

# 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**.

33

34    **1 Datatypes (section 1.18.0.1)**

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

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

38    **1.1 Id**

39    **1.1.1 Id instance**

40    **1.1.2 Id schema**

```
41 fhir:id rdf:type owl:Class ;
42   rdfs:subClassOf fhir:Element ,
43     [ rdf:type owl:Restriction ;
44       owl:onProperty fhir:value ;
45       owl:allValuesFrom [ rdf:type rdfs:Datatype ;
46         owl:onDatatype xsd:string ;
47         owl:withRestrictions ( [ xsd:pattern "[A-Za-z0-9\\-\\.]{1,64}" ] )
48       ]
49     ] ,
50     [ rdf:type owl:Restriction ;
51       owl:onProperty fhir:value ;
52       owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
53       owl:onDataRange xsd:string
54     ] ;
55   rdfs:comment "A whole number in the range 0 to 2^64-1, optionally represented in hex, a uuid, an oid or
56 any other combination of lower-case letters a-z, numerals, “-” and “.”, with a length limit of 36 characters" .
```

57    **1.2 Decimal**

58    Decimal has an additional DataProperty fhir:fractionDigits which allows the explicit declaration of scale.

59    **1.2.1 Decimal OWL instance**

```
[ a fhir:decimal ; fhir:value 123.4 ; fhir:fractionDigits 3 ]
```

61    **1.2.2 Decimal OWL Schema**

```
62 fhir:decimal rdf:type owl:Class ;
63   rdfs:subClassOf fhir:Element ,
64     [ rdf:type owl:Restriction ;
65       owl:onProperty fhir:fractionDigits ;
66       owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
67       owl:onDataRange xsd:nonNegativeInteger
68     ] ,
69     [ rdf:type owl:Restriction ;
70       owl:onProperty fhir:fractionDigits ;
71       owl:allValuesFrom xsd:nonNegativeInteger
72     ] ,
73     [ rdf:type owl:Restriction ;
74       owl:onProperty fhir:value ;
75       owl:allValuesFrom xsd:decimal
76     ] ,
77     [ rdf:type owl:Restriction ;
78       owl:onProperty fhir:value ;
79       owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
80       owl:onDataRange xsd:decimal
81     ] ;
82   rdfs:comment "A rational number with implicit precision" .
```

84    **1.3 FHIR CodeableConcept and Coding Structure Definition**

85    **1.3.1 FHIR XML**

```
86 <code>
87   <coding>
88     <system value="http://example.org/local"/>
89     <code value="admin"/>
90     <display value="Admin"/>
91   </coding>
92 </code>
```

93    CodeableConcept Structural Definition

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

99

100   Coding Structural Definition

```
101 <[name] xmlns="http://hl7.org/fhir">
102   <!-- from Element: extension -->
103   <system value="[uri]" /><!-- 0..1 Identity of the terminology system -->
104   <version value="[string]" /><!-- 0..1 Version of the system - if relevant -->
105   <code value="[code]" /><!-- 0..1 Symbol in syntax defined by the system -->
106   <display value="[string]" /><!-- 0..1 Representation defined by the system -->
107   <primary value="[boolean]" /><!-- 0..1 If this code was chosen directly by the user -->
108 </[name]>
```

109

110   **1.3.2 RDF Data for Coding Instance**

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

```
113 xxx.code [ a fhir:CodeableConcept ;
114   ConceptBase.coding [ rdf:type fhir:CodingBase ;
115     fhir:CodingBase.system [ a fhir:uri; "fhir:value http://example.org/local" ] ;
116     fhir:CodingBase.code [ a fhir:codeBase ; fhir:value "admin" ] ;
117     fhir:CodingBase.display [ a fhir:string; fhir:value "Admin" ] ;
118   ] ;
119 ] ;
```

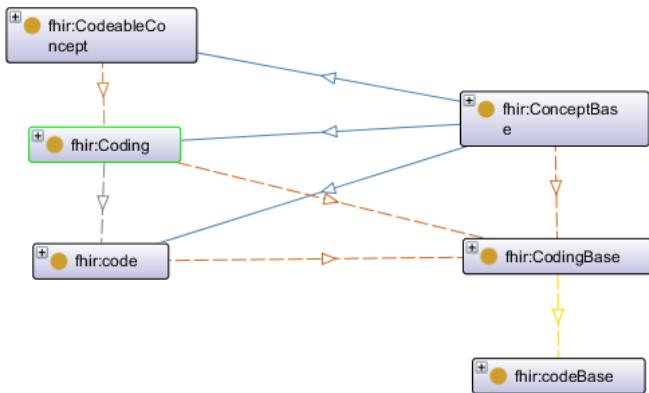
120

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

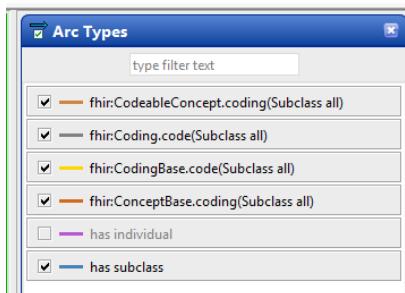
123   This approach will be implemented by creating ConceptBase, CodingBase and codeBase individuals as blank  
124   nodes.

125    1.3.3    FHIR OWL Schema

126    ConceptBase has subclasses fhir:CodeableConcept, fhir:Coding and fhir:code.



127



128

```
129 [ rdf:type owl:AllDisjointClasses ;
130   owl:members ( fhir:CodingBase
131                 fhir:ConceptBase
132                 fhir:codeBase
133                 )
134 ] .
```

135

```
136 #####
137 # Classes
138 #####
139
140 ### http://hl7.org/fhir/ConceptBase
141
142 fhir:ConceptBase rdf:type owl:Class ;
143   rdfs:subClassOf fhir:Datatype ,
144     [ rdf:type owl:Restriction ;
145       owl:onProperty fhir:ConceptBase.coding ;
146       owl:allValuesFrom fhir:CodingBase
147     ] ,
148     [ rdf:type owl:Restriction ;
149       owl:onProperty fhir:ConceptBase.text ;
150       owl:maxCardinality "1"^^xsd:nonNegativeInteger
151     ] ,
152     [ rdf:type owl:Restriction ;
153       owl:onProperty fhir:ConceptBase.text ;
154       owl:allValuesFrom fhir:string
155     ]
156 .
157
```

```
158     ### http://hl7.org/fhir/CodingBase
159     fhir:CodingBase rdf:type owl:Class ;
160         rdfs:subClassOf fhir:Element ,
161             [ rdf:type owl:Restriction ;
162                 owl:onProperty fhir:CodingBase.system ;
163                 owl:allValuesFrom fhir:uri
164             ] ,
165             [ rdf:type owl:Restriction ;
166                 owl:onProperty fhir:CodingBase.system ;
167                 owl:maxCardinality "1"^^xsd:nonNegativeInteger
168             ] ,
169             [ rdf:type owl:Restriction ;
170                 owl:onProperty fhir:CodingBase.version ;
171                 owl:allValuesFrom fhir:string
172             ] ,
173             [ rdf:type owl:Restriction ;
174                 owl:onProperty fhir:CodingBase.version ;
175                 owl:maxCardinality "1"^^xsd:nonNegativeInteger
176             ] ,
177             [ rdf:type owl:Restriction ;
178                 owl:onProperty fhir:CodingBase.code ;
179                 owl:allValuesFrom fhir:codeBase
180             ] ,
181             [ rdf:type owl:Restriction ;
182                 owl:onProperty fhir:CodingBase.code ;
183                 owl:maxCardinality "1"^^xsd:nonNegativeInteger
184             ] ,
185             [ rdf:type owl:Restriction ;
186                 owl:onProperty fhir:CodingBase.display ;
187                 owl:allValuesFrom fhir:string
188             ] ,
189             [ rdf:type owl:Restriction ;
190                 owl:onProperty fhir:CodingBase.display ;
191                 owl:maxCardinality "1"^^xsd:nonNegativeInteger
192             ] ,
193             [ rdf:type owl:Restriction ;
194                 owl:onProperty fhir:CodingBase.primary ;
195                 owl:maxCardinality "1"^^xsd:nonNegativeInteger
196             ] ,
197             [ rdf:type owl:Restriction ;
198                 owl:onProperty fhir:CodingBase.primary ;
199                 owl:allValuesFrom fhir:boolean
200             ] .
201
```

```
202     fhir:codeBase rdf:type owl:Class ;
203         rdfs:subClassOf fhir:Element ,
204             [ rdf:type owl:Restriction ;
205                 owl:onProperty fhir:value ;
206                 owl:allValuesFrom xsd:token
207             ] ,
208             [ rdf:type owl:Restriction ;
209                 owl:onProperty fhir:value ;
210                 owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
211                 owl:onDataRange xsd:token
212             ] .
213
```

214 The concrete subclasses of ConceptBase apply the additional restrictions:

```
215     ### http://hl7.org/fhir/CodeableConcept
216     fhir:CodeableConcept rdf:type owl:Class ;
217         rdfs:subClassOf fhir:ConceptBase ;
218         rdfs:comment "The set of possible coded values this coding was chosen from or constrained by." .
219
```

```
220     ### http://hl7.org/fhir/Coding
221     fhir:Coding rdf:type owl:Class ;
222         rdfs:subClassOf fhir:ConceptBase ,
223             [ rdf:type owl:Restriction ;
224                 owl:onProperty fhir:ConceptBase.text ;
225                 owl:maxCardinality "0"^^xsd:nonNegativeInteger
226             ] ,
227             [ rdf:type owl:Restriction ;
228                 owl:onProperty fhir:ConceptBase.coding ;
229                 owl:cardinality "1"^^xsd:nonNegativeInteger
230             ] .
```

```
231
232     fhir:code rdf:type owl:Class ;
233         rdfs:subClassOf fhir:ConceptBase , [ rdf:type owl:Restriction ;
234             owl:onProperty fhir:ConceptBase.coding ;
235             owl:allValuesFrom [ rdf:type owl:Class ;
236                 owl:intersectionOf ( fhir:CodingBase
237                     [ rdf:type owl:Restriction ;
238                         owl:onProperty fhir:CodingBase.code ;
239                         owl:cardinality "1"^^xsd:nonNegativeInteger
240                     ] ,
241                     [ rdf:type owl:Restriction ;
242                         owl:onProperty fhir:CodingBase.display ;
243                         owl:maxCardinality "0"^^xsd:nonNegativeInteger
244                     ] ,
245                     [ rdf:type owl:Restriction ;
246                         owl:onProperty fhir:CodingBase.primary ;
247                         owl:maxCardinality "0"^^xsd:nonNegativeInteger
248                     ] ,
249                     [ rdf:type owl:Restriction ;
250                         owl:onProperty fhir:CodingBase.system ;
251                         owl:maxCardinality "1"^^xsd:nonNegativeInteger
252                     ] ,
253                     [ rdf:type owl:Restriction ;
254                         owl:onProperty fhir:CodingBase.version ;
255                         owl:maxCardinality "1"^^xsd:nonNegativeInteger
256                     ]
257                 )
258             ]
259         ] ,
260         [ rdf:type owl:Restriction ;
261             owl:onProperty fhir:ConceptBase.coding ;
262             owl:cardinality "1"^^xsd:nonNegativeInteger
263         ] .
```

264

265    **2 Terminology**

266    **2.1 Code system**

267    A code system is a namespace which makes its codes unique. A Code system may contain Concepts. You can  
268    have many concept hierarchies in the same code system (e.g. SNOMED) you can have one concept hierarchy in a  
269    code system (e.g. HL7 internal codes).

270    **2.1.1 HL7 FHIR Internal Code System XML example**

271    A definition of a code system, inlined into the value set (as a packaging convenience).

```
272 <codeSystem>
273   <extension url="http://hl7.org/fhir/StructureDefinition/valueset-oid">
274     <valueUri value="urn:oid:2.16.840.1.113883.4.642.1.50"/>
275   </extension>
276   <system value="http://hl7.org/fhir/allergy-intolerance-status"/>
277   <version value="1.0.0"/>
278   <caseSensitive value="true"/>
279   <concept>
280     <code value="active"/>
281     <display value="Active"/>
282     <definition value="An active record of a reaction to the identified Substance."/>
283     <concept>
284       <code value="confirmed"/>
285       <display value="Confirmed"/>
286       <definition value="A high level of certainty about the propensity for a reaction to the identified Substance,
287         which may include clinical evidence by testing or rechallenge."/>
288     </concept>
289   </concept>
290 </codeSystem>
```

291

292    **2.1.2 RDF CodeSystemURI declaration**

293    A code system will have one named individual representing the code system. This is a member of class:  
294    fhir:CodeSystemURI. CodeSystemURI is a subclass of fhir:uri and allows named individuals to represent the URI.  
295    The properties are added to it as annotation properties.

296    Thus the reference to a system in CodingBase.system can have a value e.g. <<http://snomed.info/sct>> and not  
297    have to declare a further anonymous individual.

298    **2.1.2.1 HL7 Internal Code system URI example**

```
299 ##### http://hl7.org/fhir/cs/allergy-intolerance-status
300
301 fhircs:allergy-intolerance-status rdf:type fhir:CodeSystemURI , owl:NamedIndividual ;
302   fhir:caseSensitive "true"^^xsd:boolean ;
303   fhir:valueset-oid "urn:oid:2.16.840.1.113883.4.642.1.50" ;
304   fhir:value "http://hl7.org/fhir/cs/allergy-intolerance-status" ;
305   fhir:prefix "http://hl7.org/fhir/allergy-intolerance-status#" ;
306   fhir:version "1.0.2" .
```

307    Note that since this acts as a namespace it has the case sensitivity indicator and a prefix to prepend the concepts  
308    to make them unique.

309    **2.1.2.2 SNOMED Code System URI example**

```
310    ##### http://snomed.info/sct  
311  
312 <http://snomed.info/sct> rdf:type fhir:CodeSystemURI , owl:NamedIndividual ;  
313   fhir:value "http://snomed.info/sct"^^xsd:anyURI .  
314   fhir:caseSensitive "false"^^xsd:boolean ;  
315   fhir:prefix "http://snomed.info/id/"^^xsd:string ;  
316   fhir:valueset-oid "2.16.840.1.113883.6.96" ;  
317   fhir:version "US1000124_20140301" .
```

318    Code systems are published at <http://hl7-fhir.github.io/terminologies-systems.html> and the URI identifier is  
319    used for FHIR/RDF rather than the OID.

320    **2.1.2.3 Code System Version**

321    Version of code system as part of the name is TBD.

322    **2.2 Concept**

323    **2.2.1 HL7 FHIR Concept XML**

324    The following fragment from Allergy Intolerance Status found at <http://hl7-fhir.github.io/valueset-allergy-intolerance-status.html>

326    In FHIR, Code System contains ValueSet.codeSystem.concept elements.

327    ValueSet.codeSystem.concept have code, abstract, display, definition, designation and nested  
328    Valueset.Concepts.

```
329 <codeSystem>  
330   <extension url="http://hl7.org/fhir/StructureDefinition/valueset-oid">  
331     <valueUri value="urn:oid:2.16.840.1.113883.4.642.1.50"/>  
332   </extension>  
333   <system value="http://hl7.org/fhir/allergy-intolerance-status"/>  
334   <version value="1.0.0"/>  
335   <caseSensitive value="true"/>  
336   <concept>  
337     <code value="active"/>  
338     <display value="Active"/>  
339     <definition value="An active record of a reaction to the identified Substance."/>  
340     <concept>  
341       <code value="confirmed"/>  
342       <display value="Confirmed"/>  
343       <definition value="A high level of certainty about the propensity for a reaction to the identified Substance,  
344         which may include clinical evidence by testing or rechallenge."/>  
345     </concept>  
346   </concept>  
347 </codeSystem>  
348 </ValueSet>
```

349    The nesting of <concept> represents general to specific concepts although the structure does not indicate that  
350    semantic but rather a containment.

351    **2.2.2 RDF Concept Definition**

352    A Concept in RDF/OWL is a named Class which has a restriction for CodingBase individuals associated with that  
353    concept. A specific Concept is a named subclass of the fhir:Concepts class or it is a subclass of another Concept.  
354    Where the restrictions are defined on the Concept they are the intersection of the restriction on  
355    ConceptBase.coding and CodingBase.code and CodingBase.system.

356    Concepts may have one or more CodingBase restrictions. The FHIR valueset resource structure definition only  
357    allows one but the RDF equivalent will relax that cardinality. A Concept which has multiple Codes associated  
358    with it, have a union of multiple CodingBase.code restrictions.

359    ***2.2.2.1 FHIR internal XML Concept mapping***

360    The RDF Concept is a named Class which maps to the components of the ValueSet.codeSystem.concept element  
361    in FHIR Valueset Resource.

- 362       • System maps to the restriction on CodingBase.system  
363       • Code maps to the restriction on CodingBase.code  
364       • Display maps to rdfs:label  
365       • Definition maps to fhir:concept\_definition annotation  
366       • Nesting maps to subclass assertions (as a default)  
367       • An abstract Concept (ValueSetConcept.abstract = “true”) has no restriction on CodingBase.code just a  
368       position in the class hierarchy.  
369       • Designation will probably transform into annotation language (e.g. @en) or type.

## 2.2.2.2 HL7 Internal Concept RDF Example

```

371  #### http://hl7.org/fhir/allergy-intolerance-status#Concept
372
373  allergy-intolerance-status:Concept rdf:type owl:Class ;
374    rdfs:label "Allergy Intolerance Status Concept" ;
375    rdfs:subClassOf fhir:Concepts ;
376    fhir:concept_definition "Assertion about certainty associated with a propensity, or potential risk, of a reaction to the
377 identified Substance." .
378
379  #### http://hl7.org/fhir/allergy-intolerance-status#active
380
381  allergy-intolerance-status:active rdf:type owl:Class ;
382    rdfs:label "Active" ;
383    rdfs:subClassOf allergy-intolerance-status:Concept ;
384    fhir:concept_definition "An active record of a reaction to the identified Substance" .
385
386  [ rdf:type owl:Restriction ;
387    rdfs:subClassOf allergy-intolerance-status:active ; owl:onProperty fhir:ConceptBase.coding ;
388    owl:someValuesFrom [ rdf:type owl:Class ;
389      owl:intersectionOf ( [ rdf:type owl:Restriction ;
390        owl:onProperty fhir:CodingBase.code ;
391        owl:allValuesFrom [ rdf:type owl:Restriction ;
392          owl:onProperty fhir:value ;
393          owl:hasValue "active"
394        ]
395      ]
396      [ rdf:type owl:Restriction ;
397        owl:onProperty fhir:CodingBase.system ;
398        owl:hasValue fhircs:allergy-intolerance-status
399      ]
400    )
401  ]
402
403 ] .
404
405  #### http://hl7.org/fhir/allergy-intolerance-status#confirmed
406
407  allergy-intolerance-status:confirmed rdf:type owl:Class ;
408    rdfs:label "Confirmed@en" ;
409    rdfs:subClassOf allergy-intolerance-status:active ;
410    fhir:concept_definition "A high level of certainty about the propensity for a reaction to the identified Substance, which may
411 include clinical evidence by testing or rechallenge." .
412
413  [ rdf:type owl:Restriction ;
414    rdfs:subClassOf allergy-intolerance-status:confirmed ; owl:onProperty fhir:ConceptBase.coding ;
415    owl:someValuesFrom [ rdf:type owl:Class ;
416      owl:intersectionOf ( [ rdf:type owl:Restriction ;
417        owl:onProperty fhir:CodingBase.code ;
418        owl:allValuesFrom [ rdf:type owl:Restriction ;
419          owl:onProperty fhir:value ;
420          owl:hasValue "confirmed"
421        ]
422        [ rdf:type owl:Restriction ;
423          owl:onProperty fhir:CodingBase.system ;
424          owl:hasValue fhircs:allergy-intolerance-status
425        ]
426      )
427    ]
428 ] .
429

```

431 2.2.2.3 External Concept RDF Example

432 An external terminology is treated differently in that it is assumed that the ontology provided by the external  
433 organization cannot be changed. A bridging ontology is therefore provided which allows the expressions to be  
434 added to bind to the FHIR CodingBase instances.

435 The bridging ontology is constructed to add the expressions to categorize FHIR CodingBase individuals. This  
436 binding occurs at both code/system and concepts. Direct use of the declared SNOMED concept identifier is  
437 shown here but it is also possible to make an equivalent class if needed.

438 2.2.2.3.1 External SNOMED Ontology

439 The following example from the SNOMED OWL extraction shows the two top Concepts referenced in the  
440 valueset substance-code:

452 Notice there is no description and the display value is in rdfs:label. Concept 138875005 is the top level SNOMED  
453 CT concept.

454 The extensions of the value set beyond substance-code are defined in SNOMED:

```
455       ###  http://snomed.info/id/160244002
456
457       <http://snomed.info/id/160244002>  rdf:type  owl:Class ;
458           rdfs:label "No Known Allergies" ;
459           rdfs:subClassOf <http://snomed.info/id/138875005> .
460
461       ###  http://snomed.info/id/409137002
462
463       <http://snomed.info/id/409137002>  rdf:type  owl:Class ;
464           rdfs:label "No Known Drug Allergies" ;
465           rdfs:subClassOf <http://snomed.info/id/138875005> .
466
467       ###  http://snomed.info/id/428607008
468
469       <http://snomed.info/id/428607008>  rdf:type  owl:Class ;
470           rdfs:label "No Known Environmental Allergy" ;
471           rdfs:subClassOf <http://snomed.info/id/138875005> .
472
473       ###  http://snomed.info/id/429625007
474
475       <http://snomed.info/id/429625007>  rdf:type  owl:Class ;
476           rdfs:label "No Known Food Allergies" ;
477           rdfs:subClassOf <http://snomed.info/id/138875005>
```

478 These are shown as subclasses of the top concept which is incorrect.

479 2.2.2.3.2 Bridging Ontology

480 The FHIR SCTBridge ontology imports both fhir and snomed ontologies so it can see both:

```
481 <http://hl7.org/fhirSCTBridge> rdf:type owl:Ontology ;  
482     owl:imports <http://hl7.org/fhir> ,  
483             <http://snomed.info/id> .
```

484 The SNOMED ontology is named <<http://snomed.info/id>> which makes the concept URI construction natural.

485 The restrictions on the Concepts to CodingBase individuals are made through general class axioms in the same  
486 way as internal code systems:

```
487 [ rdf:type owl:Restriction ;
488   rdfs:subClassOf <http://snomed.info/id/90614001> ;
489   owl:onProperty fhir:ConceptBase.coding ;
490   owl:someValuesFrom [ rdf:type owl:Class ;
491     owl:intersectionOf ( [ rdf:type owl:Restriction ;
492       owl:onProperty fhir:CodingBase.code ;
493       owl:allValuesFrom [ rdf:type owl:Restriction ;
494         owl:onProperty fhir:value ;
495         owl:hasValue "90614001"
496       ]
497     ]
498     [ rdf:type owl:Restriction ;
499       owl:onProperty fhir:CodingBase.system ;
500       owl:hasValue <http://snomed.info/sct>
501     ]
502   )
503 ]
504 ] .
```

505 This example shows that the Concept “Beta lactam antibiotic” is inferred when the ConceptBase.coding has a  
506 CodingBase where CodingBase.code has a code of 90614001 and CodingBase.system has value  
507 <<http://snomed.info/sct>>.

### 508 **2.2.3 Relationship of Concept to Code SystemURI**

509 The concept defines its CodeSystemURI through ConceptBase.system restriction.

510 The CodeSystemURI being an individual has no relationship to the Concepts in the Code system which are  
511 Classes.

## 512 **2.3 ValueSets**

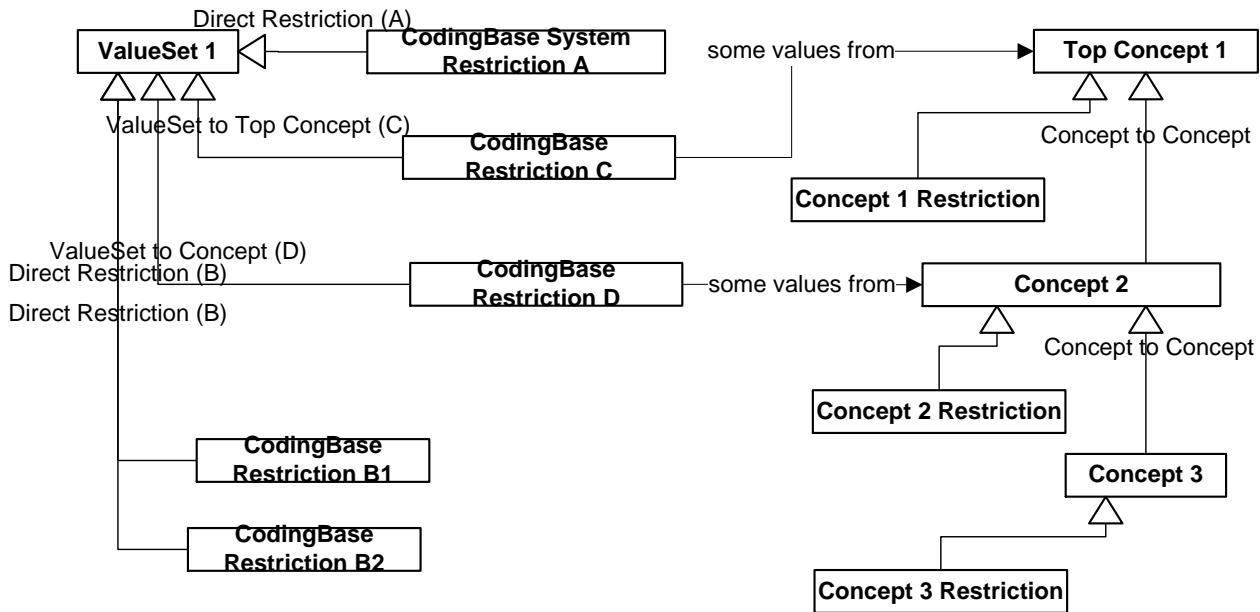
513 A ValueSet in RDF is a specific Class which defines the CodingBase individuals which are members of it.

514 There are two ways of declaring the ValueSet in RDF –

- 515 • ValueSets are named Classes with direct restrictions on CodingBase individuals (system + code)
- 516 • ValueSets are named Classes representing sets of CodingBase restrictions via Concept restrictions.

517 See the later section for more detailed consideration of the flexibility of ValueSet definitions. These definitions  
518 will be mapped into the two ways above.

519 The following diagram shows the subclass relationships between the classes:



520

A

521 valueset defines a subset of CodingBase individuals which meet the constraints of that ValueSet.

522 Four cases are explored A & B are the direct restrictions and C & D are indirect via concepts:

- 523
- A. Aligned ValueSet with Code system (all codes from).
  - B. Unaligned ValueSet direct restriction on CodingBase
  - C. Aligned ValueSet with Top Concept (all concepts from)
  - D. Unaligned ValueSet restriction on Concepts
- 524
- 525
- 526

527    2.3.1 FHIR Schema definition

528    2.3.1.1 Allergy Intolerance Status Structural Definition

```
529 <element>
530   <path value="AllergyIntolerance.status"/>
531   <short value="active | unconfirmed | confirmed | inactive | resolved | refuted | entered-in-error"/>
532   <definition value="Assertion about certainty associated with the propensity, or potential risk, of a reaction
533     to the identified Substance."/>
534   <comments value="Decision support would typically raise alerts for 'Unconfirmed', 'Confirmed', and 'Resolved'
535     and ignore a 'Refuted' reaction. In particular, 'Refuted' may be useful for reconciliation of the Adverse Reaction
536     List. Some implementations may choose to make this field mandatory."/>
537   <alias value="State"/>
538   <min value="0"/>
539   <max value="1"/>
540   <type>
541     <code value="code"/>
542   </type>
543   <isModifier value="true"/>
544   <isSummary value="true"/>
545   <binding>
546     <strength value="required"/>
547     <description value="Assertion about certainty associated with a propensity, or potential risk, of a reaction
548       to the identified Substance."/>
549   <valueSetReference>
550     <reference value="http://hl7.org/fhir/ValueSet/allergy-intolerance-status"/>
551   </valueSetReference>
552 </binding>
553 <mapping>
554   <identity value="v2"/>
555   <map value="IAM-17"/>
556 </mapping>
557 <mapping>
558   <identity value="w5"/>
559   <map value="status"/>
560 </mapping>
561 </element>
```

562    2.3.1.2 AllergyIntolerance.substance Structural Definition

```
563 <element>
564   <path value="AllergyIntolerance.substance"/>
565   <short value="Substance, (or class) considered to be responsible for risk"/>
566   <definition value="Identification of a substance, or a class of substances, that is considered to be responsible
567     for the adverse reaction risk."/>
568   <comments value="It is strongly recommended that the substance be coded with a terminology, where possible.
569     For example, some terminologies used include RxNorm, SNOMED CT, DM+D, NDFRT, ICD-9, IDC-10,
570     UNI, ATC and CPT. Plain text should only be used if there is no appropriate terminology
571     available. Additional details about a substance can be specified in the text."/>
572   <alias value="Agent"/>
573   <min value="1"/>
574   <max value="1"/>
575   <type>
576     <code value="CodeableConcept"/>
577   </type>
578   <isSummary value="true"/>
579   <binding>
580     <strength value="example"/>
581     <description value="Type of the substance and Negation codes for reporting no known allergies."/>
582   <valueSetReference>
583     <reference value="http://hl7.org/fhir/ValueSet/allergyintolerance-substance-code"/>
584   </valueSetReference>
585 </binding>
586 <mapping>
587   <identity value="v2"/>
588   <map value="AL1-3 / IAM-3"/>
589 </mapping>
590 <mapping>
591   <identity value="w5"/>
592   <map value="what"/>
593 </mapping>
594 </element>
```

595    2.3.2 OWL Schema Definition

596    **2.3.2.1 Allergy Intolerance Class**

597    The OWL schema fragment for the class and object properties is shown here:

```
598    ##### http://hl7.org/fhir/AllergyIntolerance
599
600    fhir>AllergyIntolerance rdf:type owl:Class ;
601
602                rdfs:subClassOf fhir:DomainResource ,
603                        [ rdf:type owl:Restriction ;
604                        owl:onProperty fhir>AllergyIntolerance.status ;
605                        owl:allValuesFrom fhirvs:allergy-intolerance-statusA
606                        ] ,
607                        [ rdf:type owl:Restriction ;
608                        owl:onProperty fhir>AllergyIntolerance.status ;
609                        owl:maxCardinality "1"^^xsd:nonNegativeInteger
610                        ] ,
611                        [ rdf:type owl:Restriction ;
612                        owl:onProperty fhir>AllergyIntolerance.patient ;
613                        owl:allValuesFrom fhir:Reference
614                        ] ,
615                        [ rdf:type owl:Restriction ;
616                        owl:onProperty fhir>AllergyIntolerance.patient ;
617                        owl:maxCardinality "1"^^xsd:nonNegativeInteger
618                        ] ,
619                        [ rdf:type owl:Restriction ;
620                        owl:onProperty fhir>AllergyIntolerance.substance ;
621                        owl:allValuesFrom fhir:CodeableConcept
622                        ] ,
623                        [ rdf:type owl:Restriction ;
624                        owl:onProperty fhir>AllergyIntolerance.substance ;
625                        owl:maxCardinality "1"^^xsd:nonNegativeInteger
626                        ] ,
627
628                .....
629
630    It shows that:
```

- AllergyIntolerance.status is restricted to the set defined by fhirvs:allergy-intolerance-statusA.
- AllergyIntolerance.substance is not restricted to the set defined by fhirvs:allergyintolerance-substance-code but purely to the CodeableConcept since the binding is “example”.

635    However due to OWA approaches by the reasoner (HermiT) an inconsistency is not detected.

636

### 2.3.2.2 AllergyIntolerance.status Object Property definition

```

637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654
637    ### http://hl7.org/fhir/AllergyIntolerance.status
638
639      fhir:AllergyIntolerance.status rdf:type owl:ObjectProperty ;
640        fhir:binding.valueSetReference "http://hl7.org/fhir/ValueSet/allergy-intolerance-status"^^xsd:anyURI ;
641        fhir:isModifier "true"^^xsd:boolean ;
642        fhir:isSummary "true"^^xsd:boolean ;
643        rdfs:comment "Decision support would typically raise alerts for 'Unconfirmed', 'Confirmed', and 'Resolved' and ignore a
644        'Refuted' reaction. In particular, 'Refuted' may be useful for reconciliation of the Adverse Reaction List. Some implementations
645        may choose to make this field mandatory." ;
646        fhir:short "active | unconfirmed | confirmed | inactive | resolved | refuted | entered-in-error" ;
647        fhir:binding.description "Assertion about certainty associated with a propensity, or potential risk, of a reaction to the
648        identified Substance." ;
649        fhir:concept_definition "Assertion about certainty associated with the propensity, or potential risk, of a reaction to the
650        identified Substance." ;
651        fhir:binding.strength "required" ;
652        rdfs:domain fhir:AllergyIntolerance ;
653        rdfs:range fhir:code ;
654        rdfs:subPropertyOf fhir:objectProperty .

```

655

### 2.3.2.3 AllergyIntolerance.substance Object Property

```

656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671
656    ### http://hl7.org/fhir/AllergyIntolerance.substance
657
658      fhir:AllergyIntolerance.substance rdf:type owl:ObjectProperty ;
659        fhir:isSummary "true"^^xsd:boolean ;
660        fhir:binding.valueSetReference "http://hl7.org/fhir/ValueSet/allergyintolerance-substance-code" ;
661        fhir:short "Substance, (or class) considered to be responsible for risk" ;
662        fhir:concept_definition "Identification of a substance, or a class of substances, that is considered to be responsible for the
663        adverse reaction risk." ;
664        fhir:binding.strength "example" ;
665        rdfs:comment "It is strongly recommended that the substance be coded with a terminology, where possible. For example, some
666        terminologies used include RxNorm, SNOMED CT, DM+D, NDFRT, ICD-9, IDC-10, UNI, ATC and CPT. Plain text should only be used if
667        there is no appropriate terminology available. Additional details about a substance can be specified in the text." ;
668        fhir:binding.description "Type of the substance and Negation codes for reporting no known allergies." ;
669        rdfs:domain fhir:AllergyIntolerance ;
670        rdfs:range fhir:CodeableConcept ;
671        rdfs:subPropertyOf fhir:objectProperty .

```

672

### 2.3.3 Approach to Conformance

Binding strength to a ValueSet determines the conformance of the CodingBase.

Almost all of the elements that have a coded data type are bound to a value set. The bindings are associated with various degrees of flexibility as to how closely the value set should be followed:

required	To be conformant, instances of this element SHALL include a code from the specified value set
extensible	To be conformant, instances of this element must include a code from the specified value set if any of the codes within the value set can apply to the concept being communicated. If the valueset does not cover the concept (based on human review), alternate codings (from different code systems, including local ones) or (data type allowing) text) may be included instead.
preferred	Instances are encouraged, to draw from the specified codes for interoperability purposes but are not required to do so to be considered conformant
example	Instances are not expected or even encouraged to draw from the specified value set. The value set merely provides examples of the types of concepts intended to be included

677 The classes that the CodingBase individual belong to, are inferred and the individual must belong to the  
678 ValueSet class declared in the schema if its binding strength is “required”.

679 In the example above, the individual ConceptBase has a CodingBase which is a member of **fhirvs:allergy-**  
680 **intolerance-statusA** so the ConceptBase individual is conformant to the schema.

681 This implies that a reasoner will work from the values in the CodingBase.system and CodingBase.code to infer  
682 the classes. The ValueSet Class must be equivalent or a superclass of the restriction for this to work.

683 Being a member of the Target ValueSet meets the “required” binding strength. Being a member of another  
684 ValueSet meets the “extensible” binding strength.

685 Note that the binding strength for AllergyIntolerance.substance is “example”. It is expected that a Profile would  
686 strengthen this to “required”.

687 In ORIM, the subclassing of restrictions approach (as a general Class axiom) is taken which avoids complications  
688 from propagation. This subclass approach for restrictions and the superclass approach for Concepts will be taken  
689 in FHIR/RDF.

690 The testing of the conformance is outside the scope of this paper but is expected to be performed with rules or  
691 query languages.

692    2.3.4    HL7 Internal Concept RDF Example

693    2.3.4.1    CodeSystem and Concept XML

```
694 <ValueSet xmlns="http://hl7.org/fhir">
695   <id value="allergy-intolerance-status"/>
696   <meta>
697     <lastUpdated value="2015-10-27T02:58:28.599+00:00"/>
698     <profile value="http://hl7.org/fhir/StructureDefinition/valueset-shareable-definition"/>
699   </meta>
700   <text>
701     </text>
702   <extension url="http://hl7.org/fhir/StructureDefinition/valueset-oid">
703     <valueUri value="urn:oid:2.16.840.1.113883.4.642.2.50"/>
704   </extension>
705   <url value="http://hl7.org/fhir/ValueSet/allergy-intolerance-status"/>
706   <version value="1.0.2"/>
707   <name value="AllergyIntoleranceStatus"/>
708   <status value="draft"/>
709   <experimental value="false"/>
710   <publisher value="HL7 (FHIR Project)"/>
711   <contact>
712     <telecom>
713       <system value="other"/>
714       <value value="http://hl7.org/fhir"/>
715     </telecom>
716     <telecom>
717       <system value="email"/>
718       <value value="fhir@lists.hl7.org"/>
719     </telecom>
720   </contact>
721   <date value="2015-10-27T02:58:28+00:00"/>
722   <description value="Assertion about certainty associated with a propensity, or potential risk, of a reaction
723     to the identified Substance."/>
724   <codeSystem>
725     <extension url="http://hl7.org/fhir/StructureDefinition/valueset-oid">
726       <valueUri value="urn:oid:2.16.840.1.113883.4.642.1.50"/>
727     </extension>
728     <system value="http://hl7.org/fhir/allergy-intolerance-status"/>
729     <version value="1.0.2"/>
730     <caseSensitive value="true"/>
731     <concept>
732       <code value="active"/>
733       <display value="Active"/>
734       <definition value="An active record of a reaction to the identified Substance."/>
735       <concept>
736         <code value="unconfirmed"/>
737         <display value="Unconfirmed"/>
738         <definition value="A low level of certainty about the propensity for a reaction to the identified Substance."/>
739       </concept>
740     </concept>
741     <concept>
742       <code value="confirmed"/>
743       <display value="Confirmed"/>
744       <definition value="A high level of certainty about the propensity for a reaction to the identified Substance,
745         which may include clinical evidence by testing or rechallenge."/>
746     </concept>
747   </concept>
748   <concept>
749     <code value="inactive"/>
750     <display value="Inactive"/>
751     <definition value="An inactive record of a reaction to the identified Substance."/>
752     <concept>
753       <code value="resolved"/>
754       <display value="Resolved"/>
755       <definition value="A reaction to the identified Substance has been clinically reassessed by testing or rechallenge
756         and considered to be resolved."/>
757     </concept>
758   </concept>
759   <concept>
760     <code value="refuted"/>
761     <display value="Refuted"/>
762     <definition value="A propensity for a reaction to the identified Substance has been disproven with a high
763       level of clinical certainty, which may include testing or rechallenge, and is refuted."/>
764   </concept>
765   <concept>
766     <code value="entered-in-error"/>
767     <display value="Entered In Error"/>
768     <definition value="The statement was entered in error and is not valid."/>
```

```
768 </concept>
769 </concept>
770 </codeSystem>
771 </ValueSet>
```

#### 2.3.4.2 RDF Direct Restriction Aligned with a Code System (A)

The first option for value set is where the valueset entry defines the direct restriction on code and system itself without referencing a named concept and when the ValueSet is aligned (all codes from) with the CodingSystem the declaration is simple.

Valueset allergy-intolerance-statusA is defined using general class axiom restriction on CodingBase.system

```
777 ### http://hl7.org/fhir/ValueSet/allergy-intolerance-statusA
778 fhirvs:allergy-intolerance-statusA rdf:type owl:Class ;
779   rdfs:subClassOf fhir:Valuesets .
780
781 [ rdf:type owl:Restriction ;
782   rdfs:subClassOf fhirvs:allergy-intolerance-statusA ;
783   owl:onProperty fhir:CodingBase.system ;
784   owl:hasValue fhircs:allergy-intolerance-status
785 ]
786
787 ] .
```

However, this mechanism does not validate that the coding is actually a member of the Code System which cannot be done without doing an indirect restriction (see C).

#### 2.3.4.3 RDF Direct Restriction Unaligned with a Code System (B)

When the ValueSet is not aligned with the code system, then expressions which represent the allowed code values must be included as shown in allergy-intolerance-statusB. This is the most direct equivalent of the XML example above.

```
795 ### http://hl7.org/fhir/ValueSet/allergy-intolerance-statusB
796 fhirvs:allergy-intolerance-statusB rdf:type owl:Class ;
797   rdfs:subClassOf fhir:CodingBase_in_Valuesets .
798
799 [ rdf:type owl:Class ;
800   rdfs:subClassOf fhirvs:allergy-intolerance-statusB ;
801   owl:intersectionOf ( [ rdf:type owl:Restriction ; owl:onProperty fhir:CodingBase.code ;
802     owl:someValuesFrom [ rdf:type owl:Class ;
803       owl:unionOf ( [ rdf:type owl:Restriction ; owl:onProperty fhir:value ;
804         owl:hasValue "confirmed"
805         ]
806         [ rdf:type owl:Restriction ; owl:onProperty fhir:value ;
807           owl:hasValue "unconfirmed"
808         ]
809       )
810     ]
811   ]
812   [ rdf:type owl:Restriction ; owl:onProperty fhir:CodingBase.system ;
813     owl:hasValue fhircs:allergy-intolerance-status
814   ]
815 ]
816 ) .
817 ] .
```

This expression shows the allergy-intolerance-statusB value set including the codes “confirmed” and “unconfirmed” within the Code System fhircs:allergy-intolerance-status . More sophisticated filtering expressions in FHIR will have to be translated into this language but since there is no subclass relationships between the code tokens, all subclass trees must be spelled out as lists of coding restrictions.

823    **2.3.4.4 RDF Aligned ValueSet of CodingBase individuals within Top Concept (C)**

824    Since we can use the set expressions of OWL on classes (Concepts) there is a simplification to the expression of  
825    Valuesets subclasses as shown in allergy-intolerance-statusC.

826    The concepts are named classes as shown earlier. The Valuesets subclass can now refer to these named classes  
827    avoiding repetitive declaration of anonymous classes.

828    When the valueset is aligned with the code system the ValueSet is a superclass of all the CodingBase individuals  
829    which have a type Concept of the top concept (inferred).

```
830    ##### http://hl7.org/fhir/ValueSet/allergy-intolerance-statusC
831
832    fhirvs:allergy-intolerance-statusC rdf:type owl:Class ;
833       rdfs:label "Allergy Int Status C" ;
834       rdfs:subClassOf fhir:Valuesets .
835
836    [ rdf:type owl:Restriction ;
837       rdfs:subClassOf fhirvs:allergy-intolerance-statusC ;
838       owl:onProperty fhir:CodingBase.concept ;
839       owl:someValuesFrom allergy-intolerance-status:Concept
840    ] .
```

841    This is entered as a general class axiom as in the other examples.

842    Note the Object Property CodingBase.concept which is the inverse of ConceptBase.coding:

```
843    ##### http://hl7.org/fhir/CodingBase.concept
844
845    fhir:CodingBase.concept rdf:type owl:ObjectProperty ;
846       owl:inverseOf fhir:ConceptBase.coding ;
847       rdfs:subPropertyOf fhir:objectProperty .
```

848    The object property is then used in the restriction to say that the CodingBase individual belongs to the Concept  
849    as defined in the Concept restriction (in section 4.2.3).

850    **2.3.4.5 RDF CodingBase individuals of specific Concepts (D)**

851    When the value set is not all codes from the code system it can be defined as the union of concepts.

```
852    ##### http://hl7.org/fhir/ValueSet/allergy-intolerance-statusD
853
854    fhirvs:allergy-intolerance-statusD rdf:type owl:Class ;
855       rdfs:subClassOf fhir:CodingBase_in_Valuesets .
856
857    [ rdf:type owl:Restriction ;
858       rdfs:subClassOf fhirvs:allergy-intolerance-statusD ;
859       owl:onProperty fhir:CodingBase.concept ;
860       owl:someValuesFrom [ rdf:type owl:Class ;
861                 owl:unionOf ( allergy-intolerance-status:confirmed
862                                 allergy-intolerance-status:unconfirmed
863                                 )
864         ] ]
865 ] .
```

866    Notice that the prefixes for the code system are shown which makes it readable.

867    This valueset includes all the subclasses of “confirmed” and “unconfirmed” if they exist which is a default “is-a”  
868    operator in the filter.

869    This is equivalent to <compose><include/exclude><concept> and <codeSystem><concept> in the FHIR Valueset  
870    Resource Structural Definition. (see later discussion of the mapping to RDF).

871    2.3.5 External terminology ValueSets

872    2.3.5.1 All codes from

873    No examples are given where the Valueset is all codes from an external code system since this is generally too  
874    broad. If this is required the same process as internal terminologies can be used.

875    2.3.5.2 ValueSet Resource example in XML

876    The valueset “allergyintolerance-substance-code” includes the valueset “substance-code” but adds some  
877    additional codes:

```
878 <ValueSet xmlns="http://hl7.org/fhir">  
879   <id value="substance-code"/>  
880  
881   <description value="This value set contains concept codes for specific substances"/>  
882   <copyright value="This value set includes content from SNOMED CT, which is copyright © 2002+ International  
883     Health Terminology Standards Development Organisation (IHTSDO), and distributed by agreement  
884     between IHTSDO and HL7. Implementer use of SNOMED CT is not covered by this agreement"/>  
885   <compose>  
886     <include>  
887       <system value="http://snomed.info/sct"/>  
888       <filter>  
889         <property value="concept"/>  
890         <op value="is-a"/>  
891         <value value="105590001"/>  
892       </filter>  
893     </include>  
894     <include>  
895       <system value="http://snomed.info/sct"/>  
896       <filter>  
897         <property value="concept"/>  
898         <op value="is-a"/>  
899         <value value="373873005"/>  
900       </filter>  
901     </include>  
902   </compose>  
903 </ValueSet>
```

904

```
905 <ValueSet xmlns="http://hl7.org/fhir">  
906   <id value="allergyintolerance-substance-code"/>  
907  
908   <description value="This value set includes concept codes for specific substances and negation codes to specify  
909     the absence of specific types of allergies." />  
910   <copyright value="This value set includes content from SNOMED CT, which is copyright © 2002+ International  
911     Health Terminology Standards Development Organisation (IHTSDO), and distributed by agreement  
912     between IHTSDO and HL7. Implementer use of SNOMED CT is not covered by this agreement"/>  
913   <compose>  
914     <import value="http://hl7.org/fhir/ValueSet/substance-code"/>  
915     <include>  
916       <system value="http://snomed.info/sct"/>  
917       <concept>  
918         <code value="160244002"/>  
919         <display value="No Known Allergies"/>  
920       </concept>  
921       <concept>  
922         <code value="429625007"/>  
923         <display value="No Known Food Allergies"/>  
924       </concept>  
925       <concept>  
926         <code value="409137002"/>  
927         <display value="No Known Drug Allergies"/>  
928       </concept>  
929       <concept>  
930         <code value="428607008"/>  
931         <display value="No Known Environmental Allergy"/>  
932       </concept>  
933     </include>  
934   </compose>  
935 </ValueSet>
```

936    Notice that allergyintolerance-substance-code extends substance-code with 4 concepts with their code  
937    restrictions and the system restriction at the beginning.

938    **2.3.5.3 RDF CodingBase Direct Restriction Unaligned with a Code System (B)**

939    The Valueset substance-codeB is declared in the FHIR ontology with no restrictions:

```
940    ##### http://hl7.org/fhir/ValueSet/substance-codeB  
941    fhirvs:substance-codeB rdf:type owl:Class ;  
942      rdfs:label "Substance Code" ;  
943      rdfs:subClassOf fhir:Valuesets.  
944  
945
```

946

947    In the Bridging Ontology, substance-codeB is declared against CodingBase.system and CodingBase.code  
948    restrictions.

```
949    [ rdf:type owl:Class ;  
950      rdfs:subClassOf <http://hl7.org/fhir/ValueSet/substance-codeB> ;  
951      owl:intersectionOf ( [ rdf:type owl:Restriction ; owl:onProperty fhir:CodingBase.code ;  
952        owl:allValuesFrom [ rdf:type owl:Class ;  
953          owl:unionOf ( [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "105590001" ]  
954          [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "373873005" ]  
955         )  
956        )  
957        ]  
958        [ rdf:type owl:Restriction ; owl:onProperty fhir:CodingBase.system ;  
959          owl:hasValue <http://snomed.info/sct>  
960        ]  
961        )  
962     )  
963 ].
```

944    This will only define the ValueSet as the top code and **does not** include all the subconcepts as codes. In order to  
945    do this an expansion must be made with a filter. See <http://hl7-fhir.github.io/valueset-allergyintolerance-substance-code.html>

947    The operation <filter><op> declares “is-a” to mean transitive subclassing. However this is not understood by  
948    RDF/OWL. What is understood is the subclassing of the SNOMED Concept ontology itself.

949    The only solution is to extract all the codes in the hierarchy and explicitly declare them in the Bridging Ontology.  
950    The treatment of allergyintolerance-substance-code is to add the concepts to the enumerated list.

971    **2.3.5.4 RDF ValueSet binding to Concepts(D)**

972    The valueset substance-codeD is declared in FHIR as before:

```
973    ##### http://hl7.org/fhir/ValueSet/substance-codeD  
974    fhirvs:substance-codeB rdf:type owl:Class ;  
975         rdfs:label "Substance Codes D" ;  
976         rdfs:subClassOf fhir:Valuesets .  
977
```

978

979    The allergyintolerance-substance-code valueset is also declared in FHIR

```
980    ##### http://hl7.org/fhir/ValueSet/allergyintolerance-substance-code  
981    <http://hl7.org/fhir//ValueSet/allergyintolerance-substance-code> rdf:type owl:Class ;  
982         rdfs:label "AllergyIntolerance Substance and Negation Codes" ;  
983         rdfs:subClassOf fhir:CodingBase_in_Valuesets .  
984
```

985

986    The bridging ontology declares a general Class axiom which shows the mapping to the Concepts:

```
987    [ rdf:type owl:Restriction ;  
988         rdfs:subClassOf <http://hl7.org/fhir/ValueSet/substance-codeD> ;  
989         owl:onProperty fhir:CodingBase.concept ; owl:someValuesFrom [ rdf:type owl:Class ;  
990                 owl:unionOf ( <http://snomed.info/id/105590001>  
991                         <http://snomed.info/id/373873005>  
992                         )  
993                 ]  
994         ].
```

995

```
996    [ rdf:type owl:Class ;  
997         rdfs:subClassOf <http://hl7.org/fhir/ValueSet/allergyintolerance-substance-code> ;  
998         owl:unionOf ( <http://hl7.org/fhir/ValueSet/substance-codeD>  
999                 [ rdf:type owl:Restriction ;  
1000                         owl:onProperty fhir:CodingBase.concept ; owl:someValuesFrom [ rdf:type owl:Class ;  
1001                                 owl:unionOf ( <http://snomed.info/id/160244002>  
1002                                         <http://snomed.info/id/409137002>  
1003                                         <http://snomed.info/id/428607008>  
1004                                         <http://snomed.info/id/429625007>  
1005                                 )  
1006                 ]  
1007                 )  
1008         ].
```

1009    CodingBase.concept defines the restriction on concepts for the Codingbase.

1010    The display values are redundant and since closure is achieved with these classes, their display as rdfs:label can  
1011    be shown at any time in an OWL tool.

1013    2.3.6 Coding Binding to external terminology (section 1.17.3.3.5)

1014    2.3.6.1 FHIR XML

```
1015 <AllergyIntolerance xmlns="http://hl7.org/fhir" >
1016   <id value="1"/>
1017   <text>
1018     </text>
1019   <!-- the date that this entry was recorded -->
1020   <recordedDate value="2010-03-01"/>
1021   <!-- the patient that actually has the risk of adverse reaction -->
1022   <patient>
1023     <reference value="http://record/Patient/PeterPatient"/>
1024     <display value="Peter Patient"/>
1025   </patient>
1026   <!-- substance, coded from SNOMED CT-->
1027   <substance>
1028     <coding>
1029       <system value="http://snomed.info/id"/>
1030       <code value="90614001"/>
1031       <display value="beta-Lactam antibiotic"/>
1032     </coding>
1033   </substance>
1034   <status value="confirmed"/>
1035   <criticality value="high"/>
1036   <category value="medication"/>
1037 </AllergyIntolerance>
```

1038    2.3.6.2 RDF Instance Example

1039 This is the raw instance before processing and after in green for inference and red for specific processing

```
1040 @prefix : <http://record/AllergyIntolerance/> .
1041 @prefix owl: <http://www.w3.org/2002/07/owl#> .
1042 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
1043 @prefix sct: <http://snomed.info/id/> .
1044 @prefix xml: <http://www.w3.org/XML/1998/namespace> .
1045 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
1046 @prefix fhir: <http://hl7.org/fhir/> .
1047 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
1048 @prefix profile: <http://PatientSafetyProfile/> .
1049 @base <http://record/AllergyIntolerance/1> .
1050
1051 <http://record/AllergyIntolerance/> rdf:type owl:Ontology ;
1052   owl:imports <http://PatientSafetyProfile> .
1053
1054 ### http://record/AllergyIntolerance/1
1055
1056 <http://record/AllergyIntolerance/1> rdf:type profile:DomainResource, owl:NamedIndividual ;
1057   fhir:Resource.id [ rdf:type fhir:id ; fhir:value "1" ] ;
1058   fhir:AllergyIntolerance.status [ rdf:type fhir:code , <http://hl7.org/fhir/allergyIntoleranceStatus#confirmed> ;
1059     fhir:ConceptBase.coding [ fhir:CodingBase.code [ fhir:value "confirmed" ] ]
1060   ] ;
1061   fhir:AllergyIntolerance.patient [ rdf:type fhir:Reference ;
1062     fhir:Reference.reference [ fhir:value "http://record/Patient/PeterPatient" ] ;
1063     fhir:Reference.display [ fhir:value "Peter Patient" ] ;
1064     fhir:Reference.link <http://record/Patient/PeterPatient> ;
1065   ] ;
1066   fhir:AllergyIntolerance.substance [ rdf:type fhir:CodeableConcept , <http://snomed.info/id/90614001> ;
1067     rdfs:label "beta-lactam (antibiotic)" ;
1068     fhir:ConceptBase.coding [ rdf:type fhir:CodingBase ;
1069       fhir:CodingBase.code [ rdf:type fhir:codeBase ; fhir:value "90614001" ] ;
1070       fhir:CodingBase.system [ rdf:type fhir:string ; fhir:value "http://snomed.info/sct" ] ;
1071       fhir:CodingBase.display [ rdf:type fhir:string ; fhir:value "beta-lactam (antibiotic)" ]
1072     ] ;
1073     fhir:ConceptBase.text [ rdf:type fhir:string ; fhir:value "beta-lactam (antibiotic)" ]
1074   ] .
```

1075

1076 Note the use of a profile binding through the type “profile:AllergyIntolerance” which then restricts the types of  
1077 CodingBase instances.

1078 **2.3.6.3 FHIR Allergy Intolerance OWL Schema**

1079 The schema is abridged to show the topics of interest:

```
1080 ### http://hl7.org/fhir/AllergyIntolerance
1081
1082 fhir:AllergyIntolerance rdf:type owl:Class ;
1083
1084     rdfs:subClassOf fhir:DomainResource ,
1085         [ rdf:type owl:Restriction ;
1086             owl:onProperty fhir:AllergyIntolerance.substance ;
1087             owl:maxCardinality "1"^^xsd:nonNegativeInteger
1088         ] ,
1089         [ rdf:type owl:Restriction ;
1090             owl:onProperty fhir:AllergyIntolerance.substance ;
1091             owl:allValuesFrom fhir:CodeableConcept
1092         ] ,
1093 Etc..
1094 .
```

1095 The substance Object Property has no valueset type yet only the restriction that it is a CodeableConcept type.

1096 The valueset gets applied through the structural definition or profile binding.

1097

1098 **2.3.6.4 Definitions of Code System, Concept**

1099 This section is needed to ground the definitions of Coding System, and Concept when defined in RDF/OWL.

1100 **2.3.6.4.1 Code System**

1101 *The system ensures that codes can be unambiguously traced back to their original definition, and that logical  
1102 comparisons, matching and inferences can be performed consistently by different systems.*

1103 In RDF/OWL a code system is a namespace in which the code is unique. Since a code forms a fragment of a URI,  
1104 the code-system forms a prefix to that fragment making it unique. The code system identity and the prefix may  
1105 not be the same but are related using a property of the code system.

URI	Source	OID
http://snomed.info/sct	SNOMED CT ( <a href="#">IHTSDO</a> )	2.16.840.1.113883.6.96

1106 The prefix for snomed is <http://snomed.info.id/>

1107 However, the URI is a member of the fhir:uri class and an additional class is introduced – fhir:CodeSystemURI as  
1108 a subclass of fhir:URI to define the set that are CodeSystem identifiers. The individual code system may then be  
1109 declared and referenced:

```
1110 ### http://snomed.info/sct
1111 <http://snomed.info/sct> rdf:type fhir:CodeSystemURI ,
1112           owl:NamedIndividual ;
1113
1114           fhir:value "http://snomed.info/sct" .
```

1116 A specific CodeSystem may be declared as a class which is a set of all the CodingBase individuals restricted by  
1117 the CodingBase.system property.

```
1118 ### http://snomed.info/sct
1119 <http://snomed.info/sct> rdf:type owl:Class ;
1120
1121           rdfs:subClassOf fhir:CodingBase_in_Systems .
```

1123 **2.3.6.4.2 Bridging Ontology**

1124 This forms a pun with the individual and it is declared in a bridging ontology which is aware of the constraints of  
1125 Concepts in that Code System.

1126 The bridging ontology is aware of FHIR and the external terminology ontologies.

```
1127 [ rdf:type owl:Class ;
1128   rdfs:subClassOf <http://snomed.info/id/282100009> ;
1129   owl:intersectionOf ( <http://snomed.info/sct>
1130     [ rdf:type owl:Restriction ;
1131       owl:onProperty fhir:CodingBase.code ;
1132       owl:someValuesFrom [ rdf:type owl:Restriction ;
1133         owl:onProperty fhir:value ;
1134         owl:hasValue "282100009"
1135       ]
1136     )
1137   ] .
```

1139

1140 2.3.6.4.3 Concept  
1141 A concept may be a single Class in RDF which may in turn be a union of multiple classes based on subclass  
1142 relationships.

1143 2.3.6.4.4 ValueSet  
1144 Example is substance-code used in AllergyIntolerance

1145 2.3.6.4.4.1 Summary

Defining URL:	<a href="http://hl7.org/fhir/ValueSet/substance-code">http://hl7.org/fhir/ValueSet/substance-code</a>
Name:	Substance Code
Definition:	This value set contains concept codes for specific substances
OID:	2.16.840.1.113883.4.642.2.57 (for OID based terminology systems)
Copyright:	This value set includes content from SNOMED CT, which is copyright © 2002+ International Health Terminology Standards Development Organisation (IHTSDO), and distributed by agreement between IHTSDO and HL7. Implementer use of SNOMED CT is not covered by this agreement
Source Resource	<a href="#">XML</a> / <a href="#">JSON</a>

1146

1147 2.3.6.4.4.2 Content Logical Definition 

1148 This value set includes codes from the following code systems:

1149• Include codes from <http://snomed.info/sct> where concept is-a 105590001

1150• Include codes from <http://snomed.info/sct> where concept is-a 373873005

1151 2.3.6.4.4.3 RDF Definition

1152 Since these concepts in snomed are hierarchical classes the valueset is by definition a union of concept classes.

1153 However the concept class bound to a system should have a different metatype – e.g. systemconcept.

1154 A concept class is therefore a supertype of the systemconcept classes.

1155 A named Valueset as a class is a union of named systemconcept classes (not a superclass). If an instance of CodingBase is typed to a Valueset then it probably means that the codeBase is unknown or to be selected.

1157 The FHIR “include” gets stranslated to a union expression:

1158

## 1159 2.3.6.4.5 Examples

## 1160 2.3.6.4.5.1 Example from orim

```

1161  ### CONCEPT DOMAIN
1162  ### http://hl7.org/ontology/uv/vocab/cd#ActStatus
1163
1164  cd:ActStatus rdf:type :Class ;
1165      :equivalentClass [ rdf:type :Class ;
1166          :unionOf ( [ rdf:type :Restriction ;
1167              :onProperty hl7:VocabularyConcept.codingRef ;
1168              :someValuesFrom <urn:oid:2.16.840.1.113883.1.11.159331/Recent>
1169          ]
1170          [ rdf:type :Restriction ;
1171              :onProperty dt:ANY.nullFlavor ;
1172              :minCardinality "1"^^xs:nonNegativeInteger
1173          ]
1174      )
1175      ]
1176      rdfs:subClassOf hl7:ConceptDomain .
1177
1178  ### CONCEPT
1179  ### http://hl7.org/ontology/uv/vocab/cs/ActStatus/Concept
1180
1181  <http://hl7.org/ontology/uv/vocab/cs/ActStatus/Concept> rdf:type :Class ;
1182      rdfs:subClassOf hl7:VocabularyConcept .
1183
1184  ### http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20/Concept
1185
1186  <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20/Concept> rdf:type :Class ;
1187      rdfs:subClassOf <http://hl7.org/ontology/uv/vocab/cs/ActStatus/Concept> .
1188
1189  ### http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20/Concept#active
1190
1191  <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20/Concept#active> rdf:type :Class ;
1192      :equivalentClass <urn:oid:2.16.840.1.113883.5.14/2011-12-20/Concept#active> ;
1193      rdfs:subClassOf <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20/Concept> ,
1194      <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20/Concept#normal> .
1195
1196  ### urn:oid:2.16.840.1.113883.5.14/2011-12-20/Concept#active
1197
1198  <urn:oid:2.16.840.1.113883.5.14/2011-12-20/Concept#active> rdf:type :Class ;
1199      :equivalentClass <urn:oid:2.16.840.1.113883.5.14/Recent/Concept#active> ;
1200      rdfs:subClassOf <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20/Concept> ,
1201      <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20/Concept#normal> .
1202
1203  ### urn:oid:2.16.840.1.113883.5.14/Recent/Concept#active
1204
1205  <urn:oid:2.16.840.1.113883.5.14/Recent/Concept#active> rdf:type :Class ;
1206      rdfs:subClassOf <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20/Concept> ,
1207      <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20/Concept#normal> .
1208
1209
1210  ### VALUESET
1211  ### http://hl7.org/ontology/uv/vocab/vs/ActStatus
1212
1213  vs:ActStatus rdf:type :Class ;
1214      :equivalentClass <http://hl7.org/ontology/uv/vocab/vs/ActStatus/2011-12-20> ,
1215      <urn:oid:2.16.840.1.113883.1.11.159331> ;
1216      rdfs:subClassOf hl7:ValueSet .
1217
1218  ### http://hl7.org/ontology/uv/vocab/vs/ActStatusActive
1219
1220  vs:ActStatusActive rdf:type :Class ;
1221      :equivalentClass <http://hl7.org/ontology/uv/vocab/vs/ActStatusActive/2011-12-20> ,
1222      <urn:oid:2.16.840.1.113883.1.11.20023> ;
1223      rdfs:subClassOf hl7:ValueSet .
1224

```

```

1225
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### http://hl7.org/ontology/uv/vocab/vs/ActStatus/2011-12-20

<http://hl7.org/ontology/uv/vocab/vs/ActStatus/2011-12-20> rdf:type :Class ;
  :equivalentClass <urn:oid:2.16.840.1.113883.1.11.159331/2011-12-20> ,
  [ rdf:type :Class ;
    :intersectionOf ( [ rdf:type :Restriction ; :onProperty h17:Coding.codeSystemRef ;
      :hasValue <urn:oid:2.16.840.1.113883.5.14>
    ]
    [ rdf:type :Restriction ; :onProperty h17:Coding.codeSystemVersionRef ;
      :hasValue <urn:oid:2.16.840.1.113883.5.14/Recent>
    ]
  )
  ] ;
  rdfs:subClassOf h17:ValueSet .

### http://hl7.org/ontology/uv/vocab/vs/ActStatusActive/2011-12-20

<http://hl7.org/ontology/uv/vocab/vs/ActStatusActive/2011-12-20> rdf:type :Class ;
  :equivalentClass <urn:oid:2.16.840.1.113883.1.11.20023/2011-12-20> ,
  [ rdf:type :Class ; :intersectionOf ( [ rdf:type :Restriction ;:onProperty h17:Coding.conceptRef ;
    :someValuesFrom <urn:oid:2.16.840.1.113883.5.14/2011-12-20/Concept#active>
  ]
  [ rdf:type :Restriction ; :onProperty h17:Coding.codeSystemRef ;
    :hasValue <urn:oid:2.16.840.1.113883.5.14>
  ]
  [ rdf:type :Restriction ; :onProperty h17:Coding.codeSystemVersionRef ;
    :hasValue <urn:oid:2.16.840.1.113883.5.14/Recent>
  ]
  )
  ]
  ] ;
  rdfs:subClassOf h17:ValueSet .

### CODE SYSTEM
### http://hl7.org/ontology/uv/vocab/cs/ActStatus

cs:ActStatus rdf:type h17:CodeSystem ,
  :NamedIndividual ,
  [ rdf:type :Restriction ;
    :onProperty h17:CodeSystem.versionRef ;
    :allValuesFrom [ rdf:type :Restriction ;
      :onProperty h17:CodeSystemVersion.codeSystem ;
      :hasValue "2.16.840.1.113883.5.14"^^xs:string
    ]
  ] ,
  [ rdf:type :Restriction ;
    :onProperty h17:CodeSystem.versionRef ;
    :allValuesFrom [ rdf:type :Class ;
      :oneOf ( <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20>
      )
    ]
  ]
  ] ;

h17:CodeSystem.id "2.16.840.1.113883.5.14"^^xs:string ;
  :sameAs <urn:oid:2.16.840.1.113883.5.14> .

### http://hl7.org/ontology/uv/vocab/cs/ActStatus/Recent

<http://hl7.org/ontology/uv/vocab/cs/ActStatus/Recent> rdf:type h17:CodeSystemVersion , :NamedIndividual ;
  :sameAs <urn:oid:2.16.840.1.113883.5.14/Recent> .

### http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20

<http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20> rdf:type h17:CodeSystemVersion , :NamedIndividual ,
  [ rdf:type :Restriction ; :onProperty h17:CodeSystemVersion.codingRef ;
    :allValuesFrom [ rdf:type :Restriction ;:onProperty h17:Coding.codeSystemVersion ;
      :hasValue "2011-12-20"^^xs:string
    ]
  ]

```

```

1294
1295 ] ,
1296 [ rdf:type :Restriction ; :onProperty h17:CodeSystemVersion.codingRef ;
1297   :allValuesFrom [ rdf:type :Class ;
1298     :oneOf ( <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#nullified>
1299       <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#normal>
1300       <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#suspended>
1301       <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#new>
1302       <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#obsolete>
1303       <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#aborted>
1304       <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#active>
1305       <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#held>
1306       <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#completed>
1307       <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#cancelled>
1308     )
1309   ]
1310 ]
1311 [ rdf:type :Restriction ; :onProperty h17:CodeSystemVersion.codingRef ;
1312   :allValuesFrom [ rdf:type :Restriction ;:onProperty h17:Coding.codeSystemRef ;
1313     :hasValue cs:ActStatus
1314   ]
1315   ]
1316 h17:CodeSystemVersion.codeSystem "2.16.840.1.113883.5.14"^^xs:string ;
1317 h17:CodeSystemVersion.versionDate "2011-12-20"^^xs:string ;
1318 :sameAs <urn:oid:2.16.840.1.113883.5.14/2011-12-20> .
1319
1320 #### http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#active
1321
1322 <http://hl7.org/ontology/uv/vocab/cs/ActStatus/2011-12-20#active> rdf:type h17:Coding ,:NamedIndividual ;
1323   h17:Coding.code "active"^^xs:string .

```

### 1325 2.3.6.4.5.2 ValueSet schema in FHIR

1326 A ValueSet individual will have define, compose and expansion object properties to applicable objects. The  
1327 following RDF samples show a direct translation of the metamodel viewpoint.

```

1328
1329  ### http://hl7.org/fhir/ValueSet
1330  fhir:ValueSet rdf:type owl:Class ;
1331      rdfs:subClassOf fhir:DomainResource ,
1332          [ rdf:type owl:Restriction ;
1333              owl:onProperty fhir:ValueSet.define ;
1334              owl:allValuesFrom fhir:ValueSet.Define
1335          ] ,
1336          [ rdf:type owl:Restriction ;
1337              owl:onProperty fhir:ValueSet.define ;
1338              owl:maxCardinality "1"^^xsd:nonNegativeInteger
1339          ] ,
1340          [ rdf:type owl:Restriction ;
1341              owl:onProperty fhir:ValueSet.compose ;
1342              owl:allValuesFrom fhir:ValueSet.Compose
1343          ] ,
1344          [ rdf:type owl:Restriction ;
1345              owl:onProperty fhir:ValueSet.expansion ;
1346              owl:maxCardinality "1"^^xsd:nonNegativeInteger
1347          ] ,
1348          [ rdf:type owl:Restriction ;
1349              owl:onProperty fhir:ValueSet.expansion ;
1350              owl:allValuesFrom fhir:ValueSet.Expansion
1351          ] ,
1352          [ rdf:type owl:Restriction ;
1353              owl:onProperty fhir:ValueSet.compose ;
1354              owl:maxCardinality "1"^^xsd:nonNegativeInteger
1355          ] .
1356
1357  ### http://hl7.org/fhir/ValueSet.Compose
1358  fhir:ValueSet.Compose rdf:type owl:Class ;
1359      rdfs:subClassOf fhir:BackboneElement .

```

1359

```

1360
1361  ### http://hl7.org/fhir/ValueSet.Concept
1362  fhir:ValueSet.Concept rdf:type owl:Class ;
1363      rdfs:subClassOf fhir:BackboneElement ,
1364          [ rdf:type owl:Restriction ;
1365              owl:onProperty fhir:ValueSet.Concept.display ;
1366              owl:allValuesFrom fhir:string
1367          ] ,
1368          [ rdf:type owl:Restriction ;
1369              owl:onProperty fhir:ValueSet.Concept.code ;
1370              owl:cardinality "1"^^xsd:nonNegativeInteger
1371          ] ,
1372          [ rdf:type owl:Restriction ;
1373              owl:onProperty fhir:ValueSet.Concept.code ;
1374              owl:allValuesFrom fhir:code
1375          ] ,
1376          [ rdf:type owl:Restriction ;
1377              owl:onProperty fhir:ValueSet.Concept.definition ;
1378              owl:maxCardinality "1"^^xsd:nonNegativeInteger
1379          ] ,
1380          [ rdf:type owl:Restriction ;
1381              owl:onProperty fhir:ValueSet.Concept.display ;
1382              owl:maxCardinality "1"^^xsd:nonNegativeInteger
1383          ] ,
1384          [ rdf:type owl:Restriction ;
1385              owl:onProperty fhir:ValueSet.Concept.definition ;
1386              owl:allValuesFrom fhir:string
1387          ] .

```

1387

```
1388
1389 ##### http://hl7.org/fhir/ValueSet.Define
1390 fhir:ValueSet.Define rdf:type owl:Class ;
1391     rdfs:subClassOf fhir:BackboneElement ,
1392         [ rdf:type owl:Restriction ;
1393             owl:onProperty fhir:ValueSet.Define.system ;
1394             owl:allValuesFrom fhir:uri
1395         ] ,
1396         [ rdf:type owl:Restriction ;
1397             owl:onProperty fhir:ValueSet.Define.system ;
1398             owl:cardinality "1"^^xsd:nonNegativeInteger
1399         ] ,
1400         [ rdf:type owl:Restriction ;
1401             owl:onProperty fhir:ValueSet.Define.concept ;
1402             owl:allValuesFrom fhir:ValueSet.Concept
1403         ] .
1404
1405 ##### http://hl7.org/fhir/ValueSet.Expansion
1406 fhir:ValueSet.Expansion rdf:type owl:Class ;
1407     rdfs:subClassOf fhir:BackboneElement .
```

1408

1409

1410    2.3.6.5 *FHIR internal System and Coding bindings (OWL Schema)*

1411    The system is inclusive of all the terms within it and all the instances of those terms.

```
1412 @prefix allergy-intolerance-status: <http://hl7.org/fhir/allergy-intolerance-status#> .  
1413  
1414    ### http://hl7.org/fhir/allergy-intolerance-status  
1415  
1416 fhir:allergy-intolerance-status rdf:type owl:Class ;  
1417    rdfs:subClassOf fhir:valueset-system ,  
1418    [ rdf:type owl:Class ;  
1419       owl:unionOf (  
1420           allergy-intolerance-status:confirmed  
1421           allergy-intolerance-status:entered-in-error  
1422           allergy-intolerance-status:refuted  
1423           allergy-intolerance-status:resolved  
1424           allergy-intolerance-status:unconfirmed  
1425       )  
1426    ] ,  
1427    [ rdf:type owl:Restriction ;  
1428       owl:onProperty fhir:CodingBase.system ;  
1429       owl:allValuesFrom [ rdf:type owl:Restriction ;  
1430           owl:onProperty fhir:value ; owl:hasValue "http://hl7.org/fhir/allergy-intolerance-status"  
1431       ]  
1432    ] ;  
1433    fhir:prefix "http://hl7.org/fhir/allergy-intolerance-status#" .  
1434  
1435    ### http://hl7.org/fhir/allergy-intolerance-status#confirmed  
1436  
1437 allergy-intolerance-status:confirmed rdf:type owl:Class ;  
1438    rdfs:label "Confirmed" ;  
1439    rdfs:subClassOf fhir:allergy-intolerance-status ,  
1440    [ rdf:type owl:Restriction ;  
1441       owl:onProperty fhir:CodingBase.code ;  
1442       owl:allValuesFrom [ rdf:type owl:Restriction ;  
1443           owl:onProperty fhir:value ; owl:hasValue "confirmed"  
1444       ]  
1445    ] ;  
1446    rdfs:comment "A high level of certainty about the propensity for a reaction to the identified Substance, which  
1447 may include clinical evidence by testing or rechallenge." .  
1448  
1449    ### http://hl7.org/fhir/allergy-intolerance-status#entered-in-error  
1450  
1451 allergy-intolerance-status:entered-in-error rdf:type owl:Class ;  
1452    rdfs:label "Entered In Error" ;  
1453    rdfs:subClassOf fhir:allergy-intolerance-status ,  
1454    [ rdf:type owl:Restriction ;  
1455       owl:onProperty fhir:CodingBase.code ;  
1456       owl:allValuesFrom [ rdf:type owl:Restriction ;  
1457           owl:onProperty fhir:value ; owl:hasValue "entered-in-error"  
1458       ]  
1459    ] ;  
1460    rdfs:comment "The statement was entered in error and is not valid" .
```

1461

1462    The system Class definition shows it is a subclass of the abstract valueset-system and restricts its members to  
1463    the CodingBase.system.

1464    There is also an annotation property fhir:prefix which defines the structure of the URI prefix when naming the  
1465    members of the system. It causes the @prefix declaration.

1466    Two members are shown “confirmed” and “entered-in-error”. They are subclasses of allergy-intolerance-status  
1467    and have the restrictions of that class so they do not have to declare CodingBase.system restrictions.

1468    **2.3.6.6 System and codings external RDF representation**

1469    From the SNOMED RDF:

```
1470 <http://snomed.info/id/138875005> rdf:type owl:Class ;
1471   rdfs:label "SNOMED CT Concept" .
1472
1473 <http://snomed.info/id/105590001> rdf:type owl:Class ;
1474   rdfs:label "Substance (substance)" ;
1475   rdfs:subClassOf <http://snomed.info/id/138875005> .
1476
1477 <http://snomed.info/id/373873005> rdf:type owl:Class ;
1478   rdfs:label "Pharmaceutical / biologic product (product)" ;
1479   rdfs:subClassOf <http://snomed.info/id/138875005> .
1480
1481 <http://snomed.info/id/346325008> rdf:type owl:Class ;
1482   rdfs:label "Antibacterial drugs (product)" ;
1483   rdfs:subClassOf <http://snomed.info/id/373873005> .
1484
1485 <http://snomed.info/id/90614001> rdf:type owl:Class ;
1486   rdfs:label "beta-Lactam antibiotic" ;
1487   rdfs:subClassOf <http://snomed.info/id/346325008> .
```

1488    The system is defined further in the FHIR ontology

```
1489 @prefix sct: <http://snomed.info/id/> .
1490
1491 ### http://snomed.info/sct
1492
1493 <http://snomed.info/sct> rdf:type owl:Class ;
1494   rdfs:subClassOf fhir:valueset-system ;
1495   fhir:prefix "http://snomed.info/id/" .
```

1496

1497

1498    2.3.6.7 *Valueset Definition*

1499 A ValueSet is somewhat similar to a value-set-system in that it applies constraints to the members but they can  
1500 be from different systems.

1501 The specific ValueSet is a Class which is a union of Concept classes from one or more coding-systems. It is  
1502 expected that this representation can be computed from the FHIR representation.

1503    2.3.6.7.1.1 *Anonymous codings*

1504 Here is the definition of the specific ValueSet as a Class with restrictions on values not types:

```
1505 <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type owl:Class ;  
1506   rdfs:label "Allergy Intolerance Status Value Set" ;  
1507   rdfs:subClassOf fhir:valueset ,  
1508     [ rdf:type owl:Class ;  
1509       owl:intersectionOf (  
1510         [ rdf:type owl:Restriction ;  
1511           owl:onProperty fhir:CodingBase.code ;  
1512           owl:someValuesFrom [ rdf:type owl:Class ;  
1513             owl:unionOf (  
1514               [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "confirmed" ]  
1515               [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "entered-in-error" ]  
1516               [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "refuted" ]  
1517               [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "resolved" ]  
1518               [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "unconfirmed" ]  
1519             )  
1520           ]  
1521         ]  
1522         [ rdf:type owl:Restriction ;  
1523           owl:onProperty fhir:CodingBase.system ;  
1524           owl:allValuesFrom [ rdf:type owl:Restriction ; owl:onProperty fhir:value ;  
1525             owl:hasValue "http://fhir/allergy-intolerance-status"  
1526           ]  
1527         ]  
1528       )  
1529     ] .
```

1530 If the valueset needs to identify CodingBase restrictions from other systems then the restriction will have a  
1531 slightly different structure. The example here shows the optimization for a single system (Define).

1532    2.3.6.7.2 *Named codings*

1533 If named codings are used then the expression can be greatly simplified since the restrictions are in the named  
1534 class.

```
1535 <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type owl:Class ;  
1536   rdfs:label "Allergy Intolerance Status Value Set" ;  
1537   rdfs:subClassOf fhir:valueset ,  
1538     [ rdf:type owl:Class ;  
1539       owl:unionOf ( allergy-intolerance-status:confirmed  
1540                     allergy-intolerance-status:entered-in-error  
1541                     allergy-intolerance-status:refuted  
1542                     allergy-intolerance-status:resolved  
1543                     allergy-intolerance-status:unconfirmed  
1544                   )  
1545     ] .
```

1546

1547

1548    ***2.3.6.8 ValueSet schema in the metamodel***

1549    A metamodel is introduced when Classes in the Model are instances of MetaClasses which are subclasses of  
1550    owl:Class. In general the Element Definition (1.23.0) is a metamodel.

1551    In the metamodel viewpoint, an instance of ValueSet will have object property assertions to

- 1552        a) instances of ValueSet.Define if all the codes are taken from a single system
- 1553        b) instances of ValueSet.Compose if the codes come from multiple systems and allow inclusion and  
1554              exclusion
- 1555        c) instances of ValueSet.Expansion if the valueset is converted into an enumerated list

1556    A ValueSet individual will have define, compose and expansion object properties to applicable objects. However,  
1557    these object property semantics are not understood by RDF or OWL. They are translated in the Model to  
1558    subclass, intersection and union relationships between classes.

1559

1560    2.3.6.9 *Restriction equivalents to Compose Elements*

1561    The Compose element has subelements – import, include, exclude.

1562    2.3.6.9.1 Import

1563    Import has a value of a ValueSet URI that is to be imported (see earlier Valueset example – 7.2.1)

```
1564 owl:unionOf ( <http://hl7.org/fhir/ValueSet/substance-codeD>
1565     [ rdf:type owl:Restriction ;
1566       Etc. ]
1567 )
```

1568    The import equivalent is the unionOf with the named Class representing the Valueset (here shown as  
1569    <<http://hl7.org/fhir/ValueSet/substance-codeD>>).

1570    2.3.6.9.2 CodeSystem – Concepts

1571    The extensional definition of a Code system includes its concepts as subclasses of the top concept. This is  
1572    translated into a CodeSystemURI individual with the annotation properties of the CodeSystem and the  
1573    associated Concept Classes.

1574    However, there is no direct ontology relationship between the CodeSystemURI and the top concept. Some  
1575    thoughts about a pun relationship might be useful.

1576    See - HL7 Internal Concept RDF Example.

1577    2.3.6.9.3 Filter

1578    The Filter element selects concepts by specify a matching criteria based on the properties (including  
1579    relationships) defined by the system. If multiple filters are specified, they SHALL all be true.

1580    The Filter Operator value set has an inline code system <http://hl7.org/fhir/filter-operator>, which defines the  
1581    following codes:

Code	Display	Definition
=	Equals	The specified property of the <b>code</b> equals the provided value.
is-a	Is A (by subsumption)	Includes all <b>concept</b> ids that have a transitive is-a relationship with the concept Id provided as the value, including the provided concept itself.
is-not-a	Not (Is A) (by subsumption)	The specified property of the <b>code</b> does not have an is-a relationship with the provided value.
regex	Regular Expression	The specified property of the <b>code</b> matches the regex specified in the provided value.
in	In Set	The specified property of the <b>code</b> is in the set of codes or concepts specified in the provided value (comma separated list).
not-in	Not in Set	The specified property of the <b>code</b> is not in the set of codes or concepts

		specified in the provided value (comma separated list).
--	--	---

1582    2.3.6.9.4 Is-a – by subsumption

1583    2.3.6.9.4.1 *XML example*

```

1584 <include>
1585   <system value="http://snomed.info/sct"/>
1586   <filter>
1587     <property value="concept"/>
1588     <op value="is-a"/>
1589     <value value="105590001"/>
1590   </filter>
1591 </include>
1592 <include>
1593   <system value="http://snomed.info/sct"/>
1594   <filter>
1595     <property value="concept"/>
1596     <op value="is-a"/>
1597     <value value="373873005"/>
1598   </filter>
1599 </include>
```

1600

1601    The difficulty with this filter is that while it appears to apply to the concept class which can have is-a  
1602    subsumption, the value is the CodingBase.code value which restricts it to the concept class without  
1603    subsumption. CodingBase is a single class and the instances are not subsumable.

1604    2.3.6.9.4.2 *Compose Include is-a Concept*

1605    The approach is that the value must be translated into the Concept Class Name which would be  
1606    <<http://snomed.info/id/373873005>> and would be used in the restriction.

1607    <<http://snomed.info/sct>> fhir:prefix "<http://snomed.info/id/>"^^xsd:string .

1608    An annotation property on the CodeSystem individual can be used to construct the concept name where a  
1609    simple prefix is used with the codeBase value.

1610    This may also be articulated by the ValueSet fragment class which has the system and filter annotation  
1611    properties and could be translated into the final RDF form.

1612    The include element in conjunction with filtering on is-a concept is transformed into a union of the named  
1613    concept:

```

1614   owl:someValuesFrom [ rdf:type owl:Class ;
1615     owl:unionOf ( <http://snomed.info/id/105590001>
1616       <http://snomed.info/id/373873005>
```

1617    2.3.6.9.5 Exclude

1618    2.3.6.9.5.1 *XML Example*

```

1619 <exclude>
1620   <system value="http://snomed.info/sct"/>
1621   <filter>
1622     <property value="concept"/>
1623     <op value="is-a"/>
1624     <value value="410942007"/>
1625   </filter>
1626 </exclude>
```

1627

1628 2.3.6.9.5.2 Compose Exclude is-a Concept

```
[ rdf:type owl:Class ;
  rdfs:subClassOf <http://hl7.org/fhir/ValueSet/allergyintolerance-substance-code> ;
  owl:unionOf ( <http://hl7.org/fhir/ValueSet/substance-codeD>
    [ rdf:type owl:Restriction ;
      owl:onProperty fhir:CodingBase.concept ;
      owl:someValuesFrom [ rdf:type owl:Class ;
        owl:intersectionOf ( [ rdf:type owl:Class ;
          owl:unionOf ( <http://snomed.info/id/160244002>
            <http://snomed.info/id/409137002>
            <http://snomed.info/id/428607008>
            <http://snomed.info/id/429625007>
          )
        ]
      ]
    )
  )
] .
```

1650

1651 In this case the concept <http://snomed.info/id/410942007> is in the intersection as a complementOf so as to  
1652 be excluded.

1653 2.3.6.9.6 Equals and In

1654 2.3.6.9.6.1 XML Example

```
<description value="All RxNorm codes that have TTY = IN,PIN,MIN,BN, but TTY != OCD."/>
<compose>
  <include>
    <system value="http://www.nlm.nih.gov/research/umls/rxnorm"/>
    <filter>
      <property value="TTY"/>
      <op value="in"/>
      <value value="IN,PIN,MIN,BN"/>
    </filter>
  </include>
  <exclude>
    <system value="http://www.nlm.nih.gov/research/umls/rxnorm"/>
    <filter>
      <property value="TTY"/>
      <op value="="/>
      <value value="OCD"/>
    </filter>
  </exclude>
</compose>
```

1677 These properties are specific to the code systems illustrated and would be expressed in the bridging ontology for  
1678 that system.

1679 2.3.6.9.6.2 Filter RDF Expression

1680 Each filter is defined as a class. In the RDF example these will be named to assist testing and visibility.

1681 A filter class will declare the set meeting the filter properties which are annotation properties. The set are  
1682 CodingBase individuals and the filter is therefore a fragment of a ValueSet.

```

1683
1684
1685    ### http://hl7.org/fhir/SomeBridge/fragmentA
1686
1687        <http://hl7.org/fhir/SomeBridge/fragmentA> rdf:type owl:Class ;
1688            rdfs:subClassOf fhir:Valuesets ;
1689                fhir:filter.property "TTY" ;
1690                    fhir:filter.op "in" ;
1691                        fhir:filter.system "http://www.nlm.nih.gov/research/umls/rxnorm" ;
1692                            fhir:filter.value "IN,PIN,MIN,BN" .
1693
1694    ### http://hl7.org/fhir/SomeBridge/fragmentB
1695
1696        <http://hl7.org/fhir/SomeBridge/fragmentB> rdf:type owl:Class ;
1697            rdfs:subClassOf fhir:Valuesets ;
1698                fhir:filter.property "TTY" ;
1699                    fhir:filter.op "=" ;
1700                        fhir:filter.system "http://www.nlm.nih.gov/research/umls/rxnorm" ;
1701                            fhir:filter.value "OCD" .

```

1700

1701 The definition may not be interpreted by OWL but can be through other mechanisms.

1702 Further exploration needs to be done on SPARQL and SWRL expressions to define the fragment membership of  
1703 CodingBase individuals there thereby the membership of the ValueSet.

#### 1704 2.3.6.9.6.3 *The RDF ValueSet*

1705 The fragments are combined together based on include and exclude elements:

```

1706    ### http://hl7.org/fhir/ValueSet/substance-rxnorm
1707
1708        <http://hl7.org/fhir/ValueSet/substance-rxnorm> rdf:type owl:Class ;
1709            rdfs:label "DAF Substance RxNorm Codes" ;
1710                rdfs:subClassOf fhir:Valuesets ;
1711                    fhir:telecom.other "http://hl7.org/fhir" ;
1712                        fhir:lastUpdated "2015-10-15T03:44:57.526+00:00" ;
1713                            fhir:publisher "FHIR Project team" ;
1714                                fhir:status "draft" ;
1715                                    fhir:concept_definition "All RxNorm codes that have TTY = IN,PIN,MIN,BN, but TTY != OCD." ;
1716                                        fhir:valueset-oid "urn:oid:2.16.840.1.113762.1.4.1010.7" .
1717
1718    [ rdf:type owl:Class ;
1719        rdfs:subClassOf <http://hl7.org/fhir/ValueSet/substance-rxnorm> ;
1720            owl:intersectionOf ( <http://hl7.org/fhir/SomeBridge/fragmentA>
1721                [ rdf:type owl:Class ;
1722                    owl:complementOf <http://hl7.org/fhir/SomeBridge/fragmentB>
1723                ]
1724            )
1725    ] .

```

1727

1728

## 1729 3 Resource References

### 1730 3.1 Github example

```
1731 :resource a fhir:Observation;
1732   fhir:contained fhir:Observation#23;
1733   fhir:Observation.subject [
1734     fhir:Reference.reference fhir:Observation#23
1735   ].
1736
1737 fhir:Observation#23 a fhir:Patient;
1738   fhir:Patient.name [ fhir:text "John Smith ].
```

1739 This example is partially in line with the resolved example below. Even if it were a URL it will not be understood  
1740 by reasoners or SPARQL.

### 1741 3.2 Subgroup example

#### 1742 3.2.1 FHIR XML

```
1743 <AllergyIntolerance xmlns="http://hl7.org/fhir">
1744   <id value="1"/>
1745   <text>
1746
1747   </text>
1748   <!-- the date that this entry was recorded -->
1749   <recordedDate value="2010-03-01"/>
1750   <!-- the patient that actually has the risk of adverse reaction -->
1751   <patient>
1752     <reference value="http://record/Patient/PeterPatient"/>
1753     <display value="Peter Patient"/>
1754   </patient>
1755 </AllergyIntolerance>
```

#### 1756 3.2.2 RDF Data After processing (acquiring the resource and importing)

```
1757 fhir:AllergyIntolerance.patient [ fhir:Reference.display [ fhir:value "Peter Patient" ] ;
1758   fhir:Reference.reference [ fhir:value "http://record/Patient/PeterPatient" ] ;
1759   fhir:Reference.link <http://record/Patient/PeterPatient>
1760 ] ;
```

1761 Note that Reference object has been supplemented by the URI of the Reference.link.

1762 AllergyIntolerance.patient.link can represent the property chain as shown earlier.

1763 A reverse property of the property chain can get the resources for a particular patient.

```
1764 ### http://hl7.org/fhir/AllergyForPatient
1765 fhir:AllergyForPatient rdf:type owl:ObjectProperty ;
1766   owl:inverseOf fhir:AllergyIntolerance.patient.link .
1767
1768 ### http://hl7.org/fhir/AllergyIntolerance.patient.link
1769
1770 fhir:AllergyIntolerance.patient.link rdf:type owl:ObjectProperty ;
1771   owl:propertyChainAxiom ( fhir:AllergyIntolerance.patient fhir:Reference.link ) .
```

1773 The Reference.link is declared when the resource has been imported and closure has been achieved. This allows  
1774 the consumer to determine whether the import has happened or not and can trigger that function. If the  
1775 Reference.link is pre-established there will be no indication in the import and the Resource instance will be  
1776 empty.

1777    **3.2.3 FHIR OWL Schema**

```
1778  ###  http://hl7.org/fhir/Reference
1779
1780 fhir:Reference rdf:type owl:Class ;
1781
1782     rdfs:subClassOf fhir:Element ,
1783         [ rdf:type owl:Restriction ;
1784             owl:onProperty fhir:Reference.reference ;
1785             owl:allValuesFrom fhir:string
1786         ] ,
1787         [ rdf:type owl:Restriction ;
1788             owl:onProperty fhir:Reference.reference ;
1789             owl:maxCardinality "1"^^xsd:nonNegativeInteger
1790         ] ,
1791         [ rdf:type owl:Restriction ;
1792             owl:onProperty fhir:Reference.display ;
1793             owl:allValuesFrom fhir:string
1794         ] ,
1795         [ rdf:type owl:Restriction ;
1796             owl:onProperty fhir:Reference.display ;
1797             owl:maxCardinality "1"^^xsd:nonNegativeInteger
1798         ] ,
1799         [ rdf:type owl:Restriction ;
1800             owl:onProperty fhir:Reference.link ;
1801             owl:allValuesFrom fhir:DomainResource
1802         ] ,
1803         [ rdf:type owl:Restriction ;
1804             owl:onProperty fhir:Reference.link ;
1805             owl:maxCardinality "1"^^xsd:nonNegativeInteger
1806         ] .
```

1807

1808

## 1809 4 Bundle

1810 One common operation performed with resources is to gather a collection of resources into a single instance  
1811 with containing context. In FHIR this is referred to as "bundling" the resources together. These resource bundles  
1812 are useful for a variety of different reasons, including:

- 1813 • Returning a set of resources that meet some criteria as part of a server operation (see [RESTful](#)  
1814 [Search](#))
- 1815 • Returning a set of versions of resources as part of the history operation on a server (see [History](#))
- 1816 • Sending a set of resources as part of a message exchange (see [Messaging](#))
- 1817 • Grouping a self-contained set of resources to act as an exchangeable and persistable collection with  
1818 clinical integrity - e.g. a clinical document (see [Documents](#))
- 1819 • Creating/updating/deleting a set of resources on a server as a single operation (including doing so as  
1820 a single atomic transaction) (see [Transactions](#))
- 1821 • Storing a collection of resources

### 1822 4.1 Bundle XML content description

```
1823 <Bundle xmlns="http://hl7.org/fhir">
1824   <!-- from Resource: id, meta, implicitRules, and language -->
1825   <type value="[code]" /><!-- 1..1 document | message | transaction | transaction-response | batch | batch-response
| history | searchset | collection -->
1826   <total value="[unsignedInt]" /><!-- 0..1 If search, the total number of matches -->
1827   <link> <!-- 0..* Links related to this Bundle -->
1828     <relation value="[string]" /><!-- 1..1 http://www.iana.org/assignments/link-relations/link-relations.xhtml -->
1829     <url value="[uri]" /><!-- 1..1 Reference details for the link -->
1830   </link>
1831   <entry> <!-- 0..* Entry in the bundle - will have a resource, or information -->
1832     <link><!-- 0..* Content as for Bundle.link Links related to this entry --></link>
1833     <fullUrl value="[uri]" /><!-- 0..1 Absolute URL for resource (server address, or UUID/OID) -->
1834     <resource><!-- 0..1 Resource A resource in the bundle --></resource>
1835     <search> <!-- 0..1 Search related information -->
1836       <mode value="[code]" /><!-- 0..1 match | include | outcome - why this is in the result set -->
1837       <score value="[decimal]" /><!-- 0..1 Search ranking (between 0 and 1) -->
1838     </search>
1839     <request> <!-- 0..1 Transaction Related Information -->
1840       <method value="[code]" /><!-- 1..1 GET | POST | PUT | DELETE -->
1841       <url value="[uri]" /><!-- 1..1 URL for HTTP equivalent of this entry -->
1842       <ifNoneMatch value="[string]" /><!-- 0..1 For managing cache currency -->
1843       <ifModifiedSince value="[instant]" /><!-- 0..1 For managing update contention -->
1844       <ifMatch value="[string]" /><!-- 0..1 For managing update contention -->
1845       <ifNoneExist value="[string]" /><!-- 0..1 For conditional creates -->
1846     </request>
1847     <response> <!-- 0..1 Transaction Related Information -->
1848       <status value="[string]" /><!-- 1..1 Status return code for entry -->
1849       <location value="[uri]" /><!-- 0..1 The location, if the operation returns a location -->
1850       <etag value="[string]" /><!-- 0..1 The etag for the resource (if relevant) -->
1851       <lastModified value="[instant]" /><!-- 0..1 Server's date time modified -->
1852     </response>
1853   </entry>
1854   <signature><!-- 0..1 Signature Digital Signature --></signature>
1855 </Bundle>
```

1856

1858   **4.2 Bundle RDF Content**

```
1859   ### http://record/medpres1/bundle1
1860
1861 <http://record/medpres1/bundle1> rdf:type fhir:Bundle , owl:NamedIndividual ;
1862   fhir:Bundle.entry [ rdf:type fhir:Bundle.Entry ;
1863     fhir:Bundle.Entry.resource <http://record/MedicationPrescription/1>
1864   ] ;
1865   fhir:Bundle.type [ fhir:value "searchset"];
1866   fhir:Bundle.link [ rdf:type fhir:uri ; fhir:value "self"] ;
1867   fhir:Bundle.total [ rdf:type fhir:unsignedInt ; fhir:value 3 ];
1868   fhir:Resource.meta [ rdf:type fhir:Meta ; fhir:Meta.lastUpdated
1869     [ rdf:type fhir:instant ; fhir:value "2015-08-02T00:00:00"^^xsd:dateTime]
1870   ] .
1871
1872 ### http://record/MedicationPrescription/1
1873
1874 <http://record/MedicationPrescription/1> rdf:type profile:MedicationPrescription , owl:NamedIndividual ;
1875   fhir:MedicationOrder.medicationReference [ rdf:type fhir:Reference ;
1876     fhir:Reference.link <http://record/Medication/1> ;
1877     fhir:Reference.reference [ fhir:value http://record/Medication/1 ] ;
1878     fhir:Reference.display [ fhir:value "Amoxicillin (product)" ]
1879   ] ;
1880   fhir:MedicationOrder.patient [ rdf:type fhir:Reference ;
1881     fhir:Reference.link <http://record/Patient/PeterPatient> ;
1882     fhir:Reference.display [ fhir:value "Peter Patient" ] ;
1883     fhir:Reference.reference [ fhir:value "http://record/Patient/PeterPatient" ]
1884   ] .
1885 ]
1886 ] .
```

1887

1888   A Bundle may or may not have an Id (inherited from Resource) therefore it can be referenced as an Ontology
1889   e.g. record/Bundle/123. It may therefore be a named or anonymous individual.

## 1890 4.3 Bundle RDF Schema

```
1891     ### http://hl7.org/fhir/Bundle
1892
1893      fhir:Bundle rdf:type owl:Class ;
1894        rdfs:subClassOf fhir:Resource ,
1895          [ rdf:type owl:Restriction ; owl:onProperty fhir:Bundle.total ;
1896            owl:onClass fhir:unsignedInt ;
1897              owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
1898         ] ,
1899          [ rdf:type owl:Restriction ;
1900            owl:onProperty fhir:Bundle.entry ;
1901            owl:allValuesFrom fhir:Bundle.Entry
1902       ] ,
1903          [ rdf:type owl:Restriction ;
1904            owl:onProperty fhir:Bundle.signature ;
1905            owl:onClass fhir:Signature ;
1906            owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
1907       ] ,
1908          [ rdf:type owl:Restriction ;
1909            owl:onProperty fhir:Bundle.type ;
1910            owl:onClass fhir:code ;
1911            owl:qualifiedCardinality "1"^^xsd:nonNegativeInteger
1912       ] ,
1913          [ rdf:type owl:Restriction ;
1914            owl:onProperty fhir:Bundle.link ;
1915            owl:allValuesFrom fhir:Bundle.Link
1916       ] .
1917
1918     ### http://hl7.org/fhir/Bundle.Entry
1919
1920      fhir:Bundle.Entry rdf:type owl:Class ;
1921        rdfs:subClassOf fhir:BackboneElement ,
1922          [ rdf:type owl:Restriction ;
1923            owl:onProperty fhir:Bundle.Entry.search ;
1924            owl:onClass fhir:Bundle.Search ;
1925            owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
1926       ] ,
1927          [ rdf:type owl:Restriction ;
1928            owl:onProperty fhir:Bundle.Entry.link ;
1929            owl:onClass fhir:Bundle.Link ;
1930            owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
1931       ] ,
1932          [ rdf:type owl:Restriction ;
1933            owl:onProperty fhir:Bundle.Entry.resource ;
1934            owl:onClass fhir:Resource ;
1935            owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
1936       ] ,
1937          [ rdf:type owl:Restriction ;
1938            owl:onProperty fhir:Bundle.Entry.fullURI ;
1939            owl:onClass fhir:uri ;
1940            owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
1941       ] .
```

1942

1943    **5 URI Naming**

1944    **5.1 Github example**

1945    No example

1946    **5.2 Subgroup example**

1947    Detailed rules for URI construction must be made for internally referenced resource class instances. The  
1948    example has proposed URI constructs where

- 1949        1. the Resource namespace precedes the assigned identifier for the contained instance
- 1950        2. the root resource object has an URI identifier identical to the resource class instance URI

1951    Thus <<http://record>AllergyIntolerance/1>> has “record/AllergyIntolerance” as the resource namespace with “1”  
1952    as the contained instance identifier.

1953    It is also intended that the resource namespace should also be the ontology IRI. This is to be tested.

1954    <<http://record>AllergyIntolerance/>> rdf:type owl:Ontology ;

1955

1956

1957 **6 Ordering**

1958 **6.1 Github example**

1959 No example

1960 **6.2 RDF individual ordering example**

1961 Simple integer DataProperty fhir:index can be applied to individuals of subclasses of fhir:Element

1962

```
1963 ##### http://hl7.org/fhir/index
1964 fhir:index rdf:type owl:DatatypeProperty ;
1965     rdfs:range fhir:index-primitive .
1966
1967 ##### http://hl7.org/fhir/index-primitive
1968 fhir:index-primitive rdf:type rdfs:Datatype ;
1969     owl:equivalentClass [ rdf:type rdfs:Datatype ;
1970         owl:onDatatype xsd:integer ;
1971         owl:withRestrictions ( [ xsd:minInclusive 1 ] )
1972     ] .
1973 ##### http://hl7.org/fhir/Element
1974 fhir:Element rdf:type owl:Class ;
1975     rdfs:label "Element" ;
1976     rdfs:subClassOf [ rdf:type owl:Restriction ;
1977         owl:onProperty fhir:Element.extension ;
1978         owl:someValuesFrom fhir:Extension
1979     ] ,
1980     [ rdf:type owl:Restriction ;
1981         owl:onProperty fhir:Element.id ;
1982         owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
1983         owl:onDataRange fhir:id-primitive
1984     ] ,
1985     [ rdf:type owl:Restriction ;
1986         owl:onProperty fhir:index ;
1987         owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
1988         owl:onDataRange fhir:index-primitive
1989     ] ;
1990     rdfs:comment "The base element used for all FHIR elements and resources - allows for them to be
1991 extended with extensions" .
1992 .
```

1993 In general fhir:value and fhir:Element.id are converted to an attribute in XML. fhir:index dictates the sequence  
1994 only.

1995 **6.3 RDF Object Property Ordering example**

1996 Where object properties need to be ordered to construct the sequence of properties in XML, the fhir:index is  
1997 defined as an annotation property on the Object Property. The example of ordered properties inside CodingBase  
1998 is shown:

```
1999 ##### http://hl7.org/fhir/index
2000
2001 fhir:index rdf:type owl:AnnotationProperty .
```

2002

```
2003  ### http://hl7.org/fhir/CodingBase.system
2004  fhir:CodingBase.system rdf:type owl:ObjectProperty ;
2005      fhir:index 1 ;
2006
2007  ### http://hl7.org/fhir/CodingBase.version
2008  fhir:CodingBase.version rdf:type owl:ObjectProperty ;
2009      fhir:index 2 .
2010
2011  ### http://hl7.org/fhir/CodingBase.code
2012  fhir:CodingBase.code rdf:type owl:ObjectProperty ;
2013      fhir:index 3 .
2014
2015  ### http://hl7.org/fhir/CodingBase.display
2016  fhir:CodingBase.display rdf:type owl:ObjectProperty ;
2017      fhir:index 4 ;
2018
2019  ### http://hl7.org/fhir/CodingBase.primary
2020  fhir:CodingBase.primary rdf:type owl:ObjectProperty ;
2021      fhir:index 5 ;
2022
2023
2024
```

## 2025 7 Profiles

2026 The example shows “profile” ontology restricting the Valueset of Substance:

2027 The AllergyIntolerance Resource is declared again inside the Profile ontology.

```
2028 <http://record/AllergyIntolerance/1> rdf:type profile:AllergyIntolerance , owl:NamedIndividual ;  
2029
```

2030 This prefix on the rdf:type profile:AllergyIntolerance binds to the Profile and causes typing to the  
2031 profile:AllergyIntolerance where further restrictions (and extensions) are added.

2032 AllergyIntolerance.substance.coding is defines as a property chain and allows constraints to be applied to the  
2033 codings for substance

```
2034 allergy:AllergyIntolerance.substance.coding rdf:type owl:ObjectProperty ;  
2035     owl:inverseOf fhir:Coding.Resource ;  
2036     owl:propertyChainAxiom ( allergy:AllergyIntolerance.substance fhir:ConceptBase.coding ).  
2037
```

2038 Here is a sample of the Profile Turtle.

```
2039 ### http://PatientSafetyProfile/AllergyIntolerance  
2040  
2041 profile:AllergyIntolerance rdf:type owl:Class ;  
2042     owl:equivalentClass [ rdf:type owl:Class ;  
2043         owl:intersectionOf ( profile:DomainResource  
2044             [ rdf:type owl:Restriction ;  
2045                 owl:onProperty fhir:tag ;  
2046                 owl:hasValue "AllergyIntolerance"  
2047             ]  
2048         )  
2049     ] ;  
2050     rdfs:subClassOf fhir:AllergyIntolerance ,  
2051         [ rdf:type owl:Restriction ;  
2052             owl:onProperty <http://hl7.org/fhir/AllergyIntolerance/AllergyIntolerance.substance> ;  
2053             owl:allValuesFrom <http://PatientSafetyProfile/substance-type>  
2054         ] .  
2055  
2056 ### http://PatientSafetyProfile/DomainResource  
2057  
2058 profile:DomainResource rdf:type owl:Class ;  
2059     rdfs:subClassOf fhir:DomainResource .  
2060  
2061 ### http://PatientSafetyProfile/substance-type  
2062 <http://PatientSafetyProfile/substance-type> rdf:type owl:Class ;  
2063     rdfs:subClassOf fhir:ValueSet ,  
2064         [ rdf:type owl:Class ;  
2065             owl:unionOf (  
2066                 <http://snomed.info/id/105590001>  
2067                 <http://snomed.info/id/373873005>  
2068             )  
2069         ] .  
2070  
2071
```

2072