

# The Indonesian Digital Library Network Infrastructure and Architecture

Ismail Fahmi<sup>1</sup>

<sup>1</sup> Knowledge Management Research Group, Institut Teknologi Bandung,  
Jalan Ganesha 10 Bandung, 40132, Indonesia  
{Ismail@itb.ac.id}

**Abstract.** The Indonesian Digital Library Network (IndonesiaDLN, <http://gdlhub.indonesiadln.org>) is the first digital library network in Indonesia. It was launched on June 2001 with a mission to connect the Indonesian people knowledge. Its growth is considered to be very fast. Only in a year, starting by a small network of 5 academic institutions lead by Institut Teknologi Bandung, now it has more than 30 diverse institutions that actively join the network, and about 80 digital library nodes were registered. This success was driven by its distributed architecture and by its software distribution license, The Ganesha Digital Library (GDL, <http://gdl.itb.ac.id>), as open-sources software. This paper describes infrastructure and architecture of IndonesiaDLN that uses the Open Archive Initiatives (OAI) protocol, which is extended with a capability to overcome the internet bandwidth limitation in most developing countries.

## 1 Introduction

Imagine of developing digital library network in a developing country, where most institutions are using dial-up access and often undergo the unreliable connection. It is very contrast with digital library network in the developed countries, which are fully equipped by broadband Internet connection. This is the condition the author must face when designed a digital library network for Indonesia, in 1999.

With a grant from the International Development Research Centre (IDRC) and Yayasan Litbang Telekomunikasi dan Informatika (YLTI) Indonesia, the software, network, and the community was established. The network was designed to integrate several types of node, namely institution, internet kiosk, and personal. Although server is located behind a proxy or connected using dial-up connection, the network is still functional.

IndonesiaDLN is not only consisting of academic institutions, but also receives nodes from NGO, business, government, and so on. The contents shared within the network would consists of theses, dissertations, research report, gray literatures, journal, papers, clipping, etc from health, environments, education, human rights, and so on. In the future, each community that is indicated by the same needs and contents will develop a sub-network under IndonesiaDLN. Thus, IndonesiaDLN will become a Network of Networks. We are in progress of developing network of children education, heritage, environment, health, ETD (electronic theses and dissertation), and human rights.

There are two key components required to build the network: the metadata standard and the communication protocol. How the information is represented and how it delivered through the network are two questions that arises at the first time.

## 2 Metadata Standard

Selecting and developing a metadata standard for this network is the easiest part of the job. It is because of the existence of the well-developed and maintained Dublin Core metadata element sets. We found that most of our collections can be represented by the Dublin Core metadata element sets. The flexibility to add specific qualifiers or sub-elements is also a great benefit of using the sets. For our electronic theses and dissertations collections, we modify the NDLTD (Network of Digital Library for Theses and Dissertation) metadata standards.

### 3 Communication Protocol

In 1999, OAI protocol is not well established yet. Then author develops server-to-server communication protocol to exchange the metadata. Nowadays IndonesiaDLN is being modified to use the OAI protocol. This protocol only permits *metadata harvesting* of the two classes of participants:

?? *Data Providers* administer systems that support the OAI protocol as a means of exposing metadata about the content in their systems;

?? *Service Providers* issue OAI protocol requests to the systems of data providers and use the returned metadata as a basis for building value-added services.

There are 6 OAI service requests that can be applied to a repository through HTTP request. The responses will be encapsulated using XML format. The following are the basic service requests: *GetRecord*, *Identify*, *ListIdentifiers*, *ListMetadataFormats*, *ListRecords*, *ListSets*.

In addition to the implementation of OAI protocol at IndonesiaDLN, we define new service requests namely: *Connect*, *Disconnect*, *PutRecord*, *PutListRecords*, *PutFileFragment*, and *MergeFileFragments*. These service requests are required, because requests and accesses only allowed for the registered institutions and users. Using this *metadata posting* mechanism, a digital library node with dial-up or located behind proxy will be able to share their metadata although is not always available on the internet. Its collections will be stored in the hub server and disseminated to the whole network nodes.

Repository registration is done at the hub or center Service Provider (<http://gdlhub.indonesialdn.org>), and each repository has its PUBLISHER\_ID using national library code standard. Before sending any service requests, a Data Provider should be successfully connected to the central Service Provider using *Connect* service request. This request contains keyword argument containing PUBLISHER\_ID and its serial number. Information about the repositories (Data Provider) except the serial number will be disseminated from the central Service Provider to the Data Providers for name resolution purposes. The repositories information request is sent by the Data Providers using *ListRecords* service request to the central Service Provider.

Users have to complete a free registration form in order to get full access to the repositories, including search, explore/browse, upload, and download. Registration can be done at any Data Provider once. In order to they can use the same account to access repositories other than the one they do registration, the users information should be registered to the central Service Provider by the Data Providers using *PutRecord* or *PutListRecords* service requests. We also use the service requests to post local metadata collections to the central Service Provider.

When user log into other repositories, a user authentication service request will be sent to the central Service Provider and a response will be returned whether information entered by user is true or false. This request is made using *GetRecord* service request.

Because some Data Providers are connected to internet temporarily (for example using dial-up connection) or even located behind proxy, we need to store the files from such temporary-available Data Providers to the central Service Provider. The file transfer can be done using the two defined service requests, *PutFileFragment* and *MergeFileFragments*. *PutFileFragment* uses HTTP POST method and is used to upload a part of file that has been sliced into several small size fragments (e.g. 10 KB each). This service of course also support upload resume mechanism. After all fragments of a file have been uploaded, a *MergeFileFragments* service request will be sent to central Service Provider to merge the fragments into one file as originally stored at the temporary-available Data Provider. Using this service request, a dial-up connected Data Provider will be able to send as big as file size to the central Service Provider.

We also put the functionality of the Service Provider to the Data Providers. Using this scenario, every Data Providers can harvest or download the merged metadata records at the central Service Providers, and store them locally. Then, the Data Provider become a Service Provider for its local users.

### 4 Conclusion

Using the extended OAI protocol, we able to integrate digital libraries into a network where the internet bandwidth and connection is very limited like in the most developing countries. The GDL software is open-source and free. This distribution license has proved to increase the number of nodes joined the network.