FHIR RDF Sample side by side comparisons

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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 Datatypes (section 1.18.0.1)

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

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

1.1 Id

1.1.1 Id instance

1.1.2 Id schema

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

1.2 Decimal

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

1.2.1 Decimal OWL instance

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

1.2.2 Decimal OWL Schema

```
fhir:decimal rdf:type owl:Class ;
             rdfs:subClassOf fhir:Element ,
                             [ rdf:type owl:Restriction ;
                               owl:onProperty fhir:fractionDigits ;
                               owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
                               owl:onDataRange xsd:nonNegativeInteger
                             ] ,
                             [ rdf:type owl:Restriction ;
                               owl:onProperty fhir:fractionDigits ;
                               owl:allValuesFrom xsd:nonNegativeInteger
                             ] ,
                             [ rdf:type owl:Restriction ;
                               owl:onProperty fhir:value ;
                               owl:allValuesFrom xsd:decimal
                             ] ,
                             [ rdf:type owl:Restriction ;
                               owl:onProperty fhir:value ;
                               owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
                               owl:onDataRange xsd:decimal
                             ] ;
             rdfs:comment "A rational number with implicit precision" .
```

1.3 FHIR CodeableConcept and Coding Structure Definition

1.3.1 FHIR XML

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

CodeableConcept Structural Definition

```
<[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]>
```

Coding Structural Definition

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

1.3.2 RDF Data for Coding Instance

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

```
xxx.code [ a fhir:CodeableConcept ;
  ConceptBase.coding [ rdf:type fhir:CodingBase ;
  fhir:CodingBase.system [ a fhir:uri; “fhir:value http://example.org/local”] ;
  fhir:CodingBase.code [ a fhir:codeBase ; fhir:value "admin"] ;
  fhir:CodingBase.display [ a fhir:string; fhir:value "Admin"] ;
  ] ;
] ;
```

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

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

1.3.3 FHIR OWL Schema

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

```
#################################################################
#    Classes
#################################################################

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

fhir:ConceptBase rdf:type owl:Class ;
                 rdfs:subClassOf fhir:Element ,
                                 [ rdf:type owl:Restriction ;
                                   owl:onProperty fhir:ConceptBase.coding ;
                                   owl:allValuesFrom fhir:CodingBase
                                 ] ,
                                 [ rdf:type owl:Restriction ;
                                   owl:onProperty fhir:ConceptBase.text ;
                                   owl:allValuesFrom fhir:string
                                 ] ,
                                 [ rdf:type owl:Restriction ;
                                   owl:onProperty fhir:ConceptBase.text ;
                                   owl:maxCardinality "1"^^xsd:nonNegativeInteger
                                 ] .
###  http://hl7.org/fhir/CodingBase
fhir:CodingBase rdf:type owl:Class ;
                rdfs:subClassOf fhir:Element ,
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:CodingBase.system ;
                                  owl:allValuesFrom fhir:uri
                                ] ,
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:CodingBase.system ;
                                  owl:maxCardinality "1"^^xsd:nonNegativeInteger
                                ] ,
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:CodingBase.version ;
                                  owl:allValuesFrom fhir:string
                                ] ,
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:CodingBase.version ;
                                  owl:maxCardinality "1"^^xsd:nonNegativeInteger
                                ] ,
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:CodingBase.code ;
                                  owl:allValuesFrom fhir:codeBase
                                ]
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:CodingBase.code ;
                                  owl:maxCardinality "1"^^xsd:nonNegativeInteger
                                ] ,
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:CodingBase.display ;
                                  owl:allValuesFrom fhir:string
                                ] ,
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:CodingBase.display ;
                                  owl:maxCardinality "1"^^xsd:nonNegativeInteger
                                ] ,
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:CodingBase.primary ;
                                  owl:maxCardinality "1"^^xsd:nonNegativeInteger
                                ] ,
                                [ rdf:type owl:Restriction ;
                                  owl:onProperty fhir:CodingBase.primary ;
                                  owl:allValuesFrom fhir:boolean
                                ] .
```

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

              rdfs:subClassOf fhir:Element ,
                              [ rdf:type owl:Restriction ;
                                owl:onProperty fhir:value ;
                                owl:allValuesFrom xsd:token
                              ] ,
                              [ rdf:type owl:Restriction ;
                                owl:onProperty fhir:value ;
                                owl:maxQualifiedCardinality "1"^^xsd:nonNegativeInteger ;
                                owl:onDataRange xsd:token
                              ] .
```

The concrete subclasses of ConceptBase apply the additional restrictions:

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

```
###  http://hl7.org/fhir/Coding
fhir:Coding rdf:type owl:Class ;
            rdfs:subClassOf fhir:ConceptBase ,
                            [ rdf:type owl:Restriction ;
                              owl:onProperty fhir:ConceptBase.text ;
                              owl:maxCardinality "0"^^xsd:nonNegativeInteger
                            ] ,
                            [ rdf:type owl:Restriction ;
                              owl:onProperty fhir:ConceptBase.coding ;
                              owl:cardinality "1"^^xsd:nonNegativeInteger
                            ] .
```

```
fhir:code rdf:type owl:Class ;
          rdfs:subClassOf fhir:ConceptBase ,
                          [ rdf:type owl:Restriction ;
                            owl:onProperty fhir:ConceptBase.coding ;
                            owl:cardinality "1"^^xsd:nonNegativeInteger
                          ] ,
                          [ rdf:type owl:Restriction ;
                            owl:onProperty fhir:ConceptBase.coding ;
                            owl:allValuesFrom [ rdf:type owl:Class ;
                                                owl:intersectionOf ( fhir:CodingBase
                                                 [ rdf:type owl:Restriction ;
                                                 owl:onProperty fhir:CodingBase.code ;
                                                 owl:cardinality "1"^^xsd:nonNegativeInteger
                                                 ]
                                                 [ rdf:type owl:Restriction ;
                                                 owl:onProperty fhir:CodingBase.system ;
                                                 owl:cardinality "1"^^xsd:nonNegativeInteger
                                                 ]
                                                 [ rdf:type owl:Restriction ;
                                                 owl:onProperty fhir:CodingBase.version ;
                                                 owl:cardinality "1"^^xsd:nonNegativeInteger
                                                 ]
                                                 [ rdf:type owl:Restriction ;
                                                 owl:onProperty fhir:CodingBase.display ;
                                                 owl:maxCardinality "0"^^xsd:nonNegativeInteger
                                                 ]
                                                 [ rdf:type owl:Restriction ;
                                                 owl:onProperty fhir:CodingBase.primary ;
                                                 owl:maxCardinality "0"^^xsd:nonNegativeInteger
                                                 ]
                                                 )
                              ]
                          ] .
```

2 Concept Binding external (section 1.17.3.3.5)

2.1 Github example

```
@prefix loinc: <http://loinc.org/owl#> .
:resource a fhir:Observation;
  fhir:Observation.code [
    fhir:CodeableConcept.coding [
      fhir:Coding.system <http://loinc.org>;
      fhir:Coding.code "54411-4";
      fhir:Coding.display "Rh immune globulin given Qualitative";
      ex:concept loinc:54411-4;
      ];
    fhir:CodeableConcept.text "Rh immune globulin";
  ].
```

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

2.2 Subgroup example

2.2.1 FHIR XML

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

```
<Observation xmlns="http://hl7.org/fhir">
  <code>
    <coding>
      <system value="http://loinc.org"/>
      <code value="54411-4"/>
      <display value=" Rh immune globulin given Qualitative "/>
    </coding>
    <text value="Rh immune globulin“/>
  </code>
…….
```

2.2.2 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, http://loinc.org/54411-4 ;
 fhir:Observation.code [ a fhir:CodeableConcept , <http://loinc.org/54411-4> ;
  fhir:ConceptBase.coding  [ a fhir:CodingBase , <http://loinc.org/54411-4> ;
    fhir:CodingBase.system [ a fhir:uri fhir:value “http://loinc.org”] ;
    fhir:CodingBase.code [a fhir:codeBase fhir:value "54411-4""] ;
    fhir:CodingBase.display [a fhir:string fhir:value "Rh immune globulin given Qualitative"] ;
  ];
  fhir:ConceptBase.text [a fhir:string 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 CodingBase instance is calculated based on the formation of the URL for that terminology. The type in the CodingBase instance is carried up to the CodeableConcept blank node.

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

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 Instance 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:code,
             <http://hl7.org/fhir/allergyIntoleranceStatus#confirmed> ;
       fhir:ConceptBase.coding [ rdf:type fhir:CodingBase ;
            fhir:CodingBase.code [ rdf:type fhir:codeBase; 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:CodeableConcept , http://snomed.info/id/90614001 ;
      rdfs:label "beta-lactam (antibiotic)" ;
      fhir:ConceptBase.coding [ rdf:type fhir:CodingBase , http://snomed.info/id/90614001 ;
         fhir:CodingBase.code [ rdf:type fhir:codeBase ; fhir:value "90614001" ] ;
         fhir:CodingBase.system [ rdf:type fhir:uri ; fhir:value "http://snomed.info/id/90614001" ] ;
         fhir:CodingBase.display [ rdf:type fhir:string ; fhir:value "beta-lactam (antibiotic)" ]
      ] ;
      fhir:ConceptBase.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 CodingBasey instances.

Creation of import statements is TBD.

2.3.3 FHIR OWL Schema

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

The schema is abridged to show the concepts of interest:

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

fhir:AllergyIntolerance rdf:type owl:Class ;

                        rdfs:subClassOf fhir:DomainResource ,
                                        [ rdf:type owl:Restriction ;
                                          owl:onProperty fhir:AllergyIntolerance.substance ;
                                          owl:maxCardinality "1"^^xsd:nonNegativeInteger
                                        ] ,
                                        [ rdf:type owl:Restriction ;
                                          owl:onProperty fhir:AllergyIntolerance.substance ;
                                          owl:allValuesFrom fhir:CodeableConcept
                                        ] ,
Etc..
.
```

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

The valueset gets applied through the profile binding.

3 FHIR internal System and Coding Definitions RDF

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

```
@prefix allergy-intolerance-status: <http://hl7.org/fhir/allergy-intolerance-status#> .

###  http://hl7.org/fhir/allergy-intolerance-status

fhir:allergy-intolerance-status rdf:type owl:Class ;
  rdfs:subClassOf fhir:valueset-system ,
  [ rdf:type owl:Class ;
    owl:unionOf (
      allergy-intolerance-status:confirmed
      allergy-intolerance-status:entered-in-error
      allergy-intolerance-status:refuted
      allergy-intolerance-status:resolved
      allergy-intolerance-status:unconfirmed
    )
  ] ,
  [ rdf:type owl:Restriction ;
    owl:onProperty fhir:CodingBase.system ;
    owl:allValuesFrom [ rdf:type owl:Restriction ;
      owl:onProperty fhir:value ; owl:hasValue "http://hl7.org/fhir/allergy-intolerance-status"
    ]
  ] ;
  fhir:prefix "http://hl7.org/fhir/allergy-intolerance-status#" .

###  http://hl7.org/fhir/allergy-intolerance-status#confirmed

allergy-intolerance-status:confirmed rdf:type owl:Class ;
  rdfs:subClassOf fhir:allergy-intolerance-status ,
  [ rdf:type owl:Restriction ;
    owl:onProperty fhir:CodingBase.code ;
    owl:allValuesFrom [ rdf:type owl:Restriction ;
      owl:onProperty fhir:value ; owl:hasValue "confirmed"
    ]
  ] .
###  http://hl7.org/fhir/allergy-intolerance-status#entered-in-error

allergy-intolerance-status:entered-in-error rdf:type owl:Class ;
  rdfs:subClassOf fhir:allergy-intolerance-status ,
  [ rdf:type owl:Restriction ;
    owl:onProperty fhir:CodingBase.code ;
    owl:allValuesFrom [ rdf:type owl:Restriction ;
      owl:onProperty fhir:value ; owl:hasValue "entered-in-error"
    ]
  ] .
```

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

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

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

4 System and codings external RDF representation

From the SNOMED RDF:

```
<http://snomed.info/id/138875005> rdf:type owl:Class ;
                                  rdfs:label "SNOMED CT Concept" .

<http://snomed.info/id/105590001> rdf:type owl:Class ;
                                  rdfs:label "Substance (substance)" ;
                                  rdfs:subClassOf <http://snomed.info/id/138875005> .

<http://snomed.info/id/373873005> rdf:type owl:Class ;
                                  rdfs:label "Pharmaceutical / biologic product (product)" ;
                                  rdfs:subClassOf <http://snomed.info/id/138875005> .

<http://snomed.info/id/346325008> rdf:type owl:Class ;
                                  rdfs:label "Antibacterial drugs (product)" ;
                                  rdfs:subClassOf <http://snomed.info/id/373873005> .

<http://snomed.info/id/105590001> rdf:type owl:Class ;
                                  rdfs:label "beta-Lactam antibiotic" ;
                                  rdfs:subClassOf <http://snomed.info/id/346325008> .
```

The system is defined further in the FHIR ontology

```
###  http://snomed.info/sct

<http://snomed.info/sct> rdf:type owl:Class ;
  rdfs:subClassOf fhir:valueset-system ;
  fhir:prefix "http://snomed.info/id/" .
```

5 Valueset Definition

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

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

5.1.1 Anonymous codings

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

```
<http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type owl:Class ;
  rdfs:label "Allergy Intolerance Status Value Set" ;
  rdfs:subClassOf fhir:valueset ,
  [ rdf:type owl:Class ;
    owl:intersectionOf (
      [ rdf:type owl:Restriction ;
        owl:onProperty fhir:CodingBase.code ;
        owl:someValuesFrom [ rdf:type owl:Class ;
          owl:unionOf (
            [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "confirmed" ]
            [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "entered-in-error" ]
            [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "refuted" ]
            [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "resolved" ]
            [ rdf:type owl:Restriction ; owl:onProperty fhir:value ; owl:hasValue "unconfirmed" ]
          )
        ]
      ]
      [ rdf:type owl:Restriction ;
        owl:onProperty fhir:CodingBase.system ;
        owl:allValuesFrom [ rdf:type owl:Restriction ; owl:onProperty fhir:value ;
          owl:hasValue "http://fhir/allergy-intolerance-status"
        ]
      ]
    )
  ] .
```

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

5.2 Named codings

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

```
<http://hl7.org/fhir/vs/allergy-intolerance-status> rdf:type owl:Class ;
rdfs:label "Allergy Intolerance Status Value Set" ;
rdfs:subClassOf fhir:valueset ,
  [ rdf:type owl:Class ;
    owl:unionOf ( allergy-intolerance-status:confirmed
      allergy-intolerance-status:entered-in-error
      allergy-intolerance-status:refuted
      allergy-intolerance-status:resolved
      allergy-intolerance-status:unconfirmed
    )
  ] .
```

6 ValueSet schema in the metamodel

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

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

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.

However, these object property semantics are not understood by RDF or OWL. They are translated in the Model to subclass and union relationships between classes.

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7 Resource References

7.1 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.

7.2 Subgroup example

7.2.1 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>
</AllergyIntolerance>
```

7.2.2 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.

```
###  http://hl7.org/fhir/AllergyForPatient
fhir:AllergyForPatient rdf:type owl:ObjectProperty ;
                       owl:inverseOf fhir:AllergyIntolerance.patient.link .

###  http://hl7.org/fhir/AllergyIntolerance.patient.link

fhir:AllergyIntolerance.patient.link rdf:type owl:ObjectProperty ;
                       owl:propertyChainAxiom ( fhir:AllergyIntolerance.patient fhir:Reference.link ) .
```

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

7.2.3 FHIR OWL Schema

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

fhir:Reference rdf:type owl:Class ;

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

8 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.

9 URI Naming

9.1 Githib example

No example

9.2 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 ;
```

10 Ordering

10.1 Githib example

No example

10.2 RDF individual ordering 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.

10.3 RDF Object Property Ordering example

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

```
###  http://hl7.org/fhir/CodingBasey.system
fhir:CodingBase.system rdf:type owl:ObjectProperty ;
                       fhir:index 1 ;

###  http://hl7.org/fhir/CodingBasey.version
fhir:CodingBase.version rdf:type owl:ObjectProperty ;
                        fhir:index 2 .

###  http://hl7.org/fhir/CodingBasey.code
fhir:CodingBase.code rdf:type owl:ObjectProperty ;
                     fhir:index 3 .

###  http://hl7.org/fhir/CodingBasey.display
fhir:CodingBase.display rdf:type owl:ObjectProperty ;
                        fhir:index 4 ;

###  http://hl7.org/fhir/CodingBasey.primary
fhir:CodingBase.primary rdf:type owl:ObjectProperty ;
                        fhir:index 5 ;
```

11 Profiles

The example shows “profile” ontology restricting 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:ConceptBase.coding ).
```

```
###  http://PatientSafetyProfile/AllergyIntolerance

profile:AllergyIntolerance rdf:type owl:Class ;
  owl:equivalentClass [ rdf:type owl:Class ;
    owl:intersectionOf ( profile:DomainResource
      [ rdf:type owl:Restriction ;
        owl:onProperty fhir:tag ;
        owl:hasValue "AllergyIntolerance"
      ]
    )
  ] ;
  rdfs:subClassOf fhir:AllergyIntolerance ,
  [ rdf:type owl:Restriction ;
    owl:onProperty <http://hl7.org/fhir/AllergyIntolerance/AllergyIntolerance.substance> ;
    owl:allValuesFrom <http://PatientSafetyProfile/substance-type>
  ] .

###  http://PatientSafetyProfile/DomainResource

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

###  http://PatientSafetyProfile/substance-type
<http://PatientSafetyProfile/substance-type> rdf:type owl:Class ;
  rdfs:subClassOf fhir:ValueSet ,
  [ rdf:type owl:Class ;
    owl:unionOf (
      <http://snomed.info/id/105590001>
      <http://snomed.info/id/373873005>
    )
  ] .
```