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RIF In RDF

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Abstract

This document specifies a reversible mapping (or transformation) from Rule Interchange Format (RIF) XML documents to Resource Description Framework (RDF) graphs. This mapping allows the contents of RIF documents to be interoperably stored and processed as RDF triples, using existing serializations and tools for RDF. When used with the standard mapping from RDF triples to RIF frames, this also provides a "reflection" or "introspection" mechanism, an interoperable way for RIF rules to operate on RIF documents.

Status of this Document

May Be Superseded

This section describes the status of this document at the time of its publication. Other documents may supersede this document. A list of current W3C publications and the latest revision of this technical report can be found in the W3C technical reports index at http://www.w3.org/TR/.

Set of Documents

This document is being published as one of a set of 11 documents:

1. RIF Overview
2. RIF Core Dialect
3. RIF Basic Logic Dialect
4. RIF Production Rule Dialect
5. RIF Framework for Logic Dialects
6. RIF Datatypes and Built-Ins 1.0
7. RIF RDF and OWL Compatibility
8. OWL 2 RL in RIF
9. RIF Combination with XML data
10. RIF In RDF (this document)
11. RIF Test Cases

XML Schema Datatypes Dependency

RIF is defined to use datatypes defined in the XML Schema Definition Language (XSD). As of this writing, the latest W3C Recommendation for XSD is version 1.0, with version 1.1 progressing toward Recommendation. RIF has been designed to take advantage of the new datatypes and clearer explanations available in XSD 1.1, but for now those advantages are being partially put on hold. Specifically, until XSD 1.1 becomes a W3C Recommendation, the elements of RIF which are based on it should be considered *optional*, as detailed in Datatypes and Builtins, section 2.3. Upon the publication of XSD 1.1 as a W3C Recommendation, those elements will cease to be optional and are to be considered required as otherwise specified.

We suggest that for now developers and users follow the XSD 1.1 Last Call Working Draft. Based on discussions between the Schema, RIF and OWL Working Groups, we do not expect any implementation changes will be necessary as XSD 1.1 advances to Recommendation.

First Public Working Draft

During the development of the RIF XML syntax, there was an awareness of the need for an RDF encoding. There was even a proposal for using a constrained (schema-checkable) RDF/XML serialization as the primary syntax for RIF. The final syntax turned out to be very similar to RDF/XML, making this mapping fairly simple.

Looking forward, with the publication (at the same time as this document) of the main RIF deliverables as Recommendations, and the RIF Working Group charter expiring soon, this specification is unlikely to

W3C Working Draft

become a full W3C Recommendation during the lifetime of the current Working Group. We expect, instead, that it will be left as a Working Group Note, suitable for use by implementors but without the thorough review it may eventually require if it becomes a focus of significant RIF adoption.

Please Comment By 20 July 2010

The Rule Interchange Format (RIF) Working Group seeks public feedback on this First Public Working Draft. Please send your comments to public-rif-comments@w3.org (public archive). If possible, please offer specific changes to the text that would address your concern. You may also wish to check the Wiki Version of this document and see if the relevant text has already been updated.

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Table of Contents

1 Introduction

The Rule Interchange Format (RIF) [RIF Overview] is an interlingua between rule systems. It is an overlapping family of XML languages (called "dialects") designed for transmitting and storing various kinds of computer-processable rules and related data. Three standard dialects have been defined: RIF Core [RIF Core], RIF Basic Logic Dialect (BLD) [RIF BLD], and RIF Production Rules Dialect (PRD) [RIF PRD]. RIF Core is a sublanguage of BLD and of PRD: every Core document is also a BLD document and a PRD document.

RIF was envisioned [RIF Charter] to be extensible, allowing third parties to define non-standard extensions which could be combined into new dialects, as needed, to support interchange of rule sets which include features not defined in the standard dialects. No general mechanism for extensions has been detailed in the RIF specifications, however, although the RIF Framework for Logic Dialects (FLD) [RIF FLD] specifies how to create more expressive logic dialects.

The Resource Description Framework (RDF) [RDF] is a standard abstract way to represent data. The units of data in RDF are triples consisting of a subject, property (or predicate), and value (or object), which are similar to (and compatible with) RIF Frames (see RIF-RDF Combinations [RIF RDF+OWL]). A set of triples can be viewed as a directed labeled graph, where the nodes are subjects and values and the arcs are labeled with property identifiers; we therefore speak of a set of RDF triples as an RDF graph. RDF graphs can be serialized in multiple equivalent syntaxes, including RDF/XML [RDF XML], RDFa [RDFa], and Turtle [Turtle]. RDF can be processed with a wide variety of software tools [RDF Tools].

This specification defines a reversible mapping from RIF syntactic structures to RDF graphs. The definition is presented in two ordered tables where each row in the tables shows an XML template and a corresponding RDF graph template. The mapping is performed, roughly speaking, by finding the first matching XML template, then producing the corresponding graph. In some cases, the graph will require recursive translations of XML subtrees. The resulting graph has one node, called the focus node, which represents the XML root node, which in RIF Core, BLD, and PRD is rif:Document.

A reverse mapping is possible for standard RIF by simply matching the RDF template and generating the corresponding XML. For extended RIF, the mapping is lossy, so the reverse mapping can only done if the translator has extra information.

Note that RDF serializations produced via this mapping are not standard RIF documents and cannot necessarily be understood by RIF implementations.

The rest of this document is structured as follows:

- design discussion, including use cases and requirements
- specification of the RIF-in-RDF mapping
- non-normative appendices: a complete example, an XSLT stylesheet which transforms RIF to RDF/XML, and an OWL 2 ontology of the RIF syntactic structures.

2 Use Cases

In designing this mapping a few use cases were considered:

- **UC1: Store RIF in an RDF Triplestore** — particularly when using RIF with RDF data, it may be useful to keep various RIF documents in the triplestore with the data, especially when there is associated metadata.
- **UC2: Access RIF Syntactic Structures with RDF Tools** — even more than storing whole RIF documents, it may be useful to be able to use RDF and Linked Data mechanisms to refer to and manipulate individual syntactic elements such as RIF rules, clauses, and groups.
- **UC3: Transform RIF Syntax using RIF Rules** — many logic programming techniques build on the idea of having rules which transform other rules. While RIF documents can be processed as XML, it may be desirable in some cases to process them as RDF triples or as RIF frames.
- **UC4: Provide Forward Compatibility via Fallback Rules** — it may be possible for RIF extensions to be completely or partially understood (used) by systems which do not directly implement the extensions if the systems, if the extensions are published with suitable fallback transformation rules. This is a special case of UC3.

3 Requirements

The following requirements were taken into account in this design:

- **Req1: All Standard RIF Documents Map to RDF** — Every syntactically valid RIF Core, RIF BLD, and RIF PRD has a well-defined mapping to RDF triples.
- **Req2: Extensions Can Be Written So They Will Be Automatically Mapped to RDF** — It is possible to write reasonable extensions which the mapping will handle, without the mapping being extended. It is not a requirement that *all* possible extensions be handled by this mapping.
- **Req3: Transformations Require No External Data** — The transformation can be done without any external information, such as dereferencing namespace URIs or otherwise obtaining schema information.
- **Req4: Stable Roundtrips Under RDF Simple Entailment** — A RIF document may be mapped to RDF, then the graph may be altered following RDF Simple Entailment [RDF Semantics] (including being reduced to a subgraph), and *if* the document can be extracted by the reverse mapping, it will have the same entailments and metadata. This is motivated by UC3 and especially UC4: without this property, incomplete running of transformation rules could undetectably result in incorrect results.
- **Req5: RDF View Conforms to RDF Best Practices** — the RDF form of the RIF constructs should appear as normal, well-constructed RDF data, not as some odd or surprising formation. Although this mapping uses rdf:List structures more than is common, for this application they are warranted.
- **Req6: RIF Extension are First Class in RDF View** — viewed as triples, there should be no indication of which features are in which dialects or extensions; the intent here is the allow the feature set to evolve and particular applications to use the appropriate set of features without regard to which features happen to be in RIF Core, RIF BLD, or RIF PRD.

4 Extensibility

Editor's Note: In this current design, the mapping does not use rdf:type triples. This may change in the future. This is Issue 101.

For RIF syntactic extensions to be properly handled by this mapping, they must use different properties from any existing syntax, and those properties must be *required* wherever used.

For example, if one were adding a new type of formula, "Xor", which was usable wherever "Or" was usable, it could not be merely distinguished by having a different class element (extn:Xor instead of rif:Or); it would have to replace the rif:formula property inside the rif:Or element with something else, such as extn:xorFormulas. Additionally, where rif:Or allows zero or more rif:formula property elements to occur, the

extn:xorFormulas property would have to be defined to occur exactly once. Since the Xor operation needs multiple values, the *ordered="yes"* mechanism would be used to allow them.

These restrictions are necessary in order to meet the stated requirements. In particular, without these restrictions, a RIF document (in RDF graph form) being transformed by an incomplete reasoner into another RIF document (also in RDF graph form) could produce an unintended and incorrect result just because the reasoning was incomplete. With these restrictions, the result will not match the reverse-mapping until it is sufficiently complete.

5 Mapping from RIF XML to RDF Graphs

The mapping from RIF XML to RDF Graphs is expressed as a function *Tr*:

Tr(*rif-xml-tree*) → <*focus-node*, *triples*>

For every standard RIF Document, and for certain subtrees of RIF documents and extended RIF documents, *Tr* maps to the pair of an RDF node and an RDF graph. The node, called the *focus* node represents the same syntactic element as the root of the given XML tree. The RDF graph is a standard RDF graph, a set of RDF triples, and always contains the focus node. The focus node is usually a fresh blank node, but it might have a IRI label in certain cases, as detailed below.

In this document, the Turtle [Turtle] RDF serialization syntax is used for expressing triples and graphs. Turtle has a very terse syntax for lists, *(item-1 ... item-n)* and for fresh blank nodes and the triples using them as the subject: *[property-1 value-1; ... property-n value-n]*. These constructs allow the mapping to be presented and examples to be shown with relative simplicity.

The mapping is defined recursively, with each application of *Tr* converting an XML *class element* to a focus node, with additional triples. Class elements in RIF XML have tags that begin with an uppercase letter and represent a particular syntactic entity. Except for rif:Var and rif:Const class elements (detailed in Table 1, below), all the class elements follow a general form, containing a sequence of *property elements*, each containing additional class elements. The mapping for these is detailed in Table 2 and Table 3, below.

Editor's Note: In this current design, the mapping does not use rdf:type triples. This may change in the future. This is Issue 101.

For another example of a specification of a mapping to RDF graphs, which may lend insight into how to use this specification, see OWL 2 Mapping to RDF Graphs [OWL2 Mapping].

5.1 Namespaces

All standard elements in RIF XML have the namespace "http://www.w3.org/2007/rif#", and the attributes have no namespace. Extensions are expected to use other namespaces for the elements and are not allowed to introduce new attributes.

The RIF-in-RDF mapping produces RDF graphs that use the **same namespace**, although they use that namespace name in the normal RDF way (as an IRI prefix) instead of in the XML way (as a disambiguator).

By keeping the namespace the same, transformation software can correctly operate, without modification, on all RIF documents, even ones containing extensions.

Note that this use of the same namespace means that in certain cases RIF and RDF/XML documents cannot be distinguished simply by their namespace use. Moreover, since the rdf:RDF root element is optional in RDF/XML, in some cases it is not possible to distinguish between RIF and RDF/XML documents just by schema-validating or RDF-parsing the XML. In those cases, additional inspection of the structure is necessary. In general, systems should therefore be careful to maintain external file type information. This is typically done with either the media types ("application/rif+xml" and "application/rdf+xml") or the suggested filename extensions (".rif" and ".rdf").

In the tables below, the followng XML DOCTYPE declaration is assumed, allowing for abbreviation of the RDF and RIF namespaces:

```
<!DOCTYPE rif:Document [
  <!ENTITY rdf   "http://www.w3.org/1999/02/22-rdf-syntax-ns#">
  <!ENTITY rif   "http://www.w3.org/2007/rif#">
]>
```

Also, the default XML namespace is assumed to be "http://www.w3.org/2007/rif#" and for use in Turtle, the following prefix declarations are assumed to be in effect:

```
@prefix rif: <http://www.w3.org/2007/rif#>
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
@prefix xs:  <http://www.w3.org/2001/XMLSchema#>
```

5.2 The <id> and <meta> Elements

Any RIF class element may have a first child of the form:

```
<id>
   <Const type="&rif;iri">id</Const>
</id>
```

When this child is present, it is ignored for other processing and the *id* text is used as the IRI (URI-Reference) label for the **focus_node**, instead of it being left as a blank node.

As a special case, if the rif:Document element does not have an <id> child, its **focus_node** *should* be given the Web address (IRI) of the input XML document, if it has one.

After this optional <id> element, any RIF class element may contain a <meta> element. This element is processed like other property elements, below.

Systems performing this transformation *may* also attempt to convert the metadata to RDF using the standard Frame-RDF correspondence [RIF RDF+OWL] , and include it in the returned triples. The conversion is not always possible, because some frame formulas are not expressible in RDF; systems which attempt this transformation and encounter such frame formulas in metadata *should* issue a warning. Even if the frames are converted to RDF like this, implementations *must* still keep the rif:meta triples intact, to support stable roundtripping.

5.3 The <Var> and <Const> Elements

Table 1, below, defines a portion of *Tr*. When a rif-xml-tree, X, matches the entry in column one, treating terms written *like-this* as metavariables, the result of *Tr*(X) is the pair <**focus_node**,G>, where G is the singleton set of triples indicated by the second column.

Note that, although not shown in this table, <id> and <meta> child elements are allowed before the text in these elements. Additional elements after <id> and <meta> and before the character data may be allowed by extended schemas and *must* be processed as normal (extended) property elements.

Editor's Note: If Issue 101 is resolved to allow the use of class information, this table could potentially be simplified or folded into Table 2. Perhaps the type attribute could map to a rif:symbolspace property, and any character data after the last child could map to the value of a rif:text property.

Note that metadata about Consts is applied to the **focus_node**, not to the RDF literal produced. For example an explanation comment on a Const is understood to explain why that value is used in that spot, not state general properties of that value.

Table 1: RIF-RDF *Tr* Mapping Table for Var and Const

Input XML Pattern, X	Output
<Var>*variable-name*</Var>	**focus_node** rif
<Const type="&rif;iri">*value*</Const>	**focus_node** rif
<Const type="&rif;local">*value*</Const>	**focus_node** rif
<Const type="&rdf;PlainLiteral">*text*@</Const>	**focus_node** rif
<Const type="&rdf;PlainLiteral">*text*@*langtag*</Const>	**focus_node** rif
<Const type="*type-iri*">*value*</Const>	**focus_node** rif

5.4 General Mapping

Except as noted above, the *Tr* mapping for any class element is to a new focus node and a set of triples which depend on each of the children of the class element. The exact dependency is detailed in this section.

Each child of the class element being mapped (except as noted above) is a property element. There are four kinds of property elements:

Mode 0
: These elements have the **ordered="yes"** attribute. Their children are mapped to an RDF list

Mode 1
: These elements are required by the XML schema to appear exactly once. Their children are mapped directly to the value role of an RDF triple

Mode 2
: All the (zero or more) values of these elements are gathered, in document order, into an RDF list. When these elements do not appear in their class elements, an empty RDF list is generated.

Mode 3
Special handling for the <slot> property, converting name/arg and key/value pairs into explicit pairs

The mapping for each mode is specified in Table 2 below. The mapping depends on the identity of an RDF property, written as *prop*, and the mode. Table 3 specifies special-case values for *prop* and mode, but otherwise they are determined as follows:

1. *prop* is the concatenation of the property element's tag's namespace IRI followed by its local part. For example, for the <rif:args> element, the RDF property *prop* has the IRI "http://www.w3.org/2007/rif#args".
2. If the element has an attribute "ordered" with the value "yes", it is Mode 0; otherwise, it is Mode 1. (As noted, RIF extensions must use required property elements, so Modes 2 and 3 are not available to them.)

Table 2: General *Tr* Mapping Table

Mode	Property Element XML Pattern	RDF Triples added to *Tr* r
0	. . . <*child* ordered="yes"> *item-1* . . . *item-n* </*child*> . . .	**focus_node** *prop* (*id-1* . . . *id-n*) *triples-1* . . . *triples-n* **where:** <*id-1*, *triples-1*> = *Tr*(*item-1*) ... <*id-n*, *triples-n*> = *Tr*(*item-n*)
1	. . . <*child*>*item*</*child*> . . .	**focus_node** *prop id* *triples-n* **where:** <*id*, *triples*> = *Tr*(*item*)
2	. . . <*child*>*item_1*</*child*> . . . <*child*>*item_n*</*child*> . . .	**focus_node** *prop* (*id-1* . . . *id-n*) *triples-1* . . . *triples-n* **where:** <*id-1*, *triples-1*> = *Tr*(*item-1*) ... <*id-n*, *triples-n*> = *Tr*(*item-n*)
3	*As found in <Atom> and <Expr> in BLD (but not Core or PRD):*	**focus_node** rif:namedargs ([rif:argname "*name-1*"; rif:ar

	. . . <slot ordered="yes"> <Name>*name-1*</Name> *value-1* </slot> . . . <slot ordered="yes"> <Name>*name-n*</Name> *value-n* </slot> . . .	. . . [rif:argname "*name-n*"; rif:ar *triples-1* . . . *triples-n* **where:** <*value-id-1*, *triples-1*> = *Tr*(*value* . . . <*value-id-n*, *triples-n*> = *Tr*(*value*
3	*as found in <Frame>:* <slot ordered="yes"> *key-1* *value-1* </slot> . . . <slot ordered="yes"> *key-n* *value-n* </slot>	**focus_node** rif:slots ([rif:slotkey *nk-1*; rif:slotvalue . . . [rif:slotkey *nk-n*; rif:slotvalue *tk-1* . . . *tk-n* *tv-1* . . . *tv-n* **where:** <*nk-1*, *tk-1*> = *Tr*(*key-1*) . . . <*nk-n*, *tk-n*> = *Tr*(*key-n*) <*nv-1*, *tv-1*> = *Tr*(*value-1*) . . . <*nv-n*, *tv-n*> = *Tr*(*value-n*)

This table specifies exceptions to the default rules for determining the value of *prop* and the mode of the property element:

Table 3: Mapping from RIF Parent/Child XML Elements to RDF Properties

Class Element (parent)	Property Element (child)	RDF Property (*prop*)	Mode
Document	directive	rif:directives	2
Group	sentence	rif:parts	2
Forall	declare	rif:univars	2
Exists	declare	rif:exivars	2
And	formula	rif:allTrue	2
Or	formula	rif:anyTrue	2

Frame	slot	rif:slots	3
Atom	slot	rif:namedargs	3
Expr	slot	rif:namedargs	3
Atom	op	rif:predicate	1
Expr	op	rif:function	1

Editor's Note: The names of the RDF properties in the resulting graph (the values of *prop* in Table 3) are still under discussion and may change in the future. This is Issue 102.

6 The Reverse Mapping (Extracting RIF XML)

Because the above mapping function *Tr* is not injective (one-to-one), the inverse mapping is not a function, but provides many outputs for each input. Intuitively, *Tr* loses information, such as the order in which property elements occurred in the RIF XML document, so properly reconstructing a RIF XML document requires additional information.

The reverse mapping function *XTr* is therefore the inverse of *Tr* constrained to only produce schema-valid RIF XML documents:

XTr(*focus-node*, *triples*, *XML-Schema*, *XML-Root-Element*) → *rif-xml-tree*

Editor's Note: Additional details will be provided in future versions of this document. In particular, how perfect will roundtripping be? Exactly what information is lost?

7 Acknowledgements

This document is the product of the Rules Interchange Format (RIF) Working Group (see below) whose members deserve recognition for their time and commitment. The editor extends special thanks to Dave Reynolds and Axel Polleres for their insightful review comments.

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9 Appendix: Complete Example

Here is Example 8 from BLD converted via the RIF-in-RDF mapping to Turtle:

```
@prefix : <http://www.w3.org/2007/rif#> .

<http://www.w3.org/2010/rif-schema/bld/ex8>   :payload <http://sample.org>;
                        :directives ( ).

<http://sample.org>
 :meta  [
   :object  [ :constName "pd" ];
   :slots  (
   [ :slotkey   [ :constIRI "http://purl.org/dc/terms/publisher" ];
   :slotvalue [ :constIRI "http://www.w3.org/" ] ]
   [ :slotkey   [ :constIRI "http://purl.org/dc/terms/date" ];
   :slotvalue [ :constName "2008-04-04"^^<http://www.w3.org/2001/XMLSchema#
 :parts  (
 [
     :formula  [
       :if  [
         :allTrue  (
         [     :args  ( [ :varname "item" ] );
             :predicate  [ :constIRI "http://example.com/concepts#perishabl
         [     :args  ( [ :varname "item" ]
                        [ :varname "deliverydate" ]
                   [ :constIRI "John" ] );
             :predicate  [ :constIRI "http://example.com/concepts#delivered
         [     :args  ( [ :varname "item" ]
                   [ :varname "scheduledate" ] );
             :predicate  [ :constIRI "http://example.com/concepts#scheduled
         [     :left  [ :varname "diffduration" ];
             :right [ :content  [
                 :args  ( [ :varname "deliverydate" ]
                      [ :varname "scheduledate" ] );
                 :function  [ :constIRI "http://www.w3.org/2007/rif-builtin
         [     :left  [ :varname "diffdays" ];
             :right  [ :content  [
                 :args  ( [:varname "diffduration" ] );
                 :function  [
                   :constIRI "http://www.w3.org/2007/rif-builtin-function#d
         [     :content  [
               :args  (
               [
                   :varname "diffdays" ]
               [
```

```
                    :constName 10 ] );
                 :predicate  [
                   :constIRI "http://www.w3.org/2007/rif-builtin-predicate#nu
        :then  [
          :args  ( [ :constIRI "John" ]
                   [ :varname "item" ] );
          :predicate  [ :constIRI "http://example.com/concepts#reject" ] ] ]
    :univars  ( [ :varname "item" ]
          [       :varname "deliverydate" ]
          [ :varname "scheduledate" ]
          [ :varname "diffduration" ]
          [ :varname "diffdays" ] ) ]
[
    :formula  [
      :if  [
        :args  ( [ :varname "item" ] );
        :predicate  [ :constIRI "http://example.com/concepts#unsolicited"
      :then  [ :args  ( [ :constIRI "Fred" ]
               [ :varname "item" ] );
           :predicate  [ :constIRI "http://example.com/concepts#reject" ]
    :univars  ( [ :varname "item" ] ) ] ) .
```

10 Appendix: XSLT Coding of Transformation

Editor's Note: To be provided in a future version. This transform may installed, linked from the RIF namespace for automatic use by GRDDL processors [GRDDL].

11 Appendix: OWL RL Ontology of RIF Syntactic Elements

Editor's Note: An OWL RL ontology of all the RDF properties produced by this mapping, and related classes, will be included here in a future draft. It will also be provided at the namespace address, as linked data.