BULLETIN

The INDONESIA
    Digital Library Network
                Struggles with the
                        Digital Divide

SIG/111 International Paper Competition: Information in a Networked World

Winning Papers from the SIG/111 2001 Competition

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The Indonesian Digital Library Network Is Born to Struggle with the Digital Divide

by Ismail Fahmi

Ismail Fahmi, whose interests are in network management, knowledge management and digital libraries, is a researcher at the Computer Network Research Group ITB (CNRG), the Asian Internet Interconnection Initiath-es ITB (A13), head and founder of the Knowledge Management Research Group ITB (KMRG). general secretan, of IndonesiaDLN and head of the Knowledge Resource Deivlopmernt Foundation. He can be reached at isinai)Cithac.id or http:// netman_itb_ac.id/~ismail

The Indonesian Digital Library Network, IndonesiaDLN, is the first digital library (DL) network in Indonesia (http://idln.itb.ac.id). The development was pioneered and driven by the Knowledge Management Research Group (KMRG) at the Institut Teknologi Bandung (ITB) Indonesia, together with other librarians and information engineers. This work was carried out with the aid of a grant from the International Development Research Centre (IDRC) Canada and the Indonesian Foundation for Telecommunication and Information Research (YLTI) for the period of 2000-2002. Other organizations that support this work are the Asian Internet Interconnection Initiative (A13) ITB, the ITB Central Library and *the Computer Network* Research Group (CNRG) ITB.

We also have good collaboration with the Eastern Indonesian University Development Project (EIUDP), *which* is supported by Simon Fraser University and the Canadian International Development Agency (CIDA). Other partners have included McGill University and the Indonesian Ministry of Religion Affairs in developing a DL network for *IAIN,* the Indonesian Islamic Institutes.

KMRG ITB started research on a DL network **in 1998. The IndonesiaDLN Forum was initiated** at October 2000, and the first operation of the network was launched at June 2001. The mission of IndonesiaDLN is to unlock the knowledge of the **Indonesian people - especially local content - and** share it nationally. It intends to provide information about Indonesia, including information about Indonesian final projects, theses, dissertations and research reports, as well as such topics as its heritage, regional power and history. It hopes to do so in an easy, user-friendly way that is distributed and invites contributions widely from the Indonesian people. Such information will be very useful in increasing the number of the. nation's information literate and the collaboration among them and in promoting Indonesia internationally.

IndonesiaDLN has a wide range of partners from sectors that include research, education, business, NGOs and government. Together these partners can create a large national knowledge base that can be maintained and organized to create many useful information package series. For example we could create series on such topics as theses and dissertations, children's education, the Indonesian national heritage, human rights and democratic institutions.

IndonesiaDLN can be viewed as a mother network of DL networks in Indonesia because there **will be many networks connected to it. It will serve** as a hub that will unify all metadata from all the DL networks in Indonesia. Currently there are two networks *of* DLs joined within IndonesiaDLN, namely *the* GDL-Network and the NS-Network.

The GDL-Network. The GDL-Network is a network *of DL* servers that use Ganesha Digital Library (GDL) software as their server application. **KMRG ITB** developed GDL as one of its research outputs supported by a grant from the IDRC and the YLTL It was developed using the PY1P scripting language, MySQL database server and Apache Web server. GDL is distributed as a free software, and the source code can be downloaded at http:// **gd1_itb_-_id/down1oad/ without charge_**

Currently GDL is the most widely used application by IndonesiaDLN partners. The same source code can be installed for three types of partners: Institution, Personal and Internet Cafe. Contributions from the partners to the GDL can be viewed at http://gdl-hub.indonesiaDLN.org.

Figure 1 shows the GDL-Hub front page, which contains a list and links to the publisher-partners of GDL-Network and the number of electronic collec-
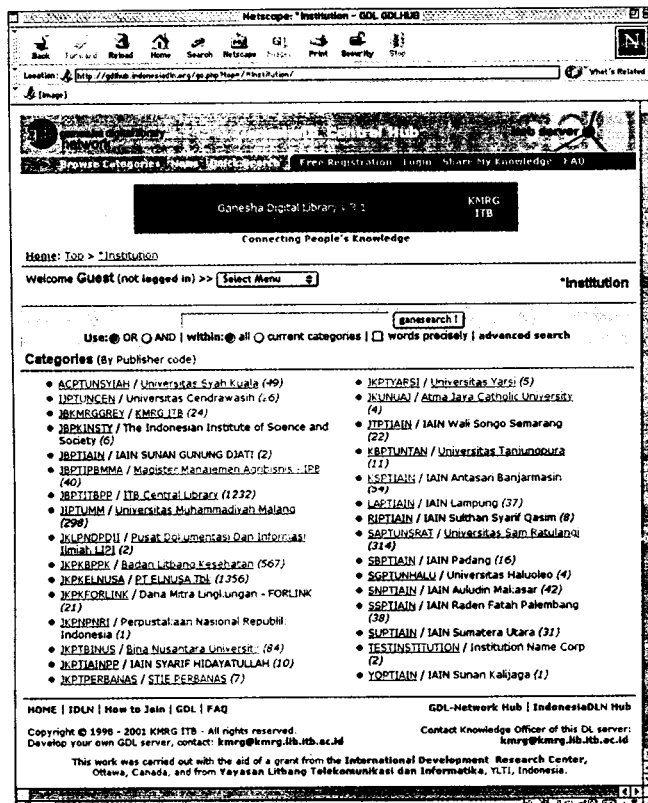
Figure 1: The GDL-Hub front page

ions they have published and shared to IndonesiaDLN. Some of the publishers use a dial-up connection to synchronize their collections to the GDL-Hub, and these names are not linked from the home page. Others use dedicated connections, and in this case the publishers' names are linked to their sites.

The NS-Network. The NS-Network is a network of DL servers that use New Spektra (NS) as the server application. NS was developed by University of Petra Surabaya Indonesia especially for members of their Christian university consortium.

Other **Efforts.** There are several other DL efforts in Indonesia such as those by KMNRT (Office of the Ministry of State for Research and Technology) and LIPI (Indonesian Institute of Sciences). In the future IndonesiaDLN also will support information about Indonesian heritage, human rights and agriculture.

By using the metadata that has been standardized for interoperability we hope we can integrate the DLs into one national DL network.

Potential Information Assets

Indonesia has 210 million inhabitants living on thousands of islands. It has thousands of tribes, hundreds of languages and invaluable cultural assets. Indonesian history has been colored by the life of kingdoms. We can find many objects related to this heritage archived at the National Library, the National Archive and in museums. But, ironically, if we want to learn more about Javanese history, for example, we have to go to Leiden in the Netherlands. There such artifacts are archived, maintained and organized very well. The Dutch brought the collections to the Netherlands during the period when Indonesia was largely a Dutch colony.

Indonesia is now entering a new era of autonomy. The central government is giving autonomy to the territories to manage their own zones. The territorial governments have to manage information about their territorial assets in order to gain advantage from national and international exchange. For example, heritage assets are one of the most important in inviting economic growth and cultural activities such as trade, tourism, education and exploration. Indonesia is well known for its rich cultural diversity.

With thousands of separated tropical islands, Indonesia is also very rich in its natural variety, another major asset. The islands attract exploration by researchers and businesses. For example, there are many plant species that can be used for traditional medicines or other purposes.

At present it is difficult to find information about the above assets. There are several reasons including the lack of documentation and information centers, the scarcity and high cost of information and telecommunication facilities, the quality of research results and their publication, and the lack of the qualified and complete online information centers. LIPI has tried to publish its research results and information regarding Indonesia online or by hard copy, but for the moment it cannot fulfill the information demand required to support the development of Indonesia.

All these conditions challenge every university, research institution or territorial government and every other kind of institution to manage their local information and knowledge. The growth of the Internet has presented them with the need to provide online information. By managing and publishing local knowledge we hope in the near future to accumulate national knowledge.

IndonesiaDLN and the Challenges of the Digital Divide

There is no effective and efficient way to integrate information from the separated islands of Indonesia that can compare with the use of information and telecommunication technology (ICT). What we need are distributed information centers and Internetworking among the centers so that we can manage and use information from many center sources easily and quickly.

We are developing a DL system that will act as the information center. This system can be implemented easily at any location because it doesn't need a big room or the complicated preparation needed by many systems. The minimal technical configuration only requires a personal computer with a dial-up modem. We plan to develop Internetworking among the DL systems to realize the IndonesiaDLN.

Struggling with the Digital Divide. The IndonesiaDLN was designed especially for Indonesia or other typical developing countries, where the digital gap is most evident in connectivity - in the lack of affordable access to PCs, Internet devices, modems, telephone lines and Internet connections. There is a gap in ICT application between a few regions that have enough access to ICT and the majority, which find it difficult to obtain.

This so-called digital divide not only happens between regions in a country, but also between nations. To struggle with the digital divide, we must address access, content and commerce issues. Madanmohan Rao lists eight parameters where the gaps tend to emerge: connectivity, content, community, commerce, capacity, culture, cooperation and capital. These are the eight Cs of success in the Internet economy [Struggling with the Digital Divide. *e-OnThelnternet* (e-OTI), 2000. http://www.isoc.org/oti/articles/1000/rao.htmlj.

His recommendations to close the gap include the following:

-*Connectivity.* Cheaper access devices, lower tariffs, Internet community access centers and competition among Internet service providers

-*Content:* More content from such sources as news media, public health services, government-citizen resources and NGOs, which should be hosted locally on a world-class Internet-hosting infrastructure

-*Community:* Better use of e-mail forums and discussion lists

-*Commerce:* Building a domestic Internet economy and promoting online transactional capabilities, including updating existing business and intellectual property rights laws

Capacity: Closing the digital skills gap by improving Internet access and educational offerings in schools and colleges, creating DLs for universities and promoting professional training institutes

-*Culture:* Overcoming cultural inhibitions and insecurities about competence for surviving the pace of the Internet age, getting government telecom monopolies to see a market opportunity on a global scale (not a threat on a local scale) and making government employees Internet aware and literate

Cooperation: No single actor can take on the Internet economy by itself. All forms of cooperation should be encouraged.

Capital: Governments should focus on creating open investment climates for Internet start-ups and conditions and safeguards conducive to the movement of domestic and international capital into the New Economy.

Internet Connectivity in Indonesia. The digital gaps between Indonesia and other countries can be easily seen in the connectivity parameter. According to *Indonesian Internet Statistics* (2001), [Rahardjo, Budi. http://www.insan.co.id] the Govern-

ment (Dirjen Postel: Post and Telecommunication) has issued more than 150 licenses, but only about 40 ISPs are operating. Many acquire licenses just to go into the VolP (Voice over IP) business.

Most ISPs are located in the Jakarta area. In other parts of Indonesia, only Wasantara net (wasantara.net.id) is available. They have the best coverage. This situation is possible because Wasantara net is owned by the PT Pos (post office). They leverage on their postal outlets (offices), which are available in many parts of Indonesia.

Table 1 gives statistics about Indonesian Internet subscribers and users.

Table 1. Indonesian Internet subscribers and users

Year	Subscribers	Users	
1996	31,000	110,000	
1997	75,000	384,000	
1998	134,000	512,000	
1999	256,000	1,000,000	Estimates
2000	384,000	1,450,000	Estimates
2001	511,000	1,980,000	Estimates

[APJII (Asosiasi Penyelenggara Jasas Internet Indonesia (Indonesian Internet Service Providers Association))] Indonesian Internet Statistics, 2000, http://www.apjii.or.id

It is estimated that there will be five million Indonesian Internet users by 2004. However, while this number seems large, it is only 2.4% of the Indonesian population. Most of these users are in the city of Jakarta or elsewhere on Java. For the near future, we hope the percentage will increase along with the development of ICT infrastructure. Unfortunately, because of the economic crisis sweeping Indonesia, this development will be very expensive.

IndonesiaDLN and the Digital Divide. In light of the conditions in Indonesia, the development of a DL network will be an appreciable contribution to narrowing the gaps of the Digital Divide. The IndonesiaDLN at least will work at the following goals:

Content: The amount of local language content will increase, and many sectors will put content online that will have local relevance and usefulness.

Community: The DL systems are not stand-alone systems; there are connections between them. Their collections are unified, managed and presented in an integrated DL net work system. These collections will promote discussion within communities, and many forums will be established, whether using Web-based application or extended by e-mail.

Capacity: DL systems, especially at research and educational institutions, will contain useful information and

knowledge available locally. For example, DLs of such materials as electronic theses and dissertations and research reports will be very useful in increasing the nation's information literate and narrowing the skill gaps. The DL network also can be utilized to deliver e-learning and distance-learning materials.

Cooperation: Cooperation is a logical impact of communication among the communities. By publishing local information on DL networks, every institution will have chances to open collaboration with other people or institutions. This process can happen at the interpersonal, state, national or regional level.

Basic Design of the IndonesiaDLN

The configuration of IndonesiaDLN should realistically consider the condition of the ICT infrastructure in Indonesia; otherwise, the networking design will not work.

The Architecture of Data Integration. There are two methods of data integration: global defined from local and global independent of local. The first can be implemented using Database Schema Integration and the second using Data Warehousing or Data Intermediation (See Figure 2.) [Ibrahim, I.K. & Schwinger, W. (2001). Data Integration in Digital Libraries: Approaches and Challenges. In *Proceedings of the International Seminar on Digital Library and Knowledge Management, 6-7 June 2001, Bandung, Indonesia.* http://dig-ilib.itb.ac.id/go.php?id jbptitbpp-gdl-pros-2001-ismail-657-integratio or http://www.scch.at/research/publications/562/index.html].

The most relevant method under IndonesiaDLN conditions is global-independent-from-local, since in the future the database structure of the partners' DLs will be different.

Figure 2. Paradigm of data integration
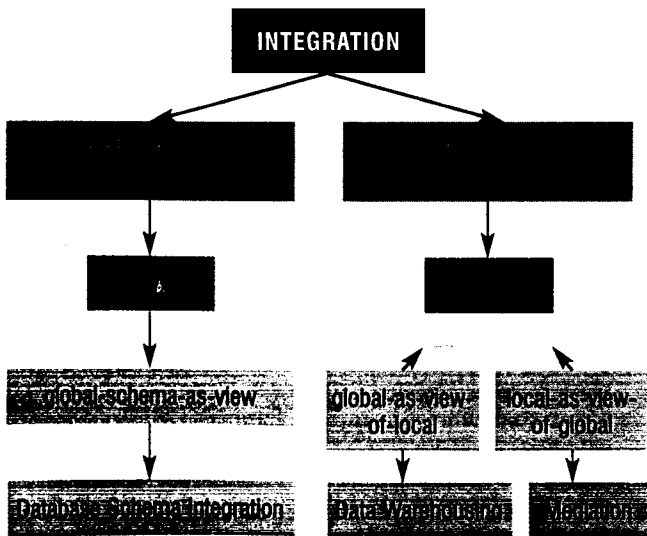
(Ibrahim & Schwinger, 2001, p. 4)

Data Warehousing collects all data of interest in a central place with a website built on top of it. It is easy to support queries and transaction, but hard to modify because the warehouse is not connected to the providers. Data intermediation, on the other hand, reroutes queries to the sources. Data remains in the original publisher's Web sources and are thus guaranteed to be up-to-date.

*Data **Integration for the IndonesiaDLN.*** Both architectures (data warehousing and data intermediation) require good Internet connections, which are to hard find in most areas of developing countries. For example, even students at the University of Irian Jaya have difficulty getting good Internet access to send queries to the ITB (Institut Teknologi Bandung) DL server. Therefore, data warehousing or data intermediation implemented at rFB will not answer their need. Generally, in Indonesia, only a few research and educational institutioris have dedicated Internet connections. Most of them only have dial-up or no connection at all. Information kiosks may eventually help provide access to a wider audience, so their needs also must be considered.

Figure 3. Mirroring in a unified metadata architecture
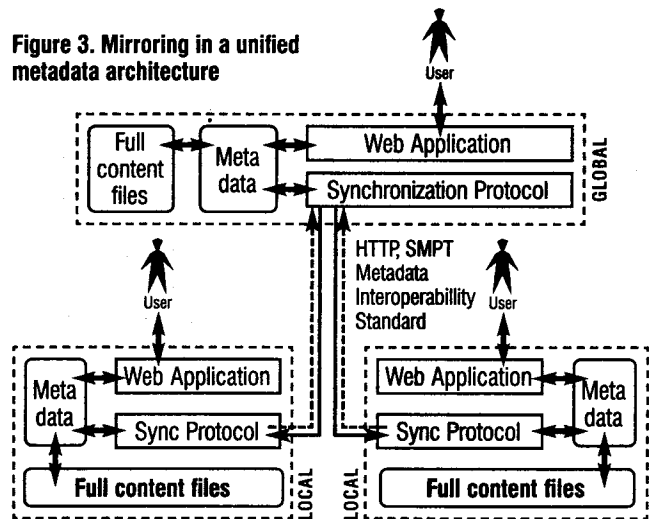
----> Upload local metadata (or with files) to hub server
——> Download metadata from hub server to local

Mirroring in a Unified Metadata Architecture. Considering the above conditions, we should design an architecture for the DL network that can answer our need to access the sources of information. Bringing the information sources close to the users can solve problems such as Internet bandwidth, availability and access.

Using this paradigm, users don't have to send their queries to the publishers' servers but to the nearest mirror server, which will allow fast processing of queries and responses. Figure 3 describes the architecture of this paradigm.

We can see that there is a hub server (global) as well as many partner servers (local). Partner servers will manage the

partner's full content files with their associated metadata, while the hub server will manage metadata from all the partners and full content files from some, especially from partners with non-dedicated Internet connection.

Regularly, partners will synchronize the metadata of their public, accessible collections with the hub, using the HTTP or SMTP protocols. Partners also can mirror their full content files to the hub using the HTTP protocol. As indicated above, this mirroring is useful especially for partners that don't have dedicated Internet connections. Their collections will remain on the hub so that users can download and access their collections even though the local servers are not online.

To serve their users, partners can download selected or complete metadata from the hub using the HTTP or SMTP protocols. During the synchronization process, the metadata will automatically be extracted and stored into local metadata table. Then users can search, browse and read metadata. from all the partners on their local systems. Users don't have to visit the hub server or every partner's server in order to find the information they need because we mirrorthe unified metadata from the hub server to each local server.

Because the full content files still remain on the partner or the hub servers, end users have to download directly from one of these sources. They can use a dial-up connection or order via e-mail.

Partners can do the synchronization whether they use dedicated Internet connections, dial-up or even run their servers behind a proxy. Of course partners should also mirror their files onto hub server if their connections are not dedicated.

Synchronization Services. Synchronization will be done on the Partner side. Figure 4 describes the services required during the synchronization.

Figure 4. IndonesiaDLN synchronization services
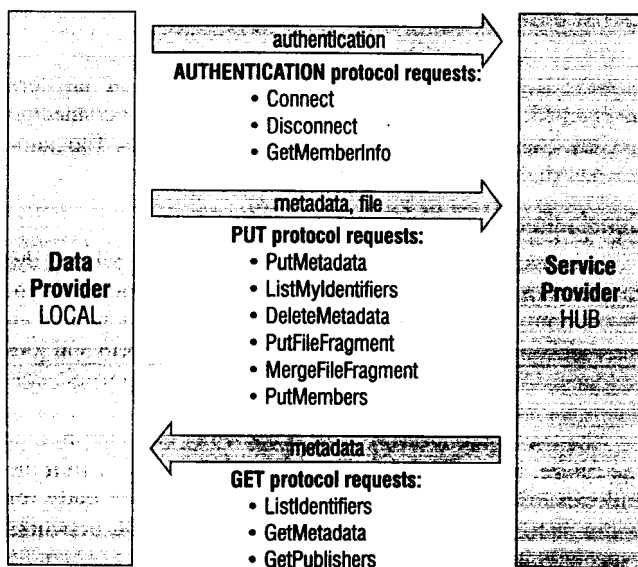
The services are grouped into three functions: AUTHENTICATION, PUT and GET. The partner's server requires authentication before metadata can be synchronized. Every partner has a Publisher ID and Publisher SerialNo, which are registered and generated by the hub.

The PUT protocol requests are facilities for a partner to send its metadata or files to the hub. The partner also needs to register its members to the hub. This registration is required in order for the partner's members to be able to get access to other partners' servers without having to register many times.

The GET protocol requests are facilities for a partner to get unified metadata from the hub. The metadata from all other partners will then be stored in its local database. Partners also can get publisher information from the hub. Users need this information to contact the publisher of the displayed metadata.

Interoperability Metadata Standard The metadata format at a local server could be independent from the global one. To overcome potential metadata format differences we have declared a metadata standard called the "IndonesiaDLN Interoperability Metadata Standard" [Fahmi, I. & Dwiyanto, A.R. (Eds.) (2000). *Standard Interoperabilitas Metadata Untuk Pertukaran Metadata Koleksi Elektronik di Lingkungan IDLN.* http://idln.itb.ac.id/meeting/Oktober2000/interoparability_metadata_standar idln.htm]. This standard was derived from NDLTD (Networked Digital Library of Theses and Dissertation) interoperability metadata standard (www.thesis.org/standards/metadata/current.htm) developed by Ed Fox and others at the Virginia Institute of Technology.

Both standards use the Dublin Core Metadata Element Set (DOMES) [Dublin Core Metadata Element Set, Version 1.1: Reference Description. (1999). http://purl.org/dc/documents/rec-dces-19990702.htm]. Selection of the DOMES as the adopted standard is the right choice because it will open up possibilities for further international collaboration on the DL network. All DL servers at IndonesiaDLN should use this standard for synchronization. The synchronization protocol at the local server will do the metadata conversion from local metadata format to the standard metadata interoperability format and vice versa.

4XML-based Transactions. Metadata, publisher and member data are formatted in XML during transactions between partner and hub. This method will open wider collaboration with other DL and distance learning efforts to build one large national DL network. As an example, the publisher records for the HUB are formatted as in Figure 5.

The Mother Network of The Digital Library Networks

There are other efforts in Indonesia such as the Digital Heritage Network, SME (Small and Medium Sized Enterprises)/Agriculture Network, Human Rights Information Network, Bibliographic Network and Distance Learning Network. All of these networks can be integrated under IndonesiaDLN easily as long as they use IndonesiaDLN Interoperability Metadata Standard for exchange.

Figure 5: Example of XML format for Publisher data.

```
<?xml version="1.0"?>
<DC.PUBLISHER>
    GaneshaDL Central Hub
    <ID>GDLHUB</ID>
    <TYPE>INSTITUTION</TYPE>
    <APPS>GDL</APPS>
    <ORGNAME>KnowledgeManagementResearchGroupITB</
ORGNAME>
    <HOSTNAME>gdlhub.indonesiaDLN.org</HOSTNAME>
    <IPADDRESS>167.205.23.27</IPADDRESS>
    <PROTOCOL>HTTP</PROTOCOL>
    <ADMIN>donfau@kmrg.lib.itb.ac.id</ADMIN>
    <CKO>cko@kmrg.lib.itb.ac.id</CKO>
    <POSTMASTER>pm@digilib.itb.ac.id</POSTMASTER>
    <CONNECTION>DEDICATED</CONNECTION>
</DC.PUBLISHER>
```
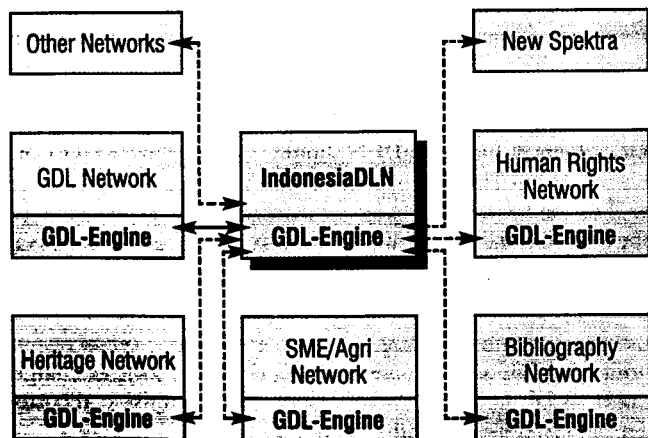
Architecture of the IndonesiaDLN. Figure 6 describes how the above networks will be integrated under IndonesiaDLN.

Figure 6. Architecture of IndonesiaDLN as the mother network of DL networks

We can see that many networks can be integrated into one big network. For this purpose GDL (Ganesha Digital Library) software will be developed to become the main engine of the IndonesiaDLN. GDL is now being developed modularly so that it can be used for different environments and purposes.

The most important part of the software is the GDL-Engine that will provide facilities and services to develop a Web-based DL. These services would be the following: membership, personal directory, authentication, search engine, content browsing and the exchange protocol. The most important service is the exchange protocol.

The Working Network. IndonesiaDLN was launched in June 2001.. The first network under IndonesiaDLN is GDL-Network. It comprises the DL servers that use GDL as their server application software.

At this moment there is only one hub server, the GDL-Hub, which acts as the mediator among the DL servers. There are 13 DL servers under GDL-Network, and more than 15 institutions are in process of developing their DL servers using GDL. Most of the servers are running on Microsoft Windows 98/2000 and others are on Linux and FreeBSD. They connect to GDL-Hub using dial-up or dedicated Internet connection.

GDL also can be installed behind a proxy. The collections still can be synchronized with the GDL-Hub, and the server also can download the metadata from the hub. This feature will enable the installation of GDL at Internet kiosks for wider distribution of information.

Work in Progress. We are now in the process of developing DL systems for heritage, human rights (NGO) and SMEs. We are also planning for the development of a DL network for distance learning in collaboration with other sponsors and partners. All of these networks are based on GDL-Engine.

Each of the networks will have a hub server and then will be integrated into the IndonesiaDLN hub server. Using any DL application, users can access any type of information provided by the IndonesiaDLN. Users with the Heritage Digital Library application can download and read information delivered by users from the SME Digital Library application and vice versa. This interoperability is possible through the IndonesiaDLN Metadata Standard.

Latest Status of IndonesiaDLN

The IndonesiaDLN is growing very quickly. Only two months after its launch the number of registered partners reached 43. Of this number, 14 have successfully connected to GDL-Hub and shared their electronic collections. The number has since increased.

Conclusion

IndonesiaDLN is a new hope, especially for helping the Indonesian people narrow the digital gaps among them. Institutions anywhere in Indonesia, as long as they have an Internet connection, can implement the GDL system and join IndonesiaDLN. They can share and download electronic collections on the Network.

The use of the DCMES will open wider collaboration in the future. Many DL networks can be integrated within the IndonesiaDLN. Furthermore, IndonesiaDLN is ready for wider international collaboration in developing DL networks especially among developing countries.