

A RDF PROPOSAL FOR MODELING RELATIONSHIPS BETWEEN A TELECONFERENCING SYSTEM'S RESOURCES

Sabin-Corneliu Buraga

*Faculty of Computer Science,
"Al.I.Cuza" University of Iași, Romania
Berthelot Str., 16 – 6600 Iași, Romania,
tel: +40 (32) 201529, fax: +40 (32) 201490,
e-mail: busaco@infoiasi.ro*

Abstract: The paper proposes an XML-based model used to represent relationships between resources (users, shared data, rooms, etc.) for an Internet teleconferencing system (in particular an advanced concurrent teleconferencing system available on Linux/UNIX operating system). Such relations are described by *Resource Description Framework* (RDF) constructs. The proposed RDF model can help to define different semantics about the users and their relations with the teleconferencing system.

Keywords: XML, RDF, teleconferencing system, Internet

1. INTRODUCTION

The paper proposes an *Extensible Markup Language* (XML)-based model used to represent various relationships between resources (users, shared data, rooms, etc.) for an Internet teleconferencing system.

Such relations can be described by *Resource Description Framework* (RDF) constructs. RDF is a foundation for processing metadata and provides interoperability between applications that exchange machine-understandable information on the World-Wide Web.

The proposed RDF model can be applied for a particular teleconferencing multimedia system to formulate high-level assertions about various data regarding users and their shared resources, such as objects, Uniform Resource Identifiers (URIs), remote files, etc. To express different RDF constructs about relationships between resources of a teleconferencing system, we choose *GAEN* – an advanced concurrent teleconferencing system, a

freely available Unix-like server (daemon) using the TCP/IP protocol suite.

For representing RDF statements about a range of properties about users and relations between users and GAEN resources it can be used an XML-based language presented in section 3.

The given RDF model can be validated and manipulated by *Simple RDF Parser and Compiler* (*SiRPAC*).

2. RESOURCE DESCRIPTION FRAMEWORK

2.1 General presentation

Resource Description Framework (RDF) is a standardized foundation for processing metadata (Lassila and Swick, 1999). RDF consists in a model for representing named properties and property values. RDF properties may be thought of as attributes of resources and in this sense correspond to conventional attribute-value pairs.

RDF properties also represent associations between resources and a RDF model can therefore resemble an entity-relationship diagram. In object-oriented design terminology, resources correspond to objects and properties correspond to instance variables.

To make possible the definition of metadata, RDF is based on *classes*. A collection of classes, usually designed for a specific purpose or domain, is called a *schema*. Through the sharability of schemas, RDF supports the reusability of metadata definitions. The RDF schemas may themselves be written in RDF.

One of the major goals of RDF is to make it possible to denote semantics for data based on *Extensible Markup Language (XML)* – a platform independent, World-Wide Web Consortium's standardized meta-language (Bray, *et al.*, 2000), subset of *Standard Generalized Markup Language (SGML)* – in a standardized, platform-independent, and object-oriented way.

The basic model of RDF consists of three object types:

- **Resources**

All objects being described by RDF expressions are called *resources* and they are always named by *Uniform Resource Identifiers* (Berners-Lee, *et al.*, 1998), plus optional anchor identifiers. A uniform resource identifier is a generalised uniform resource locator (URL). Using URI schemas (i.e. *http*, *ftp* or *file* schemas), every kind of resource can be identified in a same uniform manner.

- **Properties**

A *property* is a specific aspect, characteristic, attribute, or relation used to describe a resource. Each property has a specific meaning, defines its permitted values, the type of resources it can specify, and its relationship with other properties (via RDF Schema).

- **Statements**

A specific resource together with a named property, plus the value of that property for that resource is an RDF *statement*. These three individual parts of a statement are called, respectively, the *subject*, the *predicate*, and the *object*. The object of a statement (for example, the property value) can be another resource or a literal.

The RDF data model provides an abstract, conceptual framework for defining and using metadata. The concrete RDF syntax is based on XML language.

2.2 RDF Syntax

The Extended Backus-Naur Form (EBNF) notation for RDF constructs takes the following form:

- ```
[1] RDF ::= ['<rdf:RDF>'] descript* ['</rdf:RDF>']
[2] descript ::= '<rdf:Description' idAboutAttr? '>'
 propElt* '</rdf:Description>'
[3] idAboutAttr ::= idAttr | aboutAttr
[4] idAttr ::= 'ID=' Idsymbol ""
[5] aboutAttr ::= 'about=' URI-ref ""
[6] propElt ::= '<' propName '>' value
 '<' propName '>' | '<' propName resAttr '/>'
[7] propName ::= QName
[8] value ::= descript | string
[9] resAttr ::= 'resource=' URI-ref ""
[10] QName ::= [NSprefix ':'] name
[11] URI-ref ::= string
[12] Idsymbol ::= (any XML legal symbol)
[13] name ::= (any XML legal symbol)
[14] NSprefix ::= (any XML namespace prefix)
[15] string ::= (any XML data)
```

## 2.4 RDF Containers

The RDF model defines three types of container objects:

- **Bag**  
(an unordered list of resources or literals);
- **Sequence**  
(an ordered list of resources or literals);
- **Alternative**  
(a list of resources or literals that represent alternatives for the single value of a property).

The EBNF syntax for RDF containers follows:

- ```
[16] contain ::= seq | bag | alt
[17] seq ::= '<rdf:Seq' idAttr? '>'
           member*
           '</rdf:Seq>'
[18] bag ::= '<rdf:Bag' idAttr? '>'
           member*
           '</rdf:Bag>'
```

```
[19] alt ::= '<rdf:Alt' idAttr? '>'
      member*
      '</rdf:Alt>'
```

```
[20] member ::= referItem | inlineItem
```

```
[21] referItem ::= '<rdf:li resourceAttr '>'
```

```
[22] inlineItem ::= '<rdf:li>' value '</rdf:li>'
```

The collections can be used instead of *Description* element, and the new syntactic rules are:

```
[1a] RDF ::= '<rdf:RDF>' obj* '</rdf:RDF>'
```

```
[8a] value ::= obj | string
```

```
[23] obj ::= descript | contain
```

The object being described (indicated by the *about* attribute of *Description* element) is called the *referent*. The RDF model allows defining distributive referents expressed by statements about the members of a container.

The containers may be defined by an URI pattern. RDF can be used for building statements about other RDF statements (higher-order statements), too.

3. USING RDF CONSTRUCTS TO SPECIFY RELATIONS ABOUT A TELECONFERENCING SYSTEM

3.1 GAEN – an advanced teleconferencing system

To express different RDF constructs about relationships between resources of a teleconferencing system, it can be selected *GAEN* (Buraga, 1998) – an advanced concurrent teleconferencing system, a freely available UNIX-like server (*daemon*) using TCP/IP protocol suite.

The most important GAEN services are:

- *Support for real-time and concurrent communications* between a variable number of users, with facilities like private messages, multiple conferencing (private or public) rooms, an user rank (level) system;
- *Electronic mail*: sending and receiving of electronic messages (text only) between the users and talkers via GAEN systems;
- *Remote procedure calls*: a user can call commands which will be executed on the GAEN host machine (a Linux/UNIX server);

- *GAEN network*: multiple GAEN systems can be interconnected respectiv a special protocol based on TCP/IP.

GAEN gives to each user the possibility to execute a set of commands or actions to state common natural human behavior or to move to another room or dimension and so on. A GAEN system has one or more administrators (“superior” users of highest level). Powerful commands guarantee the clever supervision of users.

3.2 An XML-based language used to represent resources of a teleconferencing system

RDF properties also characterize relationships between teleconferencing system’s resources. For representation of RDF statements about a range of properties about users and relations between users and GAEN resources it can be used an XML-based language. This language can model a variety of information about the resources of an Internet teleconferencing system.

The Document Type Definition (DTD) is used to indicate formal rules that the XML document is following for correct parsing and processing purposes.

A DTD fragment of the proposed language is following:

```
<!-- Root element -->
<!DOCTYPE gaen [
  -- Elements list --
  <!ELEMENT gaen (user*,statistics*)>
  <!ELEMENT user (info?,identity*)>
  <!ELEMENT info (level,desc?,host?,
    totallogin?,lastlogin?)>
  <!ELEMENT level (#PCDATA)>
  <!ELEMENT desc (#PCDATA)>
  <!ELEMENT host (#PCDATA)>
  <!ELEMENT totallogin (#PCDATA)>
  <!ELEMENT lastlogin (#PCDATA)>
  <!ELEMENT identity EMPTY>
  <!ELEMENT statistics (total*)>
  <!ELEMENT total EMPTY>
]>

<!-- Attributes list -->
<!ATTLIST gaen
  userlist CDATA #IMPLIED
  date CDATA #IMPLIED
>
```

```

<!ATTLIST user
  name CDATA #REQUIRED
  err_msg CDATA #IMPLIED
>
<!ATTLIST level
  number CDATA #REQUIRED
>
<!ATTLIST total
  for CDATA #IMPLIED
  users CDATA #IMPLIED
>
<!ATTLIST identity
  firstname CDATA #REQUIRED
  lastname CDATA #REQUIRED
  age CDATA #REQUIRED
  email CDATA #REQUIRED
>

```

Also, to formally validate the constructs written in proposed language, it can be used an *XML Schema* (Ceponkus and Hoodbhoj, 1999), a high-level specification of a *Document Type Definition (DTD)* of the XML language. The XML Schema gives a formal specification of a grammar for an XML language by using XML syntax.

Our proposed language is used to particularly model various data about the resources of a GAEN system. The relations between users and other resources (rooms, remote talkers, mail files) can be represented such as RDF statements.

3.3 Examples

To express the statement “*Sabin, Victor, and Stefan are the superior level users of the teleconferencing system which run on delta.ac.tuiasi.ro machine*”, it can be formulated the following RDF construct (each user is denoted by an URI address – a Web homepage or an e-mail account):

```

<?xml version="1.0" ?>

<rdf:RDF
  xmlns:rdf=
    "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:DC="http://purl.org/dc/elements/1.0/"
  xmlns:g=
    "http://www.infoiasi.ro/~busaco/gaen/gaen.xml">
  <rdf:Bag id="UsersOfSuperiorLevel">
    <rdf:li
      resource="http://www.infoiasi.ro/~busaco" />
    <rdf:li
      resource="http://www.ac.tuiasi.ro/~otarhon" />
    <rdf:li
      resource="mailto:skocsis@uaic.ro" />
  </rdf:Bag>
  <rdf:Description
    aboutEach="#UsersOfSuperiorLevel">
    <g:gaen
      g:host="delta.ac.tuiasi.ro"
      g:mainport="7777">
    </g:gaen>
    <g:user />
  </rdf:Description>
</rdf:RDF>

```

```

<rdf:li
  resource="http://www.ac.tuiasi.ro/~otarhon" />
<rdf:li
  resource="mailto:skocsis@uaic.ro" />
</rdf:Bag>

<rdf:Description
  aboutEach="#UsersOfSuperiorLevel">
  <g:gaen g:host="delta.ac.tuiasi.ro"
    g:mainport="7777">
    <g:user>
    <g:info>
      <g:level g:number="7">
        Maximum
      </g:level>
    <g:comment>
      All users that can administrate a
      teleconferencing system
    </g:comment>
    </g:info>
    </g:user>
  </g:gaen>
</rdf:Description>
</rdf:RDF>

```

The RDF tree of the presented examples includes the nodes that represent the elements, attributes, the content and comments (see figure 1).

In this example, the namespace prefix *g* refers to a specific namespace prefix chosen by the author of the RDF expression.

The *rdf* namespace is defined by World-Wide Web Consortium to be specified in every RDF statement.

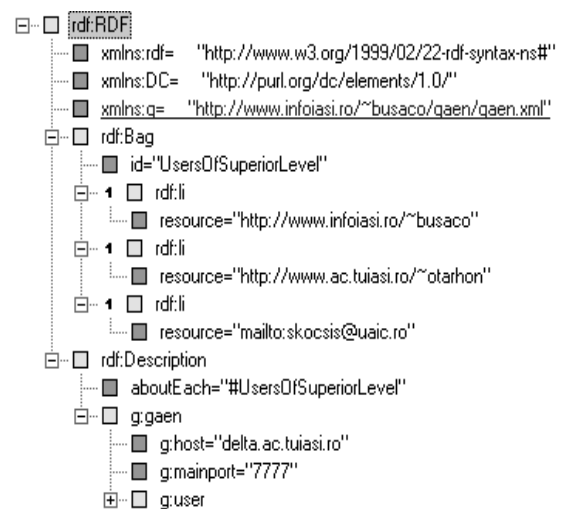


Fig. 1 The tree of the presented RDF example

The *dc* namespace is defined by *Dublin Core Metadata Initiative* (Dublin Core, 2001), which provides 15 types of elements used to describe the content of various World-Wide Web resources.

The XML namespaces are used to avoid parsing conflicts for identical elements or attributes names included in the same XML document (Bray, Hollander, Layman, 1999).

The following example shows a RDF construct that model personal information about a given user:

```
<rdf:RDF>
  <rdf:Description
    about="http://www.infoiasi.ro/~busaco">
    <g:gaen>
      <g:user>
        <g:identity>
          <g:firstname>Sabin</g:firstname>
          <g:lastname>Buraga</g:lastname>
          <g:age>27</g:age>
          <g:email>busaco@infoiasi.ro</g:email>
        </g:identity>
      </g:user>
    </g:gaen>
  </rdf:Description>
</rdf:RDF>
```

In this manner, all users of a teleconferencing system can be stored in a machine-understandable way.

4. IMPLEMENTATION PROPOSAL

The proposed RDF model can be validated and manipulated by *Simple RDF Parser and Compiler (SiRPAC)*, a freely available Java servlet based on Megginson's SAX (Simple API for XML) processor (SiRPAC, 2001).

Our own different implementation, written in Java language, is in progress. This implementation is based on *Document Object Model (DOM)* recommendation of World Wide Web Consortium (Wood, 1998).

5. CONCLUSIONS

The proposed RDF description can be used to formulate high-level assertions about resources of a teleconferencing system in a standardized and platform-independent way, on the World-Wide Web. Different implementations of such as

teleconferencing systems can interchange very easily information about their resources by using RDF constructs.

The RDF model can help to define different semantics about the users and their relations with the system.

Our proposed model needs to be enriched by a formal RDF schema and particular specifications for the actual teleconferencing systems.

REFERENCES

- Berners-Lee, T. *et al.* (1998). *Uniform Resource Identifiers (URI): General Syntax*. Internet Standard, IETF RFC 2396
- Bray, T. *et al.* (2000). *Extensible Markup Language (XML) – version 1.0 (updated)*. W3C Recommendation, Boston: <http://www.w3.org/TR/REC-xml>
- Bray, T., Hollander, D., Layman, A. (1999). *Namespaces in XML*. W3C Recommendation, Boston
- Buraga, S.C. (1998). GAEN – An advanced Concurrent Teleconferencing System. In: *The 6th International Symposium on Automatic Control and Computer Science – SACCS'98 Proceedings* (vol II). Dan Grigoraş (ed.), MATRIX ROM, Bucharest, 171 – 175
- Ceponkus, A., Hoodbhoy, F (1999). *Applied XML*. Wiley Computer Publishing, New York
- Dublin Core Initiative Web site (2001): http://purl.org/metadata/dublin_core
- Lassila, O., Swick, R. (1999). *Resource Description Framework (RDF) Model and Syntax Specification*. W3C Recommendation, Boston: <http://www.w3.org/TR/REC-rdf-syntax/>
- SiRPAC (2001): <http://www.w3.org/RDF/Implementations/SiRPAC>
- Wood, L. (1998). *Document Object Model (DOM) Level 1 Specification*. W3C Recommendation, Boston: <http://www.w3.org/TR/REC-DOM-Level-1>