

***A First Step Toward
Communication in Virtual Libraries***

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Abstract

Conventional libraries serve as meeting places for communication and collaboration. Also, the use of conventional libraries is often highly interactive and collaborative. These observations call for corresponding tools and support in virtual libraries. Hence, this paper deals with communication in virtual libraries. To do this, it introduces well known forms of communication and shows whether and how these are found in virtual libraries. In addition, DogitaLS1, a prototype of a library system basing on the Internet, is introduced with a special focus on the structures required for integrating communication support. Finally, communication services that are currently being integrated in DogitaLS1 are examined.

Keywords: virtual library, communication, WWW

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1. Introduction

The Internet and World Wide Web (WWW) afford libraries new possibilities to disseminate information. For instance, many libraries are already offering on-line public access catalogs on the Internet. In the near

future, digital documents and Internet resources will belong to the document collection of a library as well. Since these trends are changing the definition of what a conventional library is, the terms "virtual library" and "digital library" have come into use.

Besides the role as information mediator, conventional libraries serve as meeting places for communication and collaboration as well. For example, researchers or students meet each other in the library to work jointly or to exchange information. In addition, the support of librarians to patrons in seeking information is highly interactive. Finally, recent research has shown, that the idealization of a lone researcher sitting at a workstation and navigating through the WWW is wrong [EhCa94], [LeMa95]. In this context, virtual libraries are required to serve the needs of their users (librarians, authors and patrons) and to provide tools for communication and collaboration. This paper addresses mainly the issue of communication and, thus, can be regarded as a first step towards this research area.

To do this, the remainder of the paper is structured as follows: after having defined the basic conditions for this paper, section 2 introduces the term "communication" and discusses different forms of communication thereof. It also shows by example how these forms of communication can be found in conventional libraries. Next, section 3 focuses on communication in virtual libraries. Not only does this section show how the various communication forms can be integrated in virtual libraries but also introduces new forms of communication which do not exist in conventional libraries. Section 4 describes the library system DogitaLS1 with a special focus on the structures required for integrating communication services. Finally, this paper closes with a summary and outlook in section 5.

1.1 Basic Conditions

In this paper, we assume that virtual libraries are based on the Internet and the WWW, even though this is not strictly necessary. We have the following notion of what a virtual library is:

The document collection of a virtual library consists of digital documents and Internet resources. A Internet resource is a link to other digital documents which are stored elsewhere in the Internet. Thus, only the link is under control of the virtual library and not the document to which the link points. In addition, a virtual library provides digital catalogs, containing metadata about the document collection. Finally, a virtual library must accomplish as far as possible all necessary services of conventional libraries and must also exploit the advantages of the technology used.

Similar notions of the term "virtual library" can be found in [Toc96a], [GIFo94].

2. Communication in conventional libraries

This section introduces the term "communication" as well as a prominent classification of different forms

of communication. Thereafter, we outline how these forms of communication are found in conventional libraries.

2.1 Communication

There are always three components involved in communication: a source, one or several destinations, and a medium. The source forwards the information which is transmitted by a medium (e.g. text or sound) and finally received by the destinations.

Depending on the conditions and situations, communication can take various forms, and several different proposals exist to capture them. In this paper, we use the two dimensions of "time" (same, different) and "place" (same, different) to characterize communication [Joh84].

- Communication is synchronous and non-distributed, source and destination are communicating with each other at the same time in the same place, e.g. talk.
- Communication is asynchronous and distributed, if source and destination are communicating with each other at the same time in different places, e.g. a phone call.
- Communication is asynchronous and non-distributed, if source and destination are communicating with each other at different times in the same place, e.g. a notice board.
- Communication is asynchronous and distributed, if source and destination are communicating with each other at different times in different places, e.g. e-mail.

In addition to this, we also want to take into consideration how a synchronous communication is initiated (formally, informally). In [KrFi93], a formal communication is always based on an arranged appointment while an informal communication is spontaneous and takes place accidentally. For instance, a real time video conference is mostly a formal communication which is synchronous and distributed.

As we see it, if a communication is asynchronous it cannot be classified as formal and informal with respect to initiation. Nevertheless, in some publications, e.g. [GiLe96], the terms "asynchronous, formal" and "asynchronous, informal" communication are used to characterize the content of the information communicated. For instance, [GiLe96] refers to users sharing their home page by allowing other users access to it as informal communication.

2.2 Forms of communication in conventional libraries

Conventional libraries are meeting places where students and researchers meet each other either accidentally or by arrangement. Often conventional libraries have areas for collaboration where people can work jointly. Further, most of the services a library provides are highly interactive and are based on communication between the people involved. Due to this, all forms of communication introduced in the prior section exist in conventional libraries:

- There is formal, synchronous and non-distributed communication in conventional libraries when

librarians introduce patrons to the use of the library.

- Formal, synchronous and distributed communication is required if the document collection of a conventional library is distributed to several buildings. For instance, a phone conference system can be used for this kind of communication.
 - Informal, synchronous and non-distributed communication is found in conventional libraries because students and researchers often meet each other accidentally in the library. This is probably the most common form of communication in conventional libraries.
 - Informal, synchronous and distributed communication is common in the conventional library as well. For instance, patrons call librarians and ask for documents they have reserved.
 - An example for a asynchronous and non-distributed communication is a notebook in which patrons can add suggestions to or complaints about the library. Once a suggestion or complaint is made, the library can comment on that in the same book.
 - Finally, asynchronous and distributed communication is found in conventional libraries since researchers can communicate their research results to a broad community through publishing in journals or in books.
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3. Communication in virtual libraries

The previous sections introduced some basic terms and illustrated how various forms of communication are found in conventional libraries. In this section we address the issue of whether and how these communication forms can be used in virtual libraries. In addition, we encounter new forms of communication exploiting the advantages of the technology used.

3.1 Conventional forms of communication in virtual libraries

For the sake of simplicity, we refer to all forms of communication introduced in the prior section as conventional communication forms. We use this term in the remainder of the paper to distinguish the forms of communication already known from the new forms that may occur in virtual libraries.

In contrast to a conventional library which is defined as the building where its document collection is stored, there is no longer a library building for a virtual library. Instead, the document collection of a virtual library is distributed among several servers in different places. Thus, people cannot meet each other accidentally or by arrangement in the virtual library. Due to this, synchronous communication in virtual libraries is only possible if it is distributed. One might argue that people can work jointly at a computer at the client side and communicate with each other in a non-distributed way. Even though this is a non-distributed and synchronous communication it is outside the scope of the virtual library and cannot be under its control. Therefore we examine only the distributed forms of synchronous communication in virtual libraries. Additionally, we give examples of asynchronous forms of communication in virtual libraries as well.

Synchronous, formal and distributed communication

Normally, the document collection of a virtual library is distributed. This fact allows librarians to work in different places. Nevertheless, to achieve a common aim, communication is still necessary for collaboration. Therefore, a virtual library should provide corresponding services. Shared workspaces similar to virtual office systems (e.g. DIVA [SoCh94]), or electronic meeting rooms (e.g. DOLPHIN [StGe94]) should exist in virtual libraries. Apart from research prototypes, there are also communication tools that use the capabilities of the Internet and are normally available on the Internet. DigiPhone [Dig96] or VocalTec [Voc96] are prominent tools for phone conferencing on the Internet. Further, MBoone [MBo96] and Cu-SeeMe [CuS96] are often used for video conferences. For instance, the use of MBoone in a virtual library setting is known from the RPID project [DeJe95]. Also, a phone conferencing tool called CoolTalk can be connected to the most recent release of the Netscape Browser called Atlas [At196]. In addition, CoolTalk offers a white board, allowing users to collaborate on the same data (text and graphic). Finally, Marc Andreessen has recently announced that Netscape will be developing a tool called InSoft. With InSoft phone calls will directly be possible from the Netscape navigator.

Synchronous, informal and distributed communication

Spontaneity is a typical characteristic for informal communication. Hence, a virtual library should provide functionalities allowing users to get an overview of who else is on-line in the library. Users should then be able to choose one or several users with whom to communicate. For this, the tools introduced above can be employed.

Asynchronous and non-distributed communication

In conventional libraries, a notice board represents this form of communication. Similar to this, a pre-defined space in a virtual library can assume the function of a notice board. This space might be an HTML page to which users can add links to the information to be communicated. Another example is the use of annotations to documents. For instance, Hyper-G and its commercial version HyperWave afford users the ability to annotate documents or other annotations [Mau96], [HyWa96]. Finally, virtual libraries can use text-based discussion systems, like HyperNews [HyNe96], which are designed for asynchronous and non-distributed communication.

Asynchronous and distributed communication

Basically, asynchronous and distributed communication is found in every virtual library because researchers publish their research results for example in electronic journals which are available in each virtual library that subscribes to them. In addition, there are other possibilities for this form of communication. For instance, Hyper-G provides a service allowing users to see who else is on-line. One can select a single user or all on-line users with whom to start communicating using an integrated message system. Unlike e-mail, the message system displays the message on the screen of the receiver immediately after the sender has sent it. A drawback of this message system is that only one user or all

users (but not an arbitrary number of users) can be chosen for communication. Thus, communication within a group is not possible.

3.2 New forms of communication in virtual libraries

As we see it, communication and collaboration will be one of the main research fields in the context of virtual libraries. A big challenge for us is to identify and to implement new communication services for virtual libraries. First results show that communication can be based on digital agents. Basically, a digital agent is a process which carries out a well-defined task [CACM94]. Two new scenarios for communication in virtual libraries then arise. First, digital agents can support the communication between users. Second, users can not only communicate with other users but also with digital agents. The subsequent sections give illustrating examples.

Communication support through digital agents

In conventional libraries, users should be informed about the acquisition of new documents. Hence, libraries often display new documents in extra shelves for a certain period of time before these documents are put in the right place within the library. This can be regarded as an asynchronous and non-distributed communication between librarians and patrons. Virtual libraries can essentially duplicate this way of passing on information about new books. For example, an extra HTML page for new documents can provide links to them. Similar to extra shelves in conventional libraries, patrons can access this page to see what is new. One drawback of this approach, however, is that patrons have to actively choose to become informed about new documents. Another drawback is that patrons always have to search the entire collection of new books, even though they are only interested in newly acquired books of their particular research domain.

In virtual libraries, digital agents can be used to overcome these shortcomings. For example, it should be possible for patrons to define a personal profile. A patron's profile could comprise the area of interest, an e-mail address etc. On this basis, a digital agent, in this context often referred to as profile service, could inform patrons about new books with respect to their profile. Everytime, the library catalogs a new book, the profile service checks who has requested to be informed about it and then sends for example an e-mail to each of such patrons. Further, digital agents can be employed whenever information is to pass on in a stepwise fashion to a number of people. If a message contains more information than is necessary for the receiver, a digital agent can be used as information filter. Thus, only information that is pertinent to the receiver is forwarded. For instance, cataloging is highly cooperative and communicative, and usually involves more than one person. Since in each step of the cataloging process only parts of the information from the previous steps are needed, a digital agent can be used as information filter when the results of one step are passed on to the subsequent step.

In contrast to traditional libraries in which only communication between people is possible, people can also communicate with digital agents in virtual libraries. For instance, the URL-minder [[URLm96](#)] is a profile service which keeps track of Web pages. URL-minder allows users to enter URLs they are

interested in. Whenever the resource at this URL changes the profile service generates automatically an e-mail and sends it to the user. Similar services are known from the Ariadne [[Ari96](#)] project, which is part of the electronic library project MeDoc [[Med96](#)] of the German Association of Computer Science (GI). In this way, users can communicate with digital agents.

4. DogitaLS1 at a glance

DogitaLS1 is an acronym for "The Dortmund Digital Library System of LS1". It is being developed at "[Lehrstuhl Informatik 1](#)" (LS1) of the Computer Science Department at Dortmund University in cooperation with the [Center for the Study of Digital Libraries](#) at Texas A&M University.

The aim of our research is to define organizational structures for libraries that provide a heterogeneous document collection. In our case, such a heterogeneous collection comprises catalogs for (physical) books, digital documents, and Internet resources. Thus, DogitaLS1 is not a virtual library with regard to the definition given in section 1.1. Additionally, we place a special emphasis on general services as well as communication services for different types of users (e.g. patrons and librarians).

4.1 Structure of DogitaLS1

DogitaLS1 is based on Hyper-G, a second generation Internet information system developed at Graz University, Austria. One main advantage of Hyper-G is that it allows authors to organize hierarchically their documents by means of so-called "collections". A collection can be compared to folders or directories in a file system. Each collection can contain an arbitrary number of documents or other collections. Collections and documents can be protected from unauthorized access through the use of access rights granted by Hyper-G.

There are six collections at the top level of DogitaLS1 (c.f. figure 4.1). Three of them serve for storing the different kinds of documents (Catalogs, Digital Documents, Internet Resources), one provides an on-line help (Online Help), and the remaining two are needed for integrating communication features in DogitaLS1 (Services and Workspaces). We grant different types of users access to different collections so that normally each user can only access collections required for his needs.

In this paper, we do not want to explain all of these collections in detail. We rather focus on the two collections "Services" and "Workspace" which are required for supporting communication in DogitaLS1.

The collection "Services" contains other collections for the different kinds of services DogitaLS1 provides. For example, in the collection "Librarian Services" all services for librarians are found (e.g. a service for cataloging books). Since different librarians perform different tasks in a library, each librarian gets only access to the services required for his domain. To do this, we set up the collection

"Workspaces". This collection contains collections for single librarians and for groups of librarians performing the same task. In these workspaces, logical copies of the required services from the collection "Services" are stored. In addition, the collection "Workspace" also permits patrons to have their private space where they can store private documents (e.g. Internet resources). Privacy is maintained through using the access rights of Hyper-G.

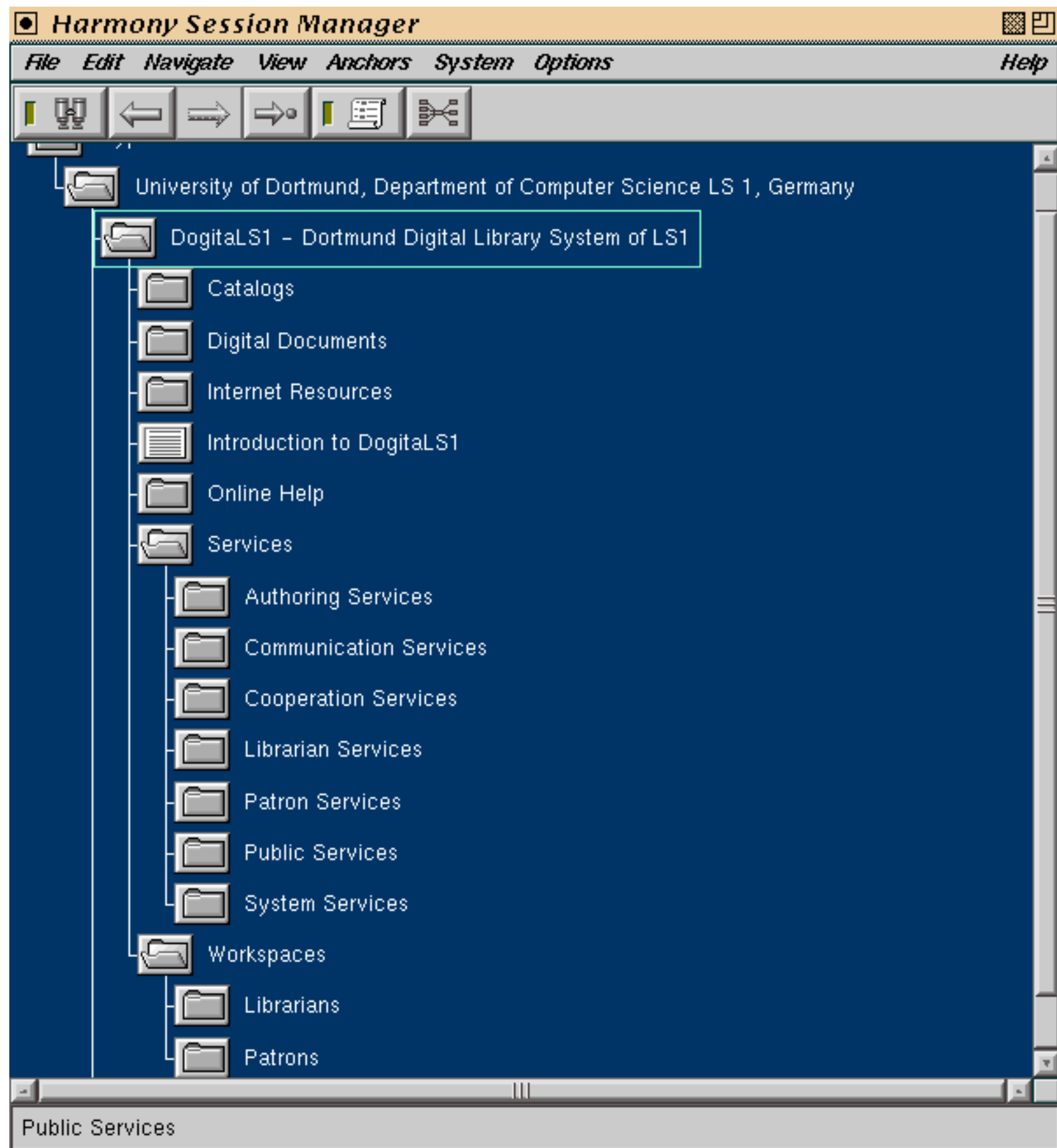


Figure 4.1: Parts of the collection hierarchy in DogitaLS1

4.2 Communication services in DogitaLS1

One of our aims is to integrate communication support in DogitaLS1. At the moment we are focusing only on asynchronous forms of communication. Services for synchronous communication are on the list for future extensions (c.f. section 5). The following services are currently under development:

Asynchronous and distributed communication

- A digital agent is being developed to permit patrons to define a personal profile. Whenever a new (physical) book is cataloged, the digital agent sends e-mail to patrons who have a corresponding profile. Instead of an e-mail, we are also thinking about putting a message in form of a Hyper-G document in the patron's private workspace. The advantage of approach is that patrons need not to have e-mail accounts.
- Patrons should be able to ask librarians for support in searching Internet resources. The idea is that patrons fill in a form with the requested information. As a result, an automatically generated document is put in the workspace of the responsible librarian. After the librarians have performed the search, the results can either be sent as e-mail to the patron or can be put as Hyper-G document in his workspace.

Asynchronous and non-distributed communication

- Several patrons should be able to set up a virtual group which has a common workspace. Each member of the group has the same access rights to the workspace. At any time, new members can join or quit the group. A virtual group can be used to share interesting documents among its members.
- Another important issue in CSCW addresses possibilities to obtain some idea of what colleagues have recently done. This issue is referred to as cooperation awareness. Since awareness is important for virtual groups, we want to integrate corresponding features. To do this, we will use a function of Hyper-G which calculates which user created which documents during a certain period of time.
- We want to use annotations to share information about the same document among members of a virtual group. In addition, each member of a group should be informed automatically when a document is annotated.
- A collection should be set up to represent a notice board. Each user (patron or librarian) can add documents to this board. Still, to avoid too many documents in this collection, each document has a date of expiration after which it is automatically removed.

4.3 Lessons learned

Up to now we have mainly learned some lessons concerning structures of virtual libraries and the integration of services. The discussion of the structures is skipped here but can be found in [Toc96b]. Basically, there are two possibilities for integrating services in virtual library. First, it can be added to the code of the server and clients resulting in specialized applications. Second, it can be added as CGI scripts or JAVA applets running on the server side or on the client side, respectively. The first approach is known from the RPID project [DeJe95]. The disadvantage of this approach, however, is that one must ensure that the server will still be compatible with other WWW servers and with existing Internet resources. Since the Internet is still a mushrooming research field, we decided to use CGI scripts for integrating services in DogitaLS1.

A further question was how to store the services. For example, initially, all services were distributed throughout the server. The disadvantage is that we would have had to gather and copy the services from several already registered users whenever a new user received a new account on DogitaLS1. In the current version of DogitaLS1 all services are stored at the same place. This makes it much easier for us to install new users.

5. Summary and outlook

Communication and collaboration are two important research fields in the domain of virtual libraries. This paper has given a first introduction of what forms of communication are reasonable and necessary in virtual libraries. We then illustrated how a small selection of mainly asynchronous communication services will be added in our library system called DogitaLS1. This system is primarily used as research library at our lab in the Department of Computer Science at Dortmund University, Germany. In addition, we will use DogitaLS1 as virtual library for a virtual class that will be taught by Roy Rada [Rad96] at Washington State University (USA) in fall 1996. We hope that the use of DogitaLS1 in our day-to-day work will give us not only further feedback for the already planned communication services but also new ideas for future requirements.

We are planning to address the following topics in the near future:

- At the moment DogitaLS1 is only based on one server. We expect further needs for communication services when several servers are used for virtual libraries.
- We are about to integrate digital documents in DogitaLS1. Digital documents, however, can change their content, even though they already belong to the document collection (such documents are called "fluid documents"). As we see it, users working on a fluid document should be informed whenever it is changed or updated. This calls for further communication services.
- Up to now we have only considered communication services for patrons and librarians but not for

publishers or authors. This domain will also belong to our future research interest.

- Finally, we are planning to integrate also synchronous communication services in DogitaLS1.
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