

# 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**.

## 22 1 Datatypes (section 1.18.0.1)

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

24 Datatypes are transformed into OWL Classes where the value is expressed as a an OWL DataProperty with  
25 restrictions (facets etc).

### 26 1.1 Id

#### 27 1.1.1 Id instance

#### 28 1.1.2 Id schema

```
29 fhir:id rdf:type owl:Class ;  
30     rdfs:subClassOf fhir:Element ,  
31         [ rdf:type owl:Restriction ;  
32           owl:onProperty fhir:value ;  
33           owl:allValuesFrom [ rdf:type rdfs:Datatype ;  
34                                 owl:onDatatype xsd:string ;  
35                                 owl:withRestrictions ( [ xsd:pattern "[A-Za-z0-9\\-\\.]{1,64}" ] )  
36                                 ]  
37         ] ,  
38         [ rdf:type owl:Restriction ;  
39           owl:onProperty fhir:value ;  
40           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;  
41           owl:onDataRange xsd:string  
42         ] ;  
43     rdfs:comment "A whole number in the range 0 to 2^64-1, optionally represented in hex, a uuid, an oid or  
44 any other combination of lower-case letters a-z, numerals, "-" and ".", with a length limit of 36 characters" .
```

### 45 1.2 Decimal

46 Decimal has an additional DataProperty fhir:fractionaDigits which allows the explicit declaration of scale.

#### 47 1.2.1 Decimal OWL instance

```
48 [ a fhir:decimal ; fhir:value 123.4 ; fhir:fractionalDigits 3 ]
```

#### 49 1.2.2 Decimal OWL Schema

```
50 fhir:decimal rdf:type owl:Class ;  
51     rdfs:subClassOf fhir:Element ,  
52         [ rdf:type owl:Restriction ;  
53           owl:onProperty fhir:fractionDigits ;  
54           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;  
55           owl:onDataRange xsd:nonNegativeInteger  
56         ] ,  
57         [ rdf:type owl:Restriction ;  
58           owl:onProperty fhir:fractionDigits ;  
59           owl:allValuesFrom xsd:nonNegativeInteger  
60         ] ,  
61         [ rdf:type owl:Restriction ;  
62           owl:onProperty fhir:value ;  
63           owl:allValuesFrom xsd:decimal  
64         ] ,  
65         [ rdf:type owl:Restriction ;  
66           owl:onProperty fhir:value ;  
67           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;  
68           owl:onDataRange xsd:decimal  
69         ] ;  
70     rdfs:comment "A rational number with implicit precision" .
```

71

## 72 1.3 FHIR CodeableConcept and Coding Structure Definition

### 73 1.3.1 FHIR XML

```
74 <code>  
75 <coding>  
76 <system value="http://example.org/local"/>  
77 <code value="admin"/>  
78 <display value="Admin"/>  
79 </coding>  
80 </code>
```

#### 81 CodeableConcept Structural Definition

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

87

#### 88 Coding Structural Definition

```
89 <[name] xmlns="http://hl7.org/fhir">  
90 <!-- from Element: extension -->  
91 <system value="[uri]"/><!-- 0..1 Identity of the terminology system -->  
92 <version value="[string]"/><!-- 0..1 Version of the system - if relevant -->  
93 <code value="[code]"/><!-- 0..1 Symbol in syntax defined by the system -->  
94 <display value="[string]"/><!-- 0..1 Representation defined by the system -->  
95 <primary value="[boolean]"/><!-- 0..1 If this code was chosen directly by the user -->  
96 </[name]>
```

97

### 98 1.3.2 RDF Data for Coding Instance

99 The RDF variant for fhir:Code, fhir:Coding and fhir:CodeableConcept are not straight translations of the FHIR  
100 representation. 3 new additional classes are introduced – codeBase, CodingBase and ConceptBase.

```
101 xxx.code [ a fhir:CodeableConcept ;  
102   ConceptBase.coding [ rdf:type fhir:CodingBase ;  
103     fhir:CodingBase.system [ a fhir:uri; "fhir:value http://example.org/local" ] ;  
104     fhir:CodingBase.code [ a fhir:codeBase ; fhir:value "admin" ] ;  
105     fhir:CodingBase.display [ a fhir:string; fhir:value "Admin" ] ;  
106   ] ;  
107 ] ;
```

108

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

111 This approach will be implemented by creating ConceptBase, CodingBase and codeBase individuals as blank  
112 nodes.

113

### 1.3.3 FHIR OWL Schema

114

ConceptBase is abstract and has subclasses fhir:CodeableConcept, fhir:Coding and fhir:code.

115

```
#####
```

116

```
# Classes
```

117

```
#####
```

118

119

```
### http://hl7.org/fhir/ConceptBase
```

120

121

```
fhir:ConceptBase rdf:type owl:Class ;
```

122

```
  rdfs:subClassOf fhir:Element ,
```

123

```
  [ rdf:type owl:Restriction ;
```

124

```
    owl:onProperty fhir:ConceptBase.coding ;
```

125

```
    owl:allValuesFrom fhir:CodingBase
```

126

```
  ] ,
```

127

```
  [ rdf:type owl:Restriction ;
```

128

```
    owl:onProperty fhir:ConceptBase.text ;
```

129

```
    owl:allValuesFrom fhir:string
```

130

```
  ] ,
```

131

```
  [ rdf:type owl:Restriction ;
```

132

```
    owl:onProperty fhir:ConceptBase.text ;
```

133

```
    owl:maxCardinality "1"^^xsd:nonNegativeInteger
```

134

```
  ] .
```

135

```
### http://hl7.org/fhir/CodingBase
```

136

```
fhir:CodingBase rdf:type owl:Class ;
```

137

```
  rdfs:subClassOf fhir:Element ,
```

138

```
  [ rdf:type owl:Restriction ;
```

139

```
    owl:onProperty fhir:CodingBase.system ;
```

140

```
    owl:allValuesFrom fhir:uri
```

141

```
  ] ,
```

142

```
  [ rdf:type owl:Restriction ;
```

143

```
    owl:onProperty fhir:CodingBase.system ;
```

144

```
    owl:maxCardinality "1"^^xsd:nonNegativeInteger
```

145

```
  ] ,
```

146

```
  [ rdf:type owl:Restriction ;
```

147

```
    owl:onProperty fhir:CodingBase.version ;
```

148

```
    owl:allValuesFrom fhir:string
```

149

```
  ] ,
```

150

```
  [ rdf:type owl:Restriction ;
```

151

```
    owl:onProperty fhir:CodingBase.version ;
```

152

```
    owl:maxCardinality "1"^^xsd:nonNegativeInteger
```

153

```
  ] ,
```

154

```
  [ rdf:type owl:Restriction ;
```

155

```
    owl:onProperty fhir:CodingBase.code ;
```

156

```
    owl:allValuesFrom fhir:codeBase
```

157

```
  ]
```

158

```
  [ rdf:type owl:Restriction ;
```

159

```
    owl:onProperty fhir:CodingBase.code ;
```

160

```
    owl:maxCardinality "1"^^xsd:nonNegativeInteger
```

161

```
  ] ,
```

162

```
  [ rdf:type owl:Restriction ;
```

163

```
    owl:onProperty fhir:CodingBase.display ;
```

164

```
    owl:allValuesFrom fhir:string
```

165

```
  ] ,
```

166

```
  [ rdf:type owl:Restriction ;
```

167

```
    owl:onProperty fhir:CodingBase.display ;
```

168

```
    owl:maxCardinality "1"^^xsd:nonNegativeInteger
```

169

```
  ] ,
```

170

```
  [ rdf:type owl:Restriction ;
```

171

```
    owl:onProperty fhir:CodingBase.primary ;
```

172

```
    owl:maxCardinality "1"^^xsd:nonNegativeInteger
```

173

```
  ] ,
```

174

```
  [ rdf:type owl:Restriction ;
```

175

```
    owl:onProperty fhir:CodingBase.primary ;
```

176

```
    owl:allValuesFrom fhir:boolean
```

177

```
  ] .
```

178

```
179 fhir:codeBase rdf:type owl:Class ;
180
181     rdfs:subClassOf fhir:Element ,
182         [ rdf:type owl:Restriction ;
183           owl:onProperty fhir:value ;
184           owl:allValuesFrom xsd:token
185         ] ,
186         [ rdf:type owl:Restriction ;
187           owl:onProperty fhir:value ;
188           owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
189           owl:onDataRange xsd:token
190         ] .
191
```

192 The concrete subclasses of ConceptBase apply the additional restrictions:

```
193 ### http://hl7.org/fhir/CodeableConcept
194 fhir:CodeableConcept rdf:type owl:Class ;
195     rdfs:subClassOf fhir:ConceptBase ;
196     rdfs:comment "The set of possible coded values this coding was chosen from or constrained
197 by." .
```

198

```
199 ### http://hl7.org/fhir/Coding
200 fhir:Coding rdf:type owl:Class ;
201     rdfs:subClassOf fhir:ConceptBase ,
202     [ rdf:type owl:Restriction ;
203       owl:onProperty fhir:ConceptBase.text ;
204       owl:maxCardinality "0"^^xsd:nonNegativeInteger
205     ] ,
206     [ rdf:type owl:Restriction ;
207       owl:onProperty fhir:ConceptBase.coding ;
208       owl:cardinality "1"^^xsd:nonNegativeInteger
209     ] .
```

210

```
211 fhir:code rdf:type owl:Class ;
212     rdfs:subClassOf fhir:ConceptBase ,
213     [ rdf:type owl:Restriction ;
214       owl:onProperty fhir:ConceptBase.coding ;
215       owl:cardinality "1"^^xsd:nonNegativeInteger
216     ] ,
217     [ rdf:type owl:Restriction ;
218       owl:onProperty fhir:ConceptBase.coding ;
219       owl:allValuesFrom [ rdf:type owl:Class ;
220         owl:intersectionOf ( fhir:CodingBase
221         [ rdf:type owl:Restriction ;
222           owl:onProperty fhir:CodingBase.code ;
223           owl:cardinality "1"^^xsd:nonNegativeInteger
224         ]
225         [ rdf:type owl:Restriction ;
226           owl:onProperty fhir:CodingBase.system ;
227           owl:cardinality "1"^^xsd:nonNegativeInteger
228         ]
229         [ rdf:type owl:Restriction ;
230           owl:onProperty fhir:CodingBase.version ;
231           owl:cardinality "1"^^xsd:nonNegativeInteger
232         ]
233         [ rdf:type owl:Restriction ;
234           owl:onProperty fhir:CodingBase.display ;
235           owl:maxCardinality "0"^^xsd:nonNegativeInteger
236         ]
237         [ rdf:type owl:Restriction ;
238           owl:onProperty fhir:CodingBase.primary ;
239           owl:maxCardinality "0"^^xsd:nonNegativeInteger
240         ]
241       )
242     ]
243 ] .
```

244

## 245 2 Concept Binding external (section 1.17.3.3.5)

### 246 2.1 Github example

```
247 @prefix loinc: <http://loinc.org/owl#> .  
248 :resource a fhir:Observation;  
249   fhir:Observation.code [  
250     fhir:CodeableConcept.coding [  
251       fhir:Coding.system <http://loinc.org>;  
252       fhir:Coding.code "54411-4";  
253       fhir:Coding.display "Rh immune globulin given Qualitative";  
254       ex:concept loinc:54411-4;  
255     ];  
256     fhir:CodeableConcept.text "Rh immune globulin";  
257   ].
```

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

### 262 2.2 Subgroup example

#### 263 2.2.1 FHIR XML

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

```
265 <Observation xmlns="http://hl7.org/fhir">  
266   <code>  
267     <coding>  
268       <system value="http://Loinc.org"/>  
269       <code value="54411-4"/>  
270       <display value=" Rh immune globulin given Qualitative "/>  
271     </coding>  
272     <text value="Rh immune globulin"/>  
273   </code>  
274   .....
```

#### 275 2.2.2 RDF Data with Terminology blank nodes in RDF

```
276 @prefix loinc: <http://loinc.org/> .  
277 @prefix fhir: <http://hl7.org/fhir/> .  
278 <sourceNamespace/Observation/resource.id> a fhir:Observation, <http://loinc.org/54411-4> ;  
279   fhir:Observation.code [ a fhir:CodeableConcept , <http://loinc.org/54411-4> ;  
280     fhir:ConceptBase.coding [ a fhir:CodingBase , <http://loinc.org/54411-4> ;  
281       fhir:CodingBase.system [ a fhir:uri fhir:value "http://loinc.org" ] ;  
282       fhir:CodingBase.code [ a fhir:codeBase fhir:value "54411-4" ] ;  
283       fhir:CodingBase.display [ a fhir:string fhir:value "Rh immune globulin given Qualitative" ] ;  
284     ] ;  
285     fhir:ConceptBase.text [ a fhir:string fhir:value "Rh immune globulin" ]  
286   ] .
```

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

289 The type on the CodingBase instance is calculated based on the formation of the URL for that terminology. The  
290 type in the CodingBase instance is carried up to the CodeableConcept blank node.

291 There is an argument for Object Properties - .code, .type and .category to carry the type all the way to the  
292 resource itself since there is no sub state or component identified such as status, confidence etc.

## 293 2.3 Allergy Intolerance Subgroup Example

### 294 2.3.1 FHIR XML

```
295 <AllergyIntolerance xmlns=http://hl7.org/fhir >  
296   <id value="1"/>  
297   <text>  
298  
299   </text>  
300   <!-- the date that this entry was recorded -->  
301   <recordedDate value="2010-03-01"/>  
302   <!-- the patient that actually has the risk of adverse reaction -->  
303   <patient>  
304     <reference value="http://record/Patient/PeterPatient"/>  
305     <display value="Peter Patient"/>  
306   </patient>  
307   <!-- substance, coded from SNOMED CT-->  
308   <substance>  
309     <coding>  
310       <system value="http://snomed.info/id"/>  
311       <code value="90614001"/>  
312       <display value="beta-Lactam antibiotic"/>  
313     </coding>  
314   </substance>  
315   <status value="confirmed"/>  
316   <criticality value="high"/>  
317   <category value="medication"/>  
318 </AllergyIntolerance>
```

319

320



### 321 2.3.2 RDF Instance Example

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

```
323 @prefix : <http://record/AllergyIntolerance/> .
324 @prefix owl: <http://www.w3.org/2002/07/owl#> .
325 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
326 @prefix sct: <http://snomed.info/id/> .
327 @prefix xml: <http://www.w3.org/XML/1998/namespace> .
328 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
329 @prefix fhir: <http://hl7.org/fhir/> .
330 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
331 @prefix profile: <http://PatientSafetyProfile/> .
332 @base <http://record/AllergyIntolerance/1> .
333
334
335 <http://record/AllergyIntolerance/> rdf:type owl:Ontology ;
336   owl:imports <http://PatientSafetyProfile> .
337
338 ### http://record/AllergyIntolerance/1
339
340
341 <http://record/AllergyIntolerance/1> rdf:type profile:DomainResource , owl:NamedIndividual ;
342
343   fhir:tag "AllergyIntolerance" ;
344   fhir:Resource.id [ rdf:type fhir:id ; fhir:value "1" ] ;
345   fhir:AllergyIntolerance.status [ rdf:type fhir:code , <http://hl7.org/fhir/allergyIntoleranceStatus#confirmed>;
346     fhir:ConceptBase.coding [ fhir:CodingBase.code [ fhir:value "confirmed" ] ]
347   ] ;
348   fhir:AllergyIntolerance.patient [ rdf:type fhir:Reference ;
349     fhir:Reference.reference [ fhir:value "http://record/Patient/PeterPatient" ] ;
350     fhir:Reference.display [ fhir:value "Peter Patient" ] ;
351     fhir:Reference.link <http://record/Patient/PeterPatient> ;
352   ] ;
353   fhir:AllergyIntolerance.substance [ rdf:type fhir:CodeableConcept , <http://snomed.info/id/90614001> ;
354     rdfs:label "beta-lactam (antibiotic)" ;
355     fhir:ConceptBase.coding [ rdf:type fhir:CodingBase , <http://snomed.info/id/90614001> ;
356       fhir:CodingBase.code [ rdf:type fhir:codeBase ; fhir:value "90614001" ] ;
357       fhir:CodingBase.system [ rdf:type fhir:string ; fhir:value "http://snomed.info/sct" ] ;
358       fhir:CodingBase.display [ rdf:type fhir:string ; fhir:value "beta-lactam (antibiotic)" ]
359     ] ;
360     fhir:ConceptBase.text [ rdf:type fhir:string ; fhir:value "beta-lactam (antibiotic)"
361   ]
362 ] .
363
```

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

366 Creation of import statements is TBD.

### 367 2.3.3 FHIR Allergy Intolerance OWL Schema

368 The schema is abridged to show the concepts of interest:

```
369 ### http://hl7.org/fhir/AllergyIntolerance
370
371 fhir:AllergyIntolerance rdf:type owl:Class ;
372
373     rdfs:subClassOf fhir:DomainResource ,
374                   [ rdf:type owl:Restriction ;
375                     owl:onProperty fhir:AllergyIntolerance.substance ;
376                     owl:maxCardinality "1"^^xsd:nonNegativeInteger
377                   ] ,
378                   [ rdf:type owl:Restriction ;
379                     owl:onProperty fhir:AllergyIntolerance.substance ;
380                     owl:allValuesFrom fhir:CodeableConcept
381                   ] ,
382 Etc..
383 .
```

384 The substance Object Property has no valueset type yet only the restriction that it is a CodeableConcept type.

385 The valueset gets applied through the profile binding.

386

### 387 3 FHIR internal System and Coding Definitions OWL Schema

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

```
389 @prefix allergy-intolerance-status: <http://hl7.org/fhir/allergy-intolerance-status#> .
390
391 ### http://hl7.org/fhir/allergy-intolerance-status
392
393 fhir:allergy-intolerance-status rdf:type owl:Class ;
394   rdfs:subClassOf fhir:valueSet-system ,
395   [ rdf:type owl:Class ;
396     owl:unionOf (
397       allergy-intolerance-status:confirmed
398       allergy-intolerance-status:entered-in-error
399       allergy-intolerance-status:refuted
400       allergy-intolerance-status:resolved
401       allergy-intolerance-status:unconfirmed
402     )
403   ] ,
404   [ rdf:type owl:Restriction ;
405     owl:onProperty fhir:CodingBase.system ;
406     owl:allValuesFrom [ rdf:type owl:Restriction ;
407       owl:onProperty fhir:value ; owl:hasValue "http://hl7.org/fhir/allergy-intolerance-status"
408     ]
409   ] ;
410 fhir:prefix "http://hl7.org/fhir/allergy-intolerance-status#" .
411
412 ### http://hl7.org/fhir/allergy-intolerance-status#confirmed
413
414 allergy-intolerance-status:confirmed rdf:type owl:Class ;
415   rdfs:label "confirmed" ;
416   rdfs:subClassOf fhir:allergy-intolerance-status ,
417   [ rdf:type owl:Restriction ;
418     owl:onProperty fhir:CodingBase.code ;
419     owl:allValuesFrom [ rdf:type owl:Restriction ;
420       owl:onProperty fhir:value ; owl:hasValue "confirmed"
421     ]
422   ] .
423
424 ### http://hl7.org/fhir/allergy-intolerance-status#entered-in-error
425
426 allergy-intolerance-status:entered-in-error rdf:type owl:Class ;
427   rdfs:label "entered-in-error" ;
428   rdfs:subClassOf fhir:allergy-intolerance-status ,
429   [ rdf:type owl:Restriction ;
430     owl:onProperty fhir:CodingBase.code ;
431     owl:allValuesFrom [ rdf:type owl:Restriction ;
432       owl:onProperty fhir:value ; owl:hasValue "entered-in-error"
433     ]
434   ] .
```

435 The system Class definition shows it is a subclass of the abstract valueSet-system and restricts its members to  
436 the CodingBase.system.

437 There is also an annotation property fhir:prefix which defines the structure of the URI prefix when naming the  
438 members of the system. It causes the @prefix declaration.

439 Two members are shown “confirmed” and “entered-in-error”. They are subclasses of allergy-intolerance-status  
440 and have the restrictions of that class so they do not have to declare CodingBase.system restrictions.

## 441 4 System and codings external RDF representation

442 From the SNOMED RDF:

```
443 <http://snomed.info/id/138875005> rdf:type owl:Class ;  
444     rdfs:label "SNOMED CT Concept" .  
445  
446 <http://snomed.info/id/105590001> rdf:type owl:Class ;  
447     rdfs:label "Substance (substance)" ;  
448     rdfs:subClassOf <http://snomed.info/id/138875005> .  
449  
450 <http://snomed.info/id/373873005> rdf:type owl:Class ;  
451     rdfs:label "Pharmaceutical / biologic product (product)" ;  
452     rdfs:subClassOf <http://snomed.info/id/138875005> .  
453  
454 <http://snomed.info/id/346325008> rdf:type owl:Class ;  
455     rdfs:label "Antibacterial drugs (product)" ;  
456     rdfs:subClassOf <http://snomed.info/id/373873005> .  
457  
458 <http://snomed.info/id/105590001> rdf:type owl:Class ;  
459     rdfs:label "beta-Lactam antibiotic" ;  
460     rdfs:subClassOf <http://snomed.info/id/346325008> .
```

461 The system is defined further in the FHIR ontology

```
462 @prefix sct: <http://snomed.info/id/> .  
463  
464 ### http://snomed.info/sct  
465  
466 <http://snomed.info/sct> rdf:type owl:Class ;  
467     rdfs:subClassOf fhir:valueSet-system ;  
468     fhir:prefix "http://snomed.info/id/" .
```

469

470

## 471 5 Valueset Definition

472 A ValueSet is somewhat similar to a value-set-system in that it applies constraints to the members but they can  
473 be from different systems.

474 The specific ValueSet is a Class which is a union of CodingBase classes from one or more valueset-systems. It is  
475 expected that this representation can be computed from the FHIR representation.

### 476 5.1.1 Anonymous codings

477 Here is the definition of the specific ValueSet as a Class with restrictions on values not types:

```
478 <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type owl:Class ;  
479 rdfs:label "Allergy Intolerance Status Value Set" ;  
480 rdfs:subClassOf fhir:valueset ,  
481 [ rdf:type owl:Class ;  
482 owl:intersectionOf (  
483 [ rdf:type owl:Restriction ;  
484 owl:onProperty fhir:CodingBase.code ;  
485 owl:someValuesFrom [ rdf:type owl:Class ;  
486 owl:unionOf (  
487 [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "confirmed" ]  
488 [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "entered-in-error" ]  
489 [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "refuted" ]  
490 [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "resolved" ]  
491 [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "unconfirmed" ]  
492 )  
493 ]  
494 ]  
495 [ rdf:type owl:Restriction ;  
496 owl:onProperty fhir:CodingBase.system ;  
497 owl:allValuesFrom [ rdf:type owl:Restriction ; owl:onProperty fhir:value ;  
498 owl:hasValue "http://fhir/allergy-intolerance-status"  
499 ]  
500 ]  
501 )  
502 ] .
```

503 If the valueset needs to identify CodingBase restrictions from other systems then the restriction will have a  
504 slightly different structure. The example here shows the optimization for a single system (Define).

## 505 5.2 Named codings

506 If named codings are used then the expression can be greatly simplified since the restrictions are in the named  
507 class.

```
508 <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type owl:Class ;  
509 rdfs:label "Allergy Intolerance Status Value Set" ;  
510 rdfs:subClassOf fhir:valueset ,  
511 [ rdf:type owl:Class ;  
512 owl:unionOf ( allergy-intolerance-status:confirmed  
513 allergy-intolerance-status:entered-in-error  
514 allergy-intolerance-status:refuted  
515 allergy-intolerance-status:resolved  
516 allergy-intolerance-status:unconfirmed  
517 )  
518 ] .
```

519

520

## 521 **6 ValueSet schema in the metamodel**

522 A metamodel is introduced when Classes in the Model are instances of MetaClasses which are subclasses of  
523 owl:class. In general the Element Definition (1.23.0) is a metamodel.

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

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

529 A ValueSet individual will have define, compose and expansion object properties to applicable objects. However,  
530 these object property semantics are not understood by RDF or OWL. They are translated in the Model to  
531 subclass, intersection and union relationships between classes.

532

## 533 7 Resource References

### 534 7.1 Github example

```
535 :resource a fhir:Observation;  
536   fhir:contained fhir:Observation\#23;  
537   fhir:Observation.subject [  
538     fhir:Reference.reference fhir:Observation\#23  
539   ] .  
540  
541 fhir:Observation\#23 a fhir:Patient;  
542   fhir:Patient.name [ fhir:text "John Smith" ] .
```

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

### 545 7.2 Subgroup example

#### 546 7.2.1 FHIR XML

```
547 <AllergyIntolerance xmlns="http://hl7.org/fhir">  
548   <id value="1"/>  
549   <text>  
550  
551   </text>  
552   <!-- the date that this entry was recorded -->  
553   <recordedDate value="2010-03-01"/>  
554   <!-- the patient that actually has the risk of adverse reaction -->  
555   <patient>  
556     <reference value="http://record/Patient/PeterPatient"/>  
557     <display value="Peter Patient"/>  
558   </patient>  
559 </AllergyIntolerance>
```

#### 560 7.2.2 RDF Data After processing (acquiring the resource and importing)

```
561 fhir:AllergyIntolerance.patient [ fhir:Reference.display [ fhir:value "Peter Patient" ] ;  
562   fhir:Reference.reference [ fhir:value "http://record/Patient/PeterPatient" ] ;  
563   fhir:Reference.link <http://record/Patient/PeterPatient>  
564   ] ;
```

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

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

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

```
568 ### http://hl7.org/fhir/AllergyForPatient  
569 fhir:AllergyForPatient rdf:type owl:ObjectProperty ;  
570   owl:inverseOf fhir:AllergyIntolerance.patient.link .  
571  
572 ### http://hl7.org/fhir/AllergyIntolerance.patient.link  
573  
574 fhir:AllergyIntolerance.patient.link rdf:type owl:ObjectProperty ;  
575   owl:propertyChainAxiom ( fhir:AllergyIntolerance.patient fhir:Reference.link ) .
```

576

577 The Reference.link is declared when the resource has been imported and closure has been achieved. This allows  
578 the consumer to determine whether the import has happened or not and can trigger that function. If the  
579 Reference.link is pre-established there will be no indication in the import and the Resource instance will be  
580 empty.

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### 7.2.3 FHIR OWL Schema

```
### http://hl7.org/fhir/Reference
fhir:Reference rdf:type owl:Class ;
    rdfs:subClassOf fhir:Element ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:Reference.reference ;
          owl:allValuesFrom fhir:string
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:Reference.reference ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:Reference.display ;
          owl:allValuesFrom fhir:string
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:Reference.display ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:Reference.link ;
          owl:allValuesFrom fhir:DomainResource
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:Reference.link ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] .
```

612



## 613 **8 Bundle**

614 Some preliminary notes:

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

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

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

## 620 **9 URI Naming**

### 621 **9.1 Github example**

622 No example

### 623 **9.2 Subgroup example**

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

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

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

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

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

632

633

## 634 10 Ordering

### 635 10.1 Github example

636 No example

### 637 10.2 RDF individual ordering example

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

639

```
640 ### http://hl7.org/fhir/index
641 fhir:index rdf:type owl:DatatypeProperty ;
642           rdfs:range fhir:index-primitive .
643
644 ### http://hl7.org/fhir/index-primitive
645 fhir:index-primitive rdf:type rdfs:Datatype ;
646                    owl:equivalentClass [ rdf:type rdfs:Datatype ;
647                                         owl:onDatatype xsd:integer ;
648                                         owl:withRestrictions ( [ xsd:minInclusive 1 ] )
649                                         ] .
650 ### http://hl7.org/fhir/Element
651 fhir:Element rdf:type owl:Class ;
652            rdfs:label "Element" ;
653            rdfs:subClassOf [ rdf:type owl:Restriction ;
654                             owl:onProperty fhir:Element.extension ;
655                             owl:someValuesFrom fhir:Extension
656                             ] ,
657                             [ rdf:type owl:Restriction ;
658                             owl:onProperty fhir:Element.id ;
659                             owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
660                             owl:onDataRange fhir:id-primitive
661                             ] ,
662                             [ rdf:type owl:Restriction ;
663                             owl:onProperty fhir:index ;
664                             owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
665                             owl:onDataRange fhir:index-primitive
666                             ] ;
667            rdfs:comment "The base element used for all FHIR elements and resources - allows for them to be
668 extended with extensions" .
669 .
```

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

### 672 10.3 RDF Object Property Ordering example

673 Where object properties need to be ordered to construct the sequence of properties in XML, the fhir:index is  
674 defined as an annotation property on the Object Property. The example of ordered properties inside CodingBase  
675 is shown:

```
676 ### http://hl7.org/fhir/index
677
678 fhir:index rdf:type owl:AnnotationProperty .
679
```

```
680 ### http://hl7.org/fhir/CodingBase.system
681 fhir:CodingBase.system rdf:type owl:ObjectProperty ;
682     fhir:index 1 ;
683
684 ### http://hl7.org/fhir/CodingBase.version
685 fhir:CodingBase.version rdf:type owl:ObjectProperty ;
686     fhir:index 2 .
687
688 ### http://hl7.org/fhir/CodingBase.code
689 fhir:CodingBase.code rdf:type owl:ObjectProperty ;
690     fhir:index 3 .
691
692 ### http://hl7.org/fhir/CodingBase.display
693 fhir:CodingBase.display rdf:type owl:ObjectProperty ;
694     fhir:index 4 ;
695
696 ### http://hl7.org/fhir/CodingBase.primary
697 fhir:CodingBase.primary rdf:type owl:ObjectProperty ;
698     fhir:index 5 ;
```

699

700

701

## 702 11 Profiles

703 The example shows “profile” ontology restricting the Valueset of Substance:

704 The AllergyIntolerance Resource is declared again inside the Profile ontology. Its type will be derived from the  
705 fhir:tag value and the declaration in the instance that it is a profile:DomainResource.

```
706 <http://record/AllergyIntolerance/1> rdf:type profile:DomainResource , owl:NamedIndividual ;  
707  
708 fhir:tag "AllergyIntolerance" ;
```

709

710 This prefix on the rdf:type profile:DomainResource binds to the Profile and causes typing to the  
711 profile:AllergyIntolerance where further restrictions (and extensions) are added.

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

```
714 allergy:AllergyIntolerance.substance.coding rdf:type owl:ObjectProperty ;  
715 owl:inverseOf fhir:Coding.Resource ;  
716 owl:propertyChainAxiom ( allergy:AllergyIntolerance.substance fhir:ConceptBase.coding ).
```

717

718 Here is a sample of the Profile Turtle.

```
719 ### http://PatientSafetyProfile/AllergyIntolerance  
720  
721 profile:AllergyIntolerance rdf:type owl:Class ;  
722 owl:equivalentClass [ rdf:type owl:Class ;  
723 owl:intersectionOf ( profile:DomainResource  
724 [ rdf:type owl:Restriction ;  
725 owl:onProperty fhir:tag ;  
726 owl:hasValue "AllergyIntolerance"  
727 ]  
728 )  
729 ] ;  
730 rdfs:subClassOf fhir:AllergyIntolerance ,  
731 [ rdf:type owl:Restriction ;  
732 owl:onProperty <http://hl7.org/fhir/AllergyIntolerance/AllergyIntolerance.substance> ;  
733 owl:allValuesFrom <http://PatientSafetyProfile/substance-type>  
734 ] .  
735  
736 ### http://PatientSafetyProfile/DomainResource  
737  
738 profile:DomainResource rdf:type owl:Class ;  
739 rdfs:subClassOf fhir:DomainResource .  
740  
741 ### http://PatientSafetyProfile/substance-type  
742 <http://PatientSafetyProfile/substance-type> rdf:type owl:Class ;  
743 rdfs:subClassOf fhir:ValueSet ,  
744 [ rdf:type owl:Class ;  
745 owl:unionOf (  
746 <http://snomed.info/id/105590001>  
747 <http://snomed.info/id/373873005>  
748 )  
749 ] .  
750
```

751

752