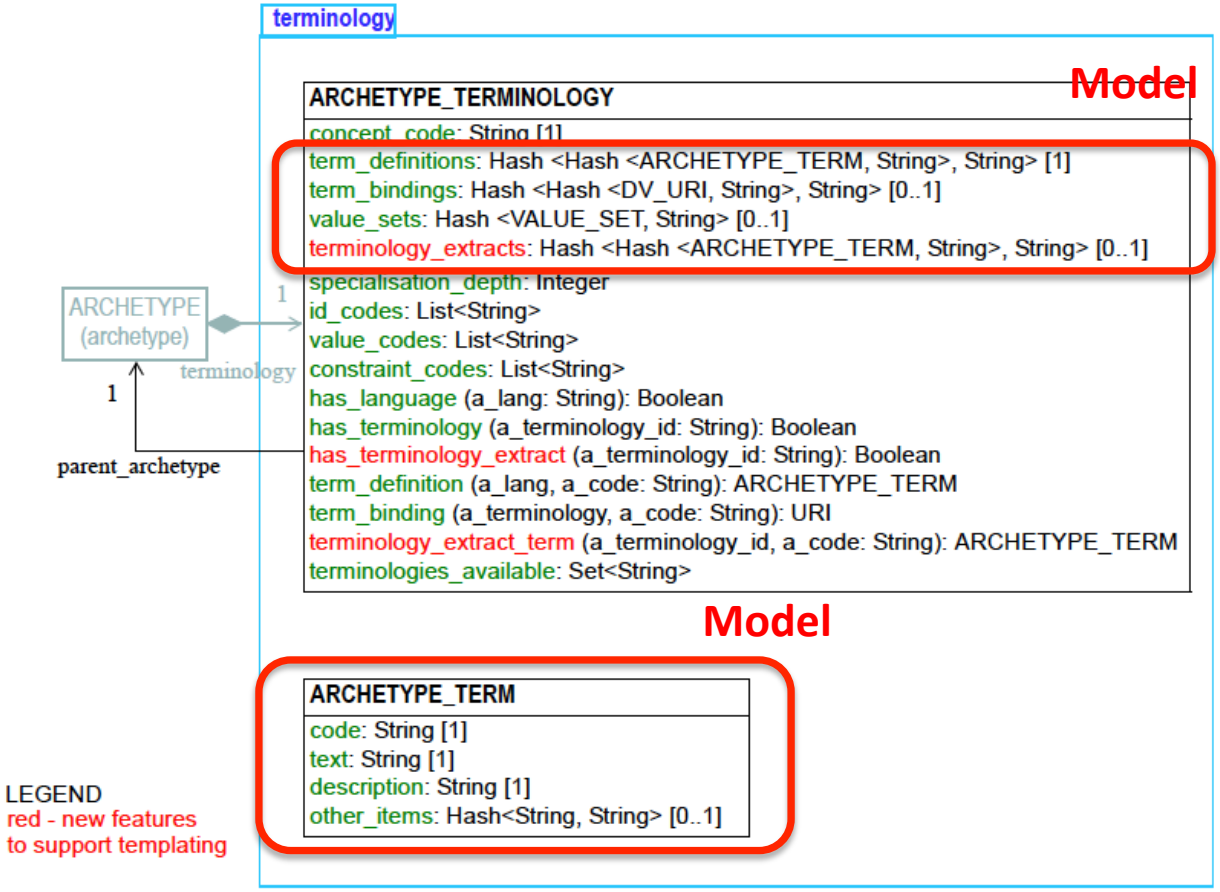



**FIGURE 20** openehr.am.archetype.terminology Package

# AOM Terminology Model

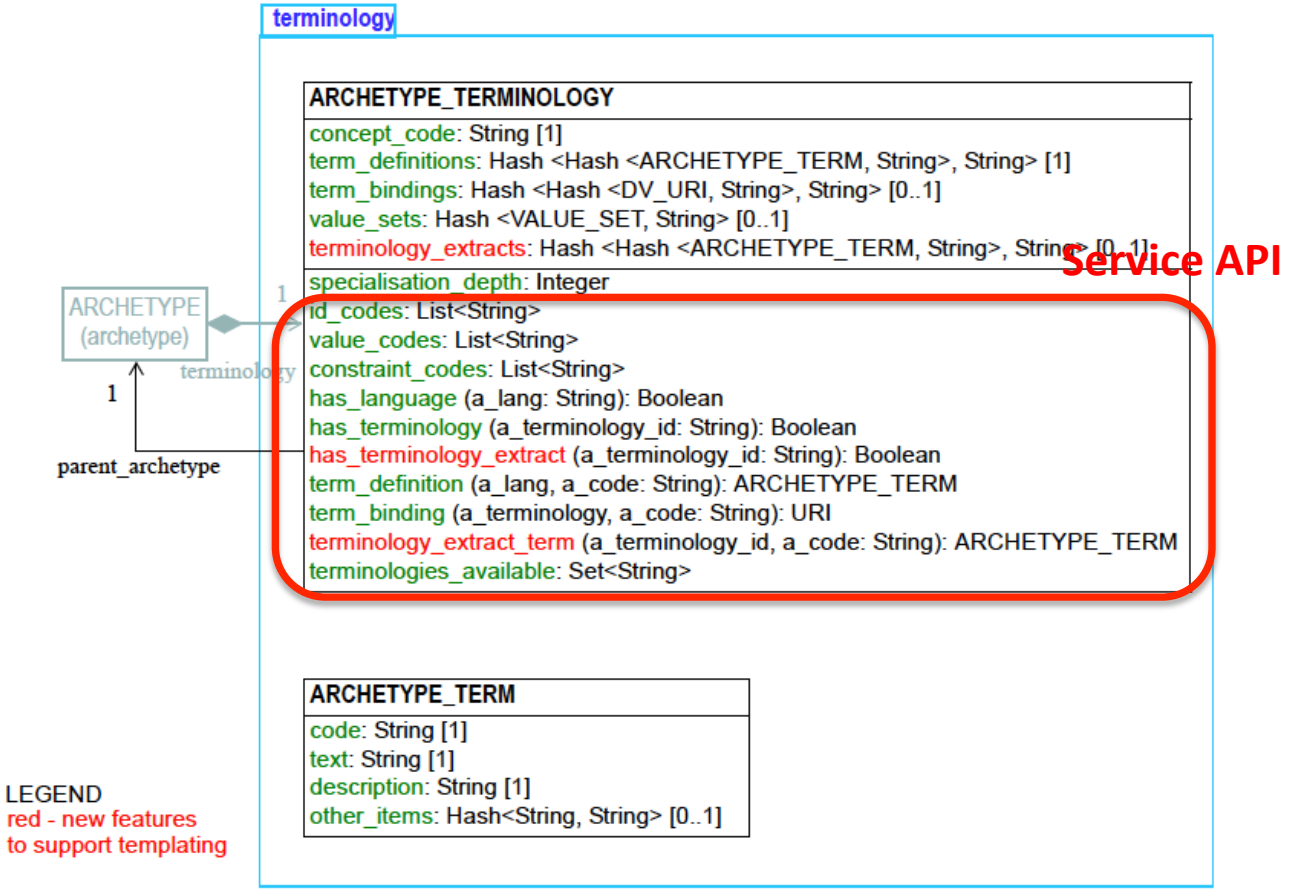
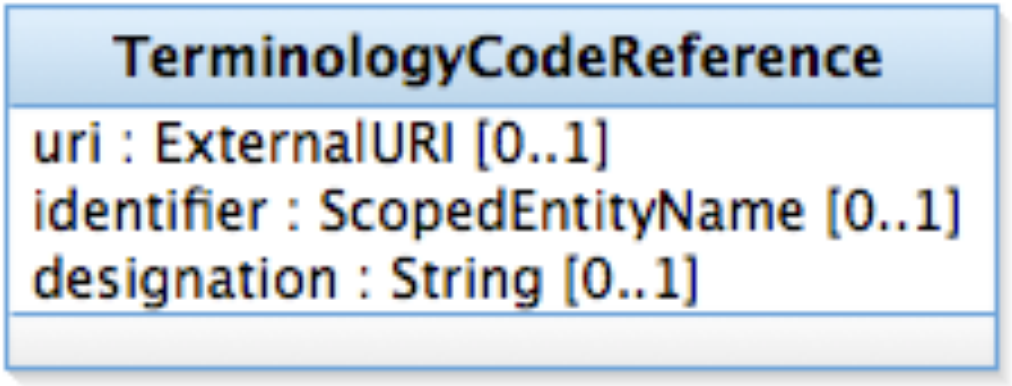
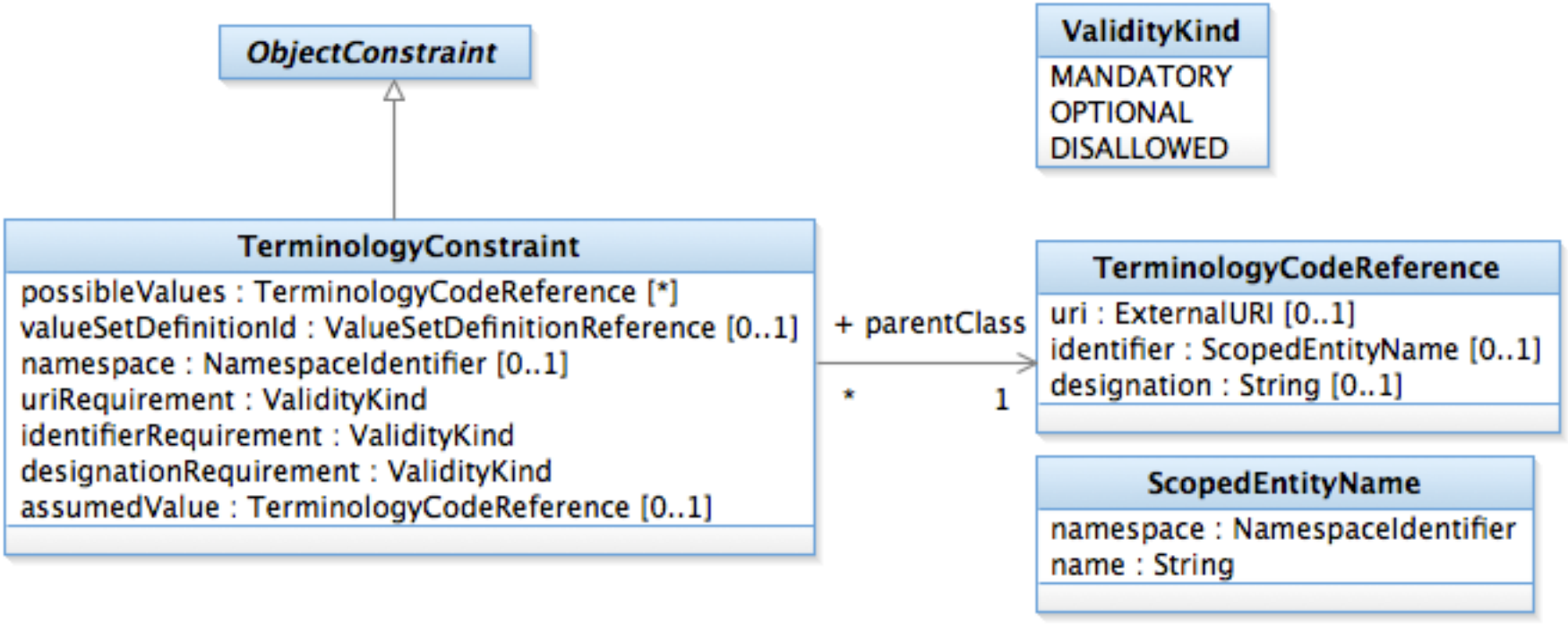



**FIGURE 20** openehr.am.archetype.terminology Package

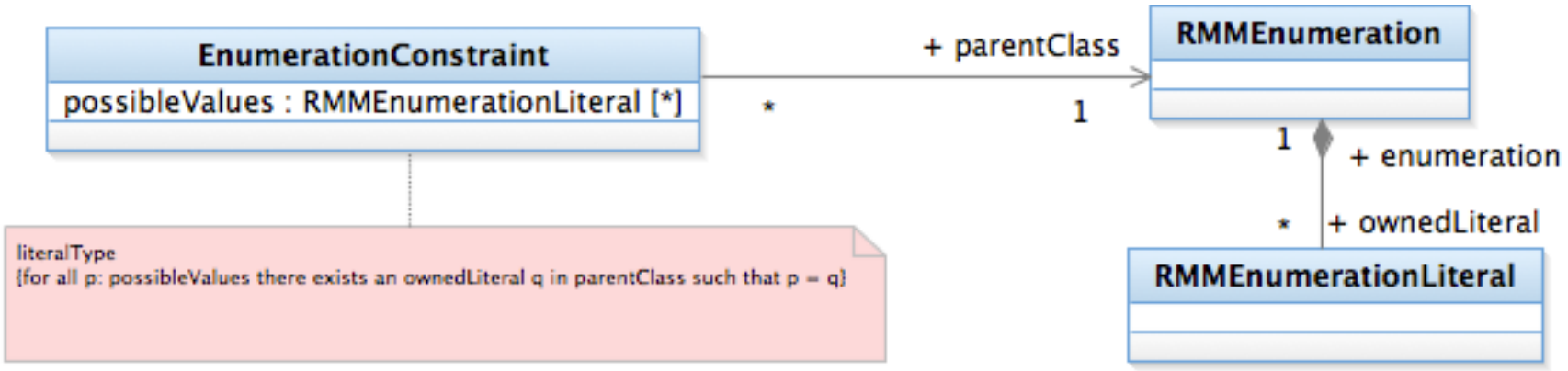
# TerminologyCodeReference "Primitive" Type



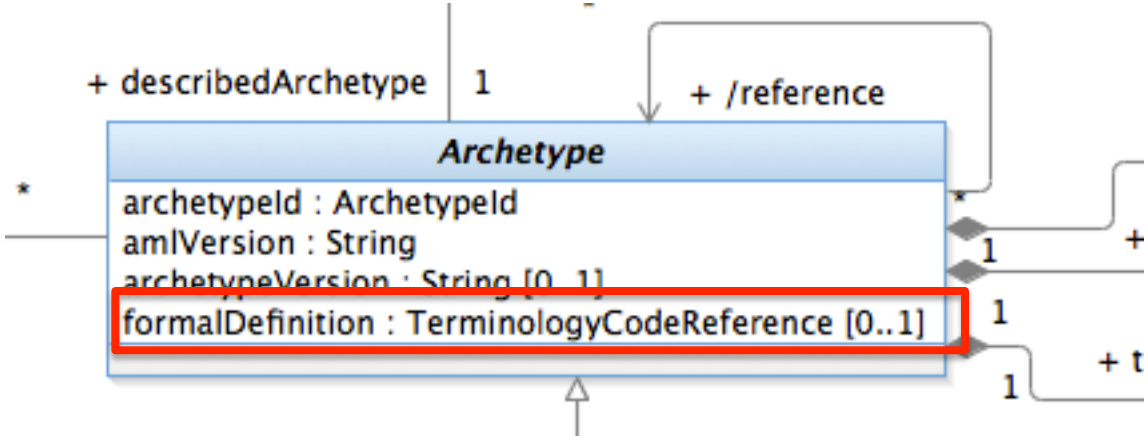
# Terminology Constraint



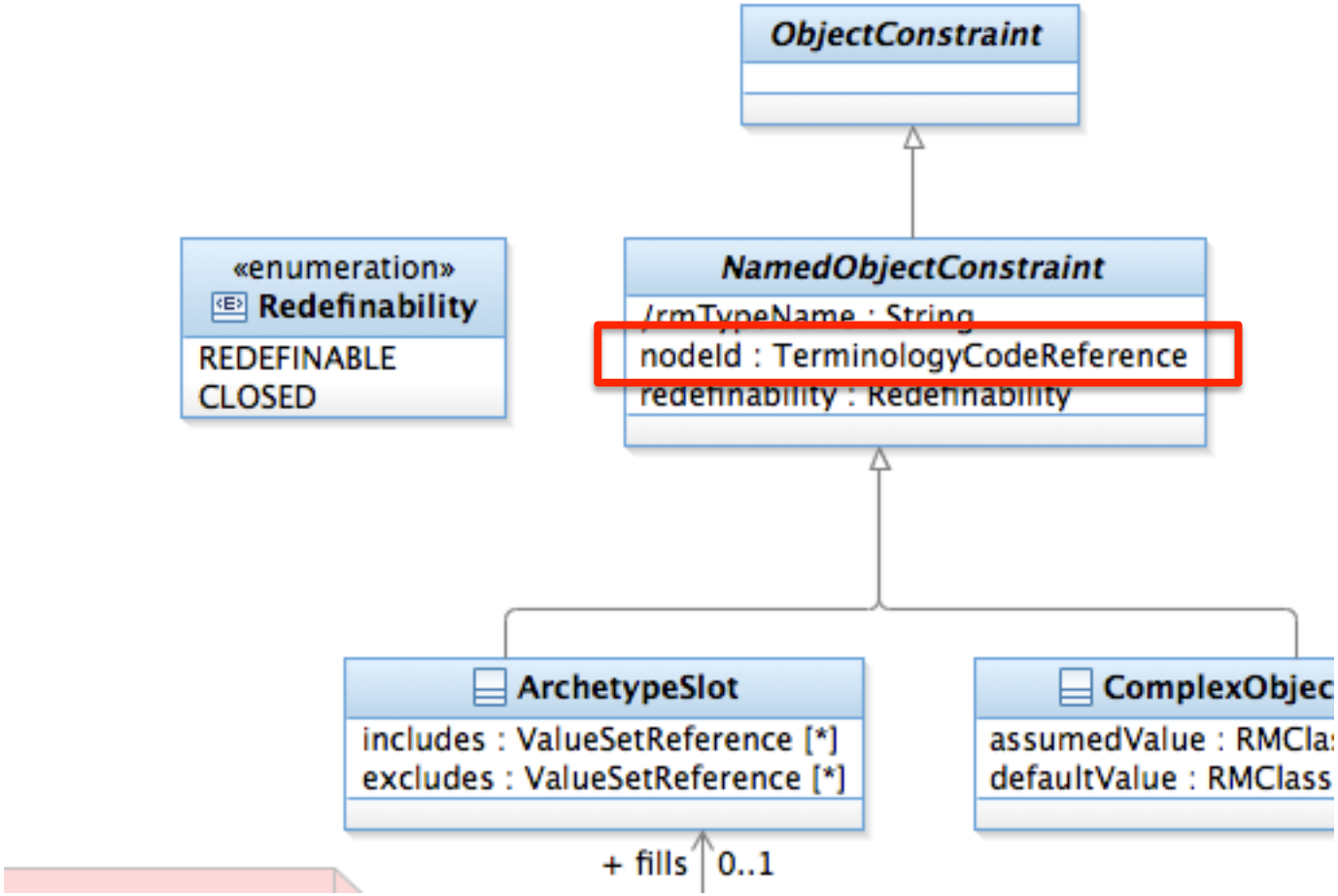
# Enumeration Constraint



# Terminology Binding Archetype Definition

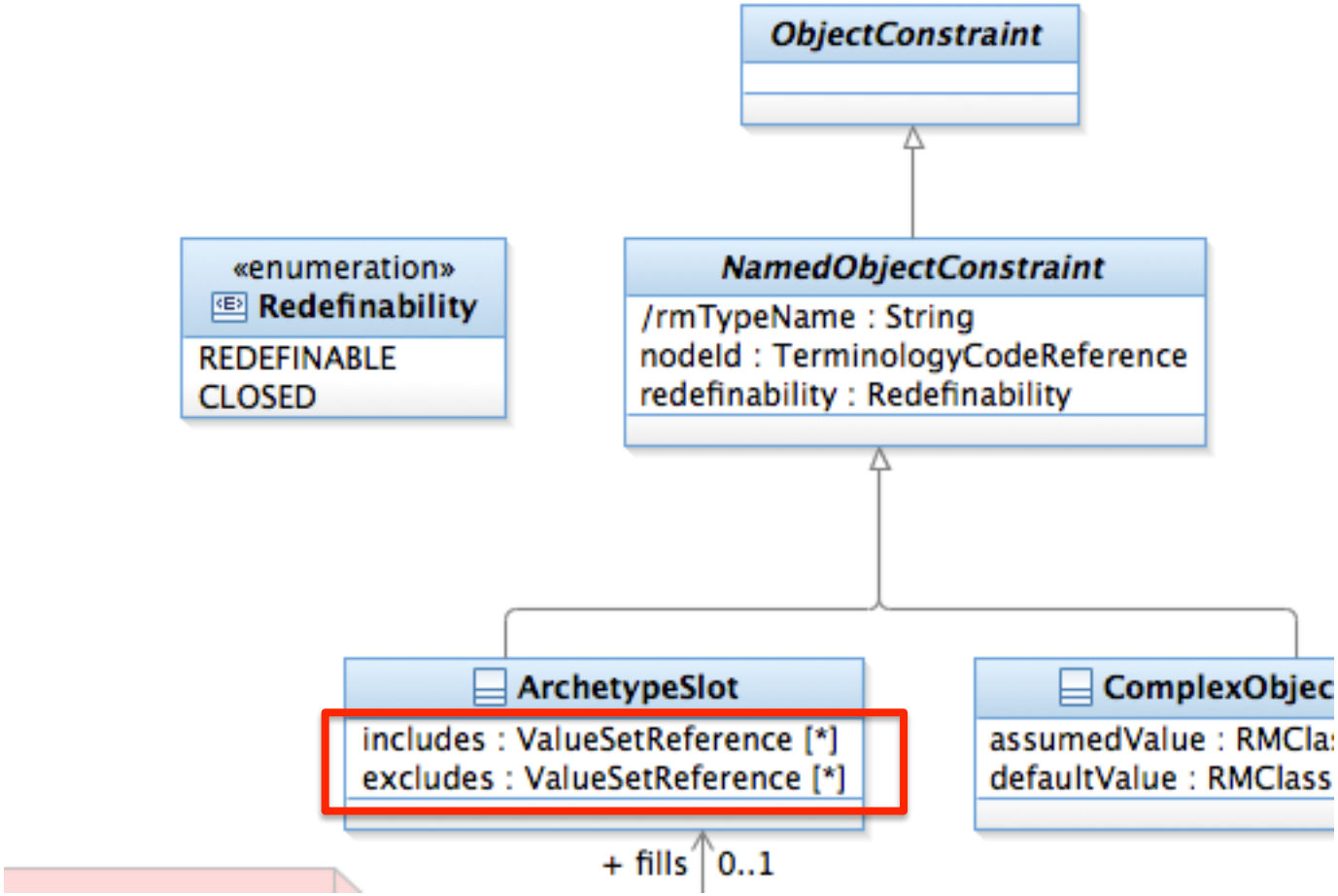


# Terminology Binding
## Object Constraint Identifier

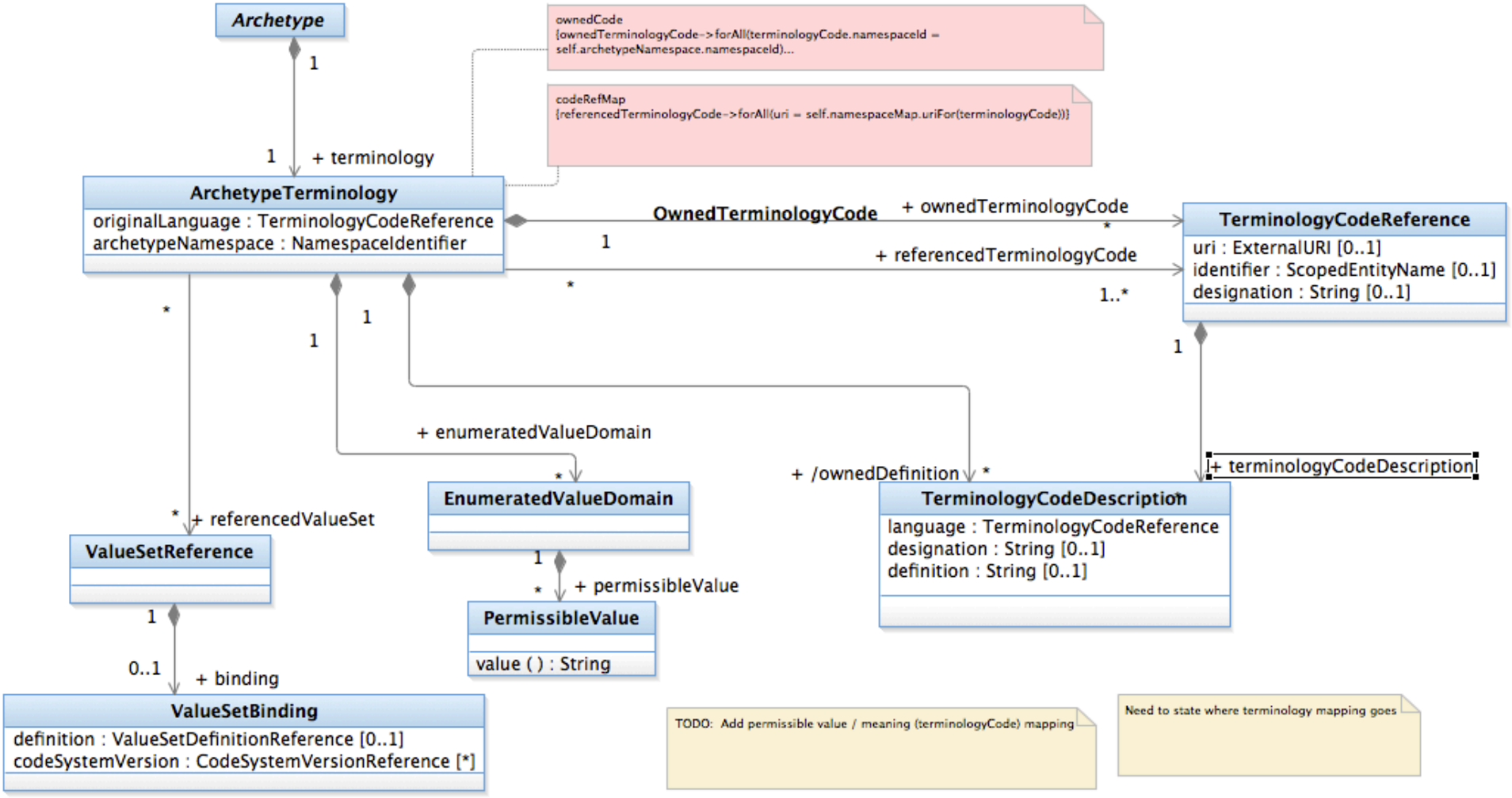


# Terminology Binding

## Archetype Slot Constraints



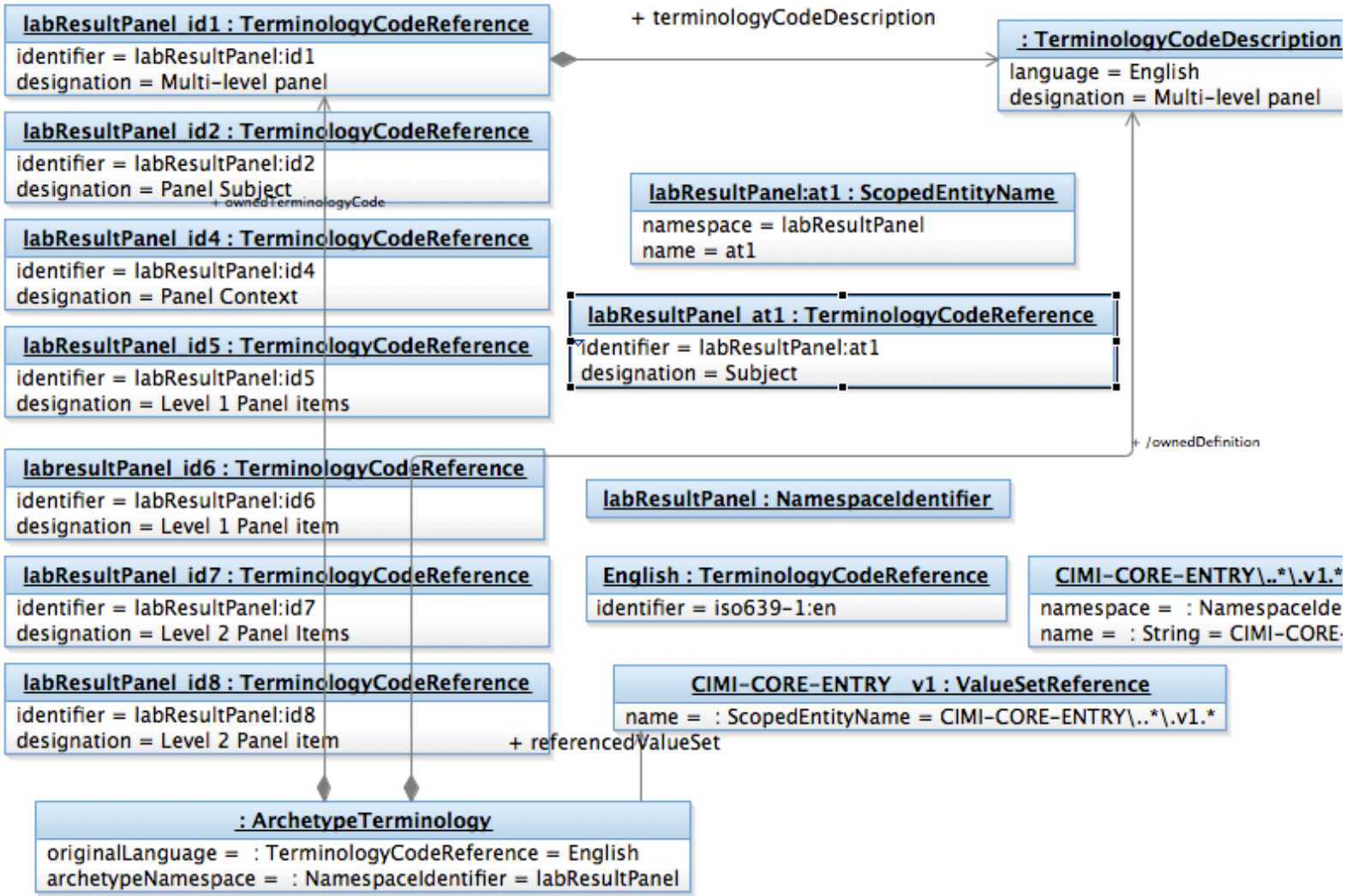
# Terminology Model



# Example

```
terminology
    term_definitions = <
        ["en"] = <
            ["id1"] = <
                text = <"Multi-level panel">
                description = <"Multi-level panel">
            >
            ["id2"] = <
                text = <"Panel Subject">
                description = <"Subject of panel">
            >
            ["id4"] = <
                text = <"Panel context">
                description = <"Panel context">
            >
            ["id5"] = <
                text = <"Level 1 Panel items">
                description = <"Level 1 Panel items">
            >
            ["id6"] = <
                text = <"Level 1 Panel item">
                description = <"Level 1 Panel item">
            >
            ["id7"] = <
                text = <"Level 2 Panel items">
                description = <"Level 2 Panel items">
            >
            ["id8"] = <
                text = <"Level 2 Panel item">
                description = <"Level 2 Panel item">
            >
            ["at1"] = <
                text = <"Subject">
                description = <"Subject">
            >
        >
    >
```

# Example


labResultPanel_id1 : TerminologyCodeReference
identifier = labResultPanel:id1
designation = Multi-level panel
+ terminologyCodeDescription
: TerminologyCodeDescription
language = English
designation = Multi-level panel
labResultPanel_id2 : TerminologyCodeReference
identifier = labResultPanel:id2
designation = Panel Subject
+ ownedTerminologyCode
labResultPanel:at1 : ScopedEntityName
namespace = labResultPanel
name = at1
labResultPanel_id4 : TerminologyCodeReference
identifier = labResultPanel:id4
designation = Panel Context
labResultPanel_at1 : TerminologyCodeReference
identifier = labResultPanel:at1
designation = Subject
labResultPanel_id5 : TerminologyCodeReference
identifier = labResultPanel:id5
designation = Level 1 Panel items
+ /ownedDefinition
labresultPanel_id6 : TerminologyCodeReference
identifier = labResultPanel:id6
designation = Level 1 Panel item
labResultPanel : NamespaceIdentifier
labResultPanel_id7 : TerminologyCodeReference
identifier = labResultPanel:id7
designation = Level 2 Panel Items
English : TerminologyCodeReference
identifier = iso639-1:en
CIMI-CORE-ENTRY\..*\.v1.*
namespace = : NamespaceIde
name = : String = CIMI-CORE
labResultPanel_id8 : TerminologyCodeReference
identifier = labResultPanel:id8
designation = Level 2 Panel item
CIMI-CORE-ENTRY_v1 : ValueSetReference
name = : ScopedEntityName = CIMI-CORE-ENTRY\..*\.v1.*
+ referencedValueSet
: ArchetypeTerminology
originalLanguage = : TerminologyCodeReference = English
archetypeNamespace = : NamespaceIdentifier = labResultPanel

# Terminology Services

- Subset of / compatible with CTS2
- Namespace – namespace ID ← → URI
- Entity – Read description /definition
- Association – specializes hierarchy
- ValueSet – Resolution, contains query
- Mapping – Between concepts

# STATE OF CURRENT SUBMISSION

# OMG Process

1) TC issues RFP – requirements document
2) Organizations submit responses
   1) Initial submission – draft responses shown, discussed.
   2) Final submission – (typically) one harmonized fesponse
3) Response(s) are balloted
4) Accepted response becomes a Beta Specification / Finalization Task Force formed
5) FTF report submitted and Beta Specification becomes a final specification.

Members Only

Public

AML

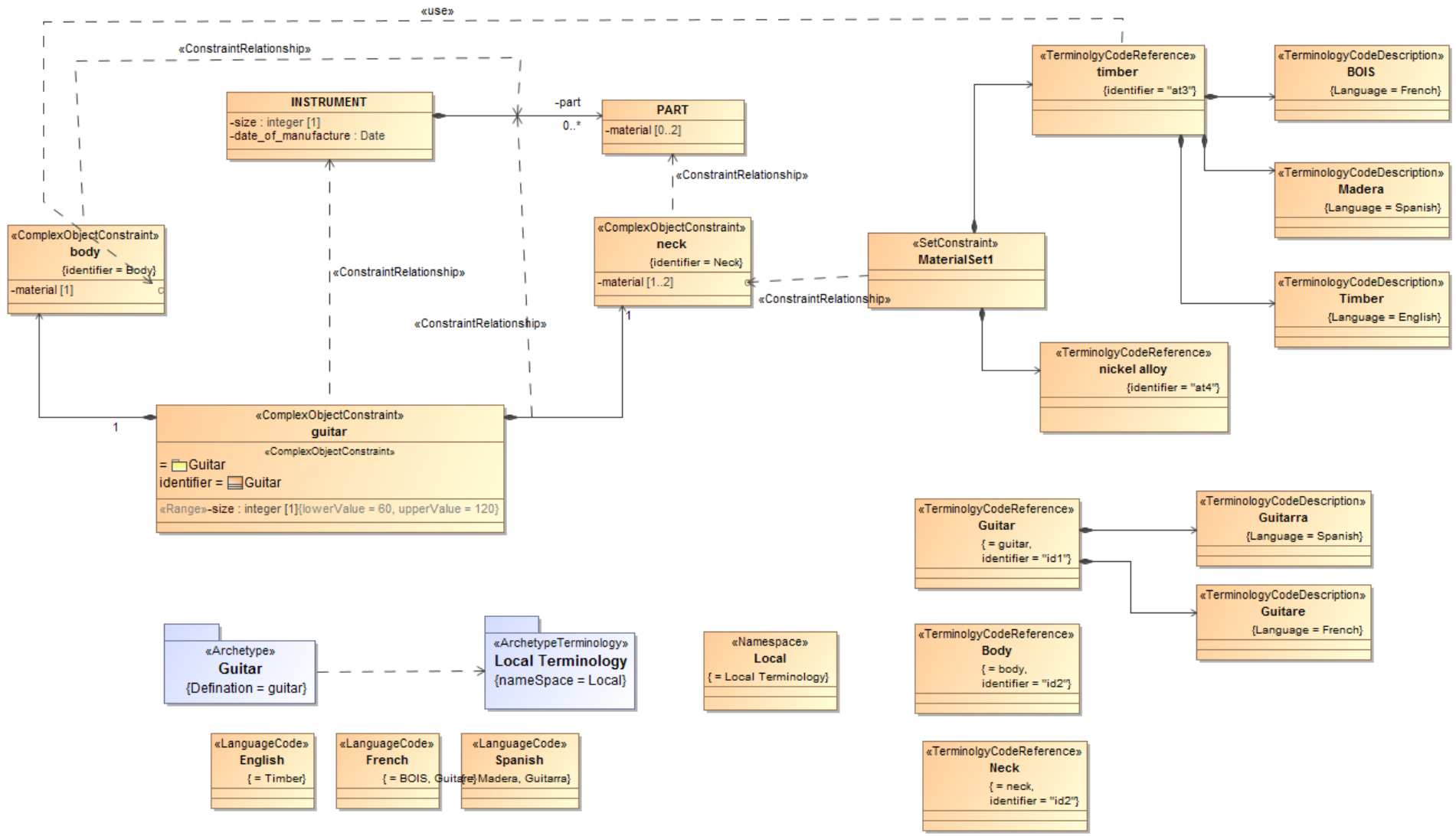
# Where we are

1) AML RFP Issued – June 2012
2) LOI Deadline – January 14, 2014
    1) VA, Mayo, SemantX, The Software Revolution, Visumpoint
3) Initial submission – Feb 24, 2014
    1) One joint submission received 

4) Submission presented to OMG – March 27, 2014
5) Revised submission – May 19, 2014

# Initial Submission

- Authored in RSA UML
- Converted to documentation by Deepak and BIRT
- Definitely rough – both format and content
  - Metamodel is close, still working on profiles
- Initial Draft of stereotypes continues to evolve


«use»
«ConstraintRelationship»
INSTRUMENT
-size : integer [1]
-date_of_manufacture : Date
-part
0..*
PART
-material [0..2]
«ConstraintRelationship»
«ComplexObjectConstraint»
body
{identifier = Body}
-material [1]
«ConstraintRelationship»
«ConstraintRelationship»
«ComplexObjectConstraint»
neck
{identifier = Neck}
-material [1..2]
«ConstraintRelationship»
«SetConstraint»
MaterialSet1
«TerminolgyCodeReference»
timber
{identifier = "at3"}
«TerminologyCodeDescription»
BOIS
{Language = French}
«TerminologyCodeDescription»
Madera
{Language = Spanish}
«TerminologyCodeDescription»
Timber
{Language = English}
«TerminolgyCodeReference»
nickel alloy
{identifier = "at4"}
1
1
«ComplexObjectConstraint»
guitar
«ComplexObjectConstraint»
= Guitar
identifier = Guitar
«Range»-size : integer [1]{lowerValue = 60, upperValue = 120}
«TerminolgyCodeReference»
Guitar
{ = guitar,
identifier = "id1"}
«TerminologyCodeDescription»
Guitarra
{Language = Spanish}
«TerminologyCodeDescription»
Guitare
{Language = French}
«Archetype»
Guitar
{Defination = guitar}
«ArchetypeTerminology»
Local Terminology
{nameSpace = Local}
«Namespace»
Local
{ = Local Terminology}
«TerminolgyCodeReference»
Body
{ = body,
identifier = "id2"}
«LanguageCode»
English
{ = Timber}
«LanguageCode»
French
{ = BOIS, Guitare}
«LanguageCode»
Spanish
{ = Madera, Guitarra}
«TerminolgyCodeReference»
Neck
{ = neck,
identifier = "id2"}

# Next Steps

- Minimal Staffing
  - ~1 FTE funded by Mayo Clinic / Chris Chute
  - 1 Admin Assistant funded by Accenture
  - Everything else (at this point) is strictly volunteer
- Next week will assess doability of June submission
  - May require additional resources

# References

**RFP**
http://www.omg.org/techprocess/meetings/schedule/AML_RFP.html

**Initial Submission**
http://www.omg.org/cgi-bin/doc?health/14-02-01

**ADL 1.5**
https://github.com/openEHR/specifications/blob/master/publishing/architecture/am/adl1.5.pdf

**AOM 1.5**
https://github.com/openEHR/specifications/blob/master/publishing/architecture/am/aom1.5.pdf

**UML 2.5**
http://www.omg.org/cgi-bin/doc?ptc/13-09-05.pdf

**SVN Repository**
https://www.projects.openhealthtools.org/svn/aml-spec/