

# 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. 3 new additional classes are introduced – `codeBase`, `CodingBase` and `ConceptBase`.

```

92 xxx.code [ a fhir:CodeableConcept ;
93   ConceptBase.coding [ rdf:type fhir:CodingBase ;
94     fhir:CodingBase.system [ a fhir:uri; "fhir:value http://example.org/local"^^fhir:uri-primitive ] ;
95     fhir:CodingBase.code [ a fhir:codeBase ; fhir:value "admin"^^fhir:code-primitive ] ;
96     fhir:CodingBase.display [ a fhir:string; fhir:value "Admin"^^fhir:string-primitive ] ;
97   ] ;
98 ] ;
99

```

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

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

#### 104 1.1.4 FHIR OWL Schema

```

105 #####
106 #   Classes
107 #####
108
109 ### http://hl7.org/fhir/ConceptBase
110
111 fhir:ConceptBase rdf:type owl:Class ;
112   rdfs:subClassOf fhir:Element ,
113     [ rdf:type owl:Restriction ;
114       owl:onProperty fhir:ConceptBase.coding ;
115       owl:allValuesFrom fhir:CodingBase
116     ] ,
117     [ rdf:type owl:Restriction ;
118       owl:onProperty fhir:ConceptBase.text ;
119       owl:allValuesFrom fhir:string
120     ] ,
121     [ rdf:type owl:Restriction ;
122       owl:onProperty fhir:ConceptBase.text ;
123       owl:maxCardinality "1"^^xsd:nonNegativeInteger
124     ] .
125

```

```
126 ### http://hl7.org/fhir/CodingBase
127 fhir:CodingBase rdf:type owl:Class ;
128     rdfs:subClassOf fhir:Element ,
129     [ rdf:type owl:Restriction ;
130       owl:onProperty fhir:CodingBase.primary ;
131       owl:maxCardinality "1"^^xsd:nonNegativeInteger
132     ] ,
133     [ rdf:type owl:Restriction ;
134       owl:onProperty fhir:CodingBase.primary ;
135       owl:allValuesFrom fhir:boolean
136     ] ,
137     [ rdf:type owl:Restriction ;
138       owl:onProperty fhir:CodingBase.display ;
139       owl:maxCardinality "1"^^xsd:nonNegativeInteger
140     ] ,
141     [ rdf:type owl:Restriction ;
142       owl:onProperty fhir:CodingBase.version ;
143       owl:maxCardinality "1"^^xsd:nonNegativeInteger
144     ] ,
145     [ rdf:type owl:Restriction ;
146       owl:onProperty fhir:CodingBase.system ;
147       owl:allValuesFrom fhir:uri
148     ] ,
149     [ rdf:type owl:Restriction ;
150       owl:onProperty fhir:CodingBase.system ;
151       owl:maxCardinality "1"^^xsd:nonNegativeInteger
152     ] ,
153     [ rdf:type owl:Restriction ;
154       owl:onProperty fhir:CodingBase.display ;
155       owl:allValuesFrom fhir:string
156     ] ,
157     [ rdf:type owl:Restriction ;
158       owl:onProperty fhir:CodingBase.version ;
159       owl:allValuesFrom fhir:string
160     ] ,
161     [ rdf:type owl:Restriction ;
162       owl:onProperty fhir:CodingBase.code ;
163       owl:maxCardinality "1"^^xsd:nonNegativeInteger
164     ] ,
165     [ rdf:type owl:Restriction ;
166       owl:onProperty fhir:CodingBase.code ;
167       owl:allValuesFrom fhir:codeBase
168     ] .
```

169

```
170 ### http://hl7.org/fhir/codeBase
171 fhir:codeBase rdf:type owl:Class ;
172     rdfs:subClassOf fhir:Element ,
173     [ rdf:type owl:Restriction ;
174       owl:onProperty fhir:value ;
175       owl:allValuesFrom fhir:code-primitive
176     ] ,
177     [ rdf:type owl:Restriction ;
178       owl:onProperty fhir:value ;
179       owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
180       owl:onDataRange fhir:code-primitive
181     ] .
182
183
```

184

```

185 ### http://hl7.org/fhir/code
186 fhir:code rdf:type owl:Class ;
187     rdfs:subClassOf fhir:ConceptBase ,
188         [ rdf:type owl:Restriction ;
189           owl:onProperty fhir:ConceptBase.coding ;
190           owl:onClass [ rdf:type owl:Class ;
191                         owl:intersectionOf ( fhir:CodingBase
192                                                 [ rdf:type owl:Restriction ;
193                                                   owl:onProperty fhir:CodingBase.code ;
194                                                     owl:cardinality "1"^^xsd:nonNegativeInteger
195                                                 ]
196                                                 [ rdf:type owl:Restriction ;
197                                                   owl:onProperty fhir:CodingBase.system ;
198                                                     owl:cardinality "1"^^xsd:nonNegativeInteger
199                                                 ]
200                                                 [ rdf:type owl:Restriction ;
201                                                   owl:onProperty fhir:CodingBase.version ;
202                                                     owl:cardinality "1"^^xsd:nonNegativeInteger
203                                                 ]
204                                                 [ rdf:type owl:Restriction ;
205                                                   owl:onProperty fhir:CodingBase.display ;
206                                                     owl:maxCardinality "0"^^xsd:nonNegativeInteger
207                                                 ]
208                                                 [ rdf:type owl:Restriction ;
209                                                   owl:onProperty fhir:CodingBase.primary ;
210                                                     owl:maxCardinality "0"^^xsd:nonNegativeInteger
211                                                 ]
212                                             )
213         ] ;
214     owl:qualifiedCardinality "1"^^xsd:nonNegativeInteger
215 ] .
216

```

217 Finally we can define the types from FHIR:

```

218 ### http://hl7.org/fhir/CodeableConcept
219 fhir:CodeableConcept rdf:type owl:Class ;
220     rdfs:subClassOf fhir:ConceptBasey ;
221     rdfs:comment "The set of possible coded values this coding was chosen from or constrained
222 by." .
223
224 ### http://hl7.org/fhir/Coding
225 fhir:Coding rdf:type owl:Class ;
226     rdfs:subClassOf fhir:ConceptBase ,
227         [ rdf:type owl:Restriction ;
228           owl:onProperty fhir:ConceptBase.text ;
229           owl:maxCardinality "0"^^xsd:nonNegativeInteger
230         ] ,
231         [ rdf:type owl:Restriction ;
232           owl:onProperty fhir:ConceptBase.coding ;
233           owl:cardinality "1"^^xsd:nonNegativeInteger
234         ] .
235
236 ### http://hl7.org/fhir/code
237
238 fhir:code rdf:type owl:Class ;
239
240     rdfs:subClassOf fhir:ConceptBase ,
241         [ rdf:type owl:Restriction ;
242           owl:onProperty fhir:ConceptBase.coding ;
243           owl:cardinality "1"^^xsd:nonNegativeInteger
244         ] ,
245         [ rdf:type owl:Restriction ;
246           owl:onProperty fhir:ConceptBase.coding ;
247           owl:allValuesFrom [ rdf:type owl:Class ;
248                                 owl:intersectionOf ( fhir:CodingBase
249                 [ rdf:type owl:Restriction ;
250                   owl:onProperty fhir:CodingBase.code ;
251                   owl:cardinality "1"^^xsd:nonNegativeInteger
252                 ]
253                 [ rdf:type owl:Restriction ;
254                   owl:onProperty fhir:CodingBase.system ;
255                   owl:cardinality "1"^^xsd:nonNegativeInteger
256                 ]
257                 [ rdf:type owl:Restriction ;
258                   owl:onProperty fhir:CodingBase.version ;
259                   owl:cardinality "1"^^xsd:nonNegativeInteger
260                 ]
261                 [ rdf:type owl:Restriction ;
262                   owl:onProperty fhir:CodingBase.display ;
263                   owl:maxCardinality "0"^^xsd:nonNegativeInteger
264                 ]
265                 [ rdf:type owl:Restriction ;
266                   owl:onProperty fhir:CodingBase.primary ;
267                   owl:maxCardinality "0"^^xsd:nonNegativeInteger
268                 ]
269             )
270         ]
271     ] .

```

272

## 273 2 Concept Binding external (section 1.17.3.3.5)

### 274 2.1 Github example

```
275 @prefix loinc: <http://loinc.org/owl#> .  
276 :resource a fhir:Observation;  
277   fhir:Observation.code [  
278     fhir:CodeableConcept.coding [  
279       fhir:Coding.system <http://loinc.org>;  
280       fhir:Coding.code "54411-4";  
281       fhir:Coding.display "Rh immune globulin given Qualitative";  
282       ex:concept loinc:54411-4;  
283     ];  
284     fhir:CodeableConcept.text "Rh immune globulin";  
285   ].
```

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

### 290 2.2 Subgroup example

#### 291 2.2.1 FHIR XML

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

```
293 <Observation xmlns="http://hl7.org/fhir">  
294   <code>  
295     <coding>  
296       <system value="http://Loinc.org"/>  
297       <code value="54411-4"/>  
298       <display value=" Rh immune globulin given Qualitative "/>  
299     </coding>  
300     <text value="Rh immune globulin"/>  
301   </code>  
302   .....
```

#### 303 2.2.2 FHIR Structure definition

304 See section 1.2.2

#### 305 2.2.3 RDF Data with Terminology blank nodes in RDF

```
306 @prefix loinc: <http://loinc.org/> .  
307 @prefix fhir: <http://hl7.org/fhir/> .  
308 <sourceNamespace/Observation/resource.id> a fhir:Observation;  
309   fhir:Observation.code [ a fhir:CodeableConcept , <http://loinc.org/54411-4> ;  
310     fhir:ConceptBase.coding [ a fhir:CodingBase , <http://loinc.org/54411-4> ;  
311       fhir:CodingBase.system [ a fhir:uri fhir:value "http://loinc.org"^^fhir:uri-primitive ] ;  
312       fhir:CodingBase.code [ a fhir:codeBase fhir:value "54411-4"^^fhir:code-primitive ] ;  
313       fhir:CodingBase.display [ a fhir:string fhir:value "Rh immune globulin given Qualitative"^^fhir:string-  
314         primitive ] ;  
315     ];  
316     fhir:ConceptBase.text [ a fhir:string fhir:value "Rh immune globulin" ]  
317   ].
```

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

320 The type on the CodingBase instance is calculated based on the formation of the URL for that terminology. The  
321 type in the CodingBase instance is carried up to the ConceptBase blank node.

## 322 2.3 Allergy Intolerance Subgroup Example

### 323 2.3.1 FHIR XML

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

348

349



### 350 2.3.2 RDF Example

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

```
352 @prefix : <http://record/AllergyIntolerance/> .
353 @prefix owl: <http://www.w3.org/2002/07/owl#> .
354 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
355 @prefix sct: <http://snomed.info/id/> .
356 @prefix xml: <http://www.w3.org/XML/1998/namespace> .
357 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
358 @prefix fhir: <http://hl7.org/fhir/> .
359 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
360 @prefix profile: <http://PatientSafetyProfile/> .
361 @base <http://record/AllergyIntolerance/1> .
362
363
364 <http://record/AllergyIntolerance/> rdf:type owl:Ontology ;
365 owl:imports <http://PatientSafetyProfile> .
366
367 ### http://record/AllergyIntolerance/1
368
369 <http://record/AllergyIntolerance/1> rdf:type profile:DomainResource , owl:NamedIndividual ,
370 profile:AllergyIntolerance ;
371 fhir:tag "AllergyIntolerance" ;
372 fhir:AllergyIntolerance.status [ rdf:type fhir:code,
373 <http://hl7.org/fhir/allergyIntoleranceStatus#confirmed> ;
374 fhir:ConceptBase.coding [ rdf:type fhir:CodingBase ;
375 fhir:CodingBase.code [ rdf:type fhir:CodingBase.Code; fhir:value "confirmed"
376 ]
377 ]
378 ] ;
379 fhir:AllergyIntolerance.patient [ rdf:type fhir:Reference ;
380 fhir:Reference.reference [ fhir:value "http://record/Patient/PeterPatient" ] ;
381 fhir:Reference.display [ fhir:value "Peter Patient" ] ;
382 fhir:Reference.link <http://record/Patient/PeterPatient> ;
383 ] ;
384 fhir:AllergyIntolerance.substance [ rdf:type fhir:CodeableConcept , http://snomed.info/id/90614001 ;
385 rdfs:label "beta-lactam (antibiotic)" ;
386 fhir:ConceptBase.coding [ rdf:type fhir:CodingBase , http://snomed.info/id/90614001 ;
387 fhir:CodingBase.code [ rdf:type fhir:CodingBase.Code ; fhir:value "90614001" ] ;
388 fhir:CodingBase.system [ rdf:type fhir:CodingBase.System ; fhir:value "http://snomed.info/id/90614001" ]
389 ;
390 fhir:CodingBase.display [ rdf:type fhir:CodingBase.Display ; fhir:value "beta-lactam (antibiotic)" ]
391 ] ;
392 fhir:ConceptBase.text [ rdf:type fhir:string ; fhir:value "beta-lactam (antibiotic)"
393 ]
394 ] .### Generated by the OWL API (version 3.5.1) http://owlapi.sourceforge.net
395
```

396

397 Note the use of a profile binding through the type "profile:DomainResource". The fhir:tag causes the inference  
398 of the type to be "profile:AllergyIntolerance" which then restricts the types of CodingBase instances.

399 Creation of import statements is TBD.

### 400 2.3.3 FHIR OWL Schema

401 See section 1.2.4.

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

403 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.category ;
          owl:allValuesFrom fhir:allergy-intolerance-category
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.reporter ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.comment ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.recorder ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.category ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.patient ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.recordedDate ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.type ;
          owl:allValuesFrom fhir:allergy-intolerance-type
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.comment ;
          owl:allValuesFrom fhir:string
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.criticality ;
          owl:allValuesFrom fhir:allergy-intolerance-criticality
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.recorder ;
          owl:allValuesFrom fhir:Reference
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.criticality ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.identifier ;
          owl:allValuesFrom fhir:Identifier
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.type ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.substance ;
          owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ] ,
        [ rdf:type owl:Restriction ;
          owl:onProperty fhir:AllergyIntolerance.patient ;
```

```

472         owl:allValuesFrom fhir:Reference
473     ] ,
474     [ rdf:type owl:Restriction ;
475       owl:onProperty fhir:AllergyIntolerance.lastOccurence ;
476       owl:maxCardinality "1"^^xsd:nonNegativeInteger
477     ] ,
478     [ rdf:type owl:Class ;
479       owl:intersectionOf ( fhir:DomainResource
480                             [ rdf:type owl:Restriction ;
481                               owl:onProperty fhir:tag ;
482                               owl:hasValue "AllergyIntolerance"
483                             ]
484                           )
485     ] ,
486     [ rdf:type owl:Restriction ;
487       owl:onProperty fhir:AllergyIntolerance.status ;
488       owl:maxCardinality "1"^^xsd:nonNegativeInteger
489     ] ,
490     [ rdf:type owl:Restriction ;
491       owl:onProperty fhir:AllergyIntolerance.lastOccurence ;
492       owl:allValuesFrom fhir:dateTime
493     ] ,
494     [ rdf:type owl:Restriction ;
495       owl:onProperty fhir:AllergyIntolerance.status ;
496       owl:allValuesFrom <http://hl7.org/fhir/vs/allergy-intolerance-status>
497     ] ,
498     [ rdf:type owl:Restriction ;
499       owl:onProperty fhir:AllergyIntolerance.reporter ;
500       owl:allValuesFrom fhir:Reference
501     ] ,
502     [ rdf:type owl:Restriction ;
503       owl:onProperty fhir:AllergyIntolerance.recordedDate ;
504       owl:allValuesFrom fhir:dateTime
505     ] .
506 ### http://hl7.org/fhir/AllergyIntolerance.Event
507 fhir:AllergyIntolerance.Event rdf:type owl:Class ;
508                               rdfs:subClassOf fhir:BackboneElement .
509

```

510 From the SNOMED RDF:

```

511 <http://snomed.info/id/138875005> rdf:type owl:Class ;
512                               rdfs:label "SNOMED CT Concept" .
513
514 <http://snomed.info/id/105590001> rdf:type owl:Class ;
515                               rdfs:label "Substance (substance)" ;
516                               rdfs:subClassOf <http://snomed.info/id/138875005> .
517
518 <http://snomed.info/id/373873005> rdf:type owl:Class ;
519                               rdfs:label "Pharmaceutical / biologic product (product)" ;
520                               rdfs:subClassOf <http://snomed.info/id/138875005> .
521
522 <http://snomed.info/id/346325008> rdf:type owl:Class ;
523                               rdfs:label "Antibacterial drugs (product)" ;
524                               rdfs:subClassOf <http://snomed.info/id/373873005> .
525
526 <http://snomed.info/id/105590001> rdf:type owl:Class ;
527                               rdfs:label "beta-Lactam antibiotic" ;
528                               rdfs:subClassOf <http://snomed.info/id/346325008> .
529

```

530

### 531 **3 Valueset Definition**

532 In FHIR ValueSet definitions are complicated.

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

534 a) instances of ValueSet.Define if all the codes are taken from a single system

535 b) instances of ValueSet.Compose if the codes come from multiple systems and allow inclusion and  
536 exclusion

537 c) instances of ValueSet.Expansion if the valueset is converted into an enumerated list

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

#### 541 **3.1 ValueSet schema in the metamodel**

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

```

544   ### http://hl7.org/fhir/ValueSet
545   fhir:ValueSet rdf:type owl:Class ;
546       rdfs:subClassOf fhir:DomainResource ,
547           [ rdf:type owl:Restriction ;
548             owl:onProperty fhir:ValueSet.define ;
549             owl:allValuesFrom fhir:ValueSet.Define
550           ] ,
551           [ rdf:type owl:Restriction ;
552             owl:onProperty fhir:ValueSet.define ;
553             owl:maxCardinality "1"^^xsd:nonNegativeInteger
554           ] ,
555           [ rdf:type owl:Restriction ;
556             owl:onProperty fhir:ValueSet.compose ;
557             owl:allValuesFrom fhir:ValueSet.Compose
558           ] ,
559           [ rdf:type owl:Restriction ;
560             owl:onProperty fhir:ValueSet.expansion ;
561             owl:maxCardinality "1"^^xsd:nonNegativeInteger
562           ] ,
563           [ rdf:type owl:Restriction ;
564             owl:onProperty fhir:ValueSet.expansion ;
565             owl:allValuesFrom fhir:ValueSet.Expansion
566           ] ,
567           [ rdf:type owl:Restriction ;
568             owl:onProperty fhir:ValueSet.compose ;
569             owl:maxCardinality "1"^^xsd:nonNegativeInteger
570           ] .
571
572   ### http://hl7.org/fhir/ValueSet.Compose
573   fhir:ValueSet.Compose rdf:type owl:Class ;
574       rdfs:subClassOf fhir:BackboneElement .
575
576   ### http://hl7.org/fhir/ValueSet.Concept
577   fhir:ValueSet.Concept rdf:type owl:Class ;
578       rdfs:subClassOf fhir:BackboneElement ,
579           [ rdf:type owl:Restriction ;
580             owl:onProperty fhir:ValueSet.Concept.display ;
581             owl:allValuesFrom fhir:string
582           ] ,
583           [ rdf:type owl:Restriction ;
584             owl:onProperty fhir:ValueSet.Concept.code ;
585             owl:cardinality "1"^^xsd:nonNegativeInteger
586           ] ,
587           [ rdf:type owl:Restriction ;
588             owl:onProperty fhir:ValueSet.Concept.code ;
589             owl:allValuesFrom fhir:code
590           ] ,
591           [ rdf:type owl:Restriction ;
592             owl:onProperty fhir:ValueSet.Concept.definition ;
593             owl:maxCardinality "1"^^xsd:nonNegativeInteger
594           ] ,
595           [ rdf:type owl:Restriction ;
596             owl:onProperty fhir:ValueSet.Concept.display ;
597             owl:maxCardinality "1"^^xsd:nonNegativeInteger
598           ] ,
599           [ rdf:type owl:Restriction ;
600             owl:onProperty fhir:ValueSet.Concept.definition ;
601             owl:allValuesFrom fhir:string
602           ] .
603

```

```

604 ### http://hl7.org/fhir/ValueSet.Define
605 fhir:ValueSet.Define rdf:type owl:Class ;
606     rdfs:subClassOf fhir:BackboneElement ,
607     [ rdf:type owl:Restriction ;
608       owl:onProperty fhir:ValueSet.Define.system ;
609       owl:allValuesFrom fhir:uri
610     ] ,
611     [ rdf:type owl:Restriction ;
612       owl:onProperty fhir:ValueSet.Define.system ;
613       owl:cardinality "1"^^xsd:nonNegativeInteger
614     ] ,
615     [ rdf:type owl:Restriction ;
616       owl:onProperty fhir:ValueSet.Define.concept ;
617       owl:allValuesFrom fhir:ValueSet.Concept
618     ] .
619
620 ### http://hl7.org/fhir/ValueSet.Expansion
621 fhir:ValueSet.Expansion rdf:type owl:Class ;
622     rdfs:subClassOf fhir:BackboneElement .

```

623  
624

### 625 3.2 ValueSet Instances (in the metamodel)

626 An example is Allergy Intolerance Status ValueSet:

```

627 ### http://hl7.org/fhir/vs/allergy-intolerance-status
628
629 <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type fhir:ValueSet , owl:NamedIndividual ;
630     rdfs:label "Allergy Intolerance Status Value Set" ;
631     fhir:ValueSet.define [ rdf:type fhir:ValueSet.Define ;
632       fhir:ValueSet.Define.system [ fhir:value "http://hl7.org/fhir/allergy-intolerance-status" ] ;
633       fhir:ValueSet.Define.concept
634         [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#confirmed> ] ,
635         [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> ] ,
636         [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#refuted> ] ,
637         [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#resolved> ] ,
638         [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#unconfirmed> ]
639     ] .
640
641

```

641

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

```

644 ### http://hl7.org/fhir/allergy-intolerance-status
645
646 fhir:allergy-intolerance-status rdf:type http://hl7.org/fhir/allergy-intolerance-status ,
647     fhir:uri , owl:NamedIndividual ;
648     fhir:value "http://hl7.org/fhir/allergy-intolerance-status" .
649

```

649

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

```

652   ### http://hl7.org/fhir/allergy-intolerance-status#confirmed
653
654   <http://hl7.org/fhir/allergy-intolerance-status#confirmed> rdf:type fhir:ValueSet.Concept ,
655     <http://hl7.org/fhir/allergy-intolerance-status#confirmed> , owl:NamedIndividual ;
656     fhir:ValueSet.Concept.code [ rdf:type fhir:code ; fhir:value "confirmed" ].
657
658   ### http://hl7.org/fhir/allergy-intolerance-status#entered-in-error
659
660   <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> rdf:type fhir:ValueSet.Concept ,
661     <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> , owl:NamedIndividual ;
662     fhir:ValueSet.Concept.code [ rdf:type fhir:code ; fhir:value " entered-in-error " ].
663
664

```

### 665 3.3 ValueSet-System and Term Definitions (in the OWL model)

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

```

667   ### http://hl7.org/fhir/allergy-intolerance-status
668
669   fhir:allergy-intolerance-status rdf:type owl:Class ;
670     rdfs:subClassOf fhir:valueset-system .
671
672   ### http://hl7.org/fhir/allergy-intolerance-status#confirmed
673
674   <http://hl7.org/fhir/allergy-intolerance-status#confirmed> rdf:type owl:Class ;
675     owl:equivalentClass [ rdf:type owl:Class ;
676       owl:intersectionOf ( fhir:allergy-intolerance-status
677         [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "confirmed" ]
678       )
679     ] .
680
681   ### http://hl7.org/fhir/allergy-intolerance-status#entered-in-error
682
683   <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> rdf:type owl:Class ;
684     owl:equivalentClass [ rdf:type owl:Class ;
685       owl:intersectionOf ( fhir:allergy-intolerance-status
686         [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "entered-in-error" ]
687       )
688     ] .
689

```

690

### 691 3.4 ValueSet Definitions (in the OWL Model)

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

```

693   ### http://hl7.org/fhir/vs/allergy-intolerance-status
694
695   <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type owl:Class ;
696     owl:equivalentClass [ rdf:type owl:Class ;
697       owl:unionOf (
698         <http://hl7.org/fhir/allergy-intolerance-status#confirmed>
699         <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error>
700         <http://hl7.org/fhir/allergy-intolerance-status#refuted>
701         <http://hl7.org/fhir/allergy-intolerance-status#resolved>
702         <http://hl7.org/fhir/allergy-intolerance-status#unconfirmed>
703       )
704     ] .

```

705

706

## 707 4 Concept Binding Internal

### 708 4.1 Github example

709 No example

### 710 4.2 Subgroup example

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

#### 713 4.2.1 FHIR XML

```
714 <AllergyIntolerance xmlns="http://hl7.org/fhir">  
715   <id value="1"/>  
716   <text>  
717  
718   </text>  
719   <!-- the date that this entry was recorded -->  
720   <recordedDate value="2010-03-01"/>  
721   <!-- the patient that actually has the risk of adverse reaction -->  
722   <patient>  
723     <reference value="http://record/Patient/PeterPatient"/>  
724   </patient>  
725   <!-- substance, coded from SNOMED CT-->  
726   <substance>  
727     <coding>  
728       <system value="http://snomed.info/id/">  
729       <code value="105590001"/>  
730       <display value="beta-Lactam antibiotic"/>  
731     </coding>  
732   </substance>  
733   <status value="confirmed"/>  
734   <criticality value="high"/>  
735   <category value="medication"/>  
736 </AllergyIntolerance>
```

737



738 **4.2.2 RDF Data After processing**

```
739 fhir:AllergyIntolerance.status [ rdf:type <http://hl7.org/fhir/allergy-intolerance-status#confirmed> ;  
740     fhir:ConceptBasey.coding [ rdf:type fhir:CodingBasey ;  
741         fhir:CodingBasey.code [ rdf:type fhir:codeBasey ; fhir:value "confirmed" ]  
742     ]  
743 ] ;
```

744 **4.2.3 FHIR OWL Schema**

745 Same mechanism as external terminologies –see 2.2.5.

746 Internal terminology expressed as Class hierarchy

```
747 fhir:AllergyIntolerance rdf:type owl:Class ;  
748     rdfs:subClassOf fhir:DomainResource ,  
749         [ rdf:type owl:Restriction ;  
750             owl:onProperty fhir:AllergyIntolerance.status ;  
751             owl:allValuesFrom <http://hl7.org/fhir/vs/allergy-intolerance-status>  
752         ] ,  
753  
754 ### http://hl7.org/fhir/vs/allergy-intolerance-status  
755 <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type owl:Class ;  
756     rdfs:subClassOf fhir:valueset ;  
757     owl:disjointUnionOf ( <http://hl7.org/fhir/allergy-intolerance-status#confirmed>  
758         <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error>  
759         <http://hl7.org/fhir/allergy-intolerance-status#refuted>  
760         <http://hl7.org/fhir/allergy-intolerance-status#resolved>  
761         <http://hl7.org/fhir/allergy-intolerance-status#unconfirmed>  
762     ) .  
763
```

764

765 The model (not the metamodel) shows the ValueSet as a disjoint Union of the qualified codes (system + code).

766

## 767 5 Resource References

### 768 5.1 Github example

```
769 :resource a fhir:Observation;  
770   fhir:contained fhir:Observation\#23;  
771   fhir:Observation.subject [  
772     fhir:Reference.reference fhir:Observation\#23  
773   ].  
774  
775 fhir:Observation\#23 a fhir:Patient;  
776   fhir:Patient.name [ fhir:text "John Smith ].
```

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

### 779 5.2 Subgroup example

#### 780 5.2.1 FHIR XML

```
781 <AllergyIntolerance xmlns="http://hl7.org/fhir">  
782   <id value="1"/>  
783   <text>  
784  
785   </text>  
786   <!-- the date that this entry was recorded -->  
787   <recordedDate value="2010-03-01"/>  
788   <!-- the patient that actually has the risk of adverse reaction -->  
789   <patient>  
790     <reference value="http://record/Patient/PeterPatient"/>  
791     <display value="Peter Patient"/>  
792   </patient>  
793 </AllergyIntolerance>
```

#### 794 5.2.2 RDF Data After processing (acquiring the resource and importing)

```
795 fhir:AllergyIntolerance.patient [ fhir:Reference.display [ fhir:value "Peter Patient" ] ;  
796                               fhir:Reference.reference [ fhir:value "http://record/Patient/PeterPatient" ] ;  
797                               fhir:Reference.link <http://record/Patient/PeterPatient>  
798                               ] ;
```

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

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

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

```
802 ### http://hl7.org/fhir/AllergyForPatient
803 fhir:AllergyForPatient rdf:type owl:ObjectProperty ;
804 owl:inverseOf fhir:AllergyIntolerance.patient.link .
805
806 ### http://hl7.org/fhir/AllergyIntolerance.patient.link
807
808 fhir:AllergyIntolerance.patient.link rdf:type owl:ObjectProperty ;
809 owl:propertyChainAxiom ( fhir:AllergyIntolerance.patient fhir:Reference.link ) .
```

### 810 5.2.3 FHIR OWL Schema

```
811 fhir:Reference rdf:type owl:Class ;
812 rdfs:subClassOf fhir:Element ,
813 [ rdf:type owl:Restriction ;
814 owl:onProperty fhir:Reference.link ;
815 owl:onClass fhir:DomainResource ;
816 owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
817 ] ,
818 [ rdf:type owl:Restriction ;
819 owl:onProperty fhir:Reference.display ;
820 owl:onClass fhir:string ;
821 owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
822 ] ,
823 [ rdf:type owl:Restriction ;
824 owl:onProperty fhir:Reference.reference ;
825 owl:onClass fhir:string ;
826 owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
827 ] .
```

828

829

## 830 **6 Bundle**

831 Some preliminary notes:

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

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

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

## 837 **7 URI Naming**

### 838 **7.1 Github example**

839 No example

### 840 **7.2 Subgroup example**

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

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

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

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

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

849

850

## 851 8 Ordering

### 852 8.1 Github example

853 No example

### 854 8.2 RDF individual ordering example

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

856

```
857 ### http://hl7.org/fhir/index
858 fhir:index rdf:type owl:DatatypeProperty ;
859           rdfs:range fhir:index-primitive .
860
861 ### http://hl7.org/fhir/index-primitive
862 fhir:index-primitive rdf:type rdfs:Datatype ;
863                    owl:equivalentClass [ rdf:type rdfs:Datatype ;
864                                           owl:onDatatype xsd:integer ;
865                                           owl:withRestrictions ( [ xsd:minInclusive 1 ] )
866                                           ] .
867 ### http://hl7.org/fhir/Element
868 fhir:Element rdf:type owl:Class ;
869            rdfs:label "Element" ;
870            rdfs:subClassOf [ rdf:type owl:Restriction ;
871                             owl:onProperty fhir:Element.extension ;
872                             owl:someValuesFrom fhir:Extension
873                             ] ,
874                             [ rdf:type owl:Restriction ;
875                             owl:onProperty fhir:Element.id ;
876                             owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
877                             owl:onDataRange fhir:id-primitive
878                             ] ,
879                             [ rdf:type owl:Restriction ;
880                             owl:onProperty fhir:index ;
881                             owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
882                             owl:onDataRange fhir:index-primitive
883                             ] ;
884            rdfs:comment "The base element used for all FHIR elements and resources - allows for them to be
885            extended with extensions" .
886 .
```

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

### 889 8.3 RDF Object Property Ordering example

890 Where object properties need to be ordered to construct the sequence of properties in XML, the fhir:index is  
891 defined as an annotation property on the Object Property. The example of ordered properties inside  
892 CodingBasey is shown:

```
893   ### http://hl7.org/fhir/CodingBasey.system
894   fhir:CodingBasey.system rdf:type owl:ObjectProperty ;
895   fhir:index 1 ;
896
897   ### http://hl7.org/fhir/CodingBasey.version
898   fhir:CodingBasey.version rdf:type owl:ObjectProperty ;
899   fhir:index 2 .
900
901   ### http://hl7.org/fhir/CodingBasey.code
902   fhir:CodingBasey.code rdf:type owl:ObjectProperty ;
903   fhir:index 3 .
904
905   ### http://hl7.org/fhir/CodingBasey.display
906   fhir:CodingBasey.display rdf:type owl:ObjectProperty ;
907   fhir:index 4 ;
908
909   ### http://hl7.org/fhir/CodingBasey.primary
910   fhir:CodingBasey.primary rdf:type owl:ObjectProperty ;
911   fhir:index 5 ;
```

912

913

914

## 915 9 Profiles

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

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

```
919 allergy:AllergyIntolerance.substance.coding rdf:type owl:ObjectProperty ;  
920     owl:inverseOf fhir:Coding.Resource ;  
921     owl:propertyChainAxiom ( allergy:AllergyIntolerance.substance fhir:ConceptBase.coding ).
```

922

```
923 ### http://PatientSafetyProfile/AllergyIntolerance  
924 profile:AllergyIntolerance rdf:type owl:Class ;  
925     rdfs:subClassOf fhir:AllergyIntolerance ,  
926     [ rdf:type owl:Restriction ; owl:onProperty  
927     <http://hl7.org/fhir/AllergyIntolerance/AllergyIntolerance.substance.coding> ;  
928     owl:allValuesFrom [ rdf:type owl:Class ;  
929     owl:unionOf ( <http://snomed.info/id/105590001> <http://snomed.info/id/373873005> )  
930     ]  
931     ] .  
932 ### http://PatientSafetyProfile/DomainResource  
933 profile:DomainResource rdf:type owl:Class ;  
934     rdfs:subClassOf fhir:DomainResource .
```

936

937