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**A Groupware-based
architecture for secure
interaction of intranet
databases and the Internet**

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Das Workgroup Computing Competence Center Paderborn befaßt sich mit Forschung, Prototyping, Produktentwicklung, Systemeinführung, Projektabwicklung, Technologietransfer, Consulting und Schulung bei Groupware-basierten Anwendungen für betriebliches Informationsmanagement. Gegenstand sind insbesondere Business- und Technologie-Frameworks für Office Systeme, Workgroup Computing, Workflow Management, Projekt Management und Connectivity-Systeme in Client-Server Architekturen. Das Workgroup Computing Competence Center Paderborn besteht aus gemeinsamen Arbeitsteams an der Universität Paderborn und der PAVONE Informationssysteme GmbH Paderborn.

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Abstract:

This paper presents a novel architecture and new methodical approach, which seamlessly combines Groupware intranet and Internet. It is a special component of a comprehensive Groupware database grounded office framework with the project name *GroupOffice* developed at the University of Paderborn.

The term *intranet* will be delineated as a computer-based environment, which provides a team with all necessary document and workflow management functions and will be loosened from its tight association with HTML, Java and so on. The GroupOffice concept will be sketched as an example of how a flexible intranet environment should appear. It integrates different objectives, such as internal document and workflow management in database applications with platform independent tools, as well as a simple management of an organization's Internet forum by the people who own, update and manage information themselves.

Concluding, the *scale of intranet/Internet security* describes various technical and conceptual options of bringing daily, up-to-date information from teams into the Internet. This concept allows for a variety of publication choices from a completely open replication environment to a fully secured messaging-based scenario.

Keywords:

Archiving, Client/Server, Compound Documents, Content Management, Database, Distributed databases, Document management, Document-based databases, Electronic documents, GroupOffice, Groupware, Internet, Intranet, Mobile Work, Office process, Office Systems, Retrieval, Security Management, Selective replication, Standard workflows, System Repository, Teamwork, Workflow Management, World Wide Web

Table of contents:

1 Introduction	1
2 Current intranet scenario and drawbacks.....	1
3 The concept of an intranet based on Groupware applications	2
3.1 What does „intranet“ actually mean?	2
3.2 Groupware intranet databases and workflow management.....	3
3.3 Teamwork in local and mobile environments	3
3.4 Repository architecture	3
3.5 Intranets and Internets - no connection possible?.....	4
4 Intranet/Internet connectivity - the technical perspective	4
4.1 The overall model: Groupware databases as information source for the Internet	4
4.2 Direct interaction and capturing data from people browsing the web site	5
4.3 A firewall concept for security in Groupware database environments	6
4.3.1 Security options: Replication mechanism vs. message objects	6
4.3.2 The scale of security for intranet and Internet interaction	7
4.3.3 Different options for different purposes	9
4.4 The process of selective publication on the Internet via messaging	9
5 Conclusion	10
5.1 Summary	10
5.2 Is a coexistence of Groupware intranet and Internet technology desirable?	11
6 References	11

A Groupware-based architecture for secure interaction of intranet databases and the Internet

Marcus Ott, Ludwig Nastansky, Frank Brockmeyer*

1 Introduction

Currently, a wide variety of views on the Internet can be found in information technology (IT) magazines, computing journals and management publications. While a lively discussion on the benefits of Internet use is underway not only in the IT sector, internal networks have been built in organizations, which are based on the same technology. Despite the public interest in the Internet these private nets or „intranets“, which use the infrastructure and standards of the Internet and the World Wide Web but are cordoned off from the public Internet, will be the factor which most likely changes today's organizational structures. Experts consider intranets as a means to open new ways of communication, to set up new possibilities to generate and distribute information and to integrate the different organization-wide information resources.

This paper presents selected technical aspects of a comprehensive Groupware based office framework with the project name GroupOffice¹ developed at the University of Paderborn. It focuses on the Groupware based *and* Internet oriented architecture, which overcomes some intranet disadvantages drafted in chapter 2. Furthermore, it strongly integrates different objectives, such as internal document and workflow management with platform independent tools, as well as a simple management of an organization's Internet forum by the people who own, update and manage information themselves. As will be outlined in chapter 3, the database architecture to be presented here is based on a fully integrated Groupware intranet technology, which provides all necessary office and workflow features. This chapter clarifies the term „intranet“ and shows that it will conceptually be used in a similar sense as intended elsewhere, i.e. for describing an environment, which easily allows for teamwork, document and workflow management, *and* information distribution. However, technically the intranet presented here is based on Groupware technology. From the technical perspective chapter 4 sketches the extension of the Groupware based framework, which can be used by all team members in local and mobile environments to perform the work tasks in their team in order to simultaneously manage the organization's Internet.

2 Current intranet scenario and drawbacks

The intranet scenario, as it is currently discussed amongst IT managers and technology experts, comprises two major drawbacks, which hinder organizations to exploit the idea of an intranet to its latent use:

While both, intranet *and* Internet, are very often understood as an environment for (passive) information presentation, marketing and external information spreading, the intranet should rather be understood as a means for actively managing internal processes such as document distribution and workflow management. Although, intranet protagonists stress the standardization of document formats and graphical presentation, these standards show only little use if applied solely to passive information objects, which are compiled once and remain unchanged for a long period.

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¹ For a general description of the GroupOffice framework refer to [Nastansky/Ott 1996]

When watching the intranet discussion, the gap between the intranet topic on the one hand and the Internet on the other hand will be furthermore noticed. In many (if not all) concepts and suggestions of setting up an intranet environment it is seen as being something exceptional which is somehow separated from the organization's Internet activities. Very few approaches understand the two as being one integrated environment, which serves both: Internal process management *and* external information distribution at once. In addition to the idea of the two areas being conceptually separated from another, this argument is stressed by technical reasons. The fact that the intranet architecture is based on TCP/IP protocols threatens IT-managers who consider this a potential security gap and a possibility for intruders to break into the organization's information systems. Technically speaking intranets are based on Internet solutions, which use the well-known TCP/IP protocol and provide users with in-house browsing, mailing or file transfer services. Due to this reason intranets are commonly set up without any connection to the outer world in order to protect security relevant information being managed within the intranet.

3 The concept of an intranet based on Groupware applications

Chapter 3 outlines the overall architecture and concept of the GroupOffice document- and workflow management system. This office system is founded on a set of interacting document databases containing semi-structured documents. Both, the database applications as well as the information objects (i.e. the documents), carry their own functionality and methods to be invoked on the respective data. Earlier papers have referred to the general architecture and specific components of this framework, such as the document-, correspondence² and workflow-management system³, archiving and distributed work⁴, purpose and implementation of a system repository⁵ or its potentials for teamwork and group access⁶, so that the following sections will briefly summarize the necessary basics, which are inevitable for the understanding of the technical concepts in chapter 4.

3.1 What does „intranet“ actually mean?

For now, most intranet Web sites are used for simple information sharing: publishing job listings, product updates, and phone directories, for example. Many companies start out with the basics - publishing information electronically and making it available to employees - and most of them stop there. Some of these simple information-sharing setups already provide a strategic advantage, though.

Nevertheless, more sophisticated intranets are necessary. They must be designed to let employees fill in electronic forms, query corporate databases, or hold virtual discussions. Using an intranet, companies have to accomplish such features as making corporate databases accessible so that employees can traverse by clicking and browsing. Corporate information systems managers have to understand an intranet as the next step in information development and distribution.

In the understanding of the GroupOffice background, document-management in intranets comprises creation, forwarding, management, filing, archiving, searching, retrieving, and other functions on documents. Currently, a large number of application systems can be found with single functionality in the respective fields, some of them already based on Internet technology. However, few provide an integrated

² [Nastansky/Ott 1996], p. 43f.

³ [Nastansky/Hilpert 1995]

⁴ [Nastansky/Ott 1996], p. 49f.

⁵ [Ott/Nastansky 1996] and [Nastansky/Ott 1996]

⁶ [Ott 1996], p. 5f.

and secure solution to support a comprehensive document- and workflow-management with all functions mentioned like it can be found with the GroupOffice approach.

3.2 Groupware intranet databases and workflow management

Document and workflow management are closely related. When allowing for a broad management of the documents containing the information, as described in the previous section, it is likewise beneficial to think about managing the *flow of information*

Usually, the term *workflow* describes tasks in office processes, which are succeeding one another and are more or less strongly connected in order to reach a given aim. Workflow management systems are computer-based systems to guide these processes by determining the next agent, providing with necessary information and watching overdue dates. Yet, office processes cannot solely be understood as closely linked and strictly defined steps of work tasks; the aspect of loosely connected and undefined communication processes in teams has to be covered as well.

Thus, an essential challenge for workflow systems is to support structure and flexibility equally. On the one hand, repeatedly recurring standard workflows and on the other hand ad-hoc workflows or exception handling must be modeled and supported. The workflow component of the GroupOffice application addresses this requirement and supports workflows on a scale from „spontaneous“ to „firmly structured“ processes⁷.

3.3 Teamwork in local and mobile environments

Common with all Groupware-based applications is the notion of a shared information space for all team members. It contains necessary information objects and the respective methods to jointly create, use, alter, and manage the information space. Often cooperative teamwork takes place in a distributed environment and without direct interaction. This circumstance leads to a situation where computer support has to cover functions in diverse work contexts. But joint and direct cooperative work necessitates interaction of people with diverse aims and points of view. The GroupOffice approach allows for a maximum of flexibility and transparency in a persons work by enabling the user to define his own rules and conventions for performing the work.

Additionally, in contrast to a scenario based on conventional Internet technology the GroupOffice intranet supports any type of interaction with mobile users. The GroupOffice model supports distributed creation and use of information objects via LAN and WAN connectivity. All mentioned features are made available to the user in the office, as well as to the mobile team member. In contrast to a *file and directory* structure, like it is used in the Internet technology, team access to information objects in databases replicated at mobile workplaces is possible with a maximum of transparency.

3.4 Repository architecture

The Groupware based intranet architecture presented here addresses another drawback of conventional intranet approaches. Of course, information is only beneficial when it can be easily located and retrieved. Internet technology allows for an anarchic structure within the local Web sites and orientation can quickly be lost. Meanwhile, the Internet provides numerous Web-Indices and search-engines as aids for structuring the Web, and very soon similar tools become necessary for intranets as well. Again, dedicated personnel has to be assigned to arrange and catalogue the information, and intranet users have to be specifically informed about sites and contents.

⁷ [Nastansky/Hilpert 1994]

With a Groupware intranet users can arrange and manage their own information structure in different database applications and can also easily browse through information provided by other users. In addition to the effortless creation and structuring of information the use of a Groupware database architecture allows for the implementation of a repository model. The GroupOffice repository represents the foundation of all database applications and information objects within the office system. On the one hand the repository contains content information, such as possible keywords, form templates or reusable text blocks, on the other it provides a basic structure for filing and retrieval of information objects.

The repository model with its inheritance features is a substantial concept for teamwork in intranets which can hardly be found nor implemented in conventional intranets based on Internet technology.

3.5 *Intranets and Internets - no connection possible?*

When applying this sketched Groupware-based intranet environment, experience shows that it will lead to the development of a lively, regularly updated and strongly used intranet in contrast to the organization's standardized Internet file system with irregularly compiled and somewhat outdated information. Today's organizations' Internets are not integrated into the employees' daily work routine and due to their technical and structural complexity need to be managed by specially assigned staff. Further, this architecture prevents from current news and information to be directly fed into the organization's Internet environment from the people who *generate and work* with the data, rather than by the specialists. The following chapter will extend the GroupOffice intranet concept to meet the requirements pointed out and to allow for a seamless integration of both intranet databases *and* Internet.

4 Intranet/Internet connectivity - the technical perspective

The GroupOffice framework, which serves as the general model and technological base for the method to be outlined here, provides a standardized way of distributing internally collected information to a world wide audience. This chapter describes how its powerful and flexible *intranet* information system based on a Groupware architecture can be combined with the *Internet* features and technologies.

4.1 *The overall model: Groupware databases as information source for the Internet*

With this model marketing brochures, project reports, publications, customer news, or product information can be made accessible worldwide to anyone interested. Generally, it is not the end user technology itself which is a current critical factor for beneficial intranet implementation. Although, a creation of the necessary (HTML) information objects with many existing authoring tools is no longer a major effort, their complete organization and updating is problematic. In contrast, a highly operable internal management system for business processes and very well designed workflow management can sometimes be found. But when it comes to the World Wide Web (WWW), information media- and process-breaks prevent teams from joint creation and management of this medium.

The conception developed and depicted here is an extension of the presented integrated Groupware database architecture to distinguish between exclusively internal information, which is highly sensitive, and common information, which can be made accessible to everyone. In other words, the intra-organizational information base will be opened to operate as an extra-organizational environment as well. While some sensitive modules from the intranet environment will not be opened for publication in the WWW others can fully or in part and securely be brought out into the net.

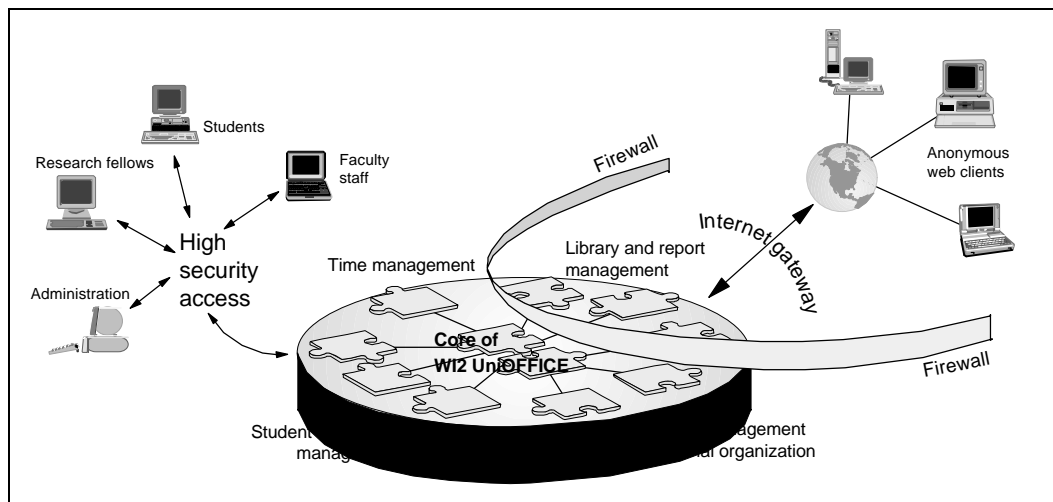


Fig. 1: Scenario for an integration of Groupware intranet and Internet/WWW

The previous figure, for example, depicts the general architecture of the GroupOffice implementation *UniOffice* at the author's institute and its integration with the Internet. This prototype implementation serves as the so called *back-office* for the management of educational processes at the university. In Fig. 1 each puzzle element represents a Groupware application database for special purposes, such as *time management*, *student and lecture support*, or others. This scenario portrays how some applications for *Library and report management* are opened from the intranet to the Web and others are not. By assigning only public modules to be openly published in the WWW, private applications and internal data will not be publicly available. Technically, Groupware applications on the intranet or Internet side of the firewall reside on different servers and are only periodically connected. Nevertheless, by means of replication between these servers, full data exchange and interoperability remain available for all database applications on one or the other side of the firewall.

4.2 Direct interaction and capturing data from people browsing the web site

Another challenge when managing a Web site is capturing data from people browsing the site and acting upon it. This depicted combination of Groupware and WWW technologies also allows for the next step in the WWW development: It reveals concepts in order to take the Web beyond static pages. Today, most pages contain canned information that can be viewed but not manipulated. With the right programming, however, a page can become interactive - an easy-to-use, fill-in-the-blank system for database queries, for example. Today a specialist has to write procedural language scripts (common gateway interface, CGI) in languages such as *Perl* or *C* to have the browser initiate actions other than just viewing texts and graphics, like querying databases, and presenting the viewer with responses.

The technology used here converts specified forms to HTML. These forms are used and developed by end users during their daily work in the Groupware intranet environment and will be published on the Internet so that someone filling in the form from a web browser will have the form submitted directly to the Groupware intranet database. Because the GroupOffice intranet supports such features as document and workflow management (e.g. triggers, agents and routing) an integration of external users, whose documents would kick off current workflow processes, is a beneficial option. A tight interrelation in workflows of people inside *and* outside an organization is a possible extension of the sketched concept. Not only would Web users trigger *new* workflows by filling in forms, but also could they take on certain minor tasks within a workflow already underway.

4.3 A firewall concept for security in Groupware database environments

While the pure presentation of text and graphic from a static Internet sever is not crucial from security perspectives, an integration and regular update of both intranet and Internet is considered being a risk. This particular fear⁸ of many organizations prevents the intranet from being used widely already. It is commonly agreed upon that the best security from the Internet is to put firewalls between the Internet and intranets, nevertheless trusted by only few organizations. This chapter proposes a combination of both technology and architecture to provide an outstanding firewall. In this particular case, the only connection between the intranet and the Internet is an asynchronous dial-up connection between two servers.

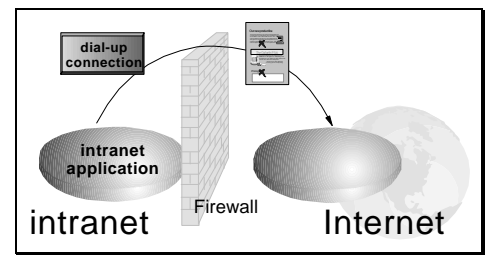


Fig. 2: Secure firewall architecture with dial-up connection between intranet and Internet

For an integration of intranet and Internet organizations may have different policies on the question of openness of intranet applications. They may be completely opened to the public for viewing or interacting, such as the *Library and report management* section in the UniOffice environment (cp. Fig. 1). More likely an organization will lock up certain areas of its intranet to the public and will publish only thoroughly filtered and monitored information, which is nevertheless kept up to date.

4.3.1 Security options: Replication mechanism vs message objects

The setup shown in Fig. 2 leverages the used reference technology to meet these requirements and keep either a replica or a copy of the intranet GroupOffice application in synch on both sides of the firewall. Two main options of transferring data from one application to the other may be feasible: transport by replication or by message objects.

The use of replica applications on both sides of the firewall enables to identify and update identical information objects in the respective applications and to exchange information. „Replicas describe identical objects of the real world. For a replication process an identical copy of a data object will be placed on another node of the computer network“⁹. Any time work is generated on one side of the firewall, i.e. either by the organization's employees and internal users or by external participants via the above described technology, it is transferred to the other replica on the other side of the firewall via this asynchronous connection¹⁰. With this concept a filtering of public intranet information from the private environment may be wanted, making sure that only the information marked public is brought out on the public Internet. Nevertheless, the *entire* private information is kept in the internal database application. It may be argued that, due to technical difficulties, the filtering and selection of information may go wrong and suddenly all internal workflow information may become available publicly on the Internet.

To overcome this danger a solution, which works solely with message objects, presents another option for working with an intranet architecture. In this case the two applications depicted in Fig. 2 are no longer identical replicas but only disconnected copies. The intranet application is still used for document and workflow management but if information is to be published on the Internet these information objects will be manually filtered and *send* as message objects into the respective web application.

⁸ [Heinrich 1996], p. 93

⁹ [Otten/Drira 1993], p.38

¹⁰ For the concept of replication see [Nastansky 1993] or [Lotus 1995]

4.3.2 The scale of security for intranet and Internet interaction

These two options of providing intranet information on the Internet present the two extremes of security and privacy for Groupware intranets: either complete publication of the entire intranet information or full locking-up with messaging. The following figure shows that these two options constitute the furthestmost alternatives on a scale of security for publishing intranet information objects. Depending on the security requirements of information stored and managed in Groupware intranets one or a combination of the different options can be adequate.

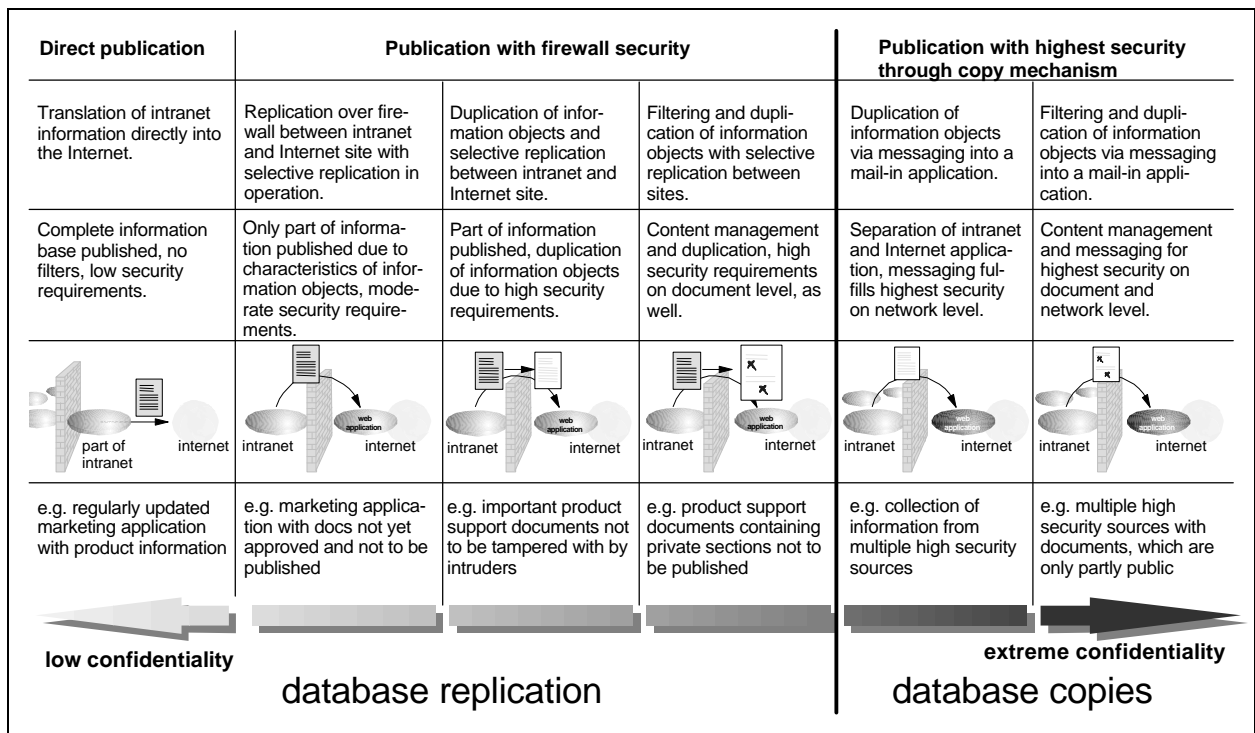


Fig. 3: The scale of security for Groupware intranet/Internet integration

4.3.2.1 Working with database replicas

The leftmost scenario comprises a Groupware application, which will be wholly published to the Internet. In this case no security on the level of information objects is necessary since all information is public. Every information will be presented identically in intranet and Internet and therefore filtering or other security means are unnecessary. A regularly attended white paper, report and literature storage, which holds a company's public marketing documents, graphics, and publications would be an example of such a scenario.

If any of these documents must move through an approval process, whenever they are newly created or changed, an organization might want to hide them from the public until approval. Once a document is approved it is also considered to be public and can be published. This scenario can be covered with selective replication, which allows to prevent documents with *no-approval* status not to be sent over the firewall, yet. Only those that are approved and stated public will be replicated and therefore be available on the Internet.

In a case when even more security is desired and necessary, a concept with document copies, which will be replicated instead of the originals can be of advantage. In this case a copy of each information object will be generated when it is to be published and only these reproductions of the original will be sent out over the

firewall. This concept ensures that even in case of an intruder only copies will be tampered with and the originals remain untouched and safe in the Groupware intranet application.

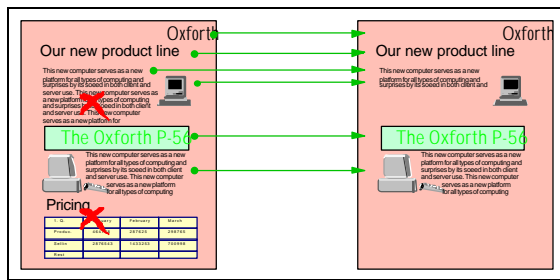


Fig. 4: Document based information filtering

A higher security level can be obtained when combining the *copy-mechanism* with selective replication on the one hand and document based filtering on the other hand. While selective replication adds security in a similar manner as described above, the process of *content management* selects relevant information for each single document. Copying a document for publication includes a process where all information items within the document are run through and the user has to explicitly pick items for publication. A document with new product information

serves as an example in Fig. 4: In the internal workflow this document might function for information purposes about the product’s features, size and color, as well as for a discussion about production costs and selling price. While pure product details are considered to be worth a publication, the cost-benefit analysis is private. When publishing, the first set of items will be chosen, whereas the private type will be left out.

4.3.2.2 Stand-alone database on the Web site

While all previous scenarios are operated on identical replicas at the intranet and Internet side of the firewall, a messaging concept provides a further level of security. A dedicated Web database application will be placed outside the firewall which provides the container for all public Internet information. Any intranet component can now serve as supplier of information objects by simply sending message objects representing a copy of process documents to this externally located application. This concept serves two purposes: First, by only placing a stand-alone database on the Internet side of the firewall, intruders have no access to any replica database, which also exists on the intranet and may contain confidential information. Even if an intruder manages to break into this particular Groupware database on the Web server and to change any potential replication information in it, access to relevant intranet applications will be blocked. Second, this architecture allows for a combination of information from *several* intranet applications, which are primarily not set up to be published. Every intranet Groupware application, whether set up for product or customer support, for financing processes or just for electronic mail can be the source for public documents in the Internet.

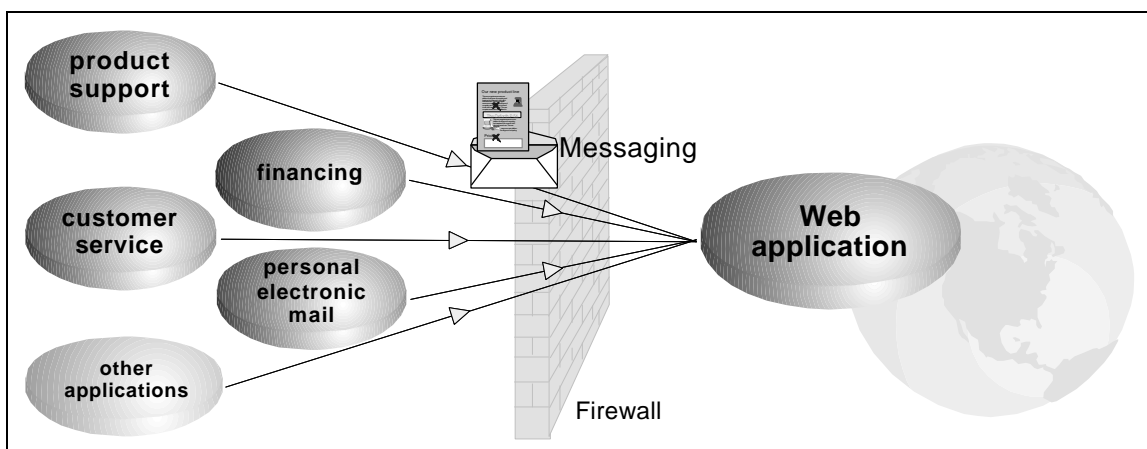


Fig. 5: Sending message objects over the firewall from various Groupware applications

Above, the term *content management* described a process of filtering information on the document level with replication as transportation mechanism. Likewise, message objects can undergo this process and be

filtered before sent to the Web application. This rightmost option on Fig. 3 provides the highest security level attainable: The Web application is a stand-alone database with no resembling replica on the intranet and all information objects are only sent to it, i.e. not replicated. Through this architecture no connection between original and copied information exists, but still regularly updated information can be made available or deleted.

4.3.3 Different options for different purposes

Both, replication based and messaging based information distribution into the Internet have their particular advantages. The use of pure replication allows for transparent workflow plus seamless publication of information from single, dedicated intranet applications. Messaging integrates any Groupware database into the Internet forum without special replication setup and provides highest security at the same time. Thus, replication serves well in an environment where few but selected database applications have to be published fully or to its biggest part on the Internet. Moreover, this concept suits for long-lived information bases with permanent but nevertheless regularly updated information objects. Messaging, in contrast, combines any number of application databases each with few and irregularly emerging public information objects that are not set up to be published completely. These information objects are likely to be short-lived such as announcements or information objects that are only valid until a fixed point of time and need to expire afterwards.

The following section will outline some thoughts of a concept to enable each Groupware intranet application for selective publication on the Internet as it has been touched in section 4.3.2.2.

4.4 The process of selective publication on the Internet via messaging

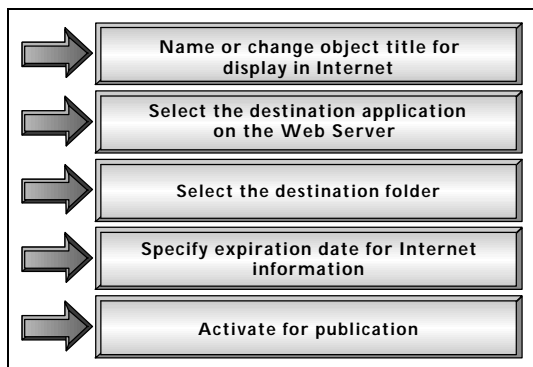


Fig. 6: Publishing information through messaging

Fig. 6 shows the steps of the process to send an information object of a local application database to any Web application for publication. Following these steps, this section will sketch the different instruments necessary to support this procedure.

In this messaging scenario the information object as such is already available. For example, a workflow management application for product support might hold a document describing the updated version of a software package and the status of its implementation. This software update is considered to be relevant information for the Internet, but

the implementation status, in contrast, is top-secret. First, the user would assign a striking title to the document for display in the Internet^①. Second, he needs to specify the destination of the information object. In the concept shown in this paper, the address of the Web application will be specified in each user's configuration document at setup time and can be altered afterwards^②.

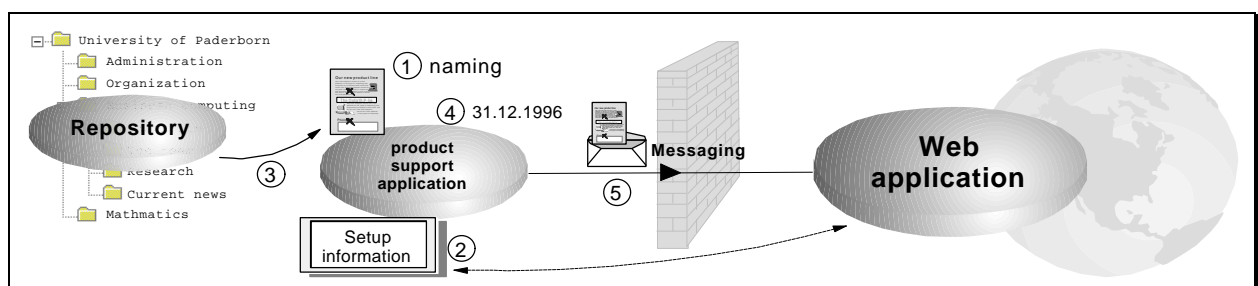


Fig. 7: Steps for publishing information through messaging

As a third step the destination folder needs to be specified. Since all information objects within the Web application may originate from different Groupware applications, a common information structure must be imposed. Of course, each intranet application has its own management structure, but very likely those of different applications will not be alike. Therefore, a repository (cp. section 3.4) for the Web application provides a given structure, which can be revised and extended by the intranet users at their needs^③. In this repository certain information categories will be defined at setup-time and understood as default and generally valid. Below, anybody entitled can add or remove new categories corresponding to newly added information objects. After an expiration date for the information to be published was specified^④, the document can be activated for publication and sent to the Web application^⑤, where it will be sorted into the specified category automatically.

5 Conclusion

With HTML forms support, sites can provide sign-up sheets, surveys, and simple scheduling. As the intranet technologies continue to evolve, the press have been positioning the classical Internet technologies as alternatives to major Groupware applications to such a point that this type of rhetoric only serves to cause confusion concerning the appropriateness of each area of technology. As always, there is not only one possible solution. However, this paper showed that conventional intranet technology can only be used in very specific situations to complement for or as an alternative to such Groupware products. It all becomes a matter of scale, cost, timescale, openness, and taste.

5.1 Summary

This paper has briefly outlined the technology of intranets based on conventional Internet technology as currently discussed widely in the press. The author showed that this intranet approach, although based on widely accepted standards, cannot provide the functionality that is needed to really support intra-organizational processes. Commonly deliberated features such as document creation and management, archiving, retrieval, workflow management, mobile work, or the use of repositories are difficult to realize with Internet technology.

Consequently, the paper has defined the term *intranet* as a computer-based environment, which provides a team with all these characteristics and has loosened its tight association with HTML, Java and so on. The GroupOffice concept has been sketched as an example of how a flexible intranet environment should appear.

Moreover, the paper has criticized the present-day separation of intranet and Internet in organization's technology strategies. A novel architecture, which seamlessly combines Groupware intranet databases and Internet acknowledges the importance of the Internet as a presentation and information distribution environment. The author has outlined the concept of automatically publishing actively used Groupware databases into the Internet. The use of a reference Groupware technology provides with a client-server based replication setup for Internet connectivity and firewall technology. The *scale of intranet/Internet security* described various technical and conceptual options of bringing daily, up-to-date information from teams into the Internet. This concept allows for a variety of publication choices from a completely open replication environment to a fully secured messaging-based scenario. In a scenario where commonly used Groupware applications are translated one-to-one on the Internet, replication serves as the transportation medium. For full featured security, information will be filtered, copied and sent as message objects over the firewall for publication.

5.2 *Is a coexistence of Groupware intranet and Internet technology desirable?*

If an organization wants to implement a solution that provides users with the ability to access and share information with fellow employees, customers, and business partners to manage the flow of information and to structure the internal information base, a Groupware intranet provides a comprehensive, powerful, and flexible answer. However, there are some advantages and benefits that the new intranet technology can deliver to the markets traditionally dominated by Groupware products. For only small-scale intranet solutions, which are rather focusing on information presentation and distribution than on information management as defined in the previous chapters, an intranet with conventional Internet technology equips with a fast, easy and extremely cost effective solution that requires significantly less development time.

Organizations that have already invested in Groupware technology may find that they can benefit from the advances in Web technology, by adopting a strategy of coexistence where both technologies are used. The automatic, seamless and (most importantly) regular conversion of Groupware information objects to HTML as described in this paper, supports such a coexistence strategy. This parallel existence values high since it integrates open standards in a wide variety of vendor and platform independent software with a technology that provides an effective teamwork environment. Concluding, it can be perceived that Internet technology is best placed for external information and document presentation as well as distribution on spread standards, whereas Groupware database intranets are best suited for operative, extensive and secure document, workflow and team management.

One of the main things that an integration of Groupware and Internet will achieve is that it will bring new customers with relevant information into the Web market for collaborative environments.

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Further internet resources

<http://novell.com/idc/nip/nbg2ii.html>

http://webcom.com/wordmark/sem_1.html

<http://www.intranet.co.uk/intranet/intranet.html>

<http://www.strom.com/pubwork/intranet1.html>