

# FHIR RDF Sample side by side comparisons

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## Legend

Most of the RDF is generated by verbatim logic (e.g. An unidentified element becomes an anonymous individual - blank node).

Where RDF is generated by special transformation it is **marked in red**

Where RDF is inferred by a reasoner it is **marked in green**.

## 1 Primitive Datatypes (section 1.18.0.1)

Difference in the treatment of datatypes code, string and uri as classes with primitive values as rdf:Datatypes.

### 1.1 Subgroup example

#### 1.1.1 FHIR XML

```
<code>
<coding>
  <system value="http://example.org/local"/>
  <code value="admin"/>
  <display value="Admin"/>
</coding>
</code>
```

#### 1.1.2 FHIR CodeableConcept and Coding Structure Definition

CodeableConcept

```
<[name] xmlns="http://hl7.org/fhir">
  <!-- from Element: extension -->
  <coding><!-- 0..* Coding Code defined by a terminology system --></coding>
  <text value="[string]"/><!-- 0..1 Plain text representation of the concept -->
</[name]>
```

## 38 Coding

```
39 <[name] xmlns="http://hl7.org/fhir">
40 <!-- from Element: extension -->
41 <system value="[uri]"/><!-- 0..1 Identity of the terminology system -->
42 <version value="[string]"/><!-- 0..1 Version of the system - if relevant -->
43 <code value="[code]"/><!-- 0..1 Symbol in syntax defined by the system -->
44 <display value="[string]"/><!-- 0..1 Representation defined by the system -->
45 <primary value="[boolean]"/><!-- 0..1 If this code was chosen directly by the user -->
46 </[name]>
```

47

## 48 Code-primitive and code

```
49 <xs:simpleType name="code-primitive">
50 <xs:restriction base="xs:token">
51 <xs:minLength value="1"/>
52 </xs:restriction>
53 </xs:simpleType>
54 <xs:complexType name="code">
55 <xs:complexContent>
56 <xs:extension base="Element">
57 <xs:attribute name="value" type="code-primitive"/>
58 </xs:extension>
59 </xs:complexContent>
60 </xs:complexType>
61
```

62

## 63 Uri-primitive and uri

```
64 <xs:simpleType name="uri-primitive">
65 <xs:restriction base="xs:anyURI"/>
66 </xs:simpleType>
67 <xs:complexType name="uri">
68 <xs:complexContent>
69 <xs:extension base="Element">
70 <xs:attribute name="value" type="uri-primitive" use="optional"/>
71 </xs:extension>
72 </xs:complexContent>
73 </xs:complexType>
74
```

75

## 76 String-primitive and string

```
77 <xs:simpleType name="string-primitive">
78 <xs:restriction base="xs:string">
79 <xs:minLength value="1"/>
80 </xs:restriction>
81 </xs:simpleType>
82 <xs:complexType name="string">
83 <xs:complexContent>
84 <xs:extension base="Element">
85 <xs:attribute name="value" type="string-primitive" use="optional"/>
86 </xs:extension>
87 </xs:complexContent>
88 </xs:complexType>
```

### 89 1.1.3 RDF Data for Coding Instance

90 The RDF variant for `fhir:Code`, `fhir:Coding` and `fhir:CodeableConcept` are not straight translations of the FHIR  
91 representation. 2 new additional classes are introduced – `CodingThingy` and `CodeableThingy`. These names are  
92 temporary and need to be finalized.

93 Other Classes (locally defined) are added for the specific object properties of CodingThingy:  
94 CodingThingy.System, CodingThingy.Version, CodingThingy.Code, CodingThingy.Display, CodingThingy.Primary  
95 This obviates the need for CodeThingy which would be the equivalent of CodingThingy.Code.

```
96 xxx.code [ a fhir:CodeableConcept ;  
97   CodeableThingy.coding [ rdf:type fhir:CodingThingy ;  
98   fhir:CodingThingy.system [ a fhir:CodingThingy.System ; "fhir:value http://example.org/local"^^fhir:uri-  
99   primitive ] ;  
100   fhir:CodingThingy.code [ a fhir:CodingThingy.Code ; fhir:value "admin"^^fhir:code-primitive ] ;  
101   fhir:CodingThingy.display [ a fhir:CodingThingy.Display; fhir:value "Admin"^^fhir:string-primitive ] ;  
102 ] ;  
103 ] ;
```

104

105 The fhir:CodeableConcept type assertion (as a marker) allows round trip back to the original XML type. The same  
106 approach will be taken for fhir:Coding and fhir:code.

107 This approach will be implemented by creating CodeableThingy, CodingThingy and CodingThingy.xxx individuals  
108 as blank nodes.

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### 1.1.4 FHIR OWL Schema

```
#####  
#   Classes  
#####  
  
### http://hl7.org/fhir/CodeableThingy  
fhir:CodeableThingy rdf:type owl:Class ;  
    rdfs:subClassOf fhir:Element ,  
        [ rdf:type owl:Restriction ;  
          owl:onProperty fhir:CodeableThingy.coding ;  
          owl:allValuesFrom fhir:CodingThingy  
        ] ,  
        [ rdf:type owl:Restriction ;  
          owl:onProperty fhir:CodeableThingy.text ;  
          owl:onClass fhir:string ;  
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger  
        ] .  
  
### http://hl7.org/fhir/CodingThingy  
fhir:CodingThingy rdf:type owl:Class ;  
    rdfs:subClassOf fhir:Element ,  
        [ rdf:type owl:Restriction ;  
          owl:onProperty fhir:CodingThingy.display ;  
          owl:onClass fhir:CodingThingy.Display ;  
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger  
        ] ,  
        [ rdf:type owl:Restriction ;  
          owl:onProperty fhir:CodingThingy.version ;  
          owl:onClass fhir:CodingThingy.Version ;  
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger  
        ] ,  
        [ rdf:type owl:Restriction ;  
          owl:onProperty fhir:CodingThingy.primary ;  
          owl:onClass fhir:CodingThingy.Primary ;  
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger  
        ] ,  
        [ rdf:type owl:Restriction ;  
          owl:onProperty fhir:CodingThingy.system ;  
          owl:onClass fhir:CodingThingy.System ;  
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger  
        ] ,  
        [ rdf:type owl:Restriction ;  
          owl:onProperty fhir:CodingThingy.code ;  
          owl:onClass fhir:CodingThingy.Code ;  
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger  
        ] .
```

```

156   ### http://hl7.org/fhir/CodingThingy.Code
157   fhir:CodingThingy.Code rdf:type owl:Class ;
158       rdfs:subClassOf fhir:Element ,
159       [ rdf:type owl:Restriction ;
160         owl:onProperty fhir:value ;
161         owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
162         owl:onDataRange fhir:code-primitive
163       ] .
164
165   ### http://hl7.org/fhir/CodingThingy.Display
166   fhir:CodingThingy.Display rdf:type owl:Class ;
167       rdfs:subClassOf fhir:Element ,
168       [ rdf:type owl:Restriction ;
169         owl:onProperty fhir:value ;
170         owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
171         owl:onDataRange fhir:string-primitive
172       ] .
173
174   ### http://hl7.org/fhir/CodingThingy.Primary
175   fhir:CodingThingy.Primary rdf:type owl:Class ;
176       rdfs:subClassOf fhir:Element ,
177       [ rdf:type owl:Restriction ;
178         owl:onProperty fhir:value ;
179         owl:someValuesFrom fhir:boolean-primitive
180       ] .
181
182   ### http://hl7.org/fhir/CodingThingy.System
183   fhir:CodingThingy.System rdf:type owl:Class ;
184       rdfs:subClassOf fhir:Element ,
185       [ rdf:type owl:Restriction ;
186         owl:onProperty fhir:value ;
187         owl:someValuesFrom fhir:uri-primitive
188       ] .
189
190   ### http://hl7.org/fhir/CodingThingy.Version
191   fhir:CodingThingy.Version rdf:type owl:Class ;
192
193       rdfs:subClassOf fhir:Element ,
194       [ rdf:type owl:Restriction ;
195         owl:onProperty fhir:value ;
196         owl:someValuesFrom fhir:string-primitive
197       ] .

```

198 Finally we can define the types from FHIR:

```

199 ### http://hl7.org/fhir/CodeableConcept
200 fhir:CodeableConcept rdf:type owl:Class ;
201     rdfs:subClassOf fhir:CodeableThingy ;
202     rdfs:comment "The set of possible coded values this coding was chosen from or constrained
203 by." .
204
205 ### http://hl7.org/fhir/Coding
206 fhir:Coding rdf:type owl:Class ;
207
208     rdfs:subClassOf fhir:CodeableThingy ,
209     [ rdf:type owl:Restriction ;
210       owl:onProperty fhir:CodeableThingy.coding ;
211       owl:onClass fhir:CodingThingy ;
212       owl:qualifiedCardinality "1"^^xsd:nonNegativeInteger
213     ] ,
214     [ rdf:type owl:Restriction ;
215       owl:onProperty fhir:CodeableThingy.text ;
216       owl:onClass fhir:string ;
217       owl:maxQualifiedCardinality "0"^^xsd:nonNegativeInteger
218     ] .
219
220 ### http://hl7.org/fhir/code
221
222 fhir:code rdf:type owl:Class ;
223
224     rdfs:subClassOf fhir:CodeableThingy ,
225     [ rdf:type owl:Restriction ;
226       owl:onProperty fhir:CodeableThingy.coding ;
227       owl:onClass [ rdf:type owl:Class ;
228         owl:intersectionOf ( fhir:CodingThingy
229           [ rdf:type owl:Restriction ;
230             owl:onProperty fhir:CodingThingy.display ;
231             owl:onClass fhir:CodingThingy.Display ;
232             owl:maxQualifiedCardinality "0"^^xsd:nonNegativeInteger
233           ]
234           [ rdf:type owl:Restriction ;
235             owl:onProperty fhir:CodingThingy.primary ;
236             owl:onClass fhir:CodingThingy.Primary ;
237             owl:maxQualifiedCardinality "0"^^xsd:nonNegativeInteger
238           ]
239           [ rdf:type owl:Restriction ;
240             owl:onProperty fhir:CodingThingy.system ;
241             owl:onClass fhir:CodingThingy.System ;
242             owl:maxQualifiedCardinality "0"^^xsd:nonNegativeInteger
243           ]
244           [ rdf:type owl:Restriction ;
245             owl:onProperty fhir:CodingThingy.version ;
246             owl:onClass fhir:CodingThingy.Version ;
247             owl:maxQualifiedCardinality "0"^^xsd:nonNegativeInteger
248           ]
249         )
250       ] ;
251     owl:qualifiedCardinality "1"^^xsd:nonNegativeInteger
252 ] .
253

```

### 254 1.1.5 Proposed Naming

255 Here is a proposed set of names that aligns with the SNOMED CT names.

256 fhir:CodeableThingy becomes a **fhir:Concept** (this is distinct from the ValueSet.Concept although related)

257 fhir:CodingThingy becomes a **fhir:Term** – a Concept represented in a specific terminology system

258 fhir:codeThingy becomes a fhir:Term.Code thereby internally declared to Term.

259 fhir:Term.Display, fhir:Term.System, fhir:Term.Version, fhir:Term.Primary are added

260 All the object properties of fhir:Term have ranges of **Term.Code**, **Term.Display**, **Term.System**, **Term.Version** and  
261 **Term.Primary**. This allows greater control of the classes as opposed to the general use of fhir:URI and fhir:String.

```
262 xxx.code [ a fhir:CodeableConcept ;  
263   fhir:Concept.term [ rdf:type fhir:Term;  
264     fhir:Term.system [ a fhir:Term.System ; "fhir:value http://example.org/local"^^fhir:uri-primitive ] ;  
265     fhir:Term.code [ a fhir:Term.Code ; fhir:value "admin"^^fhir:code-primitive ] ;  
266     fhir:Term.display [ a fhir:Term.Display ; fhir:value "Admin"^^fhir:string-primitive ] ;  
267   ] ;  
268 ] ;
```

269

## 270 **2 Concept Binding external (section 1.17.3.3.5)**

### 271 **2.1 Github example**

```
272 @prefix loinc: <http://loinc.org/owl#> .  
273 :resource a fhir:Observation;  
274   fhir:Observation.code [  
275     fhir:CodeableConcept.coding [  
276       fhir:Coding.system <http://loinc.org>;  
277       fhir:Coding.code "54411-4";  
278       fhir:Coding.display "Rh immune globulin given Qualitative";  
279       ex:concept loinc:54411-4;  
280     ] ;  
281     fhir:CodeableConcept.text "Rh immune globulin";  
282   ] .
```

283 Extension adds a new object property “concept” which points to an instance “http://loinc.org/owl#54411-4”  
284 which has a type - probably http://loinc.org/54411-4 which returns Turtle for the type not the HTML  
285 description. Notice that Coding instance is not typed but could be inferred from the range of  
286 CodeableConcept.coding.

### 287 **2.2 Subgroup example**

#### 288 **2.2.1 FHIR XML**

289 The following is a Resource instance fragment in FHIR XML showing the equivalent example:

```
290 <Observation xmlns="http://hl7.org/fhir">  
291   <code>  
292     <coding>  
293       <system value="http://Loinc.org"/>  
294       <code value="54411-4"/>  
295       <display value=" Rh immune globulin given Qualitative "/>  
296     </coding>  
297     <text value="Rh immune globulin"/>  
298   </code>  
299   .....
```

#### 300 **2.2.2 FHIR Structure definition**

301 See section 1.2.2

## 302 2.2.3 RDF Data with Terminology blank nodes in RDF

```
303 @prefix loinc: <http://loinc.org/> .  
304 @prefix fhir: <http://hl7.org/fhir/> .  
305 <sourceNamespace/Observation/resource.id> a fhir:Observation;  
306   fhir:CodeableThingy.code [ a fhir:CodeableConcept , <http://loinc.org/54411-4> ;  
307     fhir:CodeableThingy.coding [ a fhir:CodingThingy , <http://loinc.org/54411-4> ;  
308       fhir:CodingThingy.system [fhir:value "http://loinc.org"^^fhir:uri-primitive ] ;  
309       fhir:CodingThingy.code [fhir:value "54411-4"^^fhir:code-primitive ] ;  
310       fhir:CodingThingy.display [fhir:value "Rh immune globulin given Qualitative"^^fhir:string-primitive ] ;  
311     ];  
312   fhir:CodeableThingy.text [fhir:value "Rh immune globulin" ]  
313 ] .
```

314 sourceNamespace is the namespace from which the resource instance came. Resource.id is the unique name of  
315 the Observation instance within the source namespace and type (Observation).

316 The type on the CodingThingy instance is calculated based on the formation of the URL for that terminology. The  
317 type in the CodingThingy instance is carried up to the CodeableThingy blank node.

## 318 2.3 Allergy Intolerance Subgroup Example

### 319 2.3.1 FHIR XML

```
320 <AllergyIntolerance xmlns=http://hl7.org/fhir >  
321   <id value="1"/>  
322   <text>  
323  
324   </text>  
325   <!-- the date that this entry was recorded -->  
326   <recordedDate value="2010-03-01"/>  
327   <!-- the patient that actually has the risk of adverse reaction -->  
328   <patient>  
329     <reference value="http://record/Patient/PeterPatient"/>  
330     <display value="Peter Patient"/>  
331   </patient>  
332   <!-- substance, coded from SNOMED CT-->  
333   <substance>  
334     <coding>  
335       <system value="http://snomed.info/id/">  
336       <code value="90614001"/>  
337       <display value="beta-Lactam antibiotic"/>  
338     </coding>  
339   </substance>  
340   <status value="confirmed"/>  
341   <criticality value="high"/>  
342   <category value="medication"/>  
343 </AllergyIntolerance>
```

344

345



### 346 2.3.2 RDF Example

347 This is the raw instance before processing and after **in green for inference** and **red for specific processing**

```
348 @prefix : <http://record/AllergyIntolerance/> .
349 @prefix owl: <http://www.w3.org/2002/07/owl#> .
350 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
351 @prefix sct: <http://snomed.info/id/> .
352 @prefix xml: <http://www.w3.org/XML/1998/namespace> .
353 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
354 @prefix fhir: <http://hl7.org/fhir/> .
355 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
356 @prefix profile: <http://PatientSafetyProfile/> .
357 @base <http://record/AllergyIntolerance/1> .
358
359
360 <http://record/AllergyIntolerance/> rdf:type owl:Ontology ;
361     owl:imports <http://PatientSafetyProfile> .
362
363 ### http://record/AllergyIntolerance/1
364
365 <http://record/AllergyIntolerance/1> rdf:type profile:DomainResource , owl:NamedIndividual ,
366     profile:AllergyIntolerance ;
367     fhir:tag "AllergyIntolerance" ;
368     fhir:AllergyIntolerance.status [ rdf:type fhir:code,
369         <http://hl7.org/fhir/allergyIntoleranceStatus#confirmed> ;
370         fhir:CodeableThingy.coding [ rdf:type fhir:CodingThingy ;
371             fhir:CodingThingy.code [ rdf:type fhir:CodingThingy.Code; fhir:value "confirmed"
372                 ]
373         ]
374     ] ;
375     fhir:AllergyIntolerance.patient [ rdf:type fhir:Reference ;
376         fhir:Reference.reference [ fhir:value "http://record/Patient/PeterPatient" ] ;
377         fhir:Reference.display [ fhir:value "Peter Patient" ] ;
378         fhir:Reference.link <http://record/Patient/PeterPatient> ;
379     ] ;
380     fhir:AllergyIntolerance.substance [ rdf:type fhir:CodeableConcept , http://snomed.info/id/90614001 ;
381         rdfs:label "beta-lactam (antibiotic)" ;
382         fhir:CodeableThingy.coding [ rdf:type fhir:CodingThingy , http://snomed.info/id/90614001 ;
383             fhir:CodingThingy.code [ rdf:type fhir:CodingThingy.Code ; fhir:value "90614001" ] ;
384             fhir:CodingThingy.system [ rdf:type fhir:CodingThingy.System ; fhir:value
385                 "http://snomed.info/id/90614001" ] ;
386             fhir:CodingThingy.display [ rdf:type fhir:CodingThingy.Display ; fhir:value "beta-lactam (antibiotic)" ]
387         ] ;
388         fhir:CodeableThingy.text [ rdf:type fhir:string ; fhir:value "beta-lactam (antibiotic)"
389     ]
390 ] .### Generated by the OWL API (version 3.5.1) http://owlapi.sourceforge.net
391
```

392

393 Note the use of a profile binding through the type “profile:DomainResource”. The fhir:tag causes the inference  
394 of the type to be “profile:AllergyIntolerance” which then restricts the types of CodingThingy instances.

395 Creation of import statements is TBD.

### 396 2.3.3 FHIR OWL Schema

397 See section 1.2.4.

398 The example applies the rdf:type at the Coding instances.

399 This works directly with RDF terminologies such as SNOMED CT and ICD-11.

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### 2.3.4 FHIR Allergy Intolerance OWL Schema

```
### http://hl7.org/fhir/AllergyIntolerance
fhir:AllergyIntolerance rdf:type owl:Class ;

    rdfs:subClassOf fhir:DomainResource ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.recorder ;
          owl:onClass fhir:dateTime ;
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.patient.link ;
          owl:onClass fhir:Patient ;
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.comment ;
          owl:onClass fhir:string ;
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.identifier ;
          owl:allValuesFrom fhir:Identifier
        ] ,
        [ rdf:type owl:Class ;
          owl:intersectionOf ( fhir:DomainResource
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:tag ;
                                  owl:hasValue "AllergyIntolerance"
                                ]
                              )
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.patient ;
          owl:onClass fhir:Reference ;
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.reporter ;
          owl:onClass fhir:Reference ;
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.lastOccurence ;
          owl:onClass fhir:dateTime ;
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.type ;
          owl:onClass <http://hl7.org/fhir/vs/allergy-intolerance-type> ;
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.status ;
          owl:onClass <http://hl7.org/fhir/vs/allergy-intolerance-status> ;
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.criticality ;
          owl:onClass <http://hl7.org/fhir/vs/allergy-intolerance-criticality> ;
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.recordedDate ;
          owl:onClass fhir:Reference ;
          owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
        ] ,
```

```

468         [ rdf:type owl:Restriction ;
469           owl:onProperty fhir:AllergyIntolerance.substance ;
470           owl:onClass fhir:CodeableConcept ;
471           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
472         ] ,
473         [ rdf:type owl:Restriction ;
474           owl:onProperty fhir:AllergyIntolerance.category ;
475           owl:onClass <http://hl7.org/fhir/vs/allergy-intolerance-category> ;
476           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
477         ] .
478 ### http://hl7.org/fhir/AllergyIntolerance.Event
479 fhir:AllergyIntolerance.Event rdf:type owl:Class ;
480                               rdfs:subClassOf fhir:BackboneElement .
481

```

482 From the SNOMED RDF:

```

483 <http://snomed.info/id/138875005> rdf:type owl:Class ;
484                               rdfs:label "SNOMED CT Concept" .
485
486 <http://snomed.info/id/105590001> rdf:type owl:Class ;
487                               rdfs:label "Substance (substance)" ;
488                               rdfs:subClassOf <http://snomed.info/id/138875005> .
489
490 <http://snomed.info/id/373873005> rdf:type owl:Class ;
491                               rdfs:label "Pharmaceutical / biologic product (product)" ;
492                               rdfs:subClassOf <http://snomed.info/id/138875005> .
493
494 <http://snomed.info/id/346325008> rdf:type owl:Class ;
495                               rdfs:label "Antibacterial drugs (product)" ;
496                               rdfs:subClassOf <http://snomed.info/id/373873005> .
497
498 <http://snomed.info/id/105590001> rdf:type owl:Class ;
499                               rdfs:label "beta-Lactam antibiotic" ;
500                               rdfs:subClassOf <http://snomed.info/id/346325008> .
501

```

502

### 503 3 Valueset Definition

504 In FHIR ValueSet definitions are complicated.

505 In the metamodel viewpoint, an instance of ValueSet will have object property assertions to

- 506 a) instances of ValueSet.Define if all the codes are taken from a single system
- 507 b) instances of ValueSet.Compose if the codes come from multiple systems and allow inclusion and
- 508 exclusion
- 509 c) instances of ValueSet.Expansion if the valueset is converted into an enumerated list

510 In the model viewpoint which is not present in FHIR, the specific ValueSet is a Class (pun of the instance in the  
511 metamodel) which is a union of Term classes from one or more valueset-systems. It is expected that this  
512 representation can be computed from the FHIR representation.

#### 513 3.1 ValueSet schema in the metamodel

514 A ValueSet individual will have define, compose and expansion object properties to applicable objects. The  
515 following RDF samples show a direct translation of the metamodel viewpoint.

```
516 fhir:ValueSet rdf:type owl:Class ;  
517  
518     rdfs:subClassOf fhir:DomainResource ,  
519         [ rdf:type owl:Restriction ;  
520           owl:onProperty fhir:ValueSet.define ;  
521           owl:onClass fhir:ValueSet.Define ;  
522           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger  
523         ] ,  
524         [ rdf:type owl:Restriction ;  
525           owl:onProperty fhir:ValueSet.expansion ;  
526           owl:onClass fhir:ValueSet.Expansion ;  
527           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger  
528         ] ,  
529         [ rdf:type owl:Restriction ;  
530           owl:onProperty fhir:ValueSet.compose ;  
531           owl:onClass fhir:ValueSet.Compose ;  
532           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger  
533         ] .
```

534

```
535 fhir:ValueSet.Define rdf:type owl:Class ;  
536  
537     rdfs:subClassOf fhir:BackboneElement ,  
538         [ rdf:type owl:Restriction ;  
539           owl:onProperty fhir:ValueSet.Define.system ;  
540           owl:onClass fhir:uri ;  
541           owl:qualifiedCardinality "1"^^xsd:nonNegativeInteger  
542         ] ,  
543         [ rdf:type owl:Restriction ;  
544           owl:onProperty fhir:ValueSet.Define.concept ;  
545           owl:allValuesFrom fhir:ValueSet.Concept  
546         ] .
```

547

```

548 fhir:ValueSet.Concept rdf:type owl:Class ;
549
550         rdfs:subClassOf fhir:BackboneElement ,
551             [ rdf:type owl:Restriction ;
552               owl:onProperty fhir:ValueSet.Concept.definition ;
553               owl:onClass fhir:string ;
554               owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
555             ] ,
556             [ rdf:type owl:Restriction ;
557               owl:onProperty fhir:ValueSet.Concept.code ;
558               owl:onClass fhir:code ;
559               owl:qualifiedCardinality "1"^^xsd:nonNegativeInteger
560             ] ,
561             [ rdf:type owl:Restriction ;
562               owl:onProperty fhir:ValueSet.Concept.display ;
563               owl:onClass fhir:string ;
564               owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
565             ] .
566
567

```

## 568 3.2 ValueSet Instances (in the metamodel)

569 An example is Allergy Intolerance Status ValueSet:

```

570 ### http://hl7.org/fhir/vs/allergy-intolerance-status
571
572 <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type fhir:ValueSet , owl:NamedIndividual ;
573         rdfs:label "Allergy Intolerance Status Value Set" ;
574     fhir:ValueSet.define [ rdf:type fhir:ValueSet.Define ;
575       fhir:ValueSet.Define.system [ fhir:value "http://hl7.org/fhir/allergy-intolerance-status" ] ;
576       fhir:ValueSet.Define.concept
577         [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#confirmed> ] ,
578         [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> ] ,
579         [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#refuted> ] ,
580         [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#resolved> ] ,
581         [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#unconfirmed> ]
582     ] .
583
584

```

585 The ValueSet.Define.system is an individual which is a pun of its own type. The type exists in the model not the  
586 metamodel.

```

587 ### http://hl7.org/fhir/allergy-intolerance-status
588
589 fhir:allergy-intolerance-status rdf:type http://hl7.org/fhir/allergy-intolerance-status ,
590     fhir:uri , owl:NamedIndividual ;
591     fhir:value "http://hl7.org/fhir/allergy-intolerance-status" .
592

```

593 Two of the ValueSet.Concept individuals are declared in this example and have structural type of  
594 ValueSet.Concept but also of their semantic type as puns.

```

595 ### http://hl7.org/fhir/allergy-intolerance-status#confirmed
596
597 <http://hl7.org/fhir/allergy-intolerance-status#confirmed> rdf:type fhir:ValueSet.Concept ,
598 <http://hl7.org/fhir/allergy-intolerance-status#confirmed> , owl:NamedIndividual ;
599 fhir:ValueSet.Concept.code [ rdf:type fhir:code ; fhir:value "confirmed" ].
600
601 ### http://hl7.org/fhir/allergy-intolerance-status#entered-in-error
602
603 <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> rdf:type fhir:ValueSet.Concept ,
604 <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> , owl:NamedIndividual ;
605 fhir:ValueSet.Concept.code [ rdf:type fhir:code ; fhir:value " entered-in-error " ].
606
607

```

### 608 3.3 ValueSet-System and Term Definitions (in the OWL model)

609 The system is inclusive of all the terms within it and all the instances of those terms.

```

610 ### http://hl7.org/fhir/allergy-intolerance-status
611
612 fhir:allergy-intolerance-status rdf:type owl:Class ;
613 rdfs:subClassOf fhir:valueset-system .
614
615 ### http://hl7.org/fhir/allergy-intolerance-status#confirmed
616
617 <http://hl7.org/fhir/allergy-intolerance-status#confirmed> rdf:type owl:Class ;
618 owl:equivalentClass [ rdf:type owl:Class ;
619 owl:intersectionOf ( fhir:allergy-intolerance-status
620 [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "confirmed" ]
621 )
622 ] .
623
624 ### http://hl7.org/fhir/allergy-intolerance-status#entered-in-error
625
626 <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> rdf:type owl:Class ;
627 owl:equivalentClass [ rdf:type owl:Class ;
628 owl:intersectionOf ( fhir:allergy-intolerance-status
629 [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "entered-in-error" ]
630 )
631 ] .
632
633

```

### 634 3.4 ValueSet Definitions (in the OWL Model)

635 Here is the definition of the specific ValueSet as a Class in the Model viewpoint:

```

636 ### http://hl7.org/fhir/vs/allergy-intolerance-status
637
638 <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type owl:Class ;
639 owl:equivalentClass [ rdf:type owl:Class ;
640 owl:unionOf (
641 <http://hl7.org/fhir/allergy-intolerance-status#confirmed>
642 <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error>
643 <http://hl7.org/fhir/allergy-intolerance-status#refuted>
644 <http://hl7.org/fhir/allergy-intolerance-status#resolved>
645 <http://hl7.org/fhir/allergy-intolerance-status#unconfirmed>
646 )
647 ] .
648
649

```

## 650 4 Concept Binding Internal

### 651 4.1 Github example

652 No example

### 653 4.2 Subgroup example

654 The subgroup example is taken from the FHIR Current example of Allergy Intolerance to medication and  
655 modified.

#### 656 4.2.1 FHIR XML

```
657 <AllergyIntolerance xmlns="http://hl7.org/fhir">  
658   <id value="1"/>  
659   <text>  
660  
661   </text>  
662   <!-- the date that this entry was recorded -->  
663   <recordedDate value="2010-03-01"/>  
664   <!-- the patient that actually has the risk of adverse reaction -->  
665   <patient>  
666     <reference value="http://record/Patient/PeterPatient"/>  
667   </patient>  
668   <!-- substance, coded from SNOMED CT-->  
669   <substance>  
670     <coding>  
671       <system value="http://snomed.info/id"/>  
672       <code value="105590001"/>  
673       <display value="beta-Lactam antibiotic"/>  
674     </coding>  
675   </substance>  
676   <status value="confirmed"/>  
677   <criticality value="high"/>  
678   <category value="medication"/>  
679 </AllergyIntolerance>
```

680

#### 681 4.2.2 RDF Data After processing

```
682 fhir:AllergyIntolerance.status [ rdf:type <http://hl7.org/fhir/allergy-intolerance-status#confirmed> ;  
683   fhir:CodeableThing.coding [ rdf:type fhir:CodingThing ;  
684     fhir:CodingThing.code [ rdf:type fhir:codeThing ; fhir:value "confirmed" ]  
685   ]  
686 ] ;
```

#### 687 4.2.3 FHIR OWL Schema

688 Same mechanism as external terminologies –see 2.2.5.

689 Internal terminology expressed as Class hierarchy

```
690 fhir:AllergyIntolerance.status rdf:type owl:ObjectProperty ;  
691   rdfs:range fhir:allergy-intolerance-status .  
692  
693 fhir:AllergyIntolerance rdf:type owl:Class ;  
694   rdfs:subClassOf fhir:DomainResource ,  
695   [ rdf:type owl:Restriction ;  
696     owl:onProperty fhir:AllergyIntolerance.status ;  
697     owl:onClass <http://hl7.org/fhir/vs/allergy-intolerance-status> ;  
698     owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger  
699   ] ,  
700
```

701

## 702 5 Resource References

### 703 5.1 Github example

```
704 :resource a fhir:Observation;  
705   fhir:contained fhir:Observation\#23;  
706   fhir:Observation.subject [  
707     fhir:Reference.reference fhir:Observation\#23  
708   ] .  
709  
710 fhir:Observation\#23 a fhir:Patient;  
711   fhir:Patient.name [ fhir:text "John Smith" ] .
```

712 This example is partially in line with the resolved example below. Even if it were a URL it will not be understood  
713 by reasoners or SPARQL.

### 714 5.2 Subgroup example

#### 715 5.2.1 FHIR XML

```
716 <AllergyIntolerance xmlns="http://hl7.org/fhir">  
717   <id value="1"/>  
718   <text>  
719  
720   </text>  
721   <!-- the date that this entry was recorded -->  
722   <recordedDate value="2010-03-01"/>  
723   <!-- the patient that actually has the risk of adverse reaction -->  
724   <patient>  
725     <reference value="http://record/Patient/PeterPatient"/>  
726     <display value="Peter Patient"/>  
727   </patient>  
728 </AllergyIntolerance>
```

#### 729 5.2.2 RDF Data After processing (acquiring the resource and importing)

```
730 fhir:AllergyIntolerance.patient [ fhir:Reference.display [ fhir:value "Peter Patient" ] ;  
731                               fhir:Reference.reference [ fhir:value "http://record/Patient/PeterPatient" ] ;  
732                               fhir:Reference.link <http://record/Patient/PeterPatient>  
733                               ] ;
```

734 Note that Reference object has been supplemented by the URI of the Reference.link.

735 AllergyIntolerance.patient.link can represent the property chain as shown earlier.

736 A reverse property of the property chain can get the resources for a particular patient.



```
737 ### http://hl7.org/fhir/AllergyForPatient
738 fhir:AllergyForPatient rdf:type owl:ObjectProperty ;
739 owl:inverseOf fhir:AllergyIntolerance.patient.link .
740
741 ### http://hl7.org/fhir/AllergyIntolerance.patient.link
742
743 fhir:AllergyIntolerance.patient.link rdf:type owl:ObjectProperty ;
744 owl:propertyChainAxiom ( fhir:AllergyIntolerance.patient fhir:Reference.link ) .
```

### 745 5.2.3 FHIR OWL Schema

```
746 fhir:Reference rdf:type owl:Class ;
747 rdfs:subClassOf fhir:Element ,
748 [ rdf:type owl:Restriction ;
749 owl:onProperty fhir:Reference.link ;
750 owl:onClass fhir:DomainResource ;
751 owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
752 ] ,
753 [ rdf:type owl:Restriction ;
754 owl:onProperty fhir:Reference.display ;
755 owl:onClass fhir:string ;
756 owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
757 ] ,
758 [ rdf:type owl:Restriction ;
759 owl:onProperty fhir:Reference.reference ;
760 owl:onClass fhir:string ;
761 owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
762 ] .
```

763

764

## 765 **6 Bundle**

766 Some preliminary notes:

767 A Bundle instance has no special namespace semantics and therefore it can be referenced as an Ontology  
768 record/Bundle/123.

769 The contents of the Bundle.Entry have URIs and would be imported into the Bundle Ontology.

770 The Bundle.Link will be treated as a Reference and Bundle.Link.link will be created when the referenced  
771 resource has been resolved.

## 772 **7 URI Naming**

### 773 **7.1 Github example**

774 No example

### 775 **7.2 Subgroup example**

776 Detailed rules for URI construction must be made for internally referenced resource class instances. The  
777 example has proposed URI constructs where

- 778 1. the Resource namespace precedes the assigned identifier for the contained instance
- 779 2. the root resource object has an URI identifier identical to the resource class instance URI

780 Thus <http://record/AllergyIntolerance/1> has “record/AllergyIntolerance” as the resource namespace with “1”  
781 as the contained instance identifier.

782 It is also intended that the resource namespace should also be the ontology IRI. This is to be tested.

783 `<http://record/AllergyIntolerance/> rdf:type owl:Ontology ;`  
784

785

## 786 8 Ordering

### 787 8.1 Github example

788 No example

### 789 8.2 RDF individual ordering example

790 Simple integer DataProperty fhir:index can be applied to individuals of subclasses of fhir:Element

791

```
792 ### http://hl7.org/fhir/index
793 fhir:index rdf:type owl:DatatypeProperty ;
794           rdfs:range fhir:index-primitive .
795
796 ### http://hl7.org/fhir/index-primitive
797 fhir:index-primitive rdf:type rdfs:Datatype ;
798                    owl:equivalentClass [ rdf:type rdfs:Datatype ;
799                                         owl:onDatatype xsd:integer ;
800                                         owl:withRestrictions ( [ xsd:minInclusive 1 ] )
801                                         ] .
802 ### http://hl7.org/fhir/Element
803 fhir:Element rdf:type owl:Class ;
804            rdfs:label "Element" ;
805            rdfs:subClassOf [ rdf:type owl:Restriction ;
806                           owl:onProperty fhir:Element.extension ;
807                           owl:someValuesFrom fhir:Extension
808                           ] ,
809                           [ rdf:type owl:Restriction ;
810                           owl:onProperty fhir:Element.id ;
811                           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
812                           owl:onDataRange fhir:id-primitive
813                           ] ,
814                           [ rdf:type owl:Restriction ;
815                           owl:onProperty fhir:index ;
816                           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
817                           owl:onDataRange fhir:index-primitive
818                           ] ;
819            rdfs:comment "The base element used for all FHIR elements and resources - allows for them to be
820 extended with extensions" .
821 .
```

822 In general fhir:value and fhir:Element.id are converted to an attribute in XML. fhir:index dictates the sequence  
823 only.

### 824 8.3 RDF Property Ordering example

825 Where object properties need to be ordered to construct the sequence of properties in XML, the fhir:index is  
826 defined as an annotation property on the Object Property. The example of ordered properties inside  
827 CodingThingy is shown:

```
828   ### http://hl7.org/fhir/CodingThingy.system
829   fhir:CodingThingy.system rdf:type owl:ObjectProperty ;
830   fhir:index 1 ;
831
832   ### http://hl7.org/fhir/CodingThingy.version
833   fhir:CodingThingy.version rdf:type owl:ObjectProperty ;
834   fhir:index 2 .
835
836   ### http://hl7.org/fhir/CodingThingy.code
837   fhir:CodingThingy.code rdf:type owl:ObjectProperty ;
838   fhir:index 3 .
839
840   ### http://hl7.org/fhir/CodingThingy.display
841   fhir:CodingThingy.display rdf:type owl:ObjectProperty ;
842   fhir:index 4 ;
843
844   ### http://hl7.org/fhir/CodingThingy.primary
845   fhir:CodingThingy.primary rdf:type owl:ObjectProperty ;
846   fhir:index 5 ;
```

847

848

849

## 850 9 Profiles

851 The profile ontology restricts the Valueset of Substance:

852 AllergyIntolerance.substance.coding is defines as a property chain and allows constraints to be applied to the  
853 codings for substance

```
854 allergy:AllergyIntolerance.substance.coding rdf:type owl:ObjectProperty ;  
855     owl:inverseOf fhir:Coding.Resource ;  
856     owl:propertyChainAxiom ( allergy:AllergyIntolerance.substance fhir:CodeableThingy.coding ).
```

857

```
858 ### http://PatientSafetyProfile/AllergyIntolerance  
859 profile:AllergyIntolerance rdf:type owl:Class ;  
860     rdfs:subClassOf fhir:AllergyIntolerance ,  
861     [ rdf:type owl:Restriction ; owl:onProperty  
862     <http://hl7.org/fhir/AllergyIntolerance/AllergyIntolerance.substance.coding> ;  
863     owl:allValuesFrom [ rdf:type owl:Class ;  
864     owl:unionOf ( <http://snomed.info/id/105590001> <http://snomed.info/id/373873005> )  
865     ]  
866     ] .  
867 ### http://PatientSafetyProfile/DomainResource  
868 profile:DomainResource rdf:type owl:Class ;  
869     rdfs:subClassOf fhir:DomainResource .
```

871

872