FHIR RDF Sample side by side comparisons

V6 Tony Mallia 7/6/15

Contents

Legend

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

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

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

1 Primitive Datatypes (section 1.18.0.1)

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

1.1 Subgroup example

1.1.1 FHIR XML

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

1.1.2 FHIR CodeableConcept and Coding Structure Definition

CodeableConcept

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

36   Coding

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

45

46   Code-primitive and code

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

59

60

61   Uri-primitive and uri

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

73

74   String-primitive and string

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

87   ### 1.1.3 RDF Data for Coding Instance

88   The RDF variant for Code, Coding and Codeable concept are not straight translations of the FHIR representation.

89   3 new classes are introduced – codeThingy, CodingThingy and CodeableThingy. These names are temporary.

```
90        CodeableThingy.coding [ rdf:type fhir:CodingThingy ;
91      fhir:CodingThingy.system [ a fhir:uri ; "fhir:value http://example.org/local"^^fhir:uri-primitive ] ;
92      fhir:CodingThingy.code [ a fhir:codeThingy ; fhir:value "admin"^^fhir:code-primitive ] ;
93      fhir:CodingThingy.display [ a fhir:string ; fhir:value "Admin"^^fhir:string-primitive ] ;
94            ];
```

1.1.4   FHIR OWL Schema (Turtle)

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

fhir:CodeableThingy rdf:type owl:Class ;

                    rdfs:subClassOf fhir:Element ,
                                    [ rdf:type owl:Restriction ;
                                      owl:onProperty fhir:CodeableThingy.text ;
                                      owl:onClass fhir:string ;
                                      owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
                                    ] ,
                                    [ rdf:type owl:Restriction ;
                                      owl:onProperty fhir:CodeableThingy.coding ;
                                      owl:allValuesFrom fhir:CodingThingy
                                    ] .
```

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

fhir:CodingThingy rdf:type owl:Class ;

                    rdfs:subClassOf fhir:Element ,
                                    [ rdf:type owl:Restriction ;
                                      owl:onProperty fhir:CodingThingy.primary ;
                                      owl:onClass fhir:boolean ;
                                      owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
                                    ] ,
                                    [ rdf:type owl:Restriction ;
                                      owl:onProperty fhir:CodingThingy.code ;
                                      owl:onClass fhir:codeThingy ;
                                      owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
                                    ] ,
                                    [ rdf:type owl:Restriction ;
                                      owl:onProperty fhir:CodingThingy.display ;
                                      owl:onClass fhir:string ;
                                      owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
                                    ] ,
                                    [ rdf:type owl:Restriction ;
                                      owl:onProperty fhir:CodingThingy.system ;
                                      owl:onClass fhir:uri ;
                                      owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
                                    ] ,
                                    [ rdf:type owl:Restriction ;
                                      owl:onProperty fhir:CodingThingy.version ;
                                      owl:onClass fhir:string ;
                                      owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
                                    ] .
```

```
144   ###  http://hl7.org/fhir/codeThingy
145
146   fhir:codeThingy rdf:type owl:Class ;
147
148               rdfs:subClassOf fhir:Element ,
149                               [ rdf:type owl:Restriction ;
150                                 owl:onProperty fhir:value ;
151                                 owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
152                                 owl:onDataRange fhir:code-primitive
153                               ] .
```

155 This approach will be implemented by creating CodeableThingy, CodingThingy and codeThingy individuals as

156 blank nodes.

2   Concept Binding external (section 1.17.3.3.5)

2.1   Github example

```
159   @prefix loinc: <http://loinc.org/owl#> .
160   :resource a fhir:Observation;
161     fhir:Observation.code [
162       fhir:CodeableConcept.coding [
163         fhir:Coding.system <http://loinc.org>;
164         fhir:Coding.code "54411-4";
165         fhir:Coding.display "Rh immune globulin given Qualitative";
166         ex:concept loinc:54411-4;
167         ];
168       fhir:CodeableConcept.text "Rh immune globulin";
169     ].
```

170 Extension adds a new object property "concept" which points to an instance "http://loinc.org/owl#54411-4"

171 which has a type - probably http://loinc.org/54411-4 which returns Turtle for the type not the HTML

172 description. Notice that Coding instance is not typed but could be inferred from the range of

173 CodeableConcept.coding.

2.2   Subgroup example

2.2.1   FHIR XML

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

```
177   <Observation xmlns="http://hl7.org/fhir">
178     <code>
179       <coding>
180         <system value="http://loinc.org"/>
181         <code value="54411-4"/>
182         <display value=" Rh immune globulin given Qualitative "/>
183       </coding>
184       <text value="Rh immune globulin"/>
185     </code>
186   ………..
```

2.2.2   FHIR Structure definition

188 See section 1.2.2

2.2.3 RDF Data with Terminology blank nodes in RDF

```
@prefix loinc: <http://loinc.org/> .
@prefix fhir: <http://hl7.org/fhir/> .
<sourceNamespace/Observation/resource.id> a fhir:Observation;
 fhir:Observation.code [ a fhir:CodeableThingy , <http://loinc.org/54411-4> ;
   fhir:CodeableThingy.coding  [ a fhir:CodingThingy , <http://loinc.org/54411-4> ;
     fhir:CodingThingy.system [fhir:value "http://loinc.org"^^fhir:uri-primitive ] ;
     fhir:CodingThingy.code [fhir:value "54411-4"^^fhir:code-primitive ] ;
     fhir:CodingThingy.display [fhir:value "Rh immune globulin given Qualitative"^^fhir:string-primitive ] ;
   ];
   fhir:CodeableThingy.text [fhir:value "Rh immune globulin" ]
 ] .
```

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

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

2.3 Allergy Intolerance Subgroup Example

2.3.1 FHIR XML

```
<AllergyIntolerance xmlns=http://hl7.org/fhir >
  <id value="1"/>
  <text>

  </text>
<!--   the date that this entry was recorded    -->
  <recordedDate value="2010-03-01"/>
<!--   the patient that actually has the risk of adverse reaction    -->
  <patient>
    <reference value="http://record/Patient/PeterPatient"/>
    <display value="Peter Patient"/>
  </patient>
<!--   substance, coded from SNOMED CT-->
  <substance>
    <coding>
      <system value="http://snomed.info/id/"/>
      <code value="90614001"/>
      <display value="beta-Lactam antibiotic"/>
    </coding>
  </substance>
  <status value="confirmed"/>
  <criticality value="high"/>
  <category value="medication"/>
</AllergyIntolerance>
```

2.3.2 RDF Example

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

```
@prefix : <http://record/AllergyIntolerance/> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix sct: <http://snomed.info/id/> .
@prefix xml: <http://www.w3.org/XML/1998/namespace> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix fhir: <http://hl7.org/fhir/> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix profile: <http://PatientSafetyProfile/> .
@base <http://record/AllergyIntolerance/1> .


<http://record/AllergyIntolerance/> rdf:type owl:Ontology ;
  owl:imports <http://PatientSafetyProfile> .

###  http://record/AllergyIntolerance/1

<http://record/AllergyIntolerance/1> rdf:type profile:DomainResource , owl:NamedIndividual ,
profile:AllergyIntolerance ;
    fhir:tag "AllergyIntolerance" ;
    fhir:AllergyIntolerance.status [ rdf:type fhir:CodeableThingy,
              <http://hl7.org/fhir/allergyIntoleranceStatus#confirmed> ;
        fhir:CodeableThingy.coding [ rdf:type fhir:CodingThingy ;
            fhir:CodingThingy.code [ rdf:type fhir:codeThingy ; fhir:value "confirmed"
              ]
          ]
    ] ;
    fhir:AllergyIntolerance.patient [ rdf:type fhir:Reference ;
        fhir:Reference.reference [ fhir:value "http://record/Patient/PeterPatient" ] ;
        fhir:Reference.display [ fhir:value "Peter Patient" ] ;
        fhir:Reference.link <http://record/Patient/PeterPatient> ;
    ] ;
    fhir:AllergyIntolerance.substance [ rdf:type fhir:CodeableThngy , http://snomed.info/id/90614001 ;
        rdfs:label "beta-lactam (antibiotic)" ;
        fhir:CodeableTingy.coding [ rdf:type fhir:CodingThingy , http://snomed.info/id/90614001 ;
            fhir:CodingThingy.code [ rdf:type fhir:codeThingy ; fhir:value "90614001" ] ;
            fhir:CodingThingy.system [ rdf:type fhir:uri ; fhir:value "http://snomed.info/id/90614001" ] ;
            fhir:CodingThingy.display [ rdf:type fhir:string ; fhir:value "beta-lactam (antibiotic)" ]
        ] ;
        fhir:CodeableThingy.text [ rdf:type fhir:string ; fhir:value "beta-lactam (antibiotic)"
]
] .###  Generated by the OWL API (version 3.5.1) http://owlapi.sourceforge.net
```

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

Creation of import statements is TBD.

2.3.3 FHIR OWL Schema

See section 1.2.4.

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

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

2.3.4 FHIR Allergy Intolerance OWL Schema

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

fhir:AllergyIntolerance rdf:type owl:Class ;

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

```
354                                          [ rdf:type owl:Restriction ;
355                                            owl:onProperty fhir:AllergyIntolerance.substance ;
356                                            owl:onClass fhir:CodeableThingy ;
357                                            owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
358                                          ] ,
359                                          [ rdf:type owl:Restriction ;
360                                            owl:onProperty fhir:AllergyIntolerance.category ;
361                                            owl:onClass <http://hl7.org/fhir/vs/allergy-intolerance-category> ;
362                                            owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
363                                          ] .
364   ###  http://hl7.org/fhir/AllergyIntolerance.Event
365   fhir:AllergyIntolerance.Event rdf:type owl:Class ;
366                                 rdfs:subClassOf fhir:BackboneElement .
```

367

From the SNOMED RDF:

```
369   <http://snomed.info/id/138875005> rdf:type owl:Class ;
370                                     rdfs:label "SNOMED CT Concept" .
371
372   <http://snomed.info/id/105590001> rdf:type owl:Class ;
373                                     rdfs:label "Substance (substance)" ;
374                                     rdfs:subClassOf <http://snomed.info/id/138875005> .
375
376   <http://snomed.info/id/373873005> rdf:type owl:Class ;
377                                     rdfs:label "Pharmaceutical / biologic product (product)" ;
378                                     rdfs:subClassOf <http://snomed.info/id/138875005> .
379
380   <http://snomed.info/id/346325008> rdf:type owl:Class ;
381                                     rdfs:label "Antibacterial drugs (product)" ;
382                                     rdfs:subClassOf <http://snomed.info/id/373873005> .
383
384   <http://snomed.info/id/105590001> rdf:type owl:Class ;
385                                     rdfs:label "beta-Lactam antibiotic" ;
386                                     rdfs:subClassOf <http://snomed.info/id/346325008> .
```

387

388

3 Valueset Definition

In FHIR ValueSet definitions are complicated.

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

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

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

3.1 ValueSet schema in the metamodel

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

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

            rdfs:subClassOf fhir:DomainResource ,
                            [ rdf:type owl:Restriction ;
                              owl:onProperty fhir:ValueSet.define ;
                              owl:onClass fhir:ValueSet.Define ;
                              owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
                            ] ,
                            [ rdf:type owl:Restriction ;
                              owl:onProperty fhir:ValueSet.expansion ;
                              owl:onClass fhir:ValueSet.Expansion ;
                              owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
                            ] ,
                            [ rdf:type owl:Restriction ;
                              owl:onProperty fhir:ValueSet.compose ;
                              owl:onClass fhir:ValueSet.Compose ;
                              owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
                            ] .
```

```
fhir:ValueSet.Define rdf:type owl:Class ;

                    rdfs:subClassOf fhir:BackboneElement ,
                                    [ rdf:type owl:Restriction ;
                                      owl:onProperty fhir:ValueSet.Define.system ;
                                      owl:onClass fhir:uri ;
                                      owl:qualifiedCardinality "1"^^xsd:nonNegativeInteger
                                    ] ,
                                    [ rdf:type owl:Restriction ;
                                      owl:onProperty fhir:ValueSet.Define.concept ;
                                      owl:allValuesFrom fhir:ValueSet.Concept
                                    ] .
```

```
434    fhir:ValueSet.Concept rdf:type owl:Class ;
435
436                           rdfs:subClassOf fhir:BackboneElement ,
437                                           [ rdf:type owl:Restriction ;
438                                             owl:onProperty fhir:ValueSet.Concept.definition ;
439                                             owl:onClass fhir:string ;
440                                             owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
441                                           ] ,
442                                           [ rdf:type owl:Restriction ;
443                                             owl:onProperty fhir:ValueSet.Concept.code ;
444                                             owl:onClass fhir:code ;
445                                             owl:qualifiedCardinality "1"^^xsd:nonNegativeInteger
446                                           ] ,
447                                           [ rdf:type owl:Restriction ;
448                                             owl:onProperty fhir:ValueSet.Concept.display ;
449                                             owl:onClass fhir:string ;
450                                             owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
451                                           ] .
452
453
```

3.2   ValueSet Instances (in the metamodel)

An example is Allergy Intolerance Status ValueSet:

```
456    ###  http://hl7.org/fhir/vs/allergy-intolerance-status
457
458    <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type fhir:ValueSet , owl:NamedIndividual ;
459                              rdfs:label "Allergy Intolerance Status Value Set" ;
460       fhir:ValueSet.define [ rdf:type fhir:ValueSet.Define ;
461             fhir:ValueSet.Define.system [ fhir:value "http://hl7.org/fhir/allergy-intolerance-status" ] ;
462             fhir:ValueSet.Define.concept
463                 [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#confirmed> ] ,
464                 [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> ] ,
465                 [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#refuted> ] ,
466                 [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#resolved> ] ,
467                 [ fhir:valueSet.Concept.code <http://hl7.org/fhir/allergy-intolerance-status#unconfirmed> ]
468       ].
469
```

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

```
473    ###  http://hl7.org/fhir/allergy-intolerance-status
474
475    fhir:allergy-intolerance-status rdf:type http://hl7.org/fhir/allergy-intolerance-status ,
476          fhir:uri , owl:NamedIndividual ;
477          fhir:value "http://hl7.org/fhir/allergy-intolerance-status" .
```

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

```
481   ###  http://hl7.org/fhir/allergy-intolerance-status#confirmed
482
483   <http://hl7.org/fhir/allergy-intolerance-status#confirmed> rdf:type fhir:ValueSet.Concept ,
484       <http://hl7.org/fhir/allergy-intolerance-status#confirmed> , owl:NamedIndividual ;
485       fhir:ValueSet.Concept.code [ rdf:type fhir:code ; fhir:value "confirmed" ].
486
487   ###  http://hl7.org/fhir/allergy-intolerance-status#entered-in-error
488
489   <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> rdf:type fhir:ValueSet.Concept ,
490       <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> , owl:NamedIndividual ;
491       fhir:ValueSet.Concept.code [ rdf:type fhir:code ; fhir:value " entered-in-error " ].
492
```

493

3.3   System Definitions (in the OWL model)

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

```
496   ###  http://hl7.org/fhir/allergy-intolerance-status
497
498   fhir:allergy-intolerance-status rdf:type owl:Class ;
499       rdfs:subClassOf fhir:valueset-system .
500
501   ###  http://hl7.org/fhir/allergy-intolerance-status#confirmed
502
503   <http://hl7.org/fhir/allergy-intolerance-status#confirmed> rdf:type owl:Class ;
504       owl:equivalentClass [ rdf:type owl:Class ;
505           owl:intersectionOf ( fhir:allergy-intolerance-status
506               [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "confirmed" ]
507           )
508       ] .
509
510   ###  http://hl7.org/fhir/allergy-intolerance-status#entered-in-error
511
512   <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error> rdf:type owl:Class ;
513       owl:equivalentClass [ rdf:type owl:Class ;
514           owl:intersectionOf ( fhir:allergy-intolerance-status
515               [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "entered-in-error" ]
516           )
517       ] .
518
```

519

3.4   ValueSet Definitions (in the OWL Model)

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

```
522   ###  http://hl7.org/fhir/vs/allergy-intolerance-status
523
524   <http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type owl:Class ;
525       owl:equivalentClass [ rdf:type owl:Class ;
526       owl:unionOf (
527           <http://hl7.org/fhir/allergy-intolerance-status#confirmed>
528           <http://hl7.org/fhir/allergy-intolerance-status#entered-in-error>
529           <http://hl7.org/fhir/allergy-intolerance-status#refuted>
530           <http://hl7.org/fhir/allergy-intolerance-status#resolved>
531           <http://hl7.org/fhir/allergy-intolerance-status#unconfirmed>
532           )
533       ] .
534
```

535

4 Concept Binding Internal

4.1 Githib example

No example

4.2 Subgroup example

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

4.2.1 FHIR XML

```xml
<AllergyIntolerance xmlns="http://hl7.org/fhir">
  <id value="1"/>
  <text>

  </text>
<!--   the date that this entry was recorded   -->
  <recordedDate value="2010-03-01"/>
<!--   the patient that actually has the risk of adverse reaction   -->
  <patient>
    <reference value="http://record/Patient/PeterPatient"/>
  </patient>
<!--   substance, coded from SNOMED CT-->
  <substance>
    <coding>
      <system value="http://snomed.info/id/"/>
      <code value="105590001"/>
      <display value="beta-Lactam antibiotic"/>
    </coding>
  </substance>
  <status value="confirmed"/>
  <criticality value="high"/>
  <category value="medication"/>
</AllergyIntolerance>
```

4.2.2 RDF Data After processing

```
fhir:AllergyIntolerance.status [ rdf:type <http://hl7.org/fhir/allergy-intolerance-status#confirmed> ;
          fhir:CodeableThingy.coding [ rdf:type fhir:CodingThingy ;
              fhir:CodingThingy.code [ rdf:type fhir:codeThingy ; fhir:value "confirmed" ]
          ]
 ] ;
```

4.2.3 FHIR OWL Schema

Same mechanism as external terminologies –see 2.2.5.

Internal terminology expressed as Class hierarchy

```
fhir:AllergyIntolerance.status rdf:type owl:ObjectProperty ;
                               rdfs:range fhir:allergy-intolerance-status .

fhir:AllergyIntolerance rdf:type owl:Class ;
                        rdfs:subClassOf fhir:DomainResource ,
                            [ rdf:type owl:Restriction ;
                                     owl:onProperty fhir:AllergyIntolerance.status ;
                                     owl:onClass <http://hl7.org/fhir/vs/allergy-intolerance-status> ;
                                     owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
                            ] ,
```

5   Resource References

5.1   Githib example

```
:resource a fhir:Observation;
  fhir:contained fhir:Observation\#23;
  fhir:Observation.subject [
     fhir:Reference.reference fhir:Observation\#23
  ].

fhir:Observation\#23 a fhir:Patient;
  fhir:Patient.name [ fhir:text "John Smith ].
```

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

5.2   Subgroup example

5.2.1   FHIR XML

```xml
<AllergyIntolerance xmlns="http://hl7.org/fhir">
  <id value="1"/>
  <text>

  </text>
<!--   the date that this entry was recorded    -->
  <recordedDate value="2010-03-01"/>
<!--   the patient that actually has the risk of adverse reaction    -->
   <patient>
     <reference value="http://record/Patient/PeterPatient"/>
     <display value="Peter Patient"/>
   </patient>
</AllergyIntolerance>
```

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

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

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

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

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

```
623   ###  http://hl7.org/fhir/AllergyForPatient
624   fhir:AllergyForPatient rdf:type owl:ObjectProperty ;
625                          owl:inverseOf fhir:AllergyIntolerance.patient.link .
626
627   ###  http://hl7.org/fhir/AllergyIntolerance.patient.link
628
629   fhir:AllergyIntolerance.patient.link rdf:type owl:ObjectProperty ;
630                          owl:propertyChainAxiom ( fhir:AllergyIntolerance.patient fhir:Reference.link ) .
```

5.2.3   FHIR OWL Schema

```
632   fhir:Reference rdf:type owl:Class ;
633                  rdfs:subClassOf fhir:Element ,
634                                     [ rdf:type owl:Restriction ;
635                                       owl:onProperty fhir:Reference.link ;
636                                       owl:onClass fhir:DomainResource ;
637                                       owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
638                                     ] ,
639                                     [ rdf:type owl:Restriction ;
640                                       owl:onProperty fhir:Reference.display ;
641                                       owl:onClass fhir:string ;
642                                       owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
643                                     ] ,
644                                     [ rdf:type owl:Restriction ;
645                                       owl:onProperty fhir:Reference.reference ;
646                                       owl:onClass fhir:string ;
647                                       owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger
648                                     ] .
```

649

650

6 Bundle

Some preliminary notes:

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

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

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

7 URI Naming

7.1 Githib example

No example

7.2 Subgroup example

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

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

Thus <http://record/AllergyIntolerance/1> has "record/AllergyIntolerance" as the resource namespace with "1" as the contained instance identifier.

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

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

8 Ordering

8.1 Githib example

No example

8.2 Subgroup example

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

```
###  http://hl7.org/fhir/index
fhir:index rdf:type owl:DatatypeProperty ;
          rdfs:range fhir:index-primitive .

###  http://hl7.org/fhir/index-primitive
fhir:index-primitive rdf:type rdfs:Datatype ;
                     owl:equivalentClass [ rdf:type rdfs:Datatype ;
                                           owl:onDatatype xsd:integer ;
                                           owl:withRestrictions ( [ xsd:minInclusive 1 ] )
                                         ] .
###  http://hl7.org/fhir/Element
fhir:Element rdf:type owl:Class ;
            rdfs:label "Element" ;
            rdfs:subClassOf [ rdf:type owl:Restriction ;
                              owl:onProperty fhir:Element.extension ;
                              owl:someValuesFrom fhir:Extension
                            ] ,
                            [ rdf:type owl:Restriction ;
                              owl:onProperty fhir:Element.id ;
                              owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
                              owl:onDataRange fhir:id-primitive
                            ] ,
                            [ rdf:type owl:Restriction ;
                              owl:onProperty fhir:index ;
                              owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
                              owl:onDataRange fhir:index-primitive
                            ] ;
            rdfs:comment "The base element used for all FHIR elements and resources - allows for them to be
extended with extensions" .
    .
```

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

9 Profiles

The profile ontology restricts the Valueset of Substance:

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

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

```
###  http://PatientSafetyProfile/AllergyIntolerance
profile:AllergyIntolerance rdf:type owl:Class ;
  rdfs:subClassOf fhir:AllergyIntolerance ,
    [ rdf:type owl:Restriction ; owl:onProperty
      <http://hl7.org/fhir/AllergyIntolerance/AllergyIntolerance.substance.coding> ;
      owl:allValuesFrom [ rdf:type owl:Class ;
          owl:unionOf ( <http://snomed.info/id/105590001> <http://snomed.info/id/373873005> )
                       ]
    ] .
###  http://PatientSafetyProfile/DomainResource

profile:DomainResource rdf:type owl:Class ;
                       rdfs:subClassOf fhir:DomainResource .
```