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BDNG: A Dublin Core-Based Architecture for Digital Libraries

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Abstract:

Digital Libraries will be one of the main ways to access structured information through the Internet. Information related to resources or objects is known as metadata. Several metadata models have been proposed; however, the model proposed by the Dublin Core Metadata Initiative (DCMI) [1] has demonstrated great utility in digital libraries. The simplicity and generality of DCMI has facilitated the deployment of digital libraries and their interoperability. This paper proposes DCMI as metadata model in our own Digital Library Architecture (*Biblioteca Digital de Nueva Generación -BDNG*). We have extended DCMI and used some elements of *DC-Library application profile* (DC-Lib) [2] in addition to new elements not previously considered. This paper presents the metadata models for the following applications: digital library of EAFIT University (BDEeafit), integration of digital or referential libraries (BDMetaLib) and digital library for E-Learning systems (BDEI). This paper also describes the general architecture of BDNG.

Keywords:

Digital Library, Dublin Core, DCMI, DC-Lib, RDF, Metadata.

1. Introduction

The metadata models for digital or physical objects (collections) inside libraries have been one of the key aspects for managing and retrieving useful information. The Semantic Web

[3] requires new metadata models in order to organize the information distributed in the Internet. The evolution towards modern digital libraries based on Internet has had two different origins: 1) Traditional Libraries: Systems and models of cataloguing of physical objects as MAchine-Readable Cataloging (MARC) and services as Online Public Access Catalog (OPAC) and Z39.50, which have been more focused on referential metadata ratter than digital content. 2) Digital content as full text databases, digitalization process of physical objects (books, images, video, etc) and native digital content in Internet among others. The first approach has managed the information in a structured way, but has shown little usefulness because when one user finds any resource, his access is physical. The second approach has a lot of digital resources but the main problem is: How can someone find the digital resources? In the Internet case, search engines are currently the only solution to this problem, but, what is the quality of the results? These search engines search based on the syntax approach rather than semantic. The Semantic Web is proposing novel models to solve these issues. The Resource Description Framework (RDF) [4] will be the foundation of Semantic Web. In the digital libraries, a way to manage or classify the digital information is needed; Dublin Core (DC) is a good proposal since it allows assigning metadata for this content. Our proposal of digital library is a combination traditional library, Internet content and digital collections. The *Networks and Distributed Systems Research Group* at EAFIT University [5] is working on research and development of Digital Libraries. Our group has been working for five years now, developing one digital library architecture with several applications built on top of it. This paper is organized as follows: Section 2 shows a brief description of architecture and main applications of BDNG. Section 3 describes the metadata model used in BDNG and their applications. Section 4 shows the implementation issues of BDNG. Section 5 describes related works and Sections 5 and 6 describe the future works and conclusions.

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2. BDNG Architecture

2.1 Digital Libraries

A digital library is a collection of digital objects which is well-organized or structured. This organization is achieved by classifying resources according to a model. This allows managing and retrieving digital information across the Internet. The benefits of digital libraries are increased when they are interconnected in some way. Several architectures of digital libraries and their integration have been proposed. Factors such as lack of standards, many formats of digital content, hard migration to a digital library, many metadata models, and invasive approaches, among others have not allowed their successful application. According to Sanchez, J. [6], digital libraries are virtual spaces of collaboration that provide a way to acquire, share, and generate knowledge. Digital libraries are more than digital collections; they require interfaces and services to manage, search, and retrieve information for users. This architecture for design and implementation of a modular digital library is open and based on standards that incorporate a solid base of components like: widely accepted metadata models (DCMI, RDF), which are used for referential information (catalogue) and digital objects; open protocols like Open Archives Initiative - Protocol for Metadata Harvesting (OAI-PMH) [7] and Web Services for non-intrusive integration or federation, and open software, which will ease its deployment.

2.2 Requirements

BDNG has been designed and implemented according to the following premises and requirements:

- Loading information from any legacy *Librarian Information System* (LIS) or *Digital Library* (DL) in a non-intrusive way.
- A metadata model standard, open, and widely used.
- Supporting any type of digital content: traditional (texts, documents, books) and non-traditional or multimedia (video, audio, virtual reality).
- Integrating or federating referential catalogues and/or digital content based on sources such as: DL with our architecture, DL with other architectures, and LIS.
- Proposing a digital library framework in order to build other applications.

2.3 Architecture

All digital library architectures must consider

Figure 1: BDNG project.

important elements like referential catalogues management, digital content management, search and information retrieval for users, and mechanisms of integration with other digital libraries. Figure 1 shows all of the components of the BDNG project.

The following components have been proposed for BDNG, and Figure 2 shows a general overview of the digital library architecture:

- Catalogue Upload (DL:Upload)
- Search and Retrieval (DL:Search)
- Addition of digital content to catalogue (DL:AddContent)
- Creation of record and digital content (DL:CreateContent).
- Integration (DL:Metalib)
- Management (DL:Mgmnt)

2.3.1 Upload of Referential Catalogue

Normally, a LIS manages a referential catalogue of physical objects stored in a library. A LIS implements functions such as classification and indexation based on a standard like MARC, and

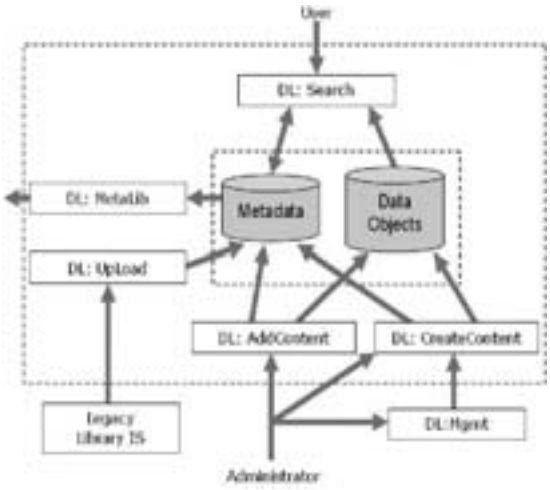

Figure 2: Overview the Digital Library Architecture.

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provides services to its users, such as loan, search (console, OPAC, Web), user management, etc. BDNG allows loading any catalogue from any LIS. We access the database directly and extract the catalogue in text format using a given convention. This process is executed periodically in a batch mode. This module standardizes information from any referential catalogue using our metadata model which is based on DCMI and RDF and implemented in XML (Extensible Mark-up Language). This metadata is stored in XML files, which are loaded to a native XML database. The search module works based on this database.

2.3.2 Addition of Digital Content to BDNG

The previous module only loads the catalogue, but it does not have any digital content; it only has metadata about physical objects. Addition of digital content module allows the association of digital content (based on text and multimedia) (DL:AddContent).Using this module, the user searches and retrieves records from the catalogue, selects one, and retrieves the current digital content (if available). Then, the user can make additions, modifications, or deletions to the digital content. BDEafit has two sources of digital content: 1) digitalization of physical objects (theses, books, magazines, technical reports, videos, etc); 2) native digital documents (doc, html, pdf, mpeg, etc.). Digital objects are stored in two types of servers: a web server for storing traditional data such as texts, books, magazines, technical reports, etc. and a multimedia server for storing non -traditional data such as video, audio, virtual reality, etc. BDNG allows associating metadata to digital content, and storing this metadata in the native XML database. The search and retrieval module only works on the metadata database, but not within the digital content itself.

2.3.3 New Objects in BDNG

This module allows creating of referential content as well as digital content. New metadata and digital content can be created with this module. It loads data in the metadata database and the data servers. First of all, the user creates general metadata information about the digital content, then creates metadata about the digital object, and finally loads the digital object.

2.3.4 Meta-Library

A Meta-Library [8] [9] [10] integrates several digital libraries or LIS to form a big digital library. These DL or LIS can be homogenous or heterogeneous. A Meta-Library allows access to all of the content in a transparent way. It has been very difficult to make effective projects of integration of libraries. This fact is due to several factors: a lack of standards and protocols, different standards of indexing and classification, low levels of integration (databases), etc. Our approach to integration or federation of several digital libraries is: 1) heterogeneous digital libraries, 2) non -intrusive approach. We use harvesting and online access while each digital library keeps its content. The user searches through the whole metadata repository which is located in one set of metadata servers, but when the desired digital content is found, the user can bring digital the content directly via an URL. When a meta-library uses the harvesting approach, it has several ways to obtain metadata information from each DL/LIS: 1) a remote DL sends metadata in plain text files via e-mail or FTP, 2) a remote DL sends metadata in XML files according to DC via e-mail or FTP, 3) a Meta-Library brings metadata (plain text or XML) via HTTP or OAI-PMH protocol. When a meta-library uses the online approach, it uses Web Services for accessing to remote sites.

3. Metadata Model in BDEafit

3.1 Metadata: an introduction.

Metadata is information that describes digital objects in a digital library. This information is used for managing, searching and retrieving these objects [11]. A metadata record consists of a set of attributes or elements that describes a resource (physical or digital). Even though there are several metadata models, Dublin Core [12] and Resource Description Framework are being widely used for the Semantic Web and Digital Libraries fields. DCMI was created by *American Librarians Association Initiative* for the project *On Line Computer Library Center* (OCLC) developed to describe a wide spectrum of resources. The simplest proposal of DCMI is known as *Simple DCMI* which is formed by 15 elements. DCMI can be codified in HTML, XML, and RDF/XML. DCMI has a more detailed semantic specification which uses qualifiers (*Qualified DCMI*) [15] in order to improve the search and retrieval of resources.

3.2 Metadata Description in BDNG

The metadata model used in BDNG is based on DCMI and RDF for referential catalogue as well as digital content. Metadata is encoded and stored in XML. BDNG uses a native XML database for storing and processing metadata. DCMI was extended to support some properties used by our digital library. These extensions were incorporated because:

1. Improving the time search and information

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retrieval through the system. We add attributes to some DC elements (creator and subject).

2. Adding the attribute *type* to identifier element. This attribute stores the identifier type for resource. We use a controlled vocabulary.

3. Adding elements to store information related with the digital library field. LIS, integration of digital libraries, and e-learning digital libraries requires additional information. Although DC-Lib has elements for this field, new elements were included. From a developer's point of view, a digital library has to define how to store metadata in order to provide its services (search and retrieval) [16]. Metadata storage can be done according to the following approaches:

1. Using DC encoded in XML for the input and output subsystems, but the storage and processing of metadata is done with conventional relational database systems (oracle, mysql, postgress, etc).

2. Using DC metadata in all stages: input, output, storage, and processing (we use a native XML database like eXist, tamino, etc) [21]. Our digital library uses the second approach, metadata is stored in a native XML database, the open source product called eXist is used [14] [17], while digital objects are stored on a web or multimedia server. This fact brings advantages as follows:

- Query languages for XML such as XPath or XQuery work better in non-structured information.
- Easy integration of digital libraries because

metadata is encoded in XML according to DC.

Simple DCMI	Description
title	Title or object name
creator	author(s) of the object
subject	Keywords or thesaurus (thesaurus's controlled vocabulary)
date	Date of work
language	Language of work (controlled vocabulary)
description	Abstract or overview of work
identifier	Id of work (ISBN, ISSN or Dewey system classification)
publisher	Editorial
coverage	Location inside the library
type	Type of collection (controlled vocabulary)
format, source, relation, contributor, and rights	- not used -

Table 1: DCMI used in the first phase.

For instance the OAI-PMH protocol. We have implemented three applications related with digital libraries: 1) digital library for EAFIT University (BDEafit). 2) integration of digital libraries based on BDNG (BDMetaLib), and 3) E-Learning digital library (BDEI).

3.2.1 Digital Library for EAFIT University (BDEafit)

BDEafit uses *simple DCMI* with some extensions. Metadata is encoded in RDF/XML. Because BDEafit manages information from different sources (LIS, digital content, integration, etc), the metadata model includes extensions. Digital library has been developed in an incremental fashion related to services and content as well as metadata. BDNG has been developed according to following phases:

BDEafit phase 1

We started with a traditional library (a LIS called SINBAD at our University) which has only physical objects and a simple proprietary catalogue system. SINBAD provides basic services such as online searching through catalogue. The goal of this first phase (2002) was to represent physical objects in DC metadata. This phase did not involve digital information, for this reason we only used a subset of DC metadata and added other elements that were not considered in DC but widely used inside our LIS. Table 1 shows metadata model for phase 1.

Modifications of simple DCMI	
identifier	We added the attribute type that associates the type of identifier used; we used a controlled vocabulary (isbn, issn, dewey).
creator	We added the attribute **id** that associates an identifier code assigned to each creator. This **id** is created dynamically, but it must be unique inside the digital library.
subject	We added the attribute **id** that associates an identifier code assigned to each subject. This **id** is created dynamically from our thesaurus system and it must be unique inside the digital library.
Additional common elements	
Library	Name of Library, institution or system
id	Unique identifier for metadata record.
Magazine collection	
magazine	Name of Magazine
volume	Volume of magazine
number	Number of magazine
year	Year of publication

Table 2: simple DCMI modified

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Controlled vocabulary for type element:

BDEafit phase 1 has extended DC (modifying *Simple DCMI*, added elements from DC-Lib and new elements) as shown in Table 2:

The second phase of BDEafit (2004) adds digital content to digital library. This digital content comes from:

1. Digitalization process.
2. Native digital content.
3. Digital content already produced from thesis, projects, technical reports, papers, etc. The following considerations were applied for the design of the metadata model:

- Creation of two different metadata databases. One for catalogue and another for digital content. Both databases should be related by a unique id.
- Supporting 1 to n relationships, in other words, the model designed for digital content in BDNG allows the association of several digital objects to one referential metadata

1 relationships. Although we could use the element relation to establishment 1 to n relationships in other contexts of use. Therefore, the metadata model was completed with the elements for the referential part and content as it is described in Table 3.

Additional common elements for all collections	
Uri	*Network address where the digital content is located. This URI can point to digital object itself or can point to metadata document about digital content (relation 1 to n).*
Magazines	
idpaper	*Paper identifier inside a magazine. BDNG adopted an unique consecutive by each magazine, volume, number and year.*

Table 3: Additional elements

We use a subset of elements proposed under DC-Lib application profile which are:

alternative	*bibliographicCitation*
abstract	*audience*
extent	*edition*
medium	*location*
tableOfContents	

The element set proposed as metadata model and the Document Type Definition (DTD) for digital content are shown in Table 4 and 5.

Metadata elements to digital content	
id	*Record identifier*
content	*Element that groups content*
description	*Description about digital content*
file	*File of digital content*
format	*Format of digital content*
type	*Type of document for a complete resource. Controlled vocabulary (cover, toc, chapter, references, fulltext, abstract)*

Table 4: Metadata elements for digital content

```
<?xml version="1.0" encoding="UTF-8"?>
<!—other definitions -->
<!ELEMENT rdf:Description (bde:id,
bde:content+)>
<!ELEMENT bde:content (dc:description, dc:type,
dc:format, bde:file)>
<!ELEMENT bde:id (#PCDATA)>
<!ELEMENT dc:description (#PCDATA)>
<!ELEMENT dc:type (#PCDATA)>
<!ELEMENT dc:format (#PCDATA)>
<!ELEMENT bde:file (#PCDATA)>
```

Table 4: Metadata elements for digital content

The examples in tables 6 and 7 show one record of metadata for referential object and a record metadata for digital content associated:

```
<?xml version="1.0" encoding="UTF-8"?>
<rdf:RDF> <rdf:Description>
<bde:id>1233323</bde:id>
<dc:title>Cien Años de Soledad</dc:title>
<dc:creator id="G103">Gabriel García Marquez
</dc:creator>
<dc:subject                    id="N201">Novela
Colombiana</dc:subject>
<dc:identifier
type="isbn">1233323</dc:identifier>
<bde:library>BDEafitE</bde:library>
<bde:url>
http://bdigital.eafit.edu.co/bdeafit/book/1233323/i
ndex.xml
</bde:url>
...
```

Table 6: Example of referential record

The examples in tables 6 and 7 show how one referential resource can have *n* digital resources associated with it. It is implemented through block *<bde:content> …… </bde:content>* which are not included in the referential document.

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```
<?xml version="1.0" encoding="UTF-8"?>
<rdf:RDF> <rdf:Description>
<bde:id>1233323</bde:id>
<bde:content>
<dc:type>cover</dc:type>
<dc:description>Portada del libro</description>
<dc:format>image/gif</format>
<bde:file>book/1233323/cover.gif</bde:file>
</bde:content>
<bde:content>
<dc:type>chapter</dc:type>
<dc:description>Capitulo 1: Introducción
</description>
<dc:format>application/pdf</format>
<bde:file>book/1233323/chapter1.pdf</bde:file>
</bde:content>
<bde:content>
<dc:type>chapter</dc:type>
<dc:description>Capitulo 2: Desarrollo de la
obra</description>
<dc:format>application/pdf</format>
<bde:file>book/1233323/chapter2.pdf</bde:file>
</bde:content>
<!-- otro contenido adicional -->
</rdf:Description></rdf:RDF>
```

Table 6: Example of referential record

Table 8 shows a subset of DTD for referential resources in BDNG.

3.2.2 Integration of Digital Libraries using BDNG

One of the problems in the integration of catalogues and digital libraries is the few real results that can be obtained but it can not be undervalued the importance of this integration in digital libraries. Some of the factors that have not allowed an effective integration of digital and/or referential libraries are: 1) the lack of standards in this field, 2) the invasive or intrusive approach, 3) many proposals for metadata, 4) the Information Technology (IT) platform, and 5) the lack of protocols. Today, the integration of digital libraries is feasible due to: 1) the advent of the Internet, 2) metadata models such as DCMI, 3) protocols such as OAI-PMH, Z39.50, and Web Services, and 4) free software.

We use BDNG as a digital library platform for EI. The first step was to define a metadata model for EI based on DCMI. Several elements were added to represent information related with the e-learning systems. Table 9 shows the DTD for this metadata model. The second step was to implement BDNG for EI and the last step was to integrate BDEI with our main digital library BDEafit. Currently, BDEI is working fine and its content can be accessed from two different interfaces: EI or BDEafit. We can search and retrieve digital resources in BDEafit using only DCMI

```
<?xml version="1.0" encoding="UTF-8"?>
<! Entity definitions for rdfnsdecl, dcnsdecl,
bdensdecl -->
<!ELEMENT rdf:RDF (rdf:Description+)>
<!ATTLIST rdf:RDF %rdfnsdecl; %dcnsdecl;
%bdensdecl; >
<!ENTITY % dcmes "dc:title | dc:creator |
dc:subject | dc:description | dc:publisher |
dc:contributor | dc:date | dc:type | dc:format |
dc:identifier | dc:source | dc:language | dc:relation
| dc:coverage | dc:rights" >
<!ENTITY % bdemes "bde:library | bde:id |
bde:topografico | bde:volumenes | bde:number |
bde:cd | bde:year | bde:magazine | bde:idarticulo"
>
<!ELEMENT rdf:Description (%dcmes; |
%bdemes;)* >
<!—Dublin Core elements -->
<!ELEMENT dc:creator (#PCDATA)>
<!ATTLIST dc:creator id CDATA #REQUIRED>
<!ELEMENT dc:subject (#PCDATA)>
<!ATTLIST dc:subject id CDATA #REQUIRED>
<!ELEMENT dc:identifier (#PCDATA)>
<!ATTLIST dc:identifier
      type (topo | isbn | issn | urn) #IMPLIED>
<!—similar definitions for otherDC elements -->
<!—bde elements -->
<!ELEMENT bde:cd (#PCDATA)>
<!ELEMENT bde:id (#PCDATA)>
<!ELEMENT bde:idarticulo (#PCDATA)>
<!ELEMENT bde:library (#PCDATA)>
<!ELEMENT bde:magazine (#PCDATA)>
<!ELEMENT bde:number (#PCDATA)>
<!ELEMENT bde:topografico (#PCDATA)>
<!ELEMENT bde:volumenes (#PCDATA)>
<!ELEMENT bde:year (#PCDATA)>
```

Table 6: Example of referential record

elements and in EI using all elements of the metadata model for the e-learning system.

4. Implementation of metadata in BDEAFIT

The previous numerals show the BDNG architecture and metadata model for the different applications which are based on simple DCMI, a subset of DC-Lib and new elements. Currently, three projects have been implemented on top of this architecture:

1. Digital library of EAFIT University (BDEafit). The query interface is shown in Figure 3.
2. Digital library for our E-Learning system: Eafit Interactiva (BDEI)
3. Two integrations of digital libraries. The first one integrates BDEafit with BDEI and the other one integrates several digital and referential libraries from different institutions forming a Regional Digital Library.

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```
<?xml version="1.0" encoding="UTF-8"?>
<! Entity definitions for rdfnsdecl, dcnsdecl,
bdensdecl -->
<!ELEMENT rdf:RDF (rdf:Description+)>
<!ATTLIST rdf:RDF %rdfnsdecl; %dcnsdecl;
%bdensdecl; %eimsdecl;>

<!ENTITY % dcmes "dc:title | dc:creator |
dc:subject | dc:description | dc:publisher |
dc:contributor | dc:date | dc:type | dc:format |
dc:identifier | dc:source | dc:language | dc:relation
| dc:coverage | dc:rights" >
<!—DC Elements  defined according to table 9 -->
<!ENTITY % bdemes "bde:library | bde:id |
bde:year" >
<!—Elements of "bde" defined according to table 1
-->
<!ENTITY % eimes "ei:course | ei:idcourse |
ei:module | ei:group | ei:semester | ei:instructor |
ei:emailinstructor" >
<!ELEMENT rdf:Description (%dcmes; |
%bdemes; | %eimes)* >
<!ELEMENT ei:course (#PCDATA)>
<!ELEMENT ei:idcourse (#PCDATA)>
<!ELEMENT ei:module (#PCDATA)>
<!ELEMENT ei:group (#PCDATA)>
<!ELEMENT ei:semester (#PCDATA)>
<!ELEMENT ei:instructor (#PCDATA)>
<!ELEMENT ei:emailinstructor (#PCDATA)>
```

Table 9: DTD for BDEI

Integration of digital libraries can be achieved by two approaches: integration using harvesting protocols like OAI-PMH and integration using online access such as Web Services, a variant of OAI-PMH [7] or a Z39.50 gateway. BDMetaLib has implemented OAI-PMH, a variant of OAI-PMH and web services. In order to allow an easy integration of digital/referential libraries, we have adopted simple DCMI with the addition of one element (*bde:library*).

Figure 3: BDEAFIT Implementation.

3.2.3 Digital Library for E-Learning system (BDEI)

EAFIT University has an E-Learning platform called *EAFIT Interativa* (EI). EI does not have a service for search and retrieval of digital information, in other words, EI does not have a digital library. EI is a simple e-learning or LMS. It does not have any metadata model (like Learning Object Metadata – LOM or Shareable Content Object Reference Model – SCORM).

These projects have been implemented in Java platform using a native XML database called *eXist* as metadata repository. BDNG uses either Apache or IIS web servers for traditional digital content and multimedia servers (Windows Media servers/Real Networks) for storing video and audio content.

5. Related works

The Nordic Metadata project (NMP): it supports cataloguing, indexing and retrieval of digital documents. NMP has as goal the design of a shared environment in the creation and use of the metadata for the digital documents included in the digital library [18]. It confirms the importance of the participation of libraries in the process of cataloguing resources (named metadata). They evaluate several formats as the MARC [13] format. It is catalogued as a complex and interesting project in Scandinavia. The BDN project [19] describes the architecture and the infrastructure components in the building of the National Digital Library (Biblioteca Digital Nacional) in Portugal. The general bibliographical metadata format in this project is UNIMARC and the structural metadata is METS. The URNA identifiers are treated and solved as simple identifiers very effectively by REVES. The storage for immediate access is provided by the LUSTRE file system and ARCO which are architectures developed on Linux servers [19]. BDBComp Project [20] allows the Department of Education in Brazil to store and manage more than 400 dissertations of graduated students in computer science. There are 29 Computer Engineering or Computer-related programs in the country presenting an increasing number of dissertations every year together with articles (papers) published in international and local conferences. BDBComp is based on several standards (OAI, DC, and SQL) as well as on new technologies in Web environment.

6. Future works

BDNG has not incorporated *Qualified DCMI* profile. DC-Library application profile has been partially implemented. BDNG does not have content-depend metadata. We plan to work on the construction

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of digital libraries for E-Learning systems (recently named LMS) to support learning objects which use metadata models based on The Sharable Content Object Reference Model (SCORM) and IEEE LTSC Learning Object Metadata (LOM). The current LMS of the University does not use any of the described models. It would be important to explore real alternatives of integration between the BDEAFIT architecture and the LMS mentioned above.

7. Conclusions

This paper describes a proposed metadata model for the BDNG architecture. Based on simple DCMI, the proposal includes extensions, recommends a subset of elements in DC-Lib and adds another proprietary set that has not been considered neither in DCMI nor in DC-Lib. The integration of digital libraries has been adopted the Simple DCMI with one additional element (either bde:library or dcterms:location taken of DC-Lib). This architecture has been implemented at EAFIT University as a digital library platform. It has been adopted by other universities for building their own digital library. Currently, we are implementing the meta-digital library in the state of Antioquia in a project involving over 15 universities as we show in this link: http://www.metabd.org. The implementation of the digital library and its services has represented a great challenge. The main objectives are: satisfying and exceeding the expectations of the users and allowing students and researchers to identify new material while increasing their productiveness. The progress of this research will allow the creation of support tools for the accomplishment of the quality goals and educational equity that our University promotes. It will also introduce changes in the strategies of resources usage. It will also allow an increase in the number of potential users by widening the offer of the services through the digital library.

References

1. Dublin Core Metadata Initiative Overview. Metadata Associated and OCLC Research (DCMI). http://www.dublincore.net.
2. The DC-Lib application profile current version. Schema and Documentation. 2004. http://dublincore.org/documents/2002/09/24 /library-application-profile/
3. E. Méndez. Metadatos y recuperación de información: Estándares, problemas y aplicabilidad en bibliotecas digitales. Ediciones Trea, 2002. 429 p. Mención de serie Biblioteconomia y administración cultural no. 66. ISBN: 84-9704-055-4.
4. WWW Consortium, Resource Description Framework (RDF), http://www.w3.org/RDF.
5. Networks and Distributed Systems Research Group. http://dis.eafit.edu.co/grupos/girsd
6. A. Sánchez. Title. U-DL-A: Bibliotecas Digitales en la UDLA. Digital Universitaria magazine. July 10, 2004, Vol. 5, Not. 6. ISSN: 1607-6079. http://www.revista.unam.mx/vol.5/num6/art 33/art33.htm.
7. C. Lagoze and H. Sompel. Library The Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). Version 2.0 of 2002/06/14, Cornell University -Computer Science and Los Alamos National Laboratory - Research http://www.openarchives.org/OAI/openarch ivesprotocol.html.
8. Marcos, R. K. F., Fox, E. A. MARIAN: Flex Interoperability for Federated Digital Libraries. Lecture Notes in Computer Science Volume, 2163:0173.
9. X. Liu, et al. Arc -An OAI Digital Service Provider for Library Federation, D-Lib magazine, April 2001, Vol. 7, Num. 4
10. A. Chandler, Digital Library Federation (DLF) Electronic Resource Management Initiative, D-Lib magazine. 2003, Vol. 9, Num. 1.
11. Anoop Kumar, Ranjani Saigal, Robert Chavez, Nikolai Schwertner. "Architecting an Extensible Digital Repository," jcdl, Vol. 00, No 00, pp. 2-10, Digital 2004, ISBN:1-58113-832-6.
12. S. Kokkelink and R. Schwanzl. Osnabruck University. April 14, 2002. http://dublincore.org/documents/2002/04/ 14/dcq-rdf-xml/.
13. Mid-America Regional Council, -MARC. Kansas City, Missouri, USA. 2005. http://www.marc.org/aboutmarc.htm.
14. S. Kimbro. XML: DB Initiative Points the Way. SD Steal, July 1, 2001. http://www.sdtimes.com/news/033/special2. htm
15. D. Hillmann. Using Dublin Core -DCMI Recommended Resource. 2003. http://dublincore.org/documents/2003/08/26 /usageguide/
16. M. Fernandez, et al. DelfosnetX: A Workbench for XML-Based Information Retrieval Systems. Seventh International Symposium on String Processing and Information Retrieval. SPIRE 2000. IEEE Computer Society. Los Alamitos, CA. September. ISBN 0-7695-0746-8, pp. 87-85. http://csdl.computer.org/comp/proceedings/ spire/2000/0746/00/0746toc.htm
17. W. Meier. eXist: An Open Source Native XML Database. Web, Web-Services, and Database Systems. Erfurt, Germany, October 2002.

https://doi.org/10.23106/dcmi.952108024

Springer LNCS Series, 2593. Darmstadt University of Technology. http://exist-db.org/webdb.pdf.

18. J. Hakala. The Nordic Metadata projects Helsinki (Finsko). Helsinki University / TKAY, last updated 21 February 2000. http://www.lib.helsinki.fi/meta/projplan.html
19. J. Borbinha, et al. BND: The Architecture of to National Digital Library. ISBN 1-58113-832-6, JCDL 2004, Tucson, AZ, USA. http://portal.acm.org/citation.cfm?Doid=996350.996356.
20. Alberto H. F. Laender, Marcos André Gonçalves, Pablo A. Roberto. BDBComp: Building a Digital Library for the Brazilian Computer Science Community (JCDL' 04), ISBN 1-58113-832-6/04. http: // csdl.computer.org/comp/proceedings/jcdl/2004/2493/00/2493023.pdf
21. A. Chaudri, et al. XML Data Management: Native XML and XML-Enabled Database Systems. ISBN: 0-201-84452-4. Ed. Addison Wesley Professional, March, 2003.

https://doi.org/10.23106/dcmi.952108024