POWDER and QUATRO Plus:
Integrating the Semantic Web with Social Networking to
Enhance the Access to Online Resources

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Outline

1. Introduction
2. POWDER
3. QUATRO Plus
4. The Quality Social Network
What is a content/quality label

**Definition**  A machine-readable description of the content/characteristics of online resources

**Purpose**  To make an end user able to take decisions on how to use a resource, depending on his/her requirements and/or preferences

**Current applications**  Child protection from possible harmful online content

**Existing standards**  Platform for Internet Content Selection (PICS), released by the W3C in 1996
[Resnick and Miller, 1996]
An Example of PICS Label

(PICS-1.1 "http://www.gcf.org/v2.5"
  by "John_Doe"
  labels on "1994.11.05 T08:15–0500"
  until "1995.12.31 T23:59–0000"
  for "http://w3.org/PICS/Overview.html"
  ratings (density 0 color/hue 1))

How to associate a PICS label with a resource:

- By embedding the label in the source code of an HTML page, using the META tag
- By configuring the web server in order to deliver the PICS label through the PICS–Label HTTP header
So far, resource labelling has not gained success:

- The effort needed to describe resources can be justified only if labels bring real benefits to a content provider.
- Web resources’ content and characteristics may frequently change, it is necessary to update content labels accordingly, to be sure that they actually describe the resources they refer to.
- There exist other alternative solutions (at least, as far as child protection is concerned).
Are Content/Quality Labels Still Useful?

The situation has changed:

- Web metadata are currently seen by content providers as a means to personalise Web access and to assure the quality of online information.
- There currently exist several Web-based social networks (WBSNs) providing their members the ability of specifying and sharing metadata (referred to as tags) concerning online resources.
- Examples of WBSNs supporting collaborative/social tagging:
  - del.icio.us: http://del.icio.us
  - RawSugar: http://rawsugar.com
  - Flickr: http://flickr.com
  - Last.fm: http://last.fm
POWDER and QUATRO Plus build on this new attitude:

- **POWDER** (Protocol for Web Description Resources) is a W3C Working Group, which started its activity on March 2007.

- It aims at the definition of a new generation of general purpose content/quality labels based on Semantic Web technologies, namely, RDF/OWL [Klyne and Carroll, 2004, Bechhofer et al., 2004], referred to as *Description Resources*.

- **QUATRO Plus** is a European project, funded in the framework of the Safer Internet *plus* Programme, which started its activity in October 2007.

- Follow-up of the former EU project QUATRO ("Content Labels for Quality Assurance"), from which POWDER has sprung.

- It aims at developing POWDER-based platform to be used by both labelling authorities and end users for creating, sharing, and distributing labels.
POWDER: http://www.w3.org/2007/powder/

Active W3C members:
- Family Online Safety Institute (FOSI), UK (WG Chair)
- America On Line (AOL.com), USA
- Deutsche Telecom, UK
- National Council for the Scientific Research (NCSR) “Demokritos”, Greece
- Opera Software, Norway
- Università degli Studi dell’Insubria, Italy
- Vodafone, UK

Published specifications:
Description Resource Requirements

- A Description Resource (DR) must be able to describe one or multiple resources.
- A DR must be able to denote any property/characteristics of a set of resources. Therefore:
  - DRs are independent from their possible uses
  - There is no restriction on the vocabularies used to describe a set of resources
- A DR must provide information which can be used to verify the DR’s provenance and, possibly, when it has been published.
- Multiple DRs may apply to the same (set of) resource(s), and the same (set of) resource(s) may refer to multiple DRs.
- It must be possible to modify a DR without the need of modifying the (set of) resources applying to it. This means that DRs must be stored separately from the resources they apply to.
The Structure of a DR

A POWDER DR consists of the following components:

- **Attribution**: It denotes the individual/organisation who created the DR, plus other information, such as the DR’s issue date.

- **Scope**: It denotes the set of resource a DR applies to, in terms of their URIs.

- **Description**: It describes the content/characteristics of the resources denoted by the DR scope.

- **Summary**: An optional component, providing a NL summary of the claims expressed in the DR.

How to associate a DR with a resource:

- By linking the file containing the DR from an HTML page, using the LINK tag.

- By configuring the web server in order to deliver the DR through the Link HTTP header.
An Example of DR

**Attribution**: Alice claims that

**Scope**: the resources hosted by example.org

**Description**: are safe for children
DRs in RDF/OWL

The previous DR can be expressed in RDF/OWL as follows:

- Define the class $S$ of resources hosted by example.org (the DR’s scope)
- Define the class $D$ of resources which are safe for children (the DR’s description)
- State that class $S$ is a subclass of class $D$

But:

- How can we define the class of resources matching a given URI?
- And what about the DR’s attribution?
Grouping Resources by URI

Two alternative ways:
- enumerating the set of resources in the DR’s scope
- use pattern matching

The former solution is feasible only if
- we know in advance the URIs of the corresponding resources
- they are not so many

The latter solution is the most suitable, but RDF does not support pattern matching.
POWDER defines the following semantic extension to RDF:

- a set of RDF properties are defined, in order to denote a set of URIs (not of resources) matching a given pattern
- an RDF property is defined (namely, wdr:hasIRI), which maps a resource to its URI (actually, its IRI)

The RDF/OWL representation of the DR in the previous example is then as follows:

- Define the class $S$ of URIs having a host component ending with string example.org
- Define the class $D$ of resources which are safe for children
- State that the class of resources having one of the URIs in class $S$ is a subclass of class $D$
DR’s Attribution

- The DR’s attribution states who is the DR’s author and when the DR has been issued.
- This means that we need to express statements on statements, which in RDF can be achieved only by using reification [Hayes, 2004], which does not work well with OWL.
- The alternative (and adopted) solution is to use an rdf:Description applying to the whole document.
- Consequences: an RDF/OWL can contain only DRs sharing the same attribution.
An Example of RDF/OWL Representation of a DR

```xml
<?xml version="1.0"?>
<rdf:RDF xmlns:wdr="http://www.w3.org/2007/05/powder#"
    xmlns:foaf="http://xmlns.com/foaf/0.1/
    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
    xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
    xmlns:owl="http://www.w3.org/2002/07/owl#"
    xmlns:dc="http://purl.org/dc/elements/1.1/"
    xmlns:dcterm="http://purl.org/dc/terms/0.1/
    xmlns:ex="http://example.org/vocab#">

    <rdf:Description rdf:about=""/>
    <foaf:maker rdf:resource="http://authority.example.org/foaf.rdf#alice" />
    <dcterm:issued>2007-12-14</dcterm:issued>
</rdf:Description>

<wdr:iriset rdf:nodeID="iriset_1">
    <owl:intersectionOf rdf:parseType="Collection">
        <owl:Restriction>
            <owl:onProperty
                rdf:resource="http://www.w3.org/2007/05/powder#includehosts" />
            <owl:hasValue>example.com</owl:hasValue>
        </owl:Restriction>
    </owl:intersectionOf>
</wdr:iriset>
```

continues in the next slide...
An Example of RDF/OWL Representation of a DR (continued)

```xml
<owl:Class rdf:nodeID="descriptorset_1">
  <owl:intersectionOf rdf:parseType="Collection">
    <owl:Restriction>
      <owl:onProperty rdf:resource="http://example.org/vocab#childsafe" />
      <owl:hasValue>true</owl:hasValue>
    </owl:Restriction>
  </owl:intersectionOf>
</owl:Class>

<owl:Restriction>
  <owl:onProperty rdf:resource="http://www.w3.org/2007/05/powder#hasIRI" />
  <owl:someValuesFrom rdf:nodeID="iriset_1" />
  <rdfs:subClassOf rdf:nodeID="descriptorset_1" />
</owl:Restriction>
</rdf:RDF>
```
Using Reification for DR’s Attribution

```xml
<owl:Restriction>
  <owl:onProperty rdf:resource="http://www.w3.org/2007/05/powder#hasIRI"/>
  <owl:someValuesFrom rdf:nodeID="iriset_1"/>
  <rdfs:subClassOf rdf:ID="dr_1" rdf:nodeID="descriptorset_1"/>
</owl:Restriction>

<rdf:Description rdf:about="#dr_1">
  <foaf:maker rdf:resource="http://authority.example.org/foaf.rdf#alice"/>
  <dcterms:issued>2007-12-14</dcterms:issued>
</rdf:Description>
```

...
Problems & Considerations

- RDF/OWL makes very difficult to represent the semantics of DRs: OWL is both too much and not enough expressive for DRs.
- The RDF/OWL representation of DRs is extremely verbose and error prone.
- There exist Semantic Web technologies which perfectly suits DRs, namely, *rule languages*, such as N3Logic [Berners-Lee et al., 2006] and SWRL (Semantic Web Rule Language) [Horrocks et al., 2004]:
  - The semantics of DR is equivalent to a *if... then* statement (e.g., “if a resource is hosted by example.org, then it is safe for children”)
  - Rule languages implement *if... then* statement is form of Horn-like clauses
- **But:** at the moment there does not exist any *standard* Semantic Web rule language.
N3Logic

Relevant features:

- it makes use of the compact and readable notation provided by N3 (Notation 3)
- *quoted formulae*: thanks to this it is possible to specify statements where the subject and/or the object are RDF graphs (each quoted formula is an RDF graph)
- support for rules
- support for a set of predicates for manipulating and comparing strings and numbers

N3Logic supports negation in the form of *scoped negation as failure*, but it does not support disjunction.

However:

\[(p \land q) \lor (r \land s) \rightarrow t \equiv (p \land q \rightarrow t) \land (r \land s \rightarrow t)\]
Example of DR in N3Logic

```
@prefix wdr: <http://www.w3.org/2007/05/powder> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix dcterms: <http://purl.org/dc/terms/0.1/> .
@prefix ex: <http://example.org/vocab#> .

{ } @forall X .
{ X wdr:hasIRI [wdr:includehosts "example.org"] }
=>
{ X ex:childsaf "true" } .
} dcterms:issued "2007-12-14"

} foaf:maker <http://authority.example.org/foaf.rdf#alice> .
```
Resolution

- The basic representation of POWDER DRs is made by using an XML dialect, enforcing their operational semantics.
- XML DRs can be converted into the corresponding RDF/OWL representation, enforcing their formal semantics, by using transformation rules.
- The W3C GRDDL technology (Gleaning Resource Descriptions from Dialects of Languages) [Connolly, 2007] is used for this purpose, possibly in combination with XSL transform rules [Clark, 1999].
An Example of XML Representation of a DR

```xml
<?xml version="1.0"?>
<powder xmlns="http://www.w3.org/2007/05/powder#"
    xmlns:ex="http://example.org/vocab#">

  <attribution>
    <maker>http://authority.example.org/foaf.rdf#alice</maker>
    <issued>2007-12-14</issued>
  </attribution>

  <dr>
    <iriset>
      <includehosts>example.org</includehosts>
    </iriset>
    <descriptorset>
      <ex:childsafe>true</ex:childsafe>
    </descriptorset>
  </dr>

</powder>
```
QUATRO Plus: http://www.quatroplus.org/

Project partners:

- Labelling authorities:
  - FOSI, UK
  - Web Mèdica Acreditada (WMA), Spain
  - The Internet Quality Agency (IQUA), Spain

- Universities:
  - NCSR “Demokritos”, Greece (Technical Coordinator)
  - Università degli Studi dell’Insubria, Italy
  - Università degli Studi di Milano, Italy

- Industry:
  - MD Partners, UK (Project Manager)
  - CoolWave, UK
  - Software 602, Czech Republic
  - ECP.NL, The Netherlands
The QUATRO Plus Platform

Quality Social Networks

ViQ+
The browser extension

QUAPRO+
The QUATRO+ Proxy

Dacc
Data Access Interface

Labelling Authority Database

Labelling

QUATRO+ Intranet

LADI+
The search engine

602 LAN Suite
What is a Web-based Social Network

- Services which allow Web users to join communities established in order to address given interests or purposes
- Provide an information space where Web users can
  - establish relationships
  - publish and share resources (personal data, blogs, photos, etc.)
- Due to the work we have carried out in this field (see, e.g., [Carminati et al., 2006, Carminati et al., 2007b, Carminati et al., 2007a, Carminati et al., 2008]), in QUATRO Plus we are responsible of the design and implementation of the social networking component of the QUATRO Plus platform, i.e., the *Quality Social Network*
The Quality Social Network (QSN)

- Besides supporting the basic social networking services, it allows its members to specify labels, and to express their dis/agreement about existing labels, by associating ratings with them.
- The collected user-defined labels and ratings are aggregated and statistically analysed in order to assess the trustworthiness of the labels associated with a given (set of) resource(s).
- What is this information used for and by whom?
  - It is made available to the other components of the QUATRO Plus platform, and to their users.
  - It is used to enforce user preferences, thanks to which end users can state which action must be performed by the user agent (in our case, ViQ+) on a given resource, upon detection of labels containing given descriptors and having a given trustworthiness.
Role of the QSN

It addresses some of the issues which have limited the success of resource labelling, by establishing a convergence between ‘official’ and collaborative labelling. More precisely, the QSN aims to:

- increase the number of labelled resources
- give a measure of how much I can trust the claimed content/characteristics of a resource
- make easier the detection of labels which no longer describe the resource(s) they are associated with
Trust Computation

Relevant information:

- number of occurrences of a descriptor in the labels associated with a given (set of) resource(s)
- number of ratings associated with (the labels containing) that descriptor

Possible rating values:

- positive: “I agree”
- negative: “I disagree”
- neutral: “I don’t know”
Global or Local Trust?

- Occurrences of labels and ratings allow the computation of a \textit{global} trust score (what is called \textit{reputation score}), i.e., a trust score computed considering all the QSN members equally trustworthy.

- It might be useful to provide also a \textit{local} trust score, which may vary depending on the QSN member.

- The principle is that I can consider more trustworthy the labels and/or ratings of member $m_1$ than those of member $m_2$.

- This can be achieved by refining trust computation by taking into account the \textit{trust relationship} existing between QSN members.
Trust Relationships

Two different types:

**Explicit** Trust relationships which are established explicitly by QSN members. E.g., Alice may state that she considers Bob to be trustworthy, but that she does not trust Eve.

**Implicit** Trust relationships derived from *trust policies*, denoting the characteristics of the QSN members that I consider to be trustworthy.

Trust relationships can be:

- *binary or scalar*: in the former case, I can just state whether I consider a given user to be trustworthy or not, whereas in the latter I can also specify how much I trust a given user.

- *topical or absolute*: i.e., I can state that I consider trustworthy a given user for specific topics or for any topics.
Trust Algorithm

The algorithm to be adopted depends on the following factors:

- whether the trust score is global or local
- whether trust relationships are binary or scalar
- whether trust relationships are topical or absolute

Possible options:

- EigenTrust [Kamvar et al., 2003], for global trust scores
- TidalTrust [Golbeck, 2005], for local trust scores
- Designing a new algorithm
QSN Architecture

Quality Social Network (QSN) Service

- Registration Module
- Authentication Module
- Label Aggregator
- Labels and Rating Retrieval Module
- User Prefs Evaluation Module

Members Base
Relationship Base
Labels Repository
Ratings Repository
User Preferences Repository

ViQ+

Web Browser

QSN User Interface

SOAP Interface

QUAPRO

POWDER and QUATRO Plus

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The QSN User Interface (QUI)

Issues to be addressed:

- QSN services must be accessed both via a Web interface ((X)HTML) and ViQ+ (XUL) [Goodger et al., 2001]
- Localised versions must be available

Adopted solution: using XML, in combination with XSLT and entity references

- XML-based interface + XSLT(s) = (X)HTML or XUL interface
- XML-based interface + XML entity references = localised versions

Advantages:

- Just one version of the QSN interface
- Language-independent interface
QUI Flow Diagram

Web Browser

ViQ+

(X)HTML

XML

ENT (ca)

ENT (cz)

ENT (el)

ENT (en)

ENT (es)

ENT (it)

ENT (nl)

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POWDER and QUATRO Plus

The Quality Social Network
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W3C Recommendation, W3C.
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PICS: Internet access controls without censorship.