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Abstract

The purpose of the thesis at hand is to assess if similar functionality to a Microsoft-only collaboration solution can be achieved using Open-Source software (OSS) on the server as well as on the client. Specifically, the software to be replaced includes Microsoft Exchange Server 2007, Microsoft Office SharePoint Server 2007 and Microsoft Office Live Communications Server 2005 on the server side. For the client the list includes the Microsoft Windows operating system as well as Microsoft Office 2003/2007 and any other client software tailored for use with the server software. A realistic assumption in this undertaking has to be that much of the collaboration will be done over the Internet and not necessarily on a local network. To provide a complete overview, topics such as mobile computing or inadequate hardware support for laptops when using OSS will be included as well.

Kurzreferat

Thema der vorliegenden Arbeit ist zu untersuchen ob mittels Verwendung von Open-Source Software (OSS) die Funktionalität von Microsoft's Software-Kollaborationsprodukten erreicht werden kann. Microsoft Serverprodukte die zu diesem Zweck evaluiert werden sind Microsoft Exchange Server 2007, Microsoft Office SharePoint Server 2007 und Microsoft Office Live Communications Server 2005. Auf der Client-Seite werden das Microsoft Windows Betriebssystem, Microsoft Office 2003 und 2007 sowie weitere, für die Verwendung mit Microsoft's Serverprodukten bestimmte Applikationen, untersucht. Eine realistische Annahme in dieser Diplomarbeit muss sein, dass nicht notwendigerweise innerhalb eines lokalen Netzwerkes kollaboriert wird sondern über das Internet. Um einen Gesamteindruck über das Thema zu geben werden ebenfalls Punkte wie mobiles Arbeiten oder unzureichender Hardware-Support für Laptop-Computer bei Einsatz von OSS behandelt.

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Table of Abbreviations

Apple	Apple, Inc.
BI	Business Intelligence
CD	Compact Disc
DMS	Document Management System
EULA	End User License Agreement
FDS	Fedora Directory Server
GNU	GNU is Not Unix
GPL	GNU General Public License
IE	Microsoft Internet Explorer
IM	Instant Messaging
IP	Internet Protocol
IT	Information Technology
KPI	Key Performance Indicator
LAN	Local Area Network
LDAP	Light-weight Directory Access Protocol
MES	Microsoft Exchange Server
MOC	Microsoft Office Communicator
MOLCS	Microsoft Office Live Communications Server
MOSS	Microsoft Office SharePoint Server
MPA	Microsoft Product Activation
MS	Microsoft
OS	Operating System
OSS	Open-Source Software

OWA	Outlook Web Access
PDF	Portable Document Format
SG	Simple Groupware
VoIP	Voice over Internet Protocol

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1 Introduction

Over the last few decades the economy has started to move away from a traditional manufacturing-based economy to a service-based economy, leading to the formulation of new terms such as “Information Worker” and “Knowledge Management”. During the course of this development the management of information has become one of the most important objectives for organizations of any kind. IT has a leading role in achieving this objective and continues to offer new ways of organizing data, information and knowledge. One key area experiencing rapid growth is collaboration using IT within organizations. It is no longer only email, often described as the killer application of the Internet, but VoIP, application sharing, and video-conferencing that are increasingly being used by organizations. Microsoft, predominantly known for its operating system and office software, also offers software applications which provide collaboration functionality such as Microsoft Exchange Server (MES), Microsoft Office SharePoint Server (MOSS), and Microsoft Office Live Communications Server (MOLCS) with corresponding software on the client. But there is some software, e.g., Skype¹ or Collanos Workplace², which provides part of this functionality for free and OSS which has gained momentum on both the server and on the client over the last years. Microsoft’s collaboration software is highly integrated with existing Microsoft products offering a consistent user experience. The purpose of this thesis is to assess if a similar user experience and functionality can be accomplished using OSS on the server as well as on the client.

1.1 OSS licenses

There are many different licenses in the OSS world, e.g., the GNU General Public License³, the Mozilla Public License⁴, the Apache License⁵, the BSD⁶ license and others. To avoid the different legal implications these licenses have the focus will be on the general

¹ Skype – <http://www.skype.com>

² Collanos Workplace – <http://www.collanos.com>

³ GNU General Public License – <http://www.gnu.org/copyleft/gpl.html>

⁴ Mozilla Public License – <http://www.mozilla.org/MPL/MPL-1.1.html>

⁵ Apache License, Version 2.0 – <http://www.apache.org/licenses/LICENSE-2.0.html>

⁶ BSD license – <http://www.opensource.org/licenses/bsd-license.php>

criterion that the source code is available for everyone and that the software may be modified to adapt it to specific uses.

1.2 Synopsis

Sections 2.1.1 to 2.1.3 take a quick look at two major new releases from Microsoft in the past year: Microsoft Windows Vista and Microsoft Office 2007, both released on January 30th, 2007. The next section will cover Microsoft's collaboration products on the server and their corresponding client applications. The objective of this section will be to provide a list of requirements for collaborative software. The third and main section is analyzing OSS for its adequacy in fulfilling these requirements. The fourth section covers additional topics, e.g., problems with hardware support under Linux when using laptop computers, and mobile phones. A fifth and final section offers a conclusion based on the preceding sections. To test and review the software discussed in this thesis virtual machines⁷ have been used. VMWare Workstation⁸ 6.0 and Microsoft Virtual PC 2007⁹ allowed the installation of different guest OSs on one host OS. Microsoft provides some products in a virtualization file format¹⁰, some of which were used in the creation of this work.

⁷ Virtual machine – http://en.wikipedia.org/wiki/Virtual_machine

⁸ VMware Workstation – <http://www.vmware.com/products/ws/>

⁹ Microsoft Virtual PC 2007 – <http://www.microsoft.com/windows/downloads/virtualpc/default.msp>

¹⁰ “Run IT on a Virtual Hard Disk” – <http://www.microsoft.com/technet/try/vhd/default.msp>

2 Requirements analysis

The term collaboration is a very broad term and there is no exact definition for it in the context of IT. However, some key areas in which IT helps people work together can be identified easily:

- **Content Management:** Ability to classify and organize resources (in most cases documents) including functions such as versioning and check-in/check-out.
- **Communication:** Several forms of electronic communication, e.g., email, instant messaging, VoIP, and video conferencing, at best integrated into one or two programs.
- **Calendaring and Scheduling:** Allowing the automatic scheduling of meetings without having to manually seek approval.
- **Portals:** A place for workers to quickly look up their current tasks and any information they need to complete those tasks.

This list will be considered when reviewing Microsoft's collaboration-oriented software. The result will be the criteria for which we will be looking in OSS.

2.1 Software to be reviewed

Microsoft covers the collaboration areas listed above with the following tools:

- On the server:
 - Microsoft Exchange Server 2007 for email, calendaring, contacts, tasks
 - Microsoft Office Live Communications Server 2005 for instant messaging and conferencing
 - Microsoft Office SharePoint Server 2007 for document management and workflow management
- On the client:
 - Microsoft Windows Vista
 - Microsoft Office (mainly Microsoft Office Outlook)
 - Microsoft Office Communicator
 - Internet Explorer (as main front-end for the Sharepoint Server)

The following section will provide a detailed overview of these products.

2.1.1 Microsoft Windows Vista

Since the release of Microsoft Windows Vista and the suite of Microsoft Office 2007 applications in January 2007 many companies and institutions are faced with the question of whether to upgrade or look for other solutions in supporting their business models. Windows Vista, although being heavily promoted by Microsoft, has received mixed reviews¹¹ by most well-known publications in the IT industry which led many companies to consider an upgrade very carefully. E.g., an upgrade to Microsoft Windows Vista in most cases will also require hardware upgrades to enable new features such as the new user interface called “Aero”. Since, at least for most corporate users, this will be the only clearly visible enhancement¹² compared to Microsoft Windows 2000/XP companies are more than reluctant to spend money on Vista. Although Vista includes many new applications (Windows Calendar, Windows Contacts, Windows Sidebar, Windows Games Explorer and Premium Games, Windows Media Center, Windows Media Player, Windows Photo Gallery) these are often not relevant for typical office workers. Those use task-specific software such as (in most cases) Outlook which was designed to interact with MS server software to manage email, contacts, and appointments rather than software built in the OS.

Another point against Vista is its compatibility with older versions of Windows. Some companies use applications that will not install or not perform adequately on Windows Vista – upgrading those would make the move to Vista even more expensive. That is why some companies and institutions have, at least until further evaluation, simply banned Vista from their infrastructure.¹³ According to a study by “AssetMetrix”¹⁴ from July 2005 Windows 2000 was then still running on 48% of all business PCs. Although this number was probably lower in January 2007 some Windows 2000 applications won’t run unmodified on Vista so those businesses still using Windows 2000 need great incentives to upgrade. Alternately, Microsoft could force these companies to upgrade by not making avail-

¹¹ "A reality check for Vista" – http://money.cnn.com/2006/09/07/technology/Reality_check_Vista.biz2/index.htm?cnn=yes

¹² "Windows Vista Hinders Users' Efficiency Even More than Windows XP Did" – http://www.it-enquirer.com/main/ite/more/pfeiffer_vista/

¹³ "Microsoft Hit By U.S. DOT Ban On Windows Vista, Explorer 7, and Office 2007" – <http://www.informationweek.com/news/showArticle.jhtml?articleID=197700789>,

¹⁴ "The slow road to Windows XP" – http://news.com.com/The+slow+road+to+Windows+XP/2100-1016_3-5746046.html?part=rss&tag=5746046&subj=news

able new software on Windows 2000. One example is Microsoft Internet Explorer 7 not being available for Windows 2000.

2.1.2 Windows Vista: security and privacy concerns

Finally, Windows Vista is plagued by security and privacy concerns. Microsoft is trying to combat piracy of its operating system through Microsoft Product Activation¹⁵ (MPA). MPA connects to a Microsoft server after installation to check if the entered product key is genuine and at certain time intervals to check if Windows is still on the same computer on which it was installed. During activation, Windows transmits “the version, language and product key of the software, the IP address of the device, and information derived from the hardware configuration of the device.”¹⁶ Although Microsoft states that they will not use the information obtained through activation to identify or contact users the IP address alone is enough in many cases to identify a user. According to Microsoft, during the use of Windows Vista’s services (and also when MPA connects to Microsoft again after certain time intervals) the OS collects “standard computer information”¹⁷ and transmits them to Microsoft. This standard information “includes information such as your IP address, operating system version, browser version, your hardware ID which indicates the device manufacturer, device name, and version and your regional and language settings.”¹⁷ This is arguably a lot of information and many users wonder why Microsoft is collecting it. Obviously, these concerns are mitigated in the OSS world since OSS allows everyone to take a look at the inner workings of the software.

2.1.3 Microsoft Office 2007

In contrast to Windows Vista, Microsoft Office 2007 has received much better reviews. Microsoft Office 2007 shows far more differences compared to its predecessor Microsoft Office 2003 than Windows Vista compared to Windows XP. Microsoft claims that most users only use a small fraction of all MS Office program features, so the decision was made to make the most-used features more accessible. As a result, Microsoft redesigned

¹⁵ “Protect Yourself from Piracy” – <http://www.microsoft.com/piracy/mpa.aspx>

¹⁶ “Find License Terms for Software Licensed from Microsoft” – <http://www.microsoft.com/about/legal/useterms/default.aspx>

¹⁷ “Windows Vista Privacy Statement” – http://www.microsoft.com/windowsvista/privacy/vistartm_full.msp#pi

the user interface to create a new menu bar which changes its layout and the options displayed according to the actions of the user. Still, users need some training to use the new MS Office 2007 which will result in additional costs for companies.

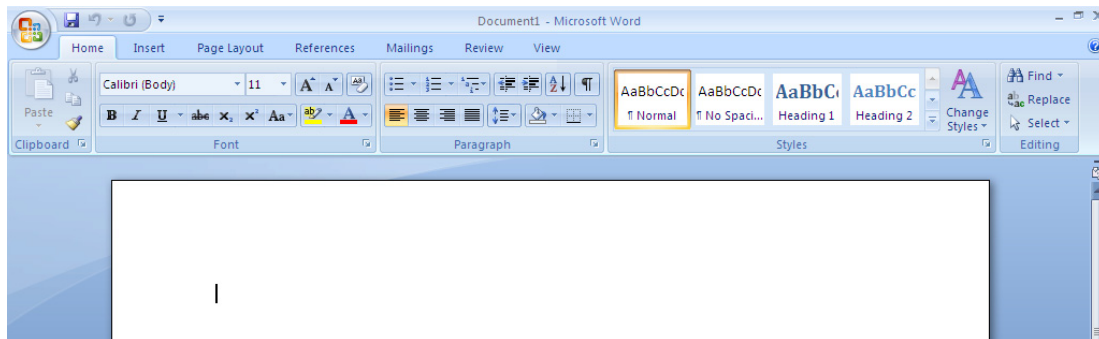


Figure 1: A Word 2007 screenshot. Note that the traditional “File”, “Edit” and so on menus have been replaced with tabs.

2.1.4 Microsoft Office SharePoint Server

Microsoft introduced Sharepoint Server in early 2001 as a document management and indexing application. This version allowed only limited interoperability with existing MS products partly because it was the fusion of products which MS had acquired from other software vendors. Version 2003 was the first version integrated with MS’ existing office products such as Word, Excel, PowerPoint and Outlook. Since Microsoft Office already had a very high market penetration it was becoming more and more difficult to generate revenue from this market. MOSS was therefore marketed as a logical extension of the MSS Office suite. Another important reason was that up until then, Microsoft Office products had no server side – they were isolated from the rest of the organization. MOSS is now the corresponding server product to the Office suite. With the introduction of the current version of MOSS Microsoft labeled their office products line-up “Microsoft Office System”.

2.1.4.1 Features

The main features of MOSS 2007 according to [Engl07] grouped by components and commented are:

- Portal: A webpage which combines information such as news from various sources to provide the user with a single location to access all the information needed to do their jobs.

- My Site: See Section 2.1.4.3.
- Search: A very powerful search and indexing engine which can index nearly any type of content (even content which is not on the SharePoint site).
- Content Management
 - Integrated document management and Records management: MOSS 2007 provides organizations with a single location for all documents and records and makes it possible to comply with legal requirements organizations face (e.g., Sarbanes-Oxley Corporate Governance regulations¹⁸).
 - Web content management with policies and workflow: SharePoint allows for the creation of a public-facing web site (MOSS 2007 completely replaces the Microsoft Content Management Server 2002¹⁹). A simple workflow model allows for approval routing.
- Business Forms: Using the Office Forms Server 2007, which is part of MOSS 2007, organizations can gather data through web-based forms (i.e., using only a browser as the client application) with features such as data validation at the time of entry.
 - Business Intelligence²⁰: The BI features of MOSS 2007 can only be used effectively with MS Office 2007 and MS SQL Server 2005.²¹ One focus lies on the integration of Excel with server-based services called Microsoft Office Excel Calculation Services where spreadsheets can maintain a connection to their data source (e.g., MS SQL Server). Other features are not relevant since they demand software not relevant in the context of this thesis.
- Collaboration
 - Documents, tasks, and calendars: See Section 2.1.4.4.
 - Blogs²² and Wikis²³
 - Email integration with MS Exchange Server: E.g., Inbox can be displayed as part of the “My Site” feature.

¹⁸ Sarbanes-Oxley – <http://www.sarbanes-oxley.com/>

¹⁹ Microsoft Content Management Server 2002 – <http://www.microsoft.com/cmserver/default.aspx>

²⁰ Business Intelligence – http://en.wikipedia.org/wiki/Business_intelligence

²¹ Microsoft SQL Server 2005 – <http://www.microsoft.com/sql/default.aspx>

²² Blog – <http://en.wikipedia.org/wiki/Blog>

²³ Wiki – <http://en.wikipedia.org/wiki/Wiki>

- Outlook integration: Outlook can automatically access MOSS 2007 and synchronize your assignments and appointments on the server with your local ones.

2.1.4.2 Selected features of Microsoft Office SharePoint Server

To provide a detailed explanation of every feature of MOSS obviously goes beyond the scope of this thesis. Instead, a few key features most relevant for effective collaboration will be highlighted. Besides communications-related features, which will be left out since those will be provided by MES and Microsoft Office Live Communications Server, the most important features of MOSS are the ability to collaborate on documents and to have a personalized page which provides a user with his current tasks and documents.

2.1.4.3 My Site

A very useful feature of MOSS is the “My Site” feature. After a user has signed in to MOSS he can click on “My Site” to view a personalized page. This page features the user’s documents, the tasks he has been assigned and it can also be integrated with MES to show the user’s calendar and email.

2.1.4.4 Document Management and Document Workspace

MOSS incorporates a document management system called “Document Libraries”. They represent the standard way of storing documents (documents can also be stored as attachments in other lists). In addition to a site-wide document library a user is allowed to have personal documents only visible to the administrator and the user. Another folder, “Shared documents”, contains documents visible to everyone logged on. A particularly useful feature in this context is the creation of common workspaces from documents. To do so, a user clicks on a document and selects “Send To” and on the appearing submenu “Create Document Workspace”. In the resulting workspace the user can then add more documents, assign tasks to other users, and post links – obviously very useful for collaborating on documents.

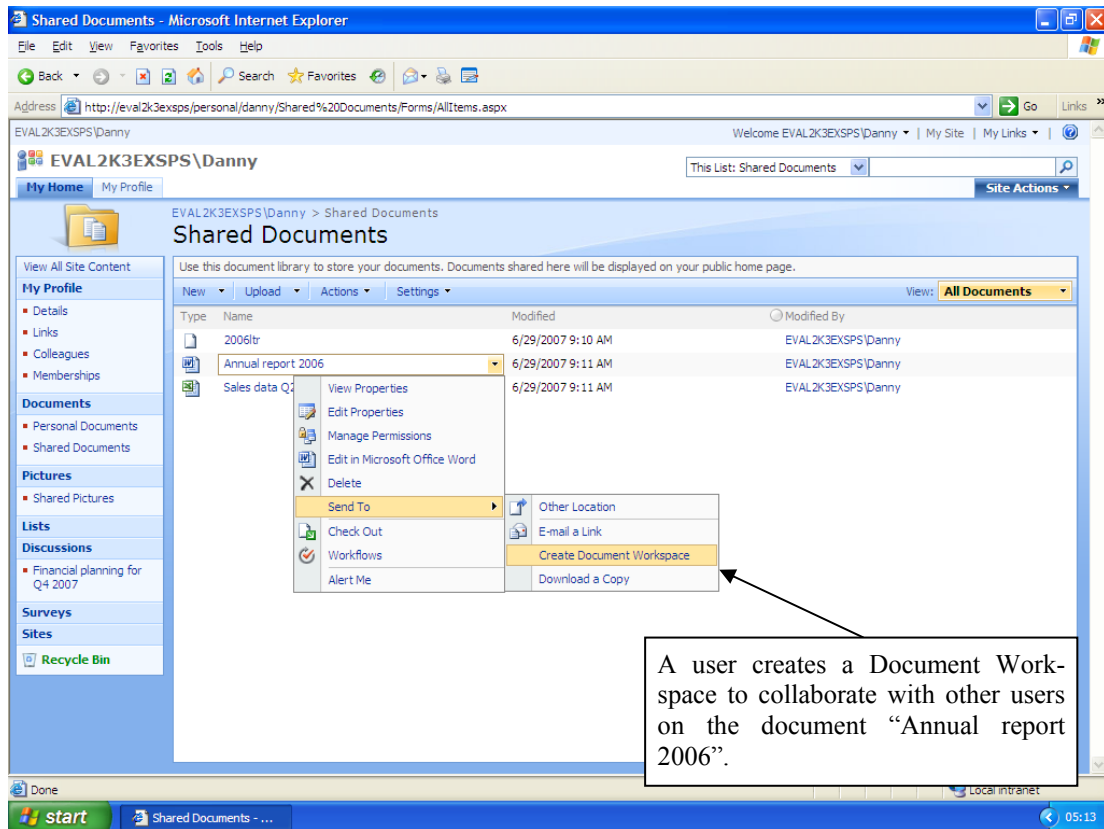


Figure 2: Creating a Document Workspace

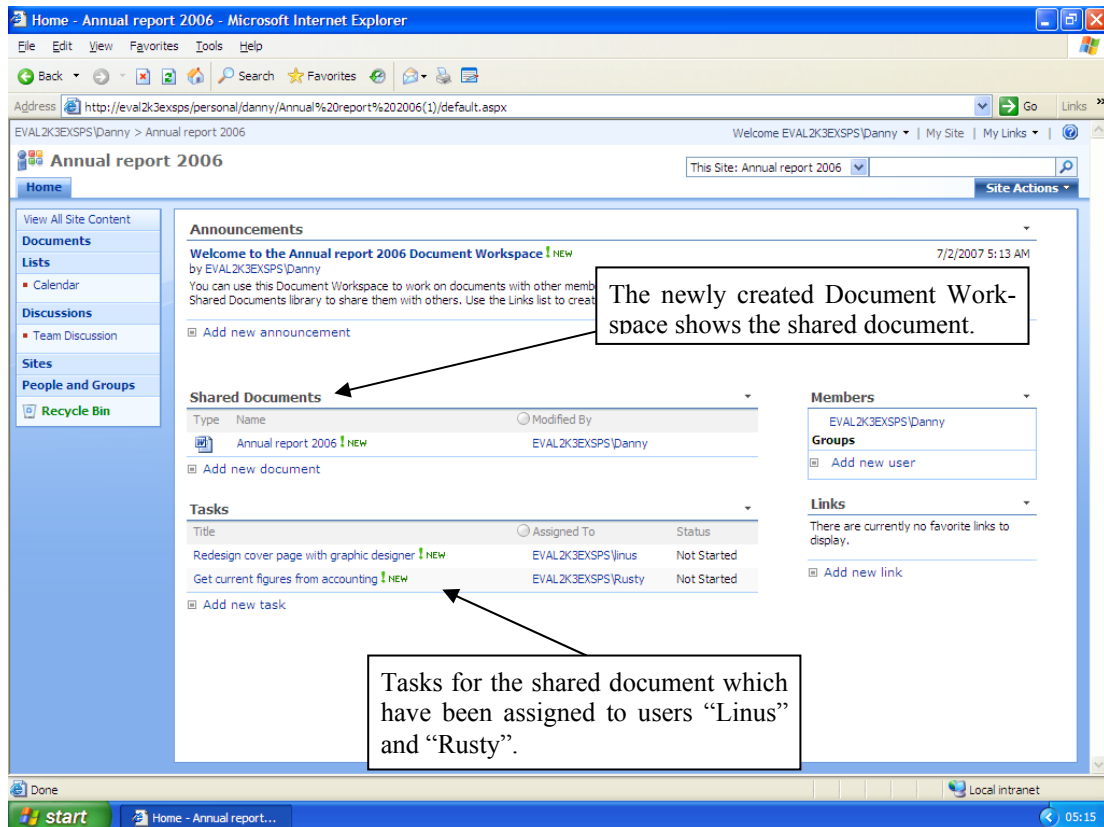
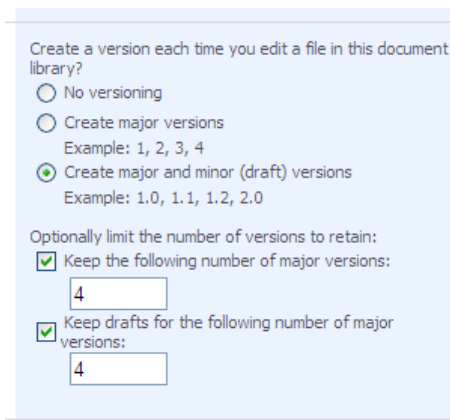


Figure 3: The new Document Workspace

An important feature considering the loss of work due to multiple users working on the same document is versioning. Document libraries feature versioning which can be configured as shown in the next figure. Settings are being inherited but can be set for each document library separately.



Create a version each time you edit a file in this document library?

No versioning

Create major versions
Example: 1, 2, 3, 4

Create major and minor (draft) versions
Example: 1.0, 1.1, 1.2, 2.0

Optionally limit the number of versions to retain:

Keep the following number of major versions:

Keep drafts for the following number of major versions:

Figure 4: Document library versioning settings

Microsoft stresses that MOSS' document management is not designed to replace a file-server storing thousands of documents. Although it is possible, Microsoft recommends no more than 2000 documents per folder. A higher number would result in a poor user interface experience and even 2000 documents per folder might degrade performance and make browsing such a large library challenging.

2.1.5 Microsoft Exchange Server

Microsoft Exchange Server (MES) is a communication platform for email, shared calendaring, contacts and tasks, and access via Microsoft Outlook²⁴, a mobile phone or the web. The current version (Microsoft Exchange Server 2007) added major new features such as remote document access via Outlook Web Access (OWA) and voice access. We will focus on the communications features of MES since we are already using MOSS to cover relevant document management features.

²⁴ Microsoft Outlook – <http://office.microsoft.com/en-us/outlook/FX100487751033.aspx>

2.1.5.1 Selected features of Microsoft Exchange Server

Again, a detailed analysis of all MES features goes beyond the scope of this thesis, so it makes sense to select only relevant features which MOSS does not provide, such as email, calendaring, and contacts. Particularly interesting are the web-based features since MES makes great use of new web technologies such as AJAX to provide a nearly feature-complete interface compared to Microsoft Outlook.

2.1.5.2 Web-based features: OWA, Search, and Remote Document Access

Web-based access to information has become very important since browsers have become ubiquitous, offering a new interface to an organization's data. MES features Outlook Web Access which, used in conjunction with Microsoft Internet Explorer, offers a rich-client like experience over the Internet. Starting with MES 2007, users' inboxes are fully indexed and can be searched via the OWA interface. Remote Document Access allows MES to retrieve documents from an MOSS site. If a user receives a link to a document via email, MES can automatically load and display it. Since MES can convert Microsoft Office documents and PDF²⁵ files to HTML, Remote Document Access can show the contents of an attachment in IE without transmitting the actual document to the user's computer, which is an important feature with regards to security.

2.1.5.3 Resource Booking Attendant

In MES resources can have mailboxes to make them available for booking. Resources can be many different things such as a meeting room, a projector or other equipment. When a user is trying to book a resource (i.e., send it an email just like every other attendee) it can auto-accept or decline, giving an appropriate explanation. It is also possible to have policies governing those resources, e.g., meeting room A is available only between 8 a.m. and 11:30 a.m.

²⁵ Portable Document Format – http://www.adobe.com/devnet/pdf/pdf_reference.html

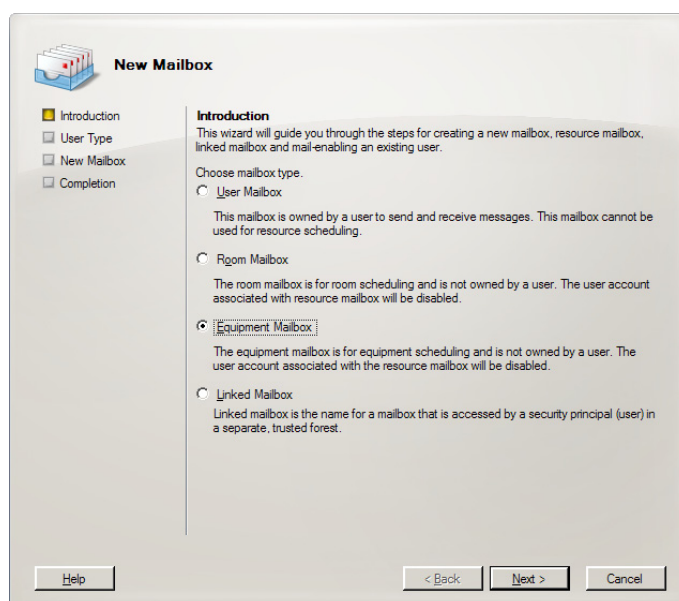


Figure 5: Equipment and rooms are represented by mailboxes and can accept or decline invitations based on pre-set policies.

2.1.5.4 Calendar Attendant

The Calendar Attendant is a tool that helps coordinate meetings. If a user invites another user he will have a tentative entry in his calendar until he accepts or declines. It also automatically updates entries to correspond to the latest invitation, thus reducing scheduling conflicts.

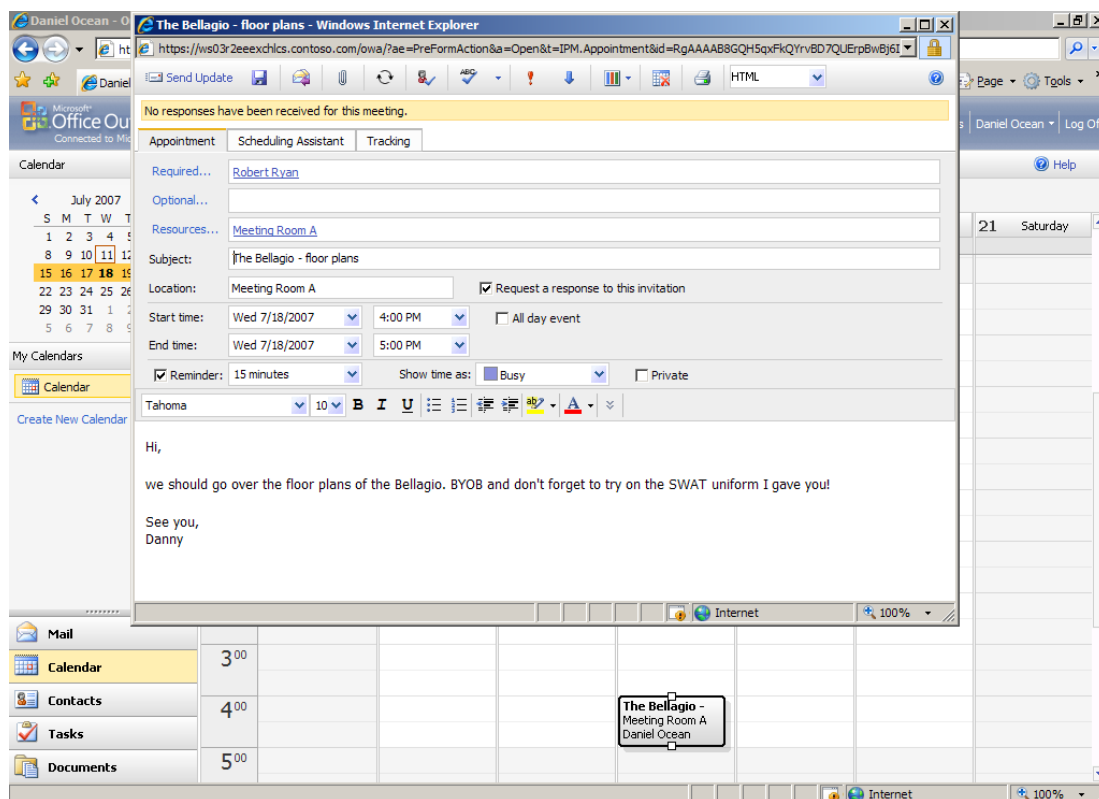


Figure 6: Meeting request. Note that a resource (Meeting Room A) is also booked

2.1.5.5 Mobile Messaging: Search and Direct Push

MES offers two very important new features for users of the Windows Mobile²⁶ (see Section 4.2.3) operating system. The development of desktop search engines over the last few years has shown that a good search infrastructure is necessary for today's organizations to compete. Likewise, mobile devices such as Smartphones²⁷ or Pocket PCs²⁸ are becoming more popular in corporate environments. MES allows users of Windows Mobile devices (in addition to searching data stored on the local device) to search their complete mailbox on the server. Another important feature, which, for a long time, was only available on RIM's²⁹ BlackBerry³⁰ devices, is Direct Push³¹, the automated delivery of new messages to a mobile device.

²⁶ Windows Mobile – <http://www.microsoft.com/windowsmobile/default.mspx>

²⁷ Smartphone – <http://en.wikipedia.org/wiki/Smartphone>

²⁸ Pocket PC – <http://www.microsoft.com/windowsmobile/default.mspx>

²⁹ „Research in Motion“ – <http://www.rim.com>

³⁰ BlackBerry – <http://www.blackberry.com>

³¹ Push email – http://en.wikipedia.org/wiki/Direct_push

2.1.5.6 Out-of-Office settings

MES allows users to schedule Out-of-Office mail settings in advance. Although this might seem trivial it is a huge benefit when working in an organization where you have to collaborate with people in different locations.

2.1.6 Microsoft Office Live Communications Server

MOLCS is Microsoft's entrance into the market for instant messaging solutions. IM has become hugely popular over the past years and many users have more than one IM account with different service providers. Popular services are ICQ³², MSN³³, and Skype¹. IM offers advantages over other forms of communication in terms of productivity and Microsoft tries to realize profit from organizations recognizing the trend to IM and unified messaging software. MOLCS is designed for use with a client application, Microsoft Office Communicator 2005 (MOC) and together they provide the following functionalities:

2.1.6.1 Instant messaging, voice and video, and file transfer

The main feature of MOLCS together with MOC is instant messaging for reasons discussed above. In addition, it also offers voice and video communication and conferencing. A useful feature is the ability to transfer files directly to another user – often quicker than using email – to, e.g., let someone take a quick look at a presentation to discuss it.

2.1.6.2 Microsoft Outlook integration

MOC can be integrated with Microsoft Outlook to let other users know if a person is available now and, if not, when they will become available again. MOC accesses the user's MS Outlook data and sets the user's status accordingly.

2.1.6.3 Application sharing

A rather new way of collaborating is actually sharing an application with another user as if they were sitting in front of it together. MOC allows you to select an application to share, e.g., Microsoft Excel and both users see the program on their screens and are then able to

³² ICQ – <http://www.icq.com>

³³ Windows Live Messenger – <http://im.live.com/messenger/im/home/?source=MSNTDLINK>

work with it. A parallel voice conversation using the VoIP feature in addition to application sharing allows for very effective collaboration.

2.1.6.4 PBX and PSTN³⁴ integration

MOLCS and MOC can be integrated with a PBX³⁵ solution and configured to allow Computer-to-Phone calls and to control existing office phones (if supported). More and more companies move to so called unified messaging solutions to lower costs and make their workforce more productive.

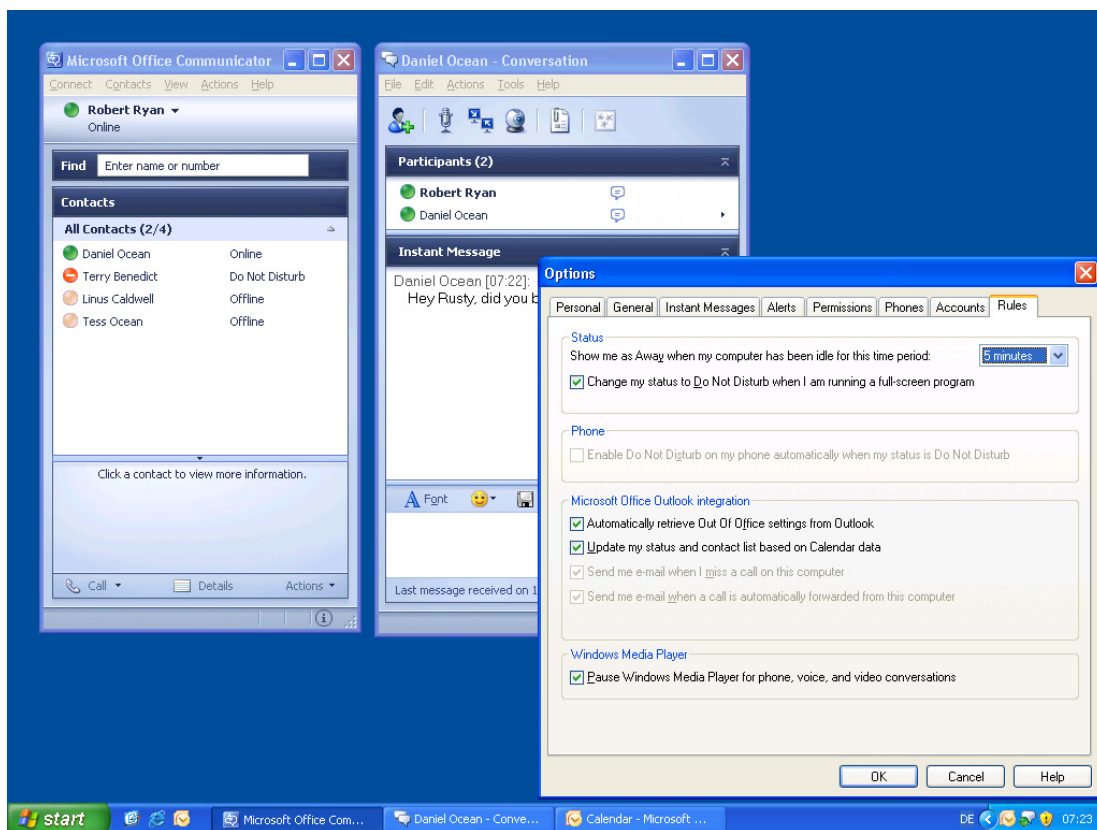


Figure 7: Screenshot showing the Microsoft Office Communicator, a conversation window and the Options window

³⁴ Public switched telephone network – <http://en.wikipedia.org/wiki/Pstn>

³⁵ Private branch exchange – <http://en.wikipedia.org/wiki/Pbx>

2.2 Conclusion and final requirements

Although the Microsoft products reviewed here have many more capabilities and features than the ones mentioned, not all of them are relevant and some are rather difficult to use. The following list will be the basis for our requirements:

- Email
 - A client program: although web interfaces are becoming more sophisticated due to new technologies such as AJAX³⁶ a user should have a rich client application installed on his computer.
 - It should be possible to mail a link to a document in the DMS instead of the actual file (e.g., to have a document approved).
 - A webmail client integrated with the email client application on the user's computer so users can switch from one to the other depending on his location or the task at hand.
- Portal: A user should have a single place to look up his or her tasks and information - alternatively, this could be integrated in the email application, its web interface or the DMS.
- Document management: A good collaboration solution cannot exist without document management. The two most important requirements are versioning and check-in/check-out functions.
- Instant messaging: Users have to be able to communicate instantly using text messages. It would be nice if the IM application also supports voice and video and allows users to call PSTN phones (see below).
- VoIP and video communication: For more complex issues VoIP and video communications might be necessary.
- Possibly application sharing: Depending on the user's work the ability to share one's screen might be desirable.

³⁶ Asynchronous JavaScript and XML – <http://www.w3.org/TR/2006/WD-XMLHttpRequest-20060619>

3 OSS replacements

To replace Microsoft's software on the server and the client an OSS replacement needs to be versatile enough to perform on both levels. The most obvious choice is Linux since it is OSS itself and the only alternative with a large community of users and developers to be used effectively. Linux will continue to gain market share and acceptance since it offers companies a way to provide their clients with complete solutions dismissing the ubiquitous, underlying Windows operating system. Examples include Novell³⁷ with the SUSE Linux Enterprise Desktop and SUSE Linux Enterprise Server products and Red Hat³⁸ with their Red Hat Enterprise Linux product line.

Another operating system which is (again)³⁹ starting to gain market share again is Sun Microsystems's Solaris. Sun has adopted its own open-source model (CDDL⁴⁰) resulting in the OpenSolaris community. Sun is making the source code of its operating system available via the OpenSolaris website where volunteers contribute to it and later on integrates the result into official releases of their Solaris operating system. Additionally, Sun has started free shipping of official Solaris release DVD's and OpenSolaris releases targeted at developers to anyone interested free of charge. So far, this has proven to be very successful and Sun claims the number of Solaris installations is rising fast and the number of licenses has multiplied from little over one million in June 2005 (when it was released under the new license model) to over five million. There are some barriers such as lack of hardware support for laptops but the growing OpenSolaris community is rapidly taking care of those shortcomings and it will be interesting to see how Solaris evolves and competes in the market.

³⁷ <http://www.novell.com/>

³⁸ <http://www.redhat.com/>

³⁹ Sun Microsystems was very successful during the "Dot-com" boom in the last years of the 20th century, providing many start-ups with server systems but suffered heavy losses, financially as well as considering market share when most of those start-ups went out of business. In 2007 Sun returned to profitability and is again rapidly strengthening its position as a vendor of complete server solutions through innovative systems design and the still pristine reputation of the Solaris operating system.

⁴⁰ Common Development and Distribution License – <http://www.sun.com/cddl>

3.1 Brief history of Linux

Linux initially was the result of two initiatives: Richard Stallman's GNU⁴¹ project and Linus Torvald's project to write a kernel⁴² specifically tailored to the x86⁴³ platform. Linus Torvald changed the license for his kernel to the GPL and then Linux and GNU developers could integrate the tools provided by the GNU project (compilers, editors, a shell, and the X Window System) with Torvald's kernel to create the Linux operating system.

3.2 Linux distributions

Since the components of Linux are available to everyone for free there are many different Linux distributions, each catering to a specific audience and with users often only committed to their distribution of choice. Users, though, can only benefit from networking effects if there are enough other users using the same or a very similar distribution. The most widely used Linux distribution according to Distrowatch⁴⁴ by far and for some time now is Ubuntu⁴⁵ by Canonical Ltd.⁴⁶, making it the obvious choice for use in this thesis. Additionally, Dell⁴⁷ has recently started to sell computers pre-installed with Ubuntu and officially supporting it, making Linux more easily available and a more secure choice for companies.

Canonical Ltd. was founded in 2004 and released the first version of Ubuntu in October of the same year. The company offers commercial support for Ubuntu installations, increasing the OS' attractiveness to companies. Version numbers in Ubuntu always consist of the year and month of the time of the release, e.g., Ubuntu 7.10 is the current version released in October of 2007.

⁴¹ GNU project – <http://www.gnu.org>

⁴² Kernel – http://en.wikipedia.org/wiki/Kernel_%28computer_science%29

⁴³ X86 architecture – <http://en.wikipedia.org/wiki/X86>

⁴⁴ Distrowatch: Put the fun back in computing – <http://distrowatch.com/>

⁴⁵ Ubuntu Linux – <http://www.ubuntu.com/>

⁴⁶ Canonical Ltd. – <http://www.canonical.com/>

⁴⁷ „Dell Unveils Three Consumer Systems Featuring Ubuntu 7.04” –

http://www.dell.com/content/topics/global.aspx/corp/pressoffice/en/2007/2007_05_24_rr_000?c=us&l=en&s=corp

3.3 Graphical user interfaces for Linux

When using MS Windows there is a default graphical user interface that consists of such elements as the desktop, the taskbar and the “Start” menu to name just a few. In Linux, however, there are many different graphical user interfaces which can differ very much. Some of those try to mimic the Windows user interface, others have their own ideas about how a user interface should look like. But there are two which by far are the most widely adopted in the Linux world.

KDE was founded in October 1996 under the name “Kool Desktop Environment” and was focused on replicating the “Common Desktop Environment”⁴⁸ – hence the name. It is based on the “Qt” toolkit by Trolltech⁴⁹ which at the time was proprietary software (but is no longer, Trolltech has released Qt for Linux under the GPL⁵⁰).



Figure 8: The KDE desktop (still 3.5 since 4.0 is not yet included in Ubuntu)

KDE was originally criticized for being based on proprietary software which led to the formation of the GNOME project in 1997. GNOME used the LGPL⁵¹ based GIMP toolkit (GTK+) which allowed programs based on it many different license models. GNOME is currently at version 2.18 with small, incremental changes being made over time (in con-

⁴⁸ <http://www.opengroup.org/cde/>

⁴⁹ “Code Less, Create More – Trolltech” – <http://trolltech.com/>

⁵⁰ GNU General Public License – <http://www.gnu.org/licenses/gpl.html>

⁵¹ GNU Lesser General Public License – <http://www.gnu.org/licenses/lgpl.html>

trast to KDE where there have been significant rewrites following the development of the underlying Qt toolkit).

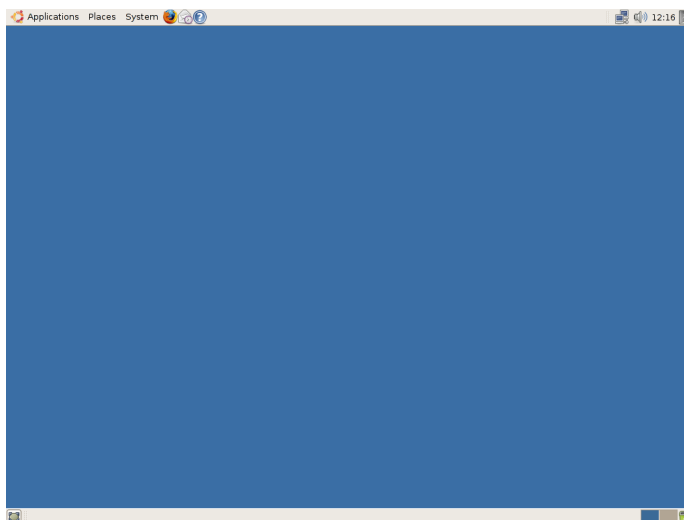


Figure 9: The Gnome desktop

3.4 Client software

Although web-based access to email, calendars, files and other resources is important there are a number of client applications for the Linux desktop that could replace Microsoft Outlook and Microsoft Office Communicator, as well as other Microsoft Office products such as MS Word, MS Excel and MS PowerPoint. This list includes (for both the GNOME and the KDE desktop):

- Novell Evolution (PIM⁵² for GNOME)
- Kontact (PIM for KDE)
- OpenOffice.org office suite
- Ekiga (Softphone for GNOME)
- Twinkle (Softphone for KDE)
- Browser (Mozilla Firefox or Konqueror)

It is important to keep this list short since users usually need training to use new software, resulting in additional costs for an organization. The less applications a user needs to fulfill his function and be productive, the better it is for the organization.

⁵² Personal Information Manager – http://en.wikipedia.org/wiki/Personal_information_manager

3.4.1 Novell Evolution

Evolution was originally developed by Ximian before the company was purchased by Novell, Inc. Novell calls it a “personal information manager” and “workgroup information management tool”. It is programmed using GTK+ and therefore targeted at the GNOME desktop environment. The user interface is designed to be very similar to that of Microsoft Outlook, for obvious reasons. Evolution can use a Microsoft Exchange Server using proprietary, commercial add-ons but supports many standards such as IMAP⁵³, POP⁵⁴, SMTP⁵⁵, Authenticated SMTP, and LDAP⁵⁶. Another interesting feature is that Evolution can be synchronized with Palm Pilot devices (using `gnome-pilot`), mobile phones and other PDAs (using `OpenSync`).

3.4.2 Kontact

Kontact is a personal information manager with a feature set similar to the one of Evolution. It is programmed using the Qt-toolkit and part of KDE. Kontact is actually a container for various existing KDE applications such as KMail, KOrganizer and others. Supported standards include IMAP, POP3, SMTP, and LDAP. Whereas Novell Evolution targets rather existing MS Exchange environments, Kontact supports various other groupware such as Kolab, Open-Xchange, eGroupware, Citadel, and Novell Groupwise.

The following figures provide a comparison of the Novell Evolution

⁵³ Internet Message Access Protocol – <http://tools.ietf.org/html/rfc3501>

⁵⁴ Post Office Protocol – <http://tools.ietf.org/html/rfc1939>

⁵⁵ Simple Mail Transfer Protocol – <http://tools.ietf.org/html/draft-klensin-rfc2821bis-04>

⁵⁶ Lightweight Directory Access Protocol – <http://tools.ietf.org/html/rfc4511>

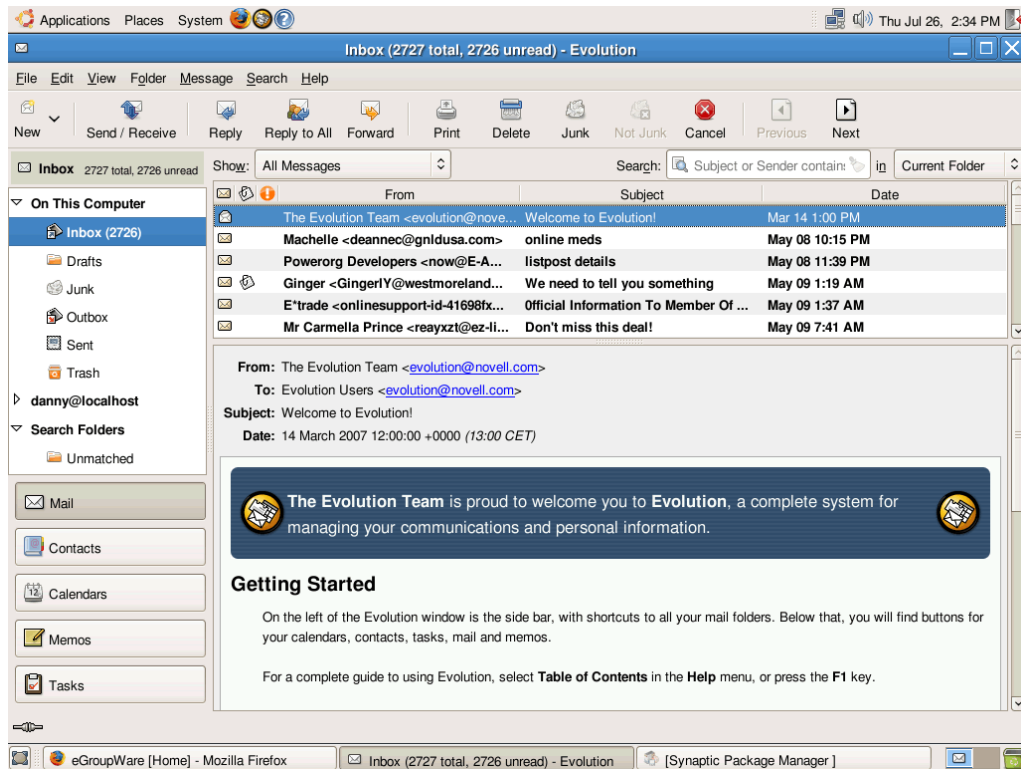


Figure 10: Novell Evolution. Notice the program interface's similarity to MS Outlook

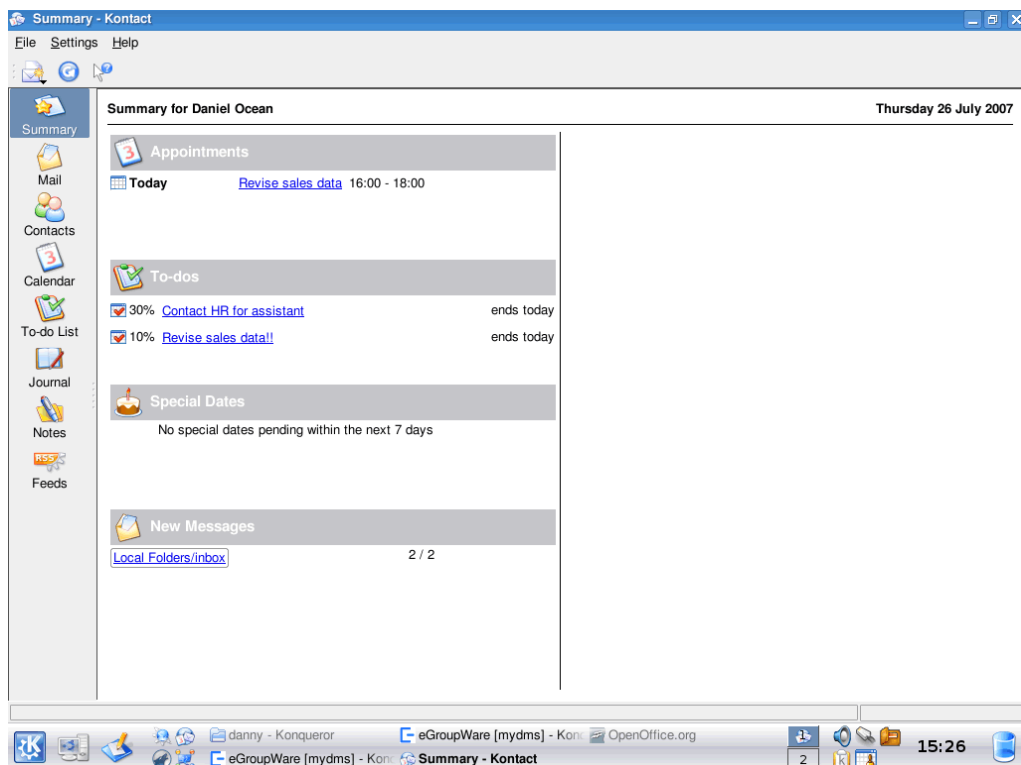


Figure 11: KDE Kontact showing the "Summary" view

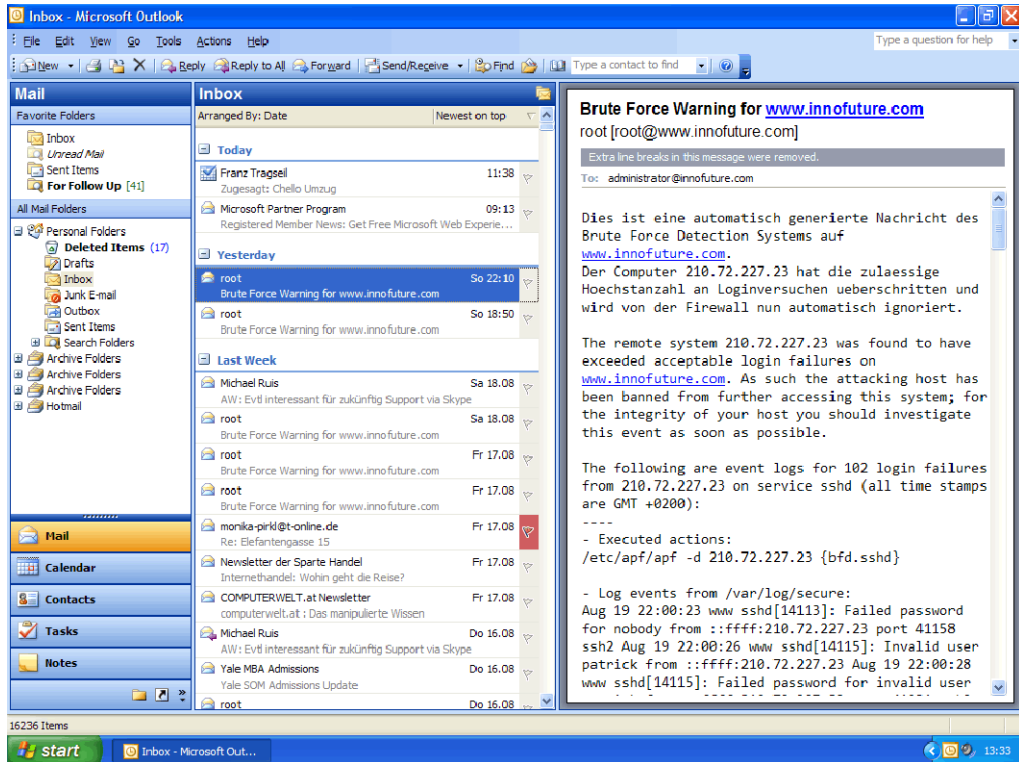


Figure 12: MS Outlook 2003

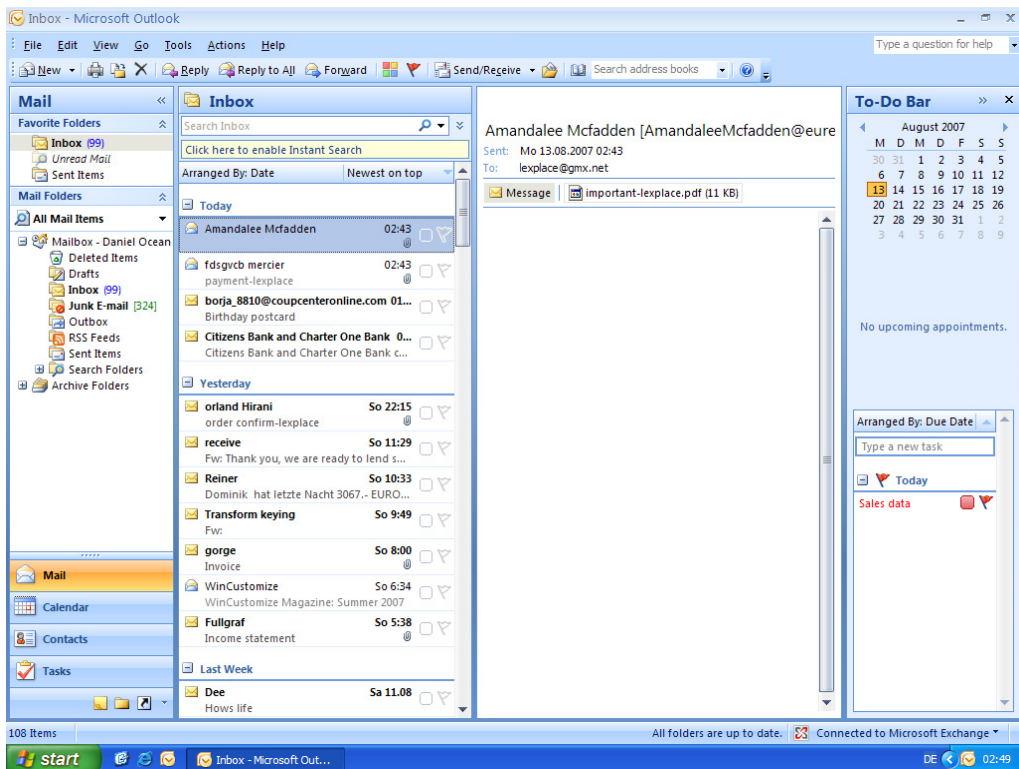


Figure 13: MS Outlook 2007

3.4.3 OpenOffice.org office suite

OpenOffice.org is a multiplatform suite of office productivity software. It was originally called StarOffice and developed by a German company called StarDivision. In 1999, Sun Microsystems acquired StarDivision and released the source code in July 2000 in the hope of threatening Microsoft's dominance in the area of office software. Like MS Office, OpenOffice.org consists of different components for different tasks:

- **Writer:** A word processor similar to MS Word (only until MS Office 2003 since MS Office 2007 introduced radical changes to the UI, this also applies to other components of OpenOffice.org).
- **Calc:** A spreadsheet similar to MS Excel. Provides an equivalent feature set compared to MS Excel.
- **Impress:** A presentation program similar to MS PowerPoint.
- **Base:** A database program similar to MS Access.
- **Draw:** A vector graphics editor.
- **Math:** An editor for mathematical formulae, similar to MS Equation Editor.
- **QuickStarter:** A tool that preloads parts of OpenOffice.org when the computer starts to allow the suite to start faster.
- **The macro recorder:** Allows the automation of tasks by recording user actions and later replaying them.

It is safe to say that OpenOffice.org offers the same look and feel as MS Office 2003 in most use cases. A former user of MS Office 2003 can expect to be up and running in very little time. An additional feature not available in MS Office is the possibility to export files in the PDF format.

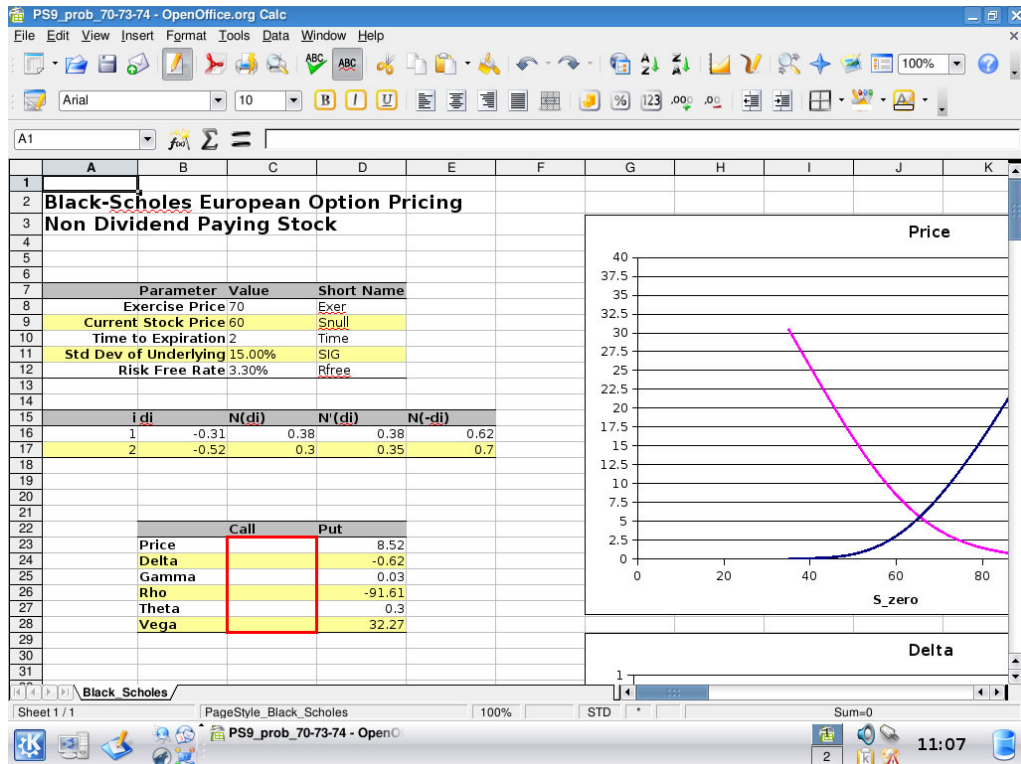


Figure 14: A complex MS Excel file correctly displayed in OpenOffice.org Calc

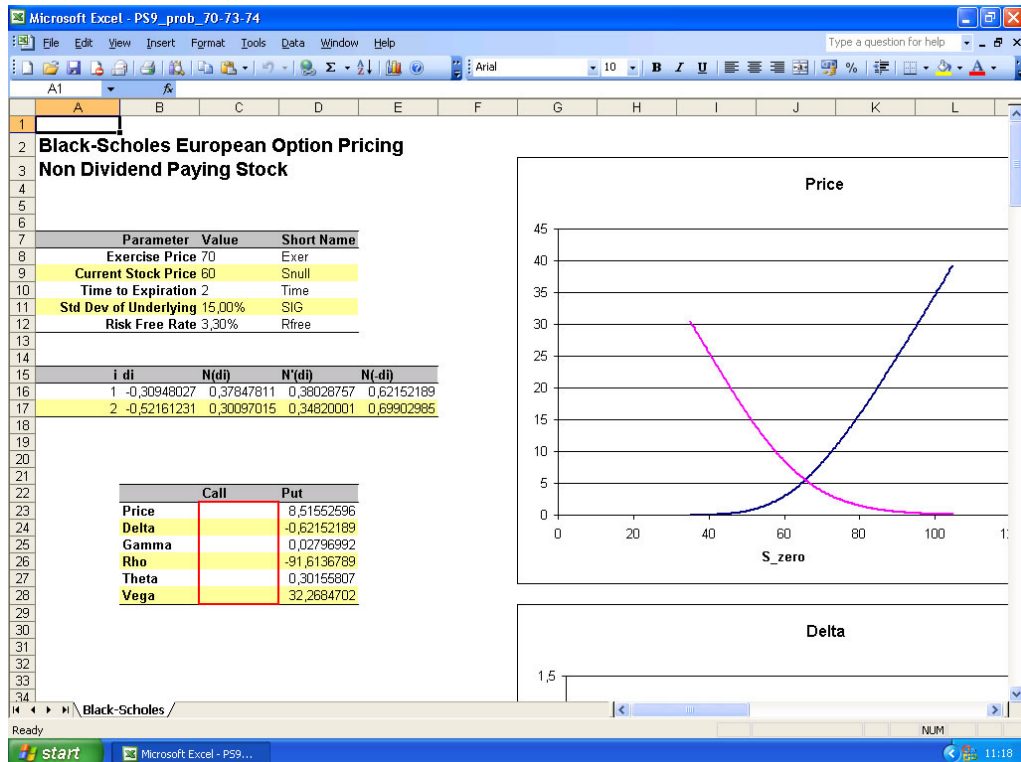


Figure 15: The same document in MS Office Excel

3.4.4 Pidgin

Pidgin (originally called “Gaim” but for legal reasons renamed to Pidgin) is the most popular instant messaging software for Linux. It supports simultaneously using a wide variety of protocols including MSN⁵⁷, ICQ³², AIM⁵⁸ and Yahoo!⁵⁹ messaging services including functionality such as file transfers or status messages (if supported by the respective protocol).

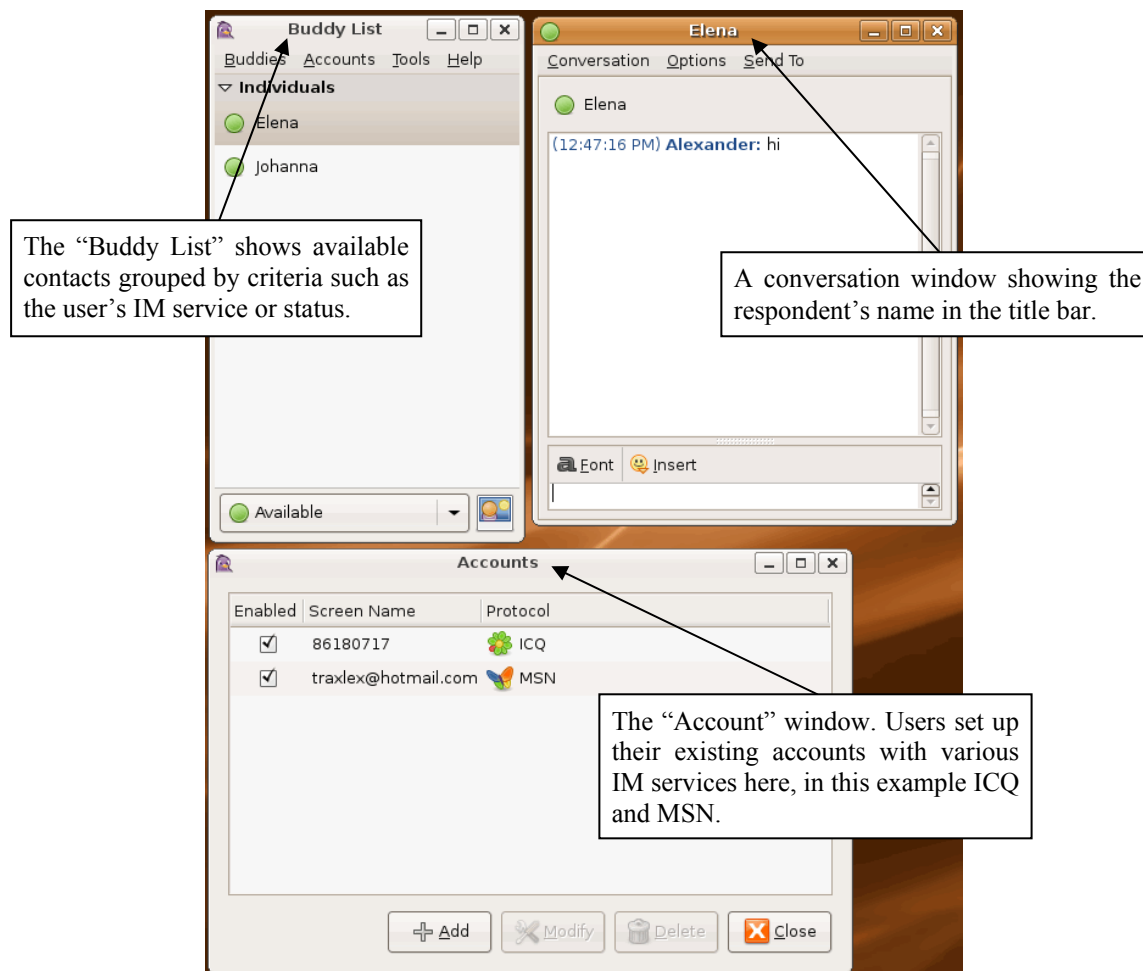


Figure 16: Pidgin (formerly Gaim) instant messaging software

⁵⁷ Microsoft Network Messenger – <http://im.live.com/messenger/im/home/?source=MSNTDLINK>

⁵⁸ AOL Instant Messenger – <http://www.aim.com/>

⁵⁹ Yahoo! Messenger – <http://messenger.yahoo.com/>

3.4.5 Kopete

Kopete is an instant messaging software for KDE with similar functionality compared to Pidgin. Not quite as popular as Pidgin (due to the fact that GNOME has a larger installed user base) Kopete is still well maintained and supports an equally impressive number of protocols including all mentioned in section 3.4.4.

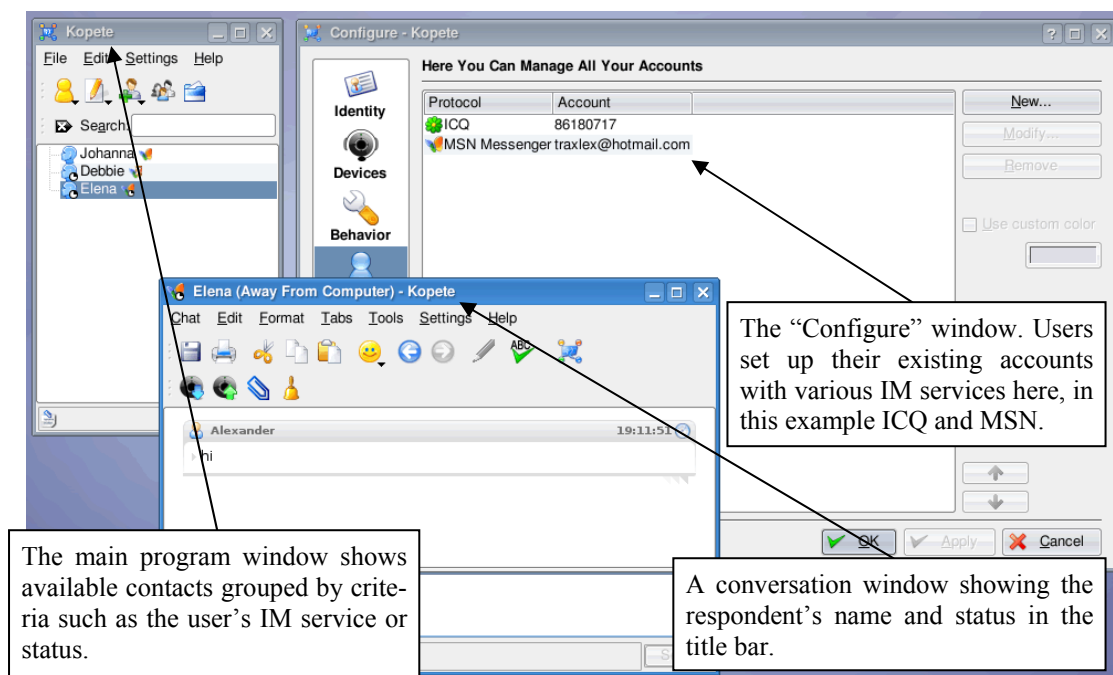


Figure 17: The Kopete instant messaging software

Both Kopete and Pidgin support most of XMPP⁶⁰ which is an open protocol for instant messaging. XMPP also features VoIP and file transfers but these features are not yet supported in the two IM applications above. Organizations that wish not to rely on an outside IM service can run their own XMPP server to ensure compliance with internal IT policies (e.g, IM messages can be encrypted using SSL).

⁶⁰ Extensible Messaging and Presence Protocol (XMPP) – <http://tools.ietf.org/html/rfc3920>

3.4.6 Ekiga

Ekiga is a VoIP and video conferencing software for GNOME (also available for MS Windows or KDE if GTK+ is installed). Like MOC it can be integrated with PBX software like Asterisk (see Section 3.5.6) to call PSTN phones and supports SIP⁶¹ as well as H.323⁶².



Figure 18: The Ekiga VoIP client, showing the dialpad; the gray area with the yellow Ekiga logo is the video screen.

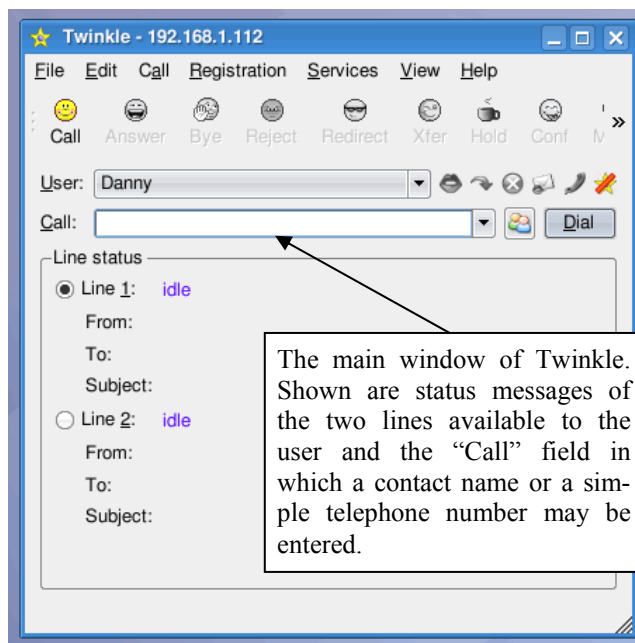


Figure 19: The Twinkle VoIP client

3.4.7 Twinkle

Twinkle is a VoIP software for KDE without video support. After thorough research on the Internet there currently seems to be no good video conferencing software available for KDE. However, Twinkle was chosen for its excellent integration into KDE and the active development team which plans to implement video support in the near future. In the meantime, administrators that (have to) deploy KDE with video conferencing can opt for a combination of KDE with GTK+ and Ekiga installed as a preliminary solution.

⁶¹ Session Initiation Protocol – <http://tools.ietf.org/html/rfc3261>

⁶² H.323 – <http://www.itu.int/rec/T-REC-H.323/e>

Figures 18 and 19 show that Twinkle's user interface is not as polished as Ekiga's since is the younger of the two programs.

3.4.8 Desktop or application sharing

In some use cases it might bring considerable advantage if users are able to share their desktop or an application to directly work together on documents. Both GNOME and KDE have client and server software for sharing the desktop using VNC⁶³. A user can specify if his desktop is accessible and, additionally, if the external user can control the shared desktop. In KDE, a user starts the KDE Desktop sharing wizard to create an invitation (Figure 20: Creating an invitation). The program then displays the connection information the invited user needs to connect to the KDE user's computer (Figure 21: Distributing the necessary connection information). In our example the invited user is connecting from a GNOME desktop using the Terminal Server Client application which support both VNC and MS' Remote Desktop Protocol⁶⁴ (Figure 22: The GNOME Terminal Server Client connection). Using the information provided by the KDE user a connection attempt is made which the KDE user has to accept (Figure 23: Accepting the connection from the invited user). The GNOME user is then able to see and control the KDE user's desktop (Figure 24: Two users sharing a desktop using VNC).

When compared to a combination of MOC and MOLCS the Linux solution is not as elegant and user friendly although the result is equally useful.

⁶³ Virtual Network Computing – <http://www.cl.cam.ac.uk/research/dtg/attarchive/vnc/xvnc.html>

⁶⁴ Understanding the Remote Desktop Protocol (RDP) – <http://support.microsoft.com/kb/186607>



Figure 20: Creating an invitation

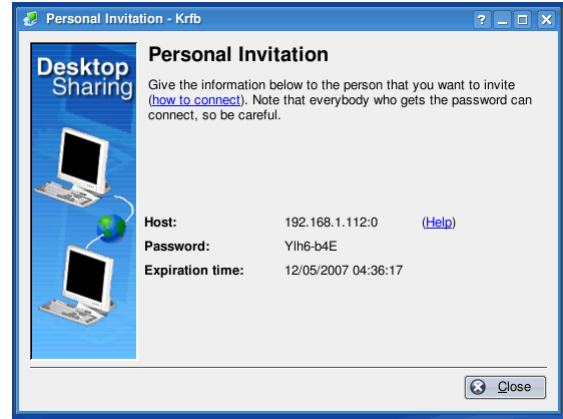


Figure 21: Distributing the necessary connection information

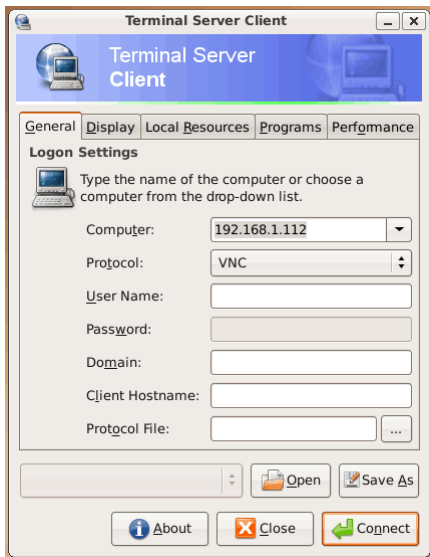


Figure 22: The GNOME Terminal Server Client connection

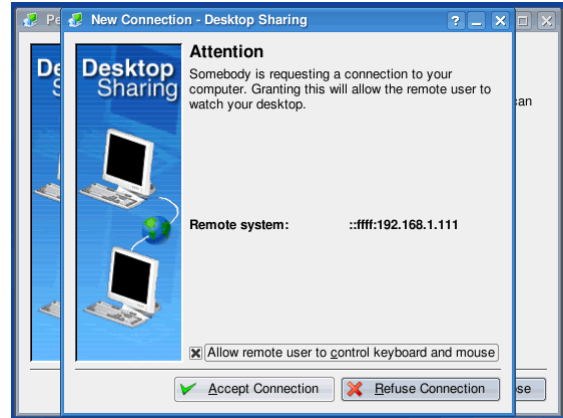


Figure 23: Accepting the connection from the invited user

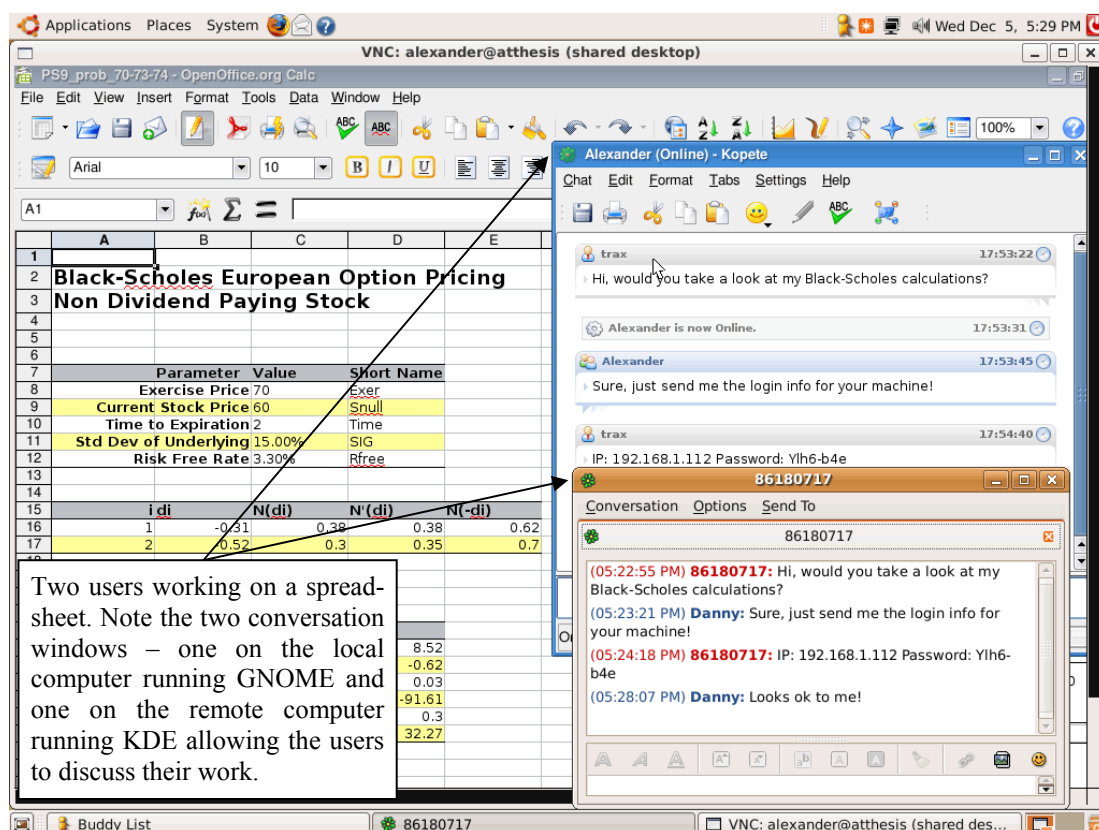


Figure 24: Two users sharing a desktop using VNC

3.5 Groupware and server software

There is only a small number of OSS available for the server that offers all the requirements listed in section two (see Section 2.2). Although it is, of course, possible to integrate different applications into one it often is impractical and requires a considerably higher investment of time and financial resources. It makes more sense to choose software for one specific area of the whole collaboration solution and then to add software for another area. This approach gives the advantage of not having to integrate applications but instead letting them operate independently. E.g., eGroupWare⁶⁵ and Asterisk⁶⁶ would be such a combination. Since these two operate independently, it is sufficient to review each software once and then identify ways in which they can be combined. The Asterisk server (see Section 3.5.6) will always be the choice for a PBX server, regardless of the content management software or email client used.

⁶⁵ eGroupWare – <http://www.egroupware.org/>

⁶⁶ Asterisk PBX – <http://www.asterisk.org>

It should be mentioned that there is a lot of OSS which provides part of the requirements in section two and is actually very good at doing so. Notable examples are the Zimbra⁶⁷ collaboration suite and Scalix⁶⁸ for email and calendaring. On the other hand, there is OSS like Alfresco⁶⁹ and Nuxeo⁷⁰ which are very good enterprise content management solutions. But those are also good examples of how difficult it would be to effectively integrate different applications to provide users with all the needed functionality. It also adds to the confusion of users and increases costs for user training.

The only complete solutions covering email, calendaring, as well as document management are eGroupWare, Open-Xchange⁷¹, Simple Groupware⁷², and SugarCRM⁷³.

3.5.1 eGroupWare

EGroupWare is collaborative software with a sophisticated web interface which also allows access via rich clients such as MS Outlook, Kontact or Novell Evolution. It was originally founded as phpgroupware in 2000 but was forked from the project in 2003. EGroupWare requires a web server (such as the Apache⁷⁴ web server) with PHP⁷⁵ enabled, a database server (e.g., MySQL⁷⁶ or PostgreSQL⁷⁷) and a mail server (preferably IMAP, e.g., Courier-IMAP⁷⁸ or even MS Exchange 5.5). Finally, an LDAP server can be used to store account and contact data.

The software offers the following modules which are installed by default:

- Calendar: A calendar (see Figure 25) that supports scheduling of, resources, groups, and contacts.
- AddressBook

⁶⁷ Zimbra Collaboration Suite – <http://www.zimbra.com>

⁶⁸ Scalix – <http://www.scalix.com>

⁶⁹ Alfresco Enterprise Content Management – <http://dev.alfresco.com>

⁷⁰ Nuxeo CPS – <http://www.nuxeo.com/en>

⁷¹ Open-Xchange – <http://www.open-xchange.com>

⁷² Simple Groupware – <http://www.simple-groupware.de/cms>

⁷³ SugarCRM – <http://www.sugarcrm.com/>

⁷⁴ Apache – <http://www.apache.org/>

⁷⁵ PHP: Hypertext Preprocessor – <http://www.php.net>

⁷⁶ MySQL – <http://www.mysql.com/>

⁷⁷ PostgreSQL – <http://www.postgresql.org/>

- FelaMIMail: An IMAP mail client.
- Mydms: a Document management application with versioning and check-out, check-in capabilities.
- FileManager: A general file manager which stores files in a VFS⁷⁹ based on files, a database, or WebDAV⁸⁰.
- InfoLog: An application to create notes, to-do list items or reminders for phone calls. This module is targeted at CRM users.
- Resources: A tool to manage resources which can then be booked in the Calendar application.
- TimeSheet: A time tracking application.
- ProjectManager: A small Project management application that is highly integrated with the other modules (e.g., a calendar entries, to-do list or time sheet items can be linked to projects).

Other, less relevant modules include:

- Wiki
- SiteMgr: An application which allows for the creation of an external website (e.g., an organization can use eGroupWare internally and to publish its public website).
- KnowledgeBase: An application for article publishing and retrieval, often used to suggest solutions to problems or for documentation purposes.
- Workflow engine: A workflow engine based on Galaxia/Tikiwiki⁸¹.

By default, eGroupWare offers a portal screen when a user logs in. Every user can decide what the software should display when he logs in which can be any of the available modules. Navigation within the software is clear and easy with a main menu on the top of the screen containing all the modules enabled for the current user (depending on his role and rights) and a module-specific second menu on the left side of the screen.

⁷⁸ Courier-IMAP – <http://www.courier-mta.org/imap/>

⁷⁹ Virtual File System – http://en.wikipedia.org/wiki/Virtual_file_system

⁸⁰ Web-based Distributed Authoring and Versioning – <http://www.webdav.org/>

⁸¹ Galaxia Workflow Engine – <http://workflow.tikiwiki.org/tiki-index.php>

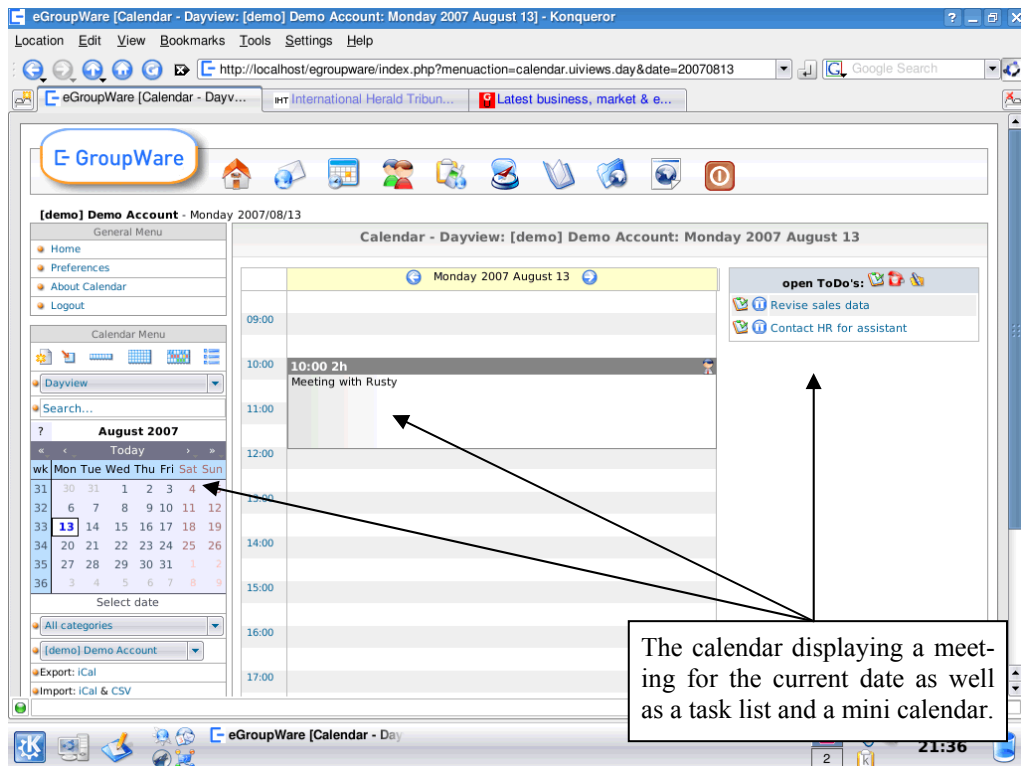


Figure 25: eGroupWare displaying the calendar after logging in

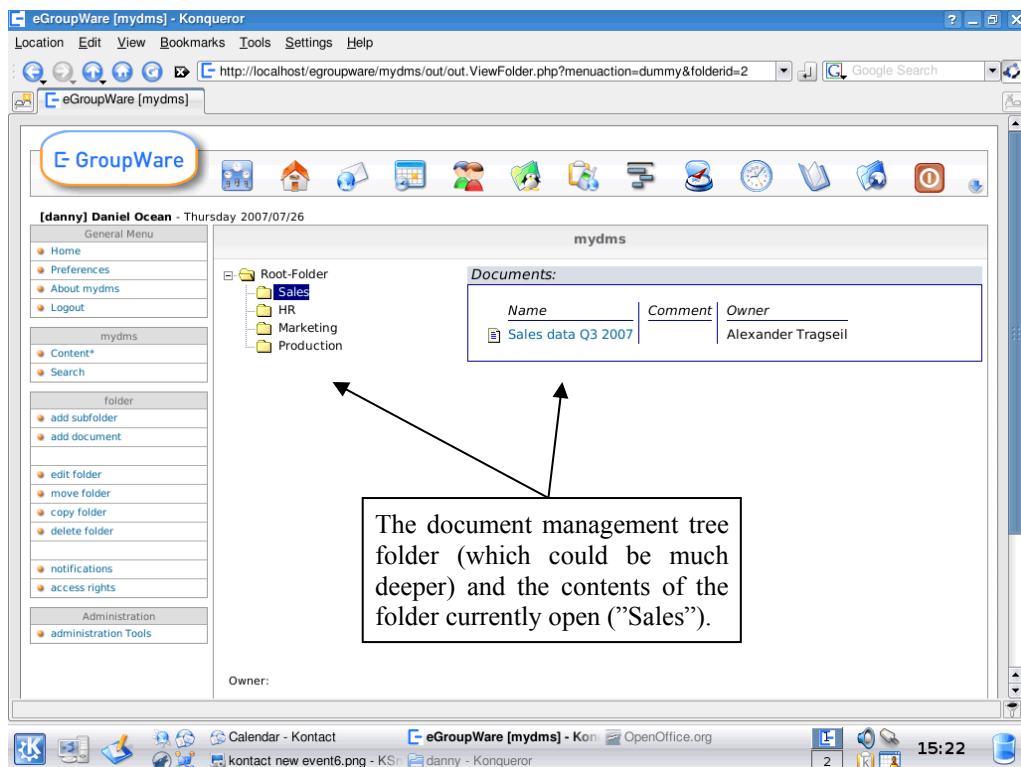


Figure 26: DMS of eGroupWare

The possibility to send the link to a document is an important feature since it simplifies versioning and updates to documents by always having the document in one location (Figure 27: Opening a link to a document in eGroupWare instead of the actual document). It is also possible to set alerts for users to have them notified of changes to a document. The following screenshot gives an example: Instead of mailing a document to every user required to read it the author simply saves the document in the document management application and sends the link to the document to every desired user.

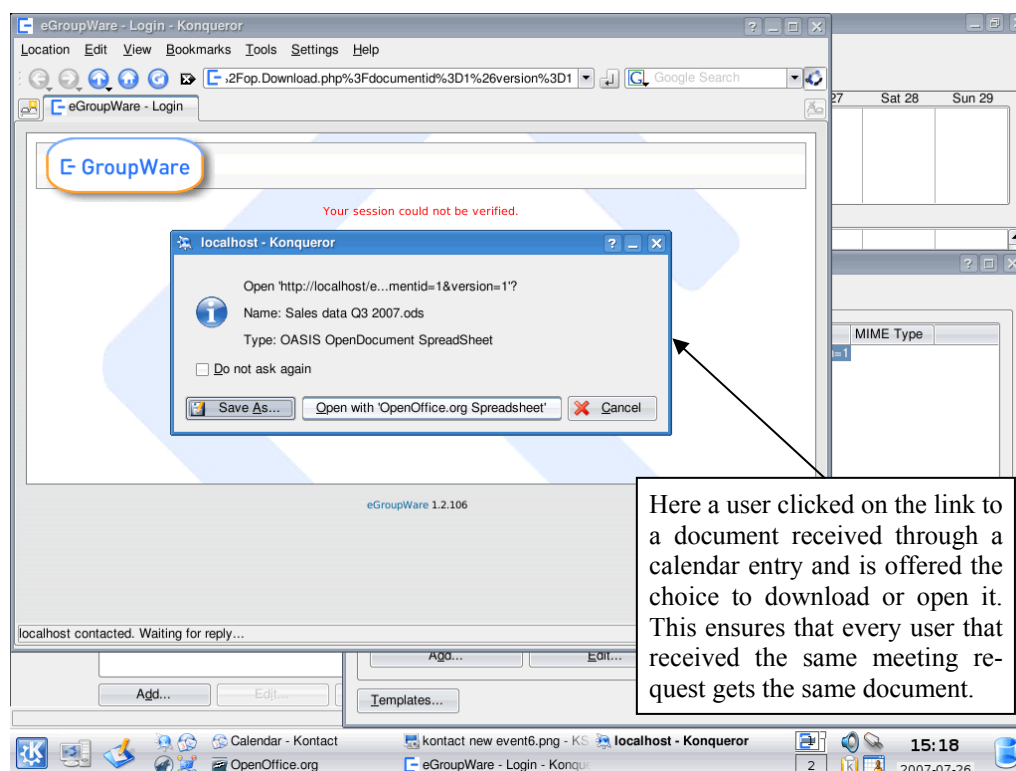


Figure 27: Opening a link to a document in eGroupWare instead of the actual document

Another requirement was that the user should have a central space to look up his or her tasks and appointments. Although eGroupWare integrates nicely with Kontact to display a user's contacts, calendar and task list (called InfoLog in eGroupWare) it doesn't do so with Novell Evolution (only using additional software). Therefore, if an organization wants to implement eGroupWare it should use Kontact as the client software.

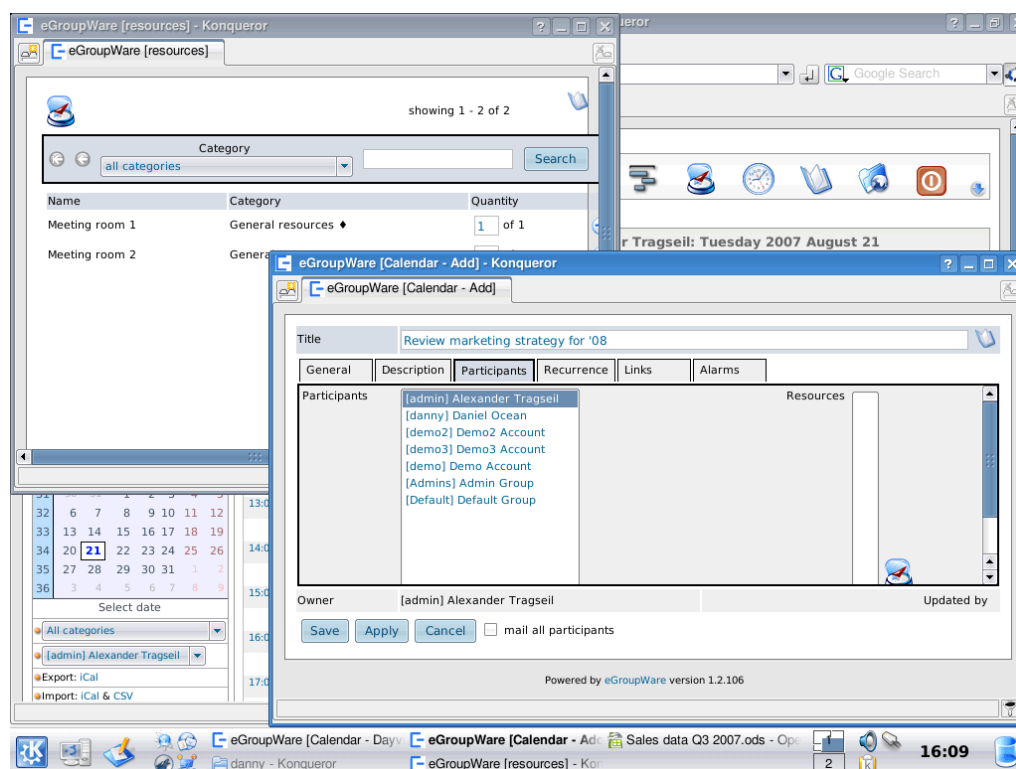


Figure 28: Booking a resource (Meeting room) in eGroupWare

A very useful feature (like in MS Exchange Server) is the ability to book resources which are then no longer available for other users. eGroupWare allows resources to be grouped in categories such as rooms, cars or equipment. Figure 28 shows a user creating a calendar entry and booking resources (in this case Meeting rooms).

3.5.2 Open-Xchange

Open-Xchange is groupware built on OSS and open standards such as IMAP, LDAP and iCalendar⁸². The software is programmed in the Java⁸³ programming language and requires many preinstalled⁸⁴ software packages on the server which also makes it the most difficult to install compared to the other groupware solutions in this thesis. Like SugarCRM (see Section 3.5.4) Open-Xchange exists in commercial versions as well as a free one. The software is licensed under the GPL but only the commercial version includes a web-based administration tool and this version can be installed only on SUSE Linux Enterprise

⁸² Internet Calendaring and Scheduling Core Object Specification – <http://tools.ietf.org/html/rfc2445>

⁸³ Java Technology – <http://java.sun.com/>

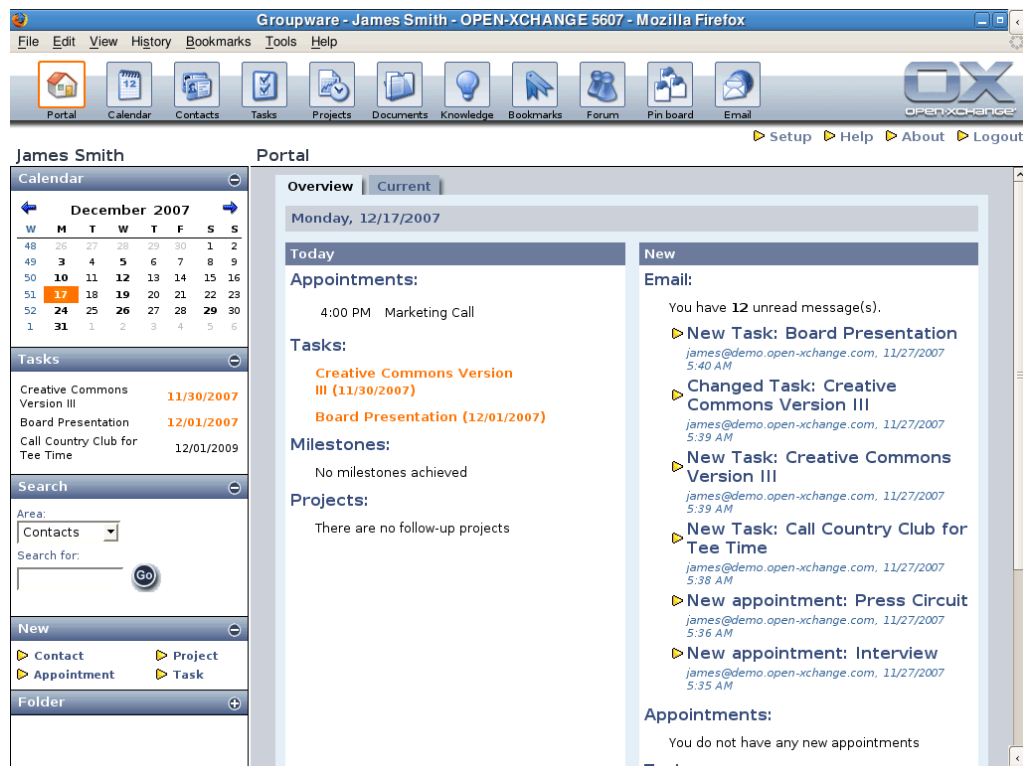
⁸⁴ Binary dependencies of Open-Xchange – http://www.open-xchange.com/wiki/wiki/index.php?title=Open_Xchange_Installation#Binary_dependencies

Server⁸⁵ or Red Hat Enterprise Linux server⁸⁶. The free version can be installed on any Linux. Another difference between Open-Xchange and the other groupware solutions in this thesis is that Open-Xchange has specific software requirements for the underlying software which can not be altered (e.g., PostgreSQL as the database software or Apache as web server).

Open-Xchange consists of the following modules:

- Portal: See Figure 29. The portal can be customized by each user according to their preferences.
- Webmail: opens in another window to have your email open at all times similar to a desktop application.
- Document management featuring locking and automatic versioning of documents.
- Calendar: a calendar application capable of linking documents to appointments and sending invitations automatically.
- Contacts: an address book application including managing distribution lists.

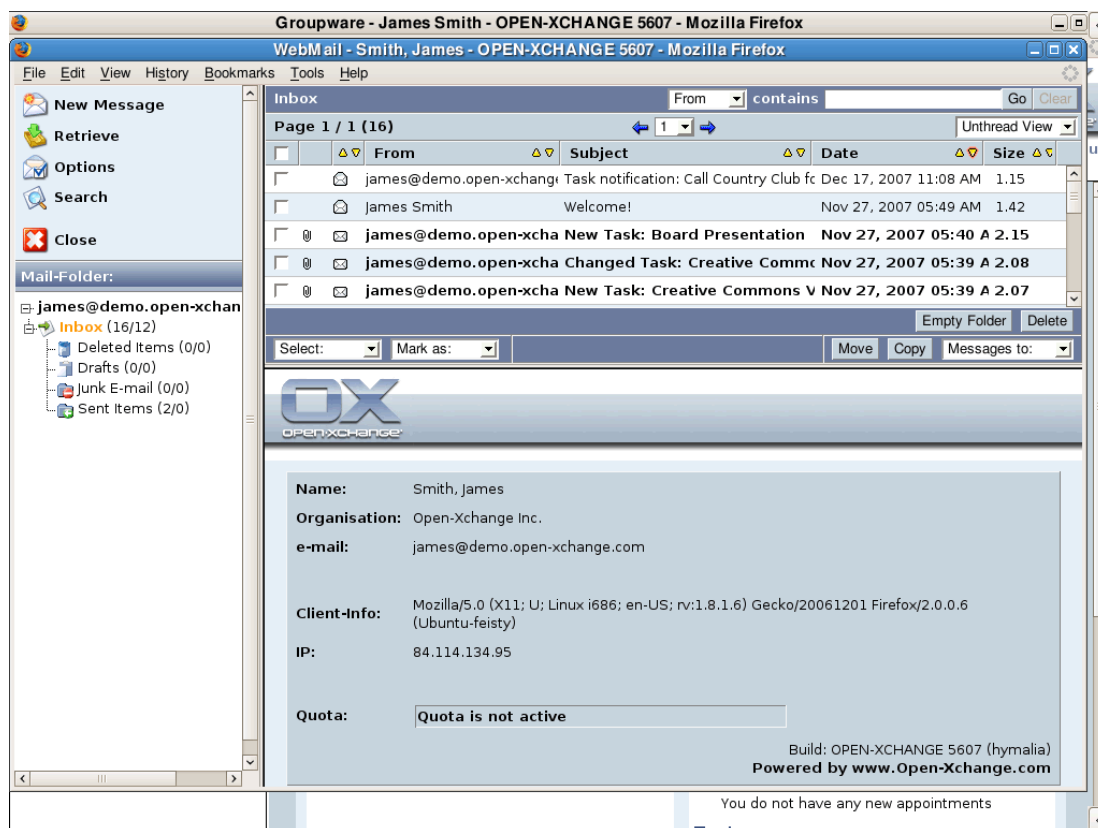
This list is not complete since Open-Xchange has more modules but only the relevant ones for this thesis are listed here.



⁸⁵ SUSE Linux Enterprise Server – <http://www.novell.com/products/server/>

Figure 29: Portal view of Open-Xchange

Navigation in Open-Xchange is similar to the concept of eGroupWare with one big difference: the email module opens in a separate window, presumably to make it seem like a regular desktop application that stays open independent of other activities by the user within Open-Xchange (see Figure 30).

**Figure 30: Open-Xchange's webmail**

Open-Xchange's webmail is not very powerful but includes the necessary functionality for common email tasks. If a user wants advanced features such as rules for sorting email a rich client offering this functionality would be a better solution. Open-Xchange supports every IMAP or POP3 capable client such as Kontact or Evolution. For an easy transition from MS Windows there is a special connector software available for MS Outlook called OXtender for MS Outlook⁸⁷ that allows synchronization of more information between MS Outlook and Open-Xchange, e.g., synchronization of reminder settings, the calendar, tasks,

⁸⁶ Red Hat Enterprise Linux server – <http://www.redhat.com/rhel/server/>

⁸⁷ OXtender for MS Outlook – http://www.open-xchange.com/header/products/openxchange_server_5/oxtender/oxtender_for_microsoft_outlook.html

et al. This, however, is a commercial product and therefore not relevant for this thesis. This also can be considered a weakness of Open-Xchange since the only real rich client support is for MS Outlook.

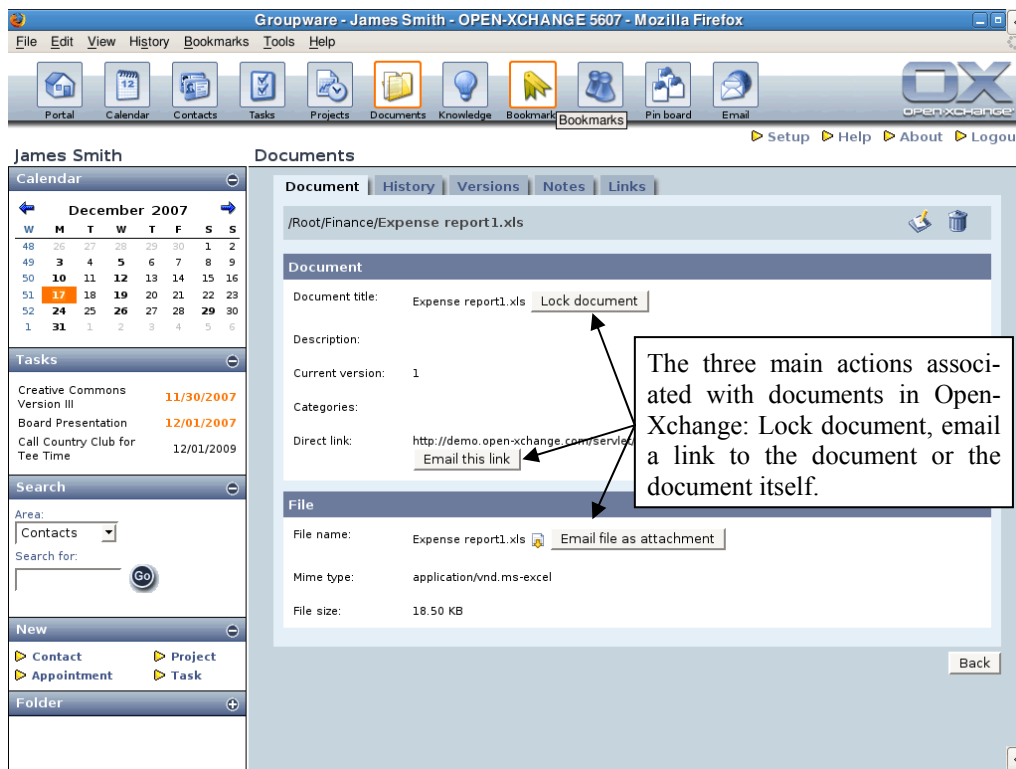


Figure 31: Open-Xchange allows to send the link to a document or the document itself

Open-Xchange features automatic locking and automatic versioning of documents. When downloading, emailing a document or emailing the link to a document users can choose to lock the document to prevent other users from editing it.

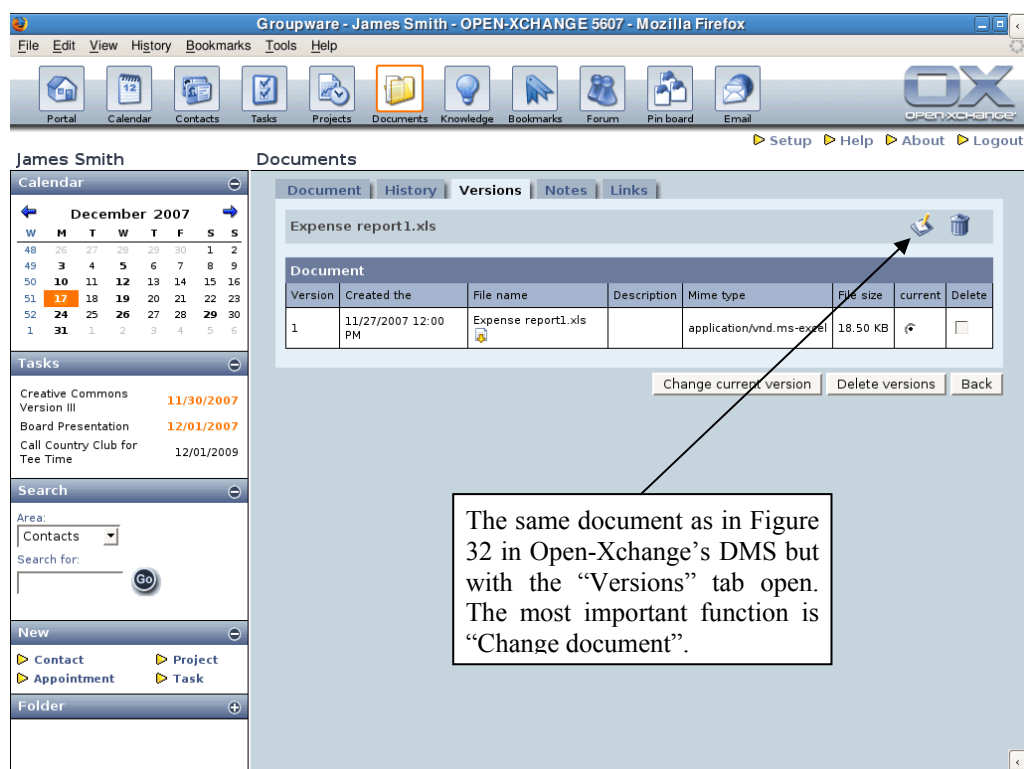


Figure 32: Version management in Open-Xchange

If the user has finished editing he can upload the document again by clicking on the “Change document” icon next to the icon for the trash can in the upper right corner of Figure 32 and the system allows him to browse for the document to upload, edit metadata⁸⁸ for the document and automatically increases the version number by one.

3.5.3 Simple Groupware

Like Open-Xchange and eGroupWare, Simple Groupware builds upon open standards such as IMAP, WebDAV or LDAP. It offers the highest level of integration with MS products among the four groupware packages in this thesis, offering synchronization with Windows Mobile devices and MS Outlook, making it an interesting choice for any organization which is already deploying various MS products or wishing to transition to OSS slowly.

Considering that Simple Groupware is a serious competitor when compared to the other two contenders in this thesis it seems amazing that the software is developed and maintained by a single individual running a company called “Simple Groupware Solutions”

⁸⁸ Metadata – <http://en.wikipedia.org/wiki/Metadata>

founded in September of 2003. The software is provided free of charge but commercial support is available.

Apart from providing the typical functionality provided by a groupware like document management or shared calendars Simple Groupware offers a few interesting features such as:

- Very easy access to documents via WebDAV.
- Integration of Google gadgets⁸⁹ in a user's portal page.
- Map an organization's structure in the tree menu using "Positions", "Departments", and "Offices", achieving high transparency.
- A user can map a module (Calendar, Tasks) to a newly created folder, enabling him to e.g., have as many separate calendars as he likes.

Navigation is different from both eGroupWare and Open-Xchange. Instead of having the main menu at the top and the sub-menu at the left side of the screen Simple Groupware uses a different concept. When logging into Simple Groupware the system displays the "Workspace" (SG's main menu) as a tree menu on the left side and a Portal view on the right side. The Workspace menu contains the modules available such as Files, Contacts, Calendar and others twice – once for the user containing his private data and a second time containing a public version. This gives a user a clear notion of e.g., where to store private documents or documents for personal use and where to look for public ones. If the user clicks on a module the sub-menu appears at the top of the screen.

⁸⁹ Google gadgets – <http://www.google.com/webmasters/gadgets/>

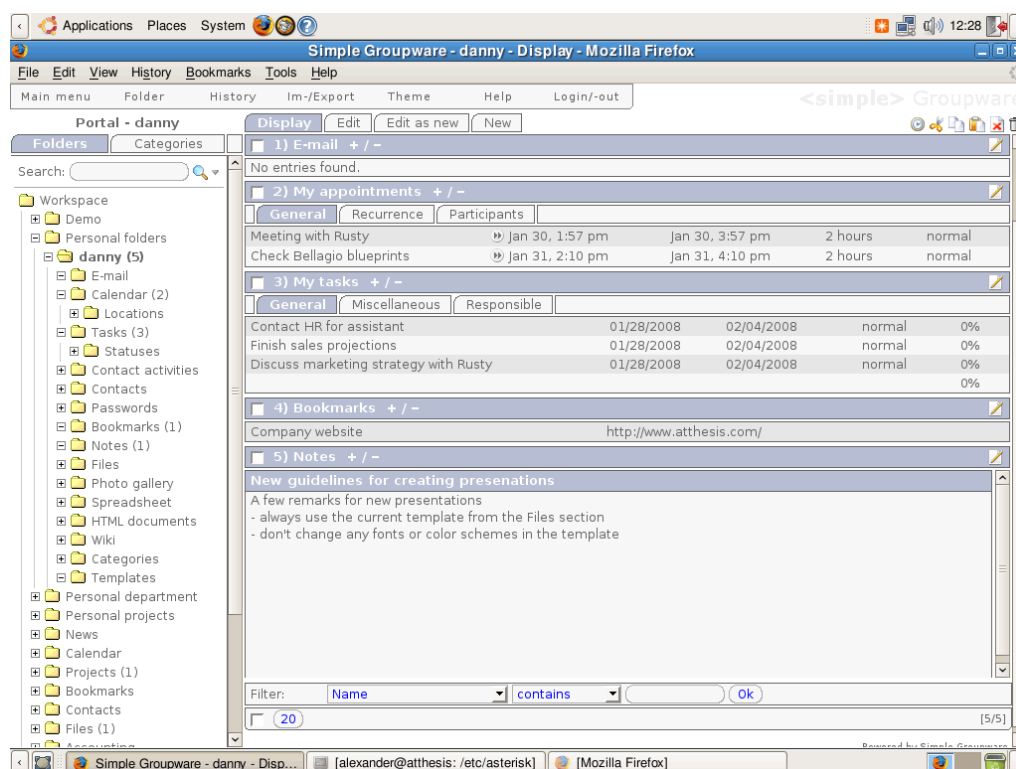


Figure 33: Portal view of Simple Groupware

Simple Groupware's portal view is a highly customizable entry point for users. It offers more options than eGroupWare or Open-Xchange but is inferior to SugarCRM's portal where users have much more possibilities of customizing the layout and information shown (see Figure 39). It is also the visually least appealing of the four. The screenshot above shows a typical portal in Simple Groupware displaying emails, calendar entries, a task list, bookmarks, and a notepad.

Simple Groupware's calendar offers nearly the same features as its counterparts in the other groupware packages in this thesis do. One exception (which is also shared by SugarCRM) is resource management. Simple Groupware only knows one type of resource (locations), limiting its usefulness in environments where there is a lot of equipment (e.g., projectors or CD-Players) to manage (see Figure 34).

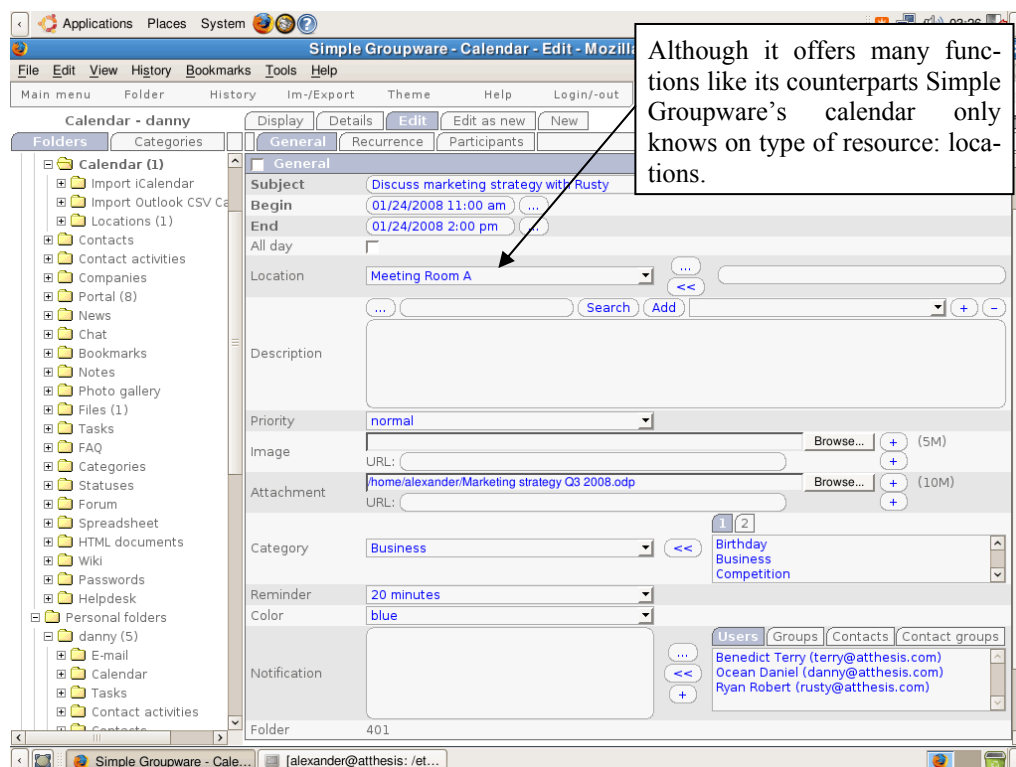


Figure 34: Editing a Calendar entry in Simple Groupware

Although the ability to access documents via WebDAV is possible with, e.g., eGroupWare, the setup and use in Simple Groupware is much easier. Simple Groupware automates versioning and check-in/check-out functions by showing documents a user edits via WebDAV as checked out in the web interface of the software. Another extra feature is the possibility of full-text search in MS Office documents and a preview function which generates a HTML file from any MS Word, MS Excel, and MS PowerPoint document (even for the new OOXML⁹⁰ file format introduced with the release of MS Office 2007).

⁹⁰ Introducing the Office (2007) Open XML File Formats – <http://msdn2.microsoft.com/en-us/library/aa338205.aspx>

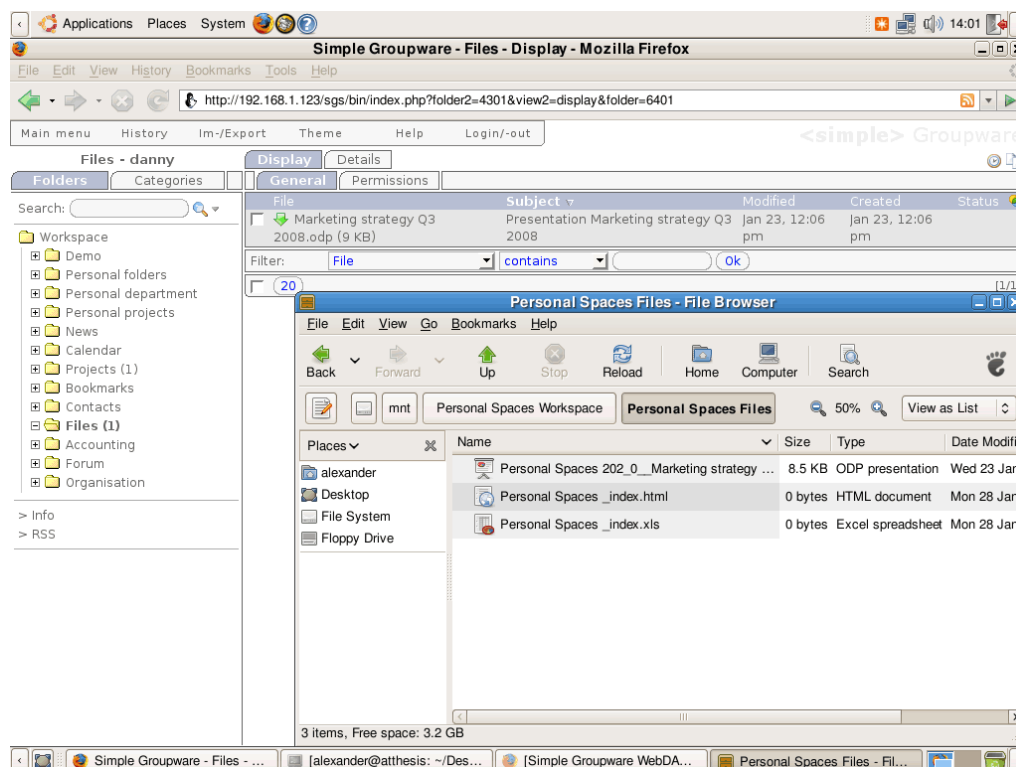


Figure 35: Accessing files via web interface and via WebDAV

3.5.4 SugarCRM

SugarCRM Community Edition is maintained by SugarCRM, a company founded in 2004 in Cupertino, California. The company distributes the software in different versions with the commercial editions under a subscription model:

- SugarCRM Community Edition: a free product, offering everything mentioned in this thesis and more.
- SugarCRM Professional: contains proprietary plugins for MS Outlook and MS Word and other advanced functionality (e.g., sales forecasting).
- SugarCRM Enterprise: all of the above plus an offline client and support for Oracle⁹¹ databases.

Originally intended as a CRM solution, the software has matured and now offers many general groupware features which justifies its place in this thesis. The latest version (5.0) makes extensive use of AJAX resulting in a very comfortable user interface. Since the user

⁹¹ Oracle – <http://www.oracle.com/>

interface might intimidate users when all modules (e.g., Leads, Accounts, Campaigns, et al) are enabled it is possible to disable some of them to reduce complexity.

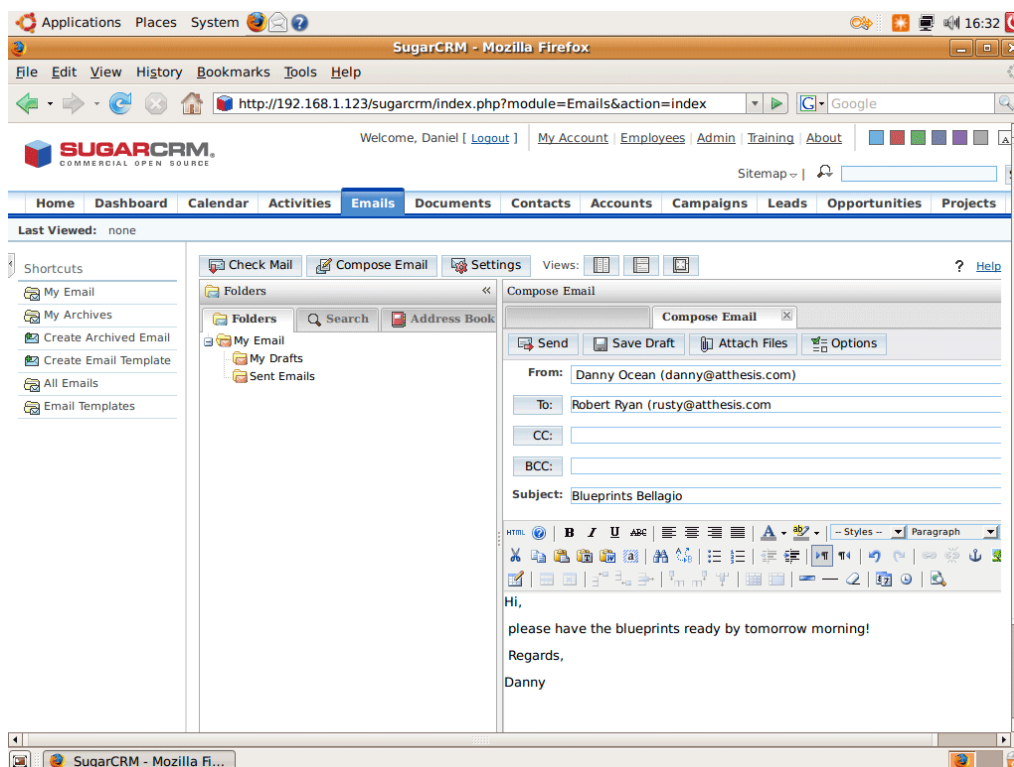


Figure 36: SugarCRM's webmail

The webmail uses standards IMAP or POP and SMTP and can therefore be easily integrated with a desktop application (see Sections 3.4.1 and 3.4.2). Since it is programmed using AJAX³⁶ it offers a high level of comfort making a rich client necessary only if advanced features such as rule-based sorting are required. The free edition of SugarCRM does not, however, support any tight integration like synchronizing additional data such as calendar entries and contacts with a rich client.

The document management fulfills the requirements for versioning and locking of documents, and checking documents in or out. The revision format is not set by the application but instead can be anything from “1.0” to “Version 2.5-a”. If this default setting is not changed, the software stores every version, not just the latest, creating a complete history of a document.

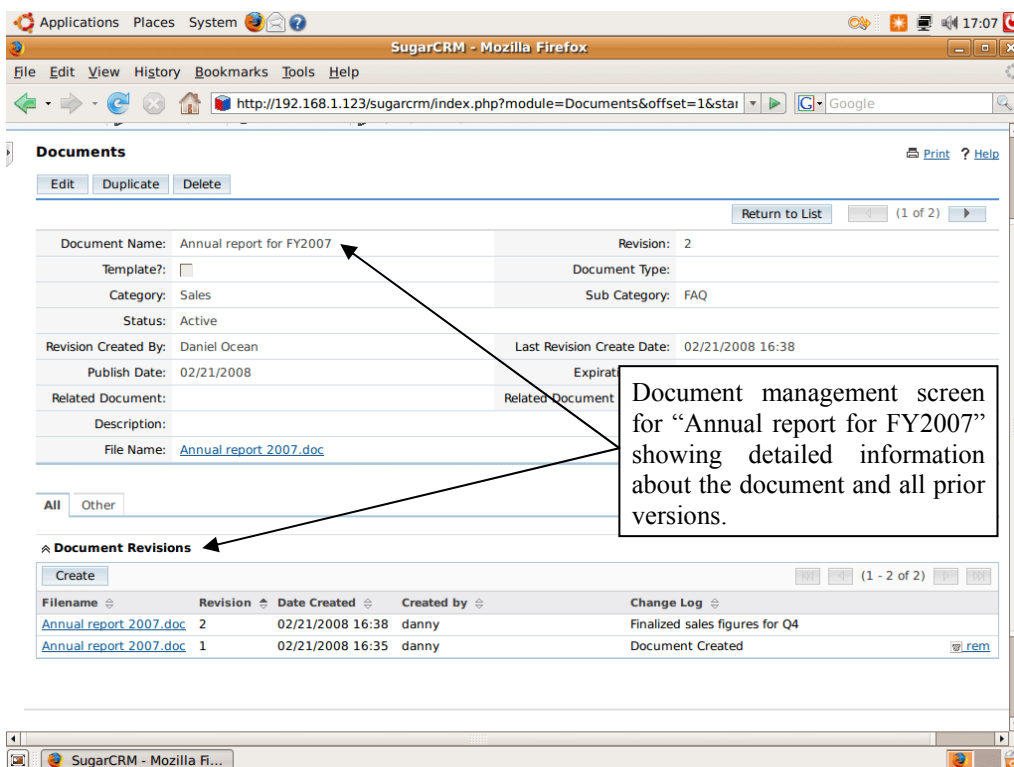


Figure 37: Document management in SugarCRM

The Calendar module supports a user’s personal calendar as well as shared calendaring to facilitate the scheduling of meetings, presentations, and other appointments. Like Simple Groupware, SugarCRM does not, however, support the creation and allocation of resources like MS Exchange or eGroupWare. A useful feature is the display of every user’s schedule invited to the meeting. This allows the meeting’s creator to immediately see and resolve conflicting schedules.

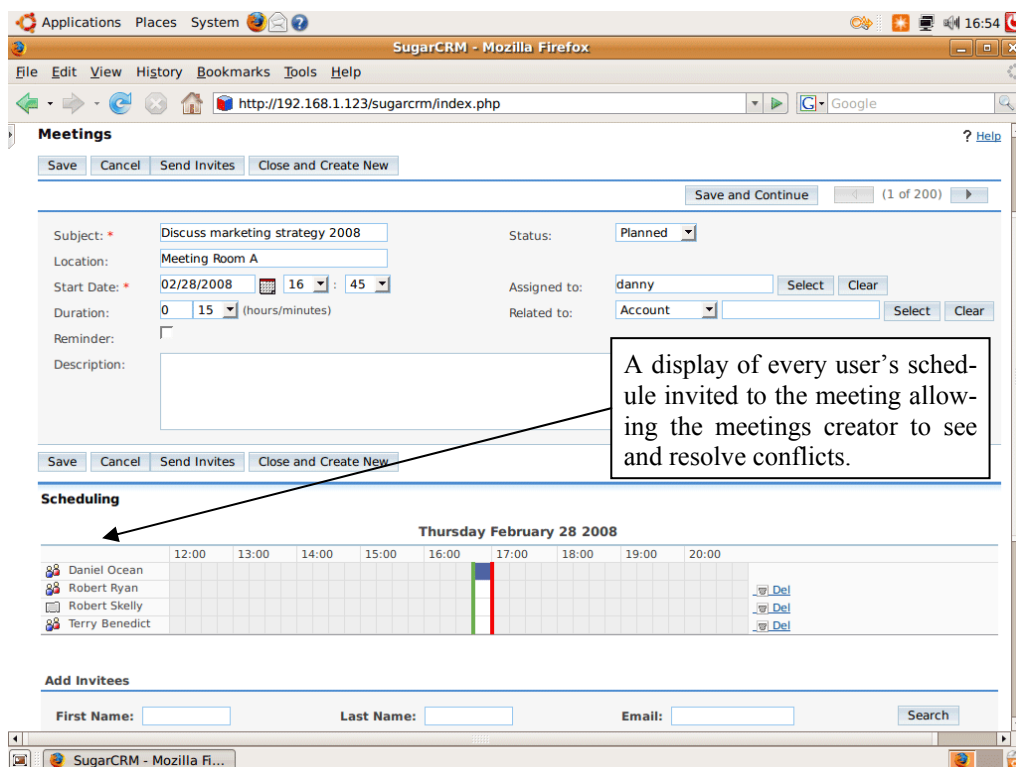


Figure 38: Scheduling a meeting in SugarCRM

SugarCRM’s portal can be customized for each user, containing a small overview of every module. Additionally for every module a user can set how many items in each category should be displayed (e.g. showing only the next three appointments) to keep the portal view clearly laid out. A little note-taking application called “JotPad” is available in the portal view, allowing users to take quick notes.

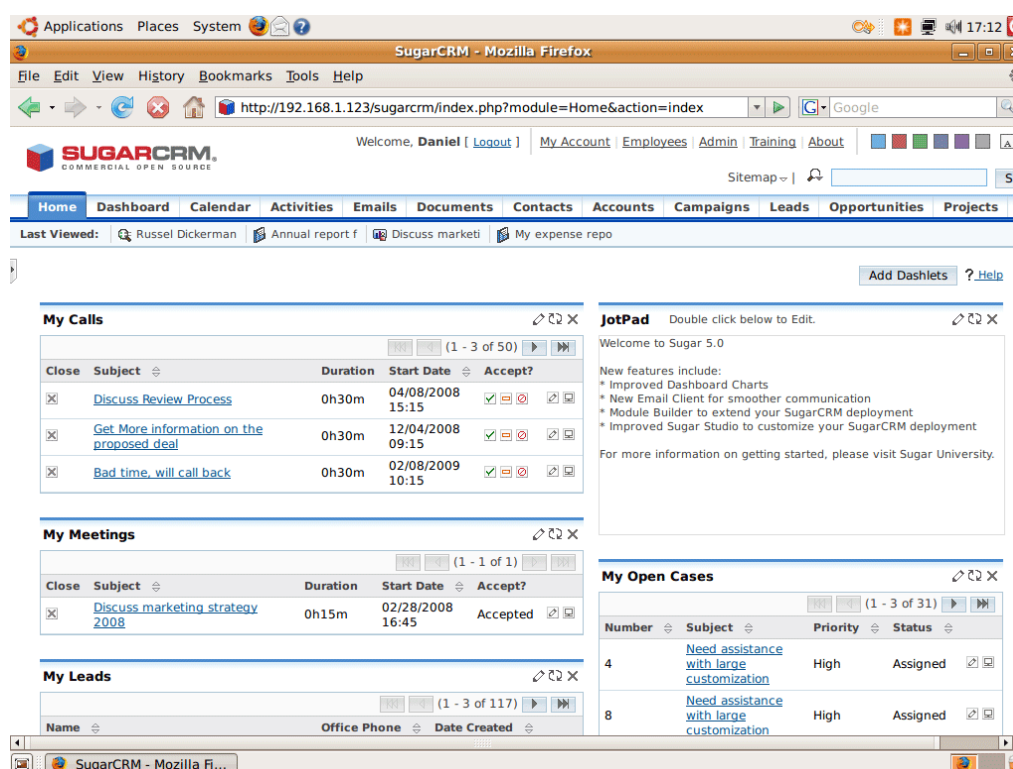


Figure 39: Portal view of SugarCRM including “JotPad”

3.5.5 Usability comparison of groupware

Although technically the four groupware solutions in this thesis provide users with the requirements arrived at in section 2.2 it is important to also assess their usability. Since all four solutions are based on web technologies the look-and-feel could be modified rather easily by using another CSS or making changes to the HTML code used. However, this will not be given much thought because this results in additional costs which should be avoided. MS’ web based software such as MOSS or the MES server’s web front-end can be modified also to reflect an organization’s corporate identity but this isn’t done often and only involves very minor changes to the interface.

Simple Groupware’s web interface can be considered the worst in terms of look-and-feel. The software offers the most features without any additional administrative effort but loses in the design and usability area. How an application looks can become important when a user has to spend most of his working time using it.

Open-Xchange and eGroupWare both offer very clear user interfaces without any unpleasant surprises. Both do not make use of the full potential of AJAX³⁶ to enhance the user experience, probably to ensure cross-browser compatibility.

SugarCRM is the most recently released of the four programs with version 5.0 coming out on January 4, 2008. The extensive use of AJAX and the clear user interface make the software very comfortable and easy to use. One feature which none of the other offer is the “Last Viewed” feature (see Figure 36) below the main menu in SugarCRM which lets users quickly navigate to the last few sections of the software they have used. In conclusion, if all four solutions are equally applicable in an organization then SugarCRM should probably be favored due to its better usability, better looks, and the possibility to use its advanced CRM functionality.

3.5.6 Asterisk

Asterisk is an open source telephony engine that was created by Digium, Inc.⁹² in 1999 and is released under the GPL. It was designed to run on Linux but can also be installed on OpenBSD⁹³, FreeBSD⁹⁴, Mac OS X, and Solaris. While Asterisk can be configured for VoIP (using many different protocols) with no additional hardware it is possible to connect it to public digital (T1/E1⁹⁵) and analog (POTS⁹⁶) telephony equipment using interface cards (standard PCI⁹⁷ cards) as well. The software scales very well from a small office with maybe five employees and no special requirements to an entire call center with advanced features such as a menu system letting callers navigate via their phones’ keypads. An impressive feature list is available.⁹⁸

For Ubuntu Linux there are Asterisk packages that can be installed very comfortably with the Synaptic⁹⁹ package manager. Configuration can be done via the Asterisk configuration files or FreePBX¹⁰⁰, a web interface for Asterisk. When Asterisk is configured (for VoIP or telephony) VoIP client software such as Ekiga or Twinkle (see Sections 3.4.6 and 3.4.7) can be used as softphones. If configured for telephony a user can be reached under a public phone number regardless of his location as long as he has a working Internet connection.

⁹² Digium, Inc. – <http://www.digium.com/>

⁹³ OpenBSD – <http://www.openbsd.org/>

⁹⁴ FreeBSD – <http://www.freebsd.org/>

⁹⁵ Digital Signal 1 – http://en.wikipedia.org/wiki/Digital_Signal_1

⁹⁶ “Plain old telephone service” – <http://en.wikipedia.org/wiki/POTS>

⁹⁷ Peripheral Component Interconnect – http://en.wikipedia.org/wiki/Peripheral_Component_Interconnect

⁹⁸ Asterisk Features – <http://www.asterisk.org/support/features>

⁹⁹ Synaptic Package Manager – <http://www.nongnu.org/synaptic/>

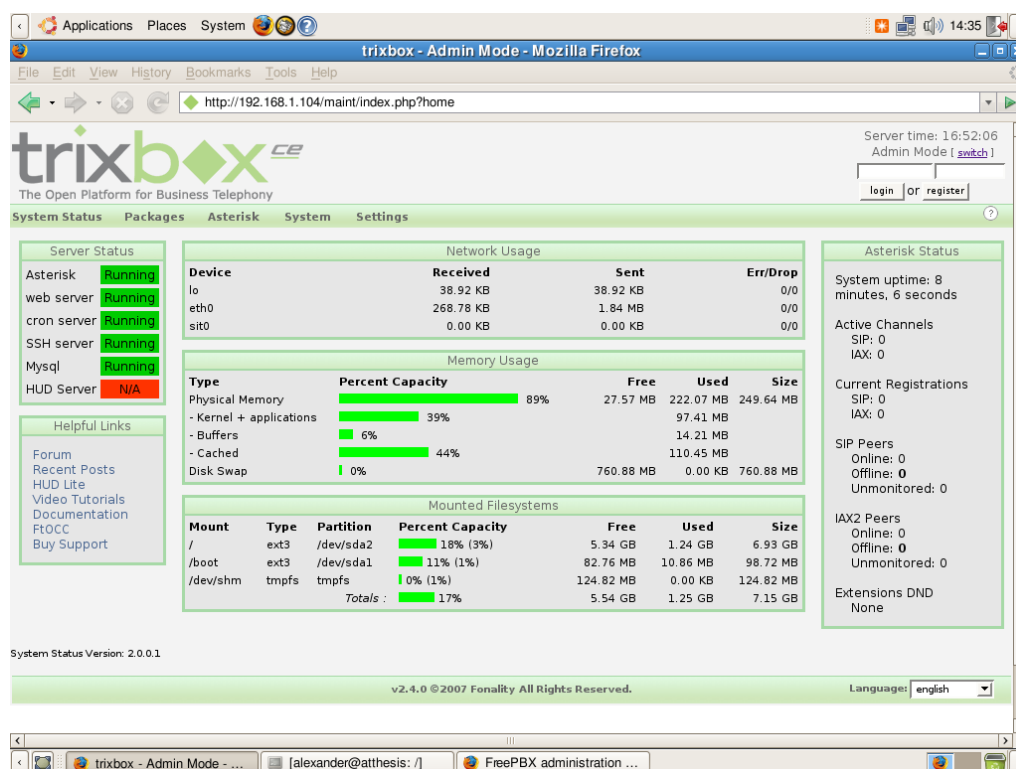


Figure 40: The trixbox web interface

Since telephony is a very important part of any organization's infrastructure it makes sense to separate it from other servers or server software and to dedicate it a separate computer to ensure availability and reliability. There is a project called trixbox¹⁰¹ which is aimed at facilitating the use of Asterisk. While it is possible to install Asterisk in Ubuntu via the Synaptic package manager the configuration is not that easy and requires manual editing of different configuration files. The installation of FreePBX on Ubuntu is even more difficult since there are no packages available and the administrator has to install the software by compiling the source code. Since this can represent a considerable hurdle for an organization trixbox offers a pre-packaged solution which requires only the setup of extensions (representing users) and the features the organization wants to use. The possibility of sending voicemail messages as email attachments to users or setting up a menu system in which a caller uses the number keys to navigate are only two examples of such features.

¹⁰⁰ FreePBX – <http://freepbx.org/>

¹⁰¹ Trixbox CE – <http://www.trixbox.org/>

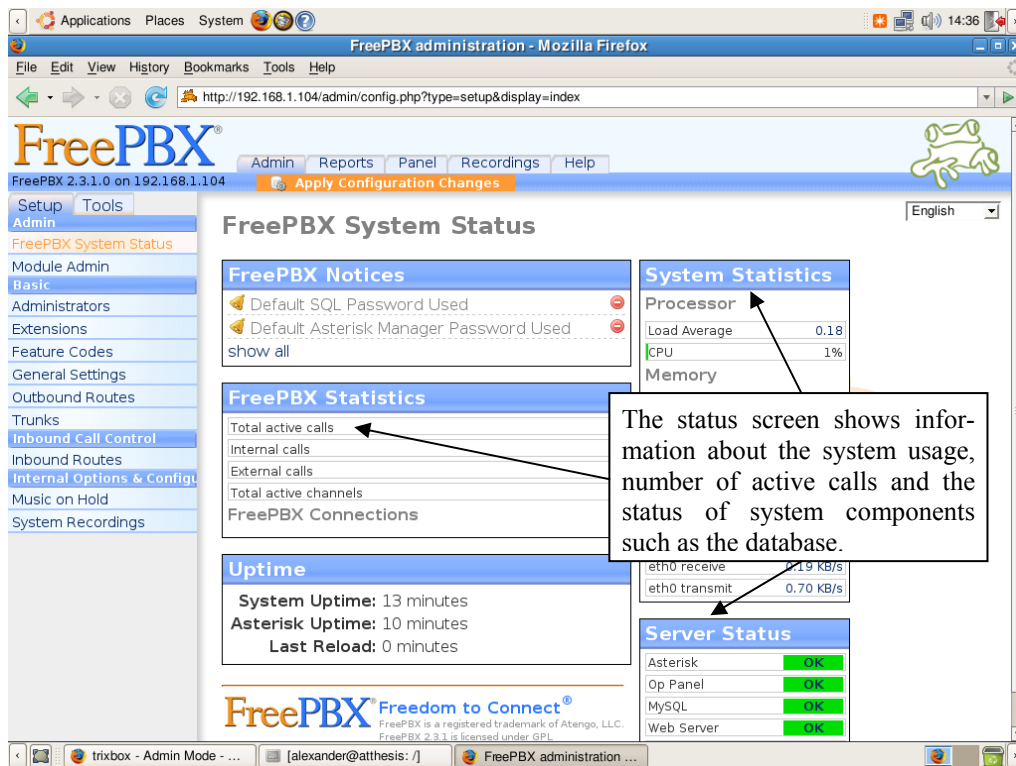


Figure 41: The FreePBX web interface (part of trixbox)

4 Mobile clients and solutions

In today's working environment mobile clients take on a more prominent role than ever. This is reflected in constantly rising sales of laptop computers in relation to desktop PCs as well as Smartphones or Pocket PCs. They also represent an array of new problems for IT departments. How are backups of these laptop computers done? How should the data on mobile devices be protected in case the device is being stolen? Not all questions are relevant for this thesis but an important point is the question of connecting to the collaboration software discussed in the previous sections. Is a VPN¹⁰² connection to be preferred or should the device only connect via the web and traffic be encrypted using SSL¹⁰³? Also, are mobile clients such as Smartphones and Pocket PCs a viable option for the scenarios discussed here?

4.1 Laptop computers

The case for laptop computers is a strong one since, a few years ago, sales of laptops started to overtake those of traditional desktop systems. In May of 2007, Dell started to sell laptop (and desktop) computers which come pre-installed with Ubuntu Linux.³⁷ Up until then, only a few niche players offered pre-installed Linux versions on their laptop and desktop computers. This has, and will continue to, benefit the adoption of Linux by a more broader audience.

Although Linux laptops have become available there are still many devices that are not supported under Linux at all, or not in a way which is feasible for the average computer user. A good example are webcams which are being used by an increasing number of users since many IM programs support video now. Having to manually compile drivers or using unofficial and unsupported drivers that do not support the full functionality of a device cannot be considered an option for an inexperienced user. Device driver problems¹⁰⁴ con-

¹⁰² Virtual Private Network – <http://en.wikipedia.org/wiki/Vpn>

¹⁰³ Secure Sockets Layer – <http://wp.netscape.com/eng/ssl3>

¹⁰⁴ Linux and Open Source: Linux Device Support – <http://gh-linux.blogspot.com/2007/10/linux-device-support.html>

tinue to stay at the top of the list of problems that vendors encounter when considering offering Linux on their systems as reported by the Linux Desktop/Client Survey.¹⁰⁵

Since laptops run (in most cases) the same version of Linux as their desktop counterparts a further discussion on Linux on laptops is not necessary. Rather, it is important how to connect a laptop and its collaboration software to the organizations systems. For every web-based application this should be done by using SSL.¹⁰³ Document management, webmail and portals are examples for web-based applications. If rich clients such as Novell Evolution or Kontact are in use communication should be encrypted via SSL, a standard feature among the mail servers and other services used by the four groupware solutions in this thesis. If instant messaging shall be secured an organization should opt for running their own XMPP⁶⁰ server which can be configured to encrypt traffic via SSL. A VPN solution doesn't seem necessary in these scenarios since it cannot add meaningful security and is more difficult to set up since every device connecting to any of the services like the groupware or IM has to have a VPN client, making the initial setup more expensive.

4.2 Mobile phone clients

The use of mobile devices capable of email and accessing the Internet has been rising sharply over the past few years. Organizations hope to gain an advantage over their competitors by supplying mobile devices to their employees.

We will focus on two software options in this area although the following paragraphs mention a few other efforts in the area of mobile device operating systems to give a better impression of all the players in this field.:

- Windows Mobile: an increasingly attractive option for organizations that already use MS software due to the high level of integration with other MS products.
- Symbian OS: even though it is not released under the GPL it deserves a place in this thesis since by far the majority of all mobile devices use Symbian.¹⁰⁶

¹⁰⁵ 2007ClientSurvey – <https://www.linux-foundation.org/en/2007ClientSurvey>

¹⁰⁶ Symbian OS licensees – <http://www.symbian.com/about/overview/licensees/licensees.html>

4.2.1 OpenMoko

Another initiative for mobile devices is OpenMoko¹⁰⁷, a project aimed at creating an operating system and additional software based on Linux and licensed under the GPL³ and LGPL¹⁰⁸ license. The first device capable of running OpenMoko was released in July 2007 but as of now (February 2008), there are still only a handful of very expensive devices running OpenMoko. In conclusion: at this time, the OpenMoko platform is not a viable alternative to Windows Mobile or Symbian OS.

4.2.2 Android

Android¹⁰⁹ is another Linux-based platform for mobile phones which could become very important in the future. Android originally was a company developing software for mobile phones that was acquired by Google in July 2005. In November 2007 the Open Handset Alliance¹¹⁰ was founded by Google and other well known names in the industry including T-Mobile¹¹¹, Motorola¹¹², Samsung¹¹³, Qualcomm¹¹⁴, HTC¹¹⁵, and Intel¹¹⁶. Other companies such as Nokia¹¹⁷ have expressed interest in joining depending on the acceptance of the Android platform. Android is released under the Apache Software License¹¹⁸ which allows the distribution of OSS in closed-source proprietary products, while the underlying Linux kernel is licensed under the GPL. An Android-based phone has been released by T-Mobile on September 23, 2008 but it's too soon to assess its impact on the mobile devices landscape.

¹⁰⁷ OpenMoko Portal Site – <http://openmoko.org/>

¹⁰⁸ GNU Lesser General Public License – <http://www.gnu.org/licenses/lgpl.html>

¹⁰⁹ Android – <http://code.google.com/android/>

¹¹⁰ Open Handset Alliance – <http://www.openhandsetalliance.com/>

¹¹¹ T-Mobile – <http://www.t-mobile.net/>

¹¹² Motorola – <http://www.motorola.com/>

¹¹³ Samsung Electronics – <http://www.samsung.com/>

¹¹⁴ Qualcomm Home – <http://www.qualcomm.com/>

¹¹⁵ High Tech Computer Corp. – <http://www.htc.com/>

¹¹⁶ Welcome to Intel – <http://www.intel.com/>

¹¹⁷ Nokia on the Web – <http://www.nokia.com/>

¹¹⁸ Apache License, Version 2.0 – <http://www.apache.org/licenses/LICENSE-2.0.html>

4.2.3 Windows Mobile

Windows Mobile is MS' operating system for Smartphones and Pocket PCs. Recently, Windows Mobile became capable of running on on-board computers for certain automobiles. Microsoft originally released Pocket PC in 2000, following up with several new versions, the current one being Windows Mobile 6.0. In addition to the usual cell phone functionality Windows Mobile offers three main applications.

- Office Mobile: this feature consists of mobile versions of MS Word, MS Excel and MS PowerPoint. While these versions do not offer the functionality of their desktop counterparts they still are of enormous value for someone who needs to edit MS Office documents while not at his desk.
- Outlook Mobile: a version of Outlook that can be synchronized with the desktop version or an MS Exchange server and offers almost the same feature set as the desktop version.
- Internet Explorer: a version of MS Internet Explorer to access MOSS or the web in general.
- VPN client: A VPN client to connect to MS Windows computers.

Windows Mobile includes other features such as a version of Windows Media Player and support for MS SQL Server 2005 Compact edition¹¹⁹ but the aforementioned are most relevant in the context of this thesis.

¹¹⁹ MS SQL Server 2005 Compact 3.5 – <http://www.microsoft.com/sql/editions/compact/default.msp>

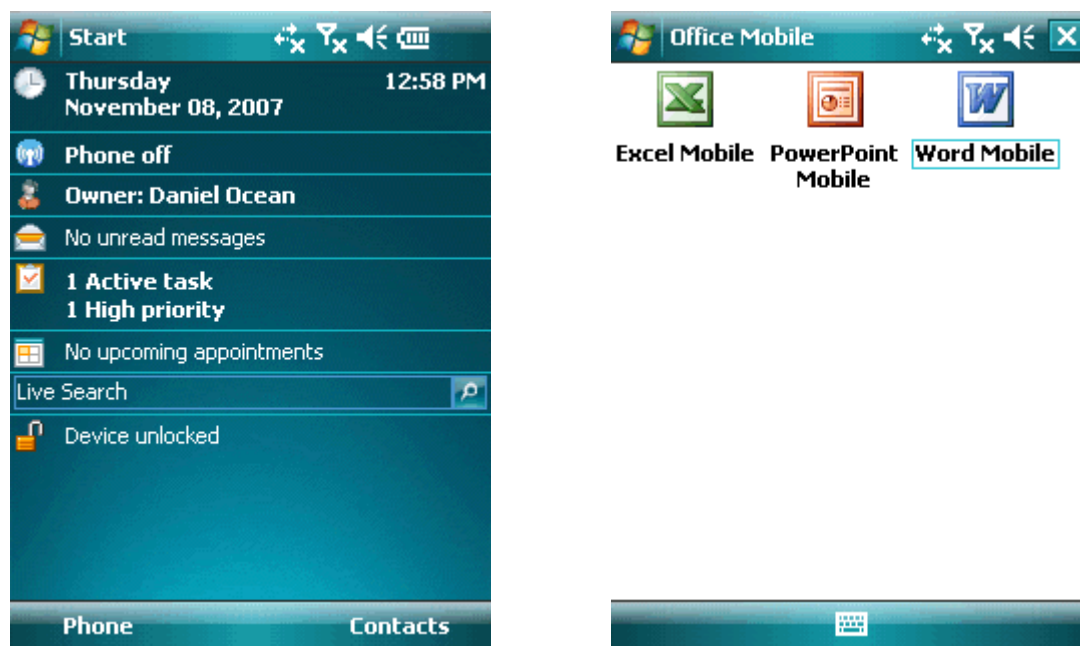


Figure 42: Windows Mobile Home screen and Office Mobile

4.2.4 Symbian OS

Symbian OS¹²⁰ is the leading operating system for mobile phones. It is owned by Nokia, Sony Ericsson¹²¹, Panasonic¹²², Siemens¹²³, and Samsung which use the OS on their products. Symbian OS, originally based on Psion's¹²⁴ EPOC¹²⁵, is therefore by far the most widely used operating system for mobile phones. In 2006 it had a market share of 67%, compared to Microsoft's Windows Mobile having 14%, RIM (manufacturer of the BlackBerry line of devices) having 7%, Linux having 6% and ACCESS/PalmSource¹²⁶ with the Garnet OS¹²⁷ having 5%.¹²⁸ Although Symbian is closed-source software it is the strongest contender in this thesis due to its presence on most mobile devices today and support for

¹²⁰ Symbian Operating System – <http://www.symbian.com/>

¹²¹ Sony Ericsson – <http://www.sonyericsson.com/>

¹²² Panasonic Electronics – <http://www.panasonic.com/>

¹²³ Siemens AG – <http://www.siemens.com/>

¹²⁴ Psion Teklogix – <http://www.psionteklogix.com/>

¹²⁵ EPOC – http://en.wikipedia.org/wiki/EPOC_%28computing%29

¹²⁶ ACCESS – <http://www.access-company.com/>

¹²⁷ Garnet OS – <http://www.access-company.com/products/garnet/index.html>

¹²⁸ 64 million smart phones shipped worldwide in 2006 – <http://www.canalys.com/pr/2007/r2007024.htm>

open technologies such as Java⁸³ enabling interoperability with software such as Funambol (see Section 4.2.5).

4.2.5 Funambol

All four groupware solutions featured in this thesis are being accessed via the web and/or a rich client. While most mobile phones today are able to access the web via a built-in web browser, this often is not practical because of the reduced screen size or the lack of a standards-compliant browser. Since many business professionals consider it important to be able to access email, calendar and contacts via their mobile device this should be possible in a practical way – at best using a designated application suited to the possibilities of the mobile device.

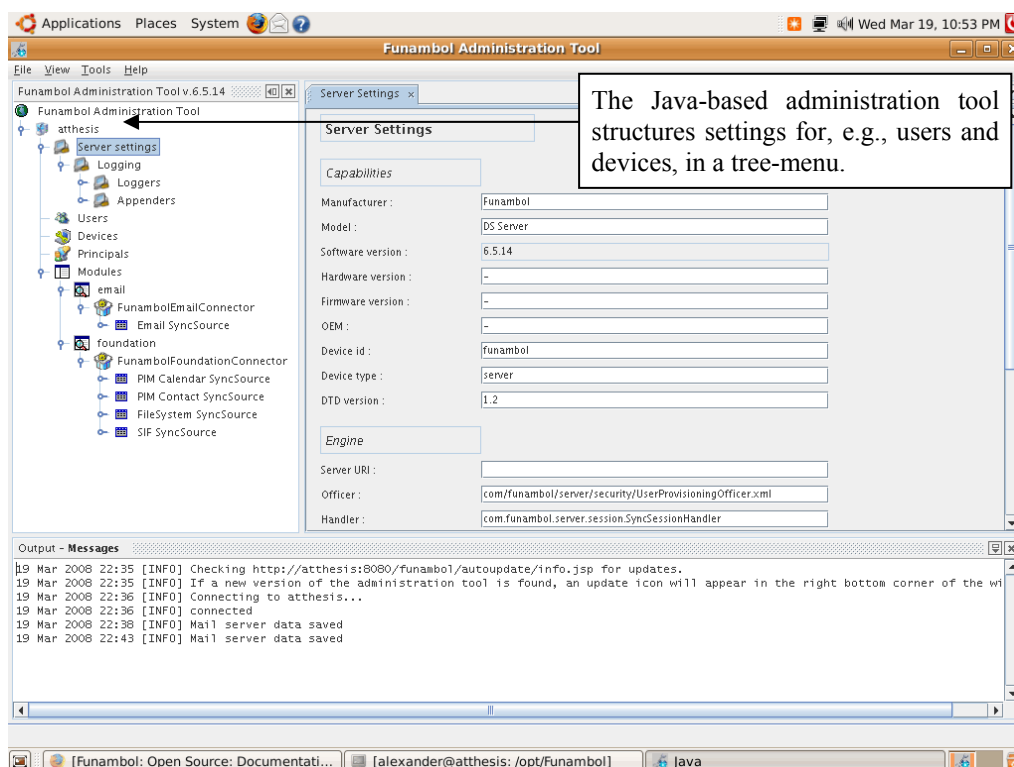


Figure 43: The Funambol administration tool

Funambol¹²⁹ is an OSS project that aims to fulfill these requirements. It is a Java-based application that can be installed under Linux and MS Windows. Funambol is available in a community edition (Funambol Community Edition) and a commercial edition (Funambol Carrier Edition) designed for large-scale deployments. Like other OSS in this thesis it eas-

ily integrates with popular applications like MS Outlook for synchronizing the Funambol server, alleviating the transition from MS Windows to Linux. The two main components are the Funambol server and the Java email client for mobile devices. Supported devices include practically all mobile phones that support Java (the majority running Symbian) so Funambol works with most modern mobile phones from manufacturers such as Nokia or Sony Ericsson. The client has push email functionality which was until recently only available with Blackberry's system (in combination with Blackberry devices) and MS Exchange Server (in combination with Windows Mobile devices).

After the installation and the first start of the Funambol server the IT administrator can use the Funambol administration (Figure 43) tool to enter the sources for email, calendar, and contacts which the Funambol server then synchronizes with the Java client on the mobile devices. Sources can be email servers such as Courier, SugarCRM, Simple Groupware or even MS Exchange server but also simply files for calendars (like iCalendar files).

¹²⁹ Funambol – <http://www.funambol.com/>

5 Costs, hardware compatibility and further considerations

After evaluating OSS' feasibility when replacing MS software from a technical perspective other, equally important, considerations have to be made:

5.1 Integration and usability

Microsoft has some advantage because it can provide everything from the user's desktop software to high-end server software. By providing every tool from word processor and spreadsheet to server products like MOSS or MES Microsoft achieves a level of integration so far unmatched on the OSS side and establishes a platform in which it can easily integrate new products to extend functionality at any time. This high level of integration ultimately results in a high level of convenience both for end users and for administrators since they have a familiar work environment at all times. One example of that is the expansion into the market for mobile devices and the availability of versions of MS Office programs for Windows Mobile (see Section 4.2.3). Another example is desktop sharing under Linux (see Section 3.4.8) compared to desktop or application sharing under Windows using MOC (see Section 2.1.6.3) which is a lot easier and more convenient when using the latter. MOC unifies application sharing as well as IM, VoIP and video conferencing in one product, making deployment, maintenance and user training easier.

5.2 Proprietary software

Another aspect is vendor lock-in, meaning that it can become difficult to switch to other software solutions if there is a conflict between an organization's IT policy and MS' product offerings. MS has been criticized repeatedly for its almost monopolistic practices and policies when it comes to interoperability with other software vendors' products. The company also has a history of forcing software upgrades or file formats upon users, generating discontent among its user base and IT administrators. The EU commission repeatedly fined Microsoft for charging competitors high prices for access to its software and then later again for the company's refusal to comply with the ruling. The last fine, imposed in Janu-

ary of 2008, was a record €899 million.¹³⁰ The problem of vendor lock-in has become somewhat mitigated over the last years since many OSS now offers interfaces to MS products (e.g., Simple Groupware and Funambol synchronize with MS Outlook and Windows Mobile).

5.3 Costs

Costs in our scenario consist of the purchase price of software, the maintenance cost due to support contracts and costs for user training. The first factor drops out due to the fact that the OSS reviewed in this thesis is available at no cost, making maintenance cost (which includes the initial setup) more important.

In favor of MS' software is the fact that over time the initial cost of software becomes less important and maintenance cost more important. This can make MS software relatively cheap for certain organizations that calculate long lifespans for their software deployments. An example are the many organizations still using MS Windows 2000.¹⁴ For IT administrators, deploying MS software is attractive because there is one support contact for every software, reducing costs and complexity.

Organizations using Linux have the advantage of being able to update to the latest version at often no additional cost. When using Ubuntu, updating even to the next version of the OS is possible by simply entering a few commands on the console. Updates of MS software come at a discount but even those lower costs still can account for a large part of the IT budget in an organization.

Training users to work with a particular software can be expensive. Until now, MS has an advantage here since almost everyone has used MS Windows in the past or is currently using it and is familiar with MS' way of doing things. If a user has ever worked with MS Outlook he will almost always immediately be able to work with OWA in MES since it offers a web interface almost identical to MS Outlook. It is difficult to assess how many users need training to be able to work productively under GNOME when they have only been using MS Windows before. KDE with its taskbar at the bottom on the screen and the main menu in the lower left corner is similar to MS Windows and might therefore be more

¹³⁰ European commission fines Microsoft record £680m –
<http://www.guardian.co.uk/business/2008/feb/27/microsoft.europe>

attractive than GNOME for some organizations hoping to reduce user training costs. Many other OSS try to copy the look and feel of MS software to make the transition to OSS easier (e.g., Novell Evolution and MS Outlook). Still, no final conclusion can be drawn about how expensive user training will be. Too many factors such as the number of new programs, age of the users, organization size and upgrade intervals have to be considered. It is not clear if Linux is always the cheaper solution.

5.4 Hardware compatibility

MS Windows has a clear advantage in the area of hardware compatibility due to its almost ubiquitous use. Almost every manufacturer of hardware of any kind (regardless if it is a computer mouse or a RAID¹³¹ card) will develop drivers for Windows. In most cases drivers for Linux are not available from the manufacturer but are being reverse engineered by enthusiasts. This has become a severe problem which led to initiatives such as the Linux Kernel programmers offering free driver development to every hardware manufacturers¹³², announced in January of 2007. The project so far has been successful and led Novell to recruit Linux kernel developer Greg Kroah-Hartman to lead the Linux Driver Project.¹³³ The situation will only further improve with the increasing use of Linux which, of course, would be helped by the availability of more drivers.

5.5 Mobile devices

There is currently only one operating system for mobile devices in production available under an OSS license, Android by Google. The OS is still too young and offers too few applications to assess its long term impact. The next best choice is a combination of Funambol and Symbian. Funambol provides a server and client software but there is no underlying OS to run the mobile device. Symbian is the most likely choice since it is pre-installed on most mobile devices today, not causing any additional cost. Of all the OSS projects for mobile devices Android is the most interesting and promising since it is backed by Google and prominent companies are already using it (T-Mobile) or planning to (Motorola).

¹³¹ Redundant Arrays of Independent Disks – <http://en.wikipedia.org/wiki/RAID>

¹³² linux kernel monkey log – http://www.kroah.com/log/linux/free_drivers.html

5.6 Support contracts

Software support contracts are a very important aspect for any organization when purchasing software. They not only offer protection against the disruption of workflows due to software errors but they can also relieve IT personnel which can then be assigned to other tasks (other than supporting software) or simply help to minimize IT staff.

MS software is traditionally purchased in conjunction with a support contract, making it a secure choice for many organizations while similar contracts were not available for OSS for a long time. Over the last few years, however, many companies have started to commercialize and offer OSS with attached support contracts. The Linux distribution used throughout this thesis, Ubuntu Linux, is available with support contracts from Canonical Ltd. Other prominent examples include Red Hat and Sun Microsystems. MS offers certifications for most of their products which give companies additional confidence when considering support contracts. Certifications for OSS is seldom available and difficult to obtain since, in most cases, the software is coming from many different sources.

¹³³ Linux Driver Project - <http://www.linuxdriverproject.org/twiki/bin/view>

6 Two case studies

After reviewing OSS to replace MS' software and considering additional factors such as costs when doing so, two case studies will now provide practical examples of organizations switching to OSS. The following criteria will be discussed:

- Selection of appropriate software
- Describe potential problems
 - Hardware, especially laptops
- Costs
 - Licensing costs
 - Support costs
- Software maintenance
 - Maintained by a company or hobbyists?
- Installation
 - Required time
 - Does the software need to be compiled, are packages available for download or is the software available via Ubuntu's package management system?
- Mobile devices
 - How to synchronize with mobile devices

Other criteria such as backups, choice of firewall, setting up a printer or hardware RAID¹³¹, or getting certificates for SSL-enabled communications, will not be considered since they do not influence the choice between MS software and OSS. E.g., an equal effort for implementing backups can be assumed regardless of platform choice. Detailed setup instructions will not be provided here since only How-to's and tutorials from the Internet have been used but these will be available in the footnotes or referenced at the end.

6.1 Small business case

The first case covers a small business with five employees and one executive who also needs access to company data from the internet, e.g., when giving presentations at a client's office. The six regular employees do not need access via the internet since they only work at the company's office. An IM solution, therefore, is not among the requirements, as is the need to integrate software for mobile devices. The hardware in use consists of stan-

standard PCs and laptops and since no devices such as webcams are being used there are no hardware problems.

The company is in the investment research industry. Employees do not use any special applications but standard email and office software and produce lots of reports on (potential) investments including complicated spreadsheets, putting the focus for the server software on a good document management solution. To reduce costs the company does not have any in-house IT staff but instead relies on an external IT consulting company. The small and rather simple setup of the company's infrastructure only requires the assistance of one IT consultant. The following organization chart shall illustrate the first case:

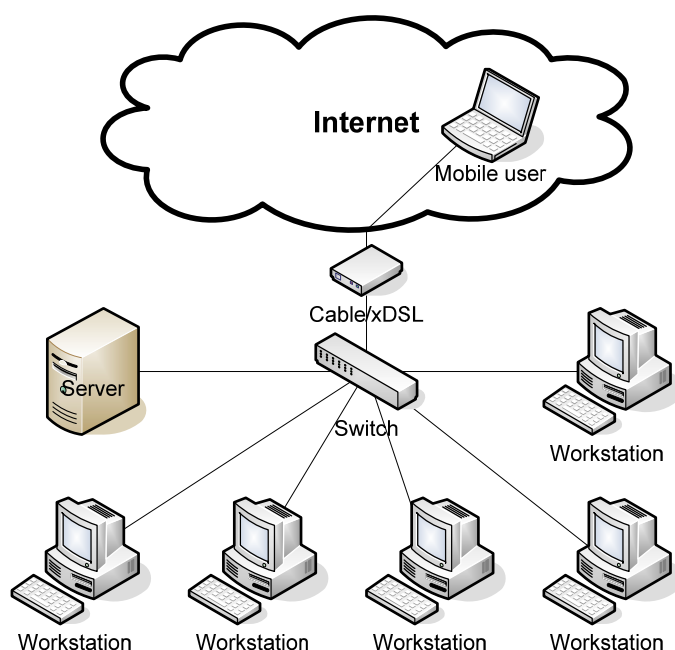


Figure 44: Organizational chart for the small business case

This small business uses the following software:

- Ubuntu Linux on the server, the workstations and the executive's laptop computer.
- On the workstations and the laptop Ubuntu is a standard setup with applications such as Novell Evolution and OpenOffice.org preinstalled.
- On the server installed applications include the Apache web server, the MySQL database server and eGroupWare for document management purposes. Email is outsourced to an external provider to guarantee the highest possible availability and preserve bandwidth at the office location.

6.1.1 Costs

The company uses an external IT consultant who bills by the hour. The organization's setup is not complex, so the same consultant advises on all IT-related matters. After the initial, higher, costs for the setup of the systems and software and training of the users costs quickly fall to a low level when the IT consultant only has to perform maintenance tasks such as updating installed software or occasionally supporting users. The costs for administering the Ubuntu installations will likely be lower than for MS Windows workstations since there are no viruses or malware¹³⁴ to cause problems and no anti-virus, anti-malware or firewall software distracting users from their work, resulting in a lower number of support calls.

6.1.2 Software maintenance

Every software used in this case is supported by a company or a well-known organization. Ubuntu Linux is developed and maintained by Canonical.⁴⁶ The company promises to release a new version every six months and that the software will forever be free of charge. Instead, Canonical finances its operations through support contracts. The main desktop applications for this small business are Novell Evolution and OpenOffice.org. Behind Novell Evolution stands Novell, Inc., the company that releases the free OpenSUSE Linux distribution and SUSE Enterprise Linux only available by purchase. The OpenOffice.org suite of office applications is backed by many well-known companies and organizations such as Sun Microsystems, Inc. and is actively developed with version 3 available as a release candidate at the time of this writing.

6.1.3 Installation

Ubuntu Linux for desktops will be installed on all workstations, the executive's laptop, and the server. Ubuntu has very good hardware detection with current hardware and since the company is not using any special equipment there are no problems with non-functioning hardware. On the client the installation is straight forward since all required applications are installed by default, 25 minutes per PC is a good estimate including setting up the users.

¹³⁴ Malware – <http://en.wikipedia.org/wiki/Malware>

The server runs eGroupWare which is available via Ubuntu's package repository using the Synaptic package manager. Two ways of installing software in Ubuntu using the package management system are shown here. These two ways will not be demonstrated for each software being installed since the process is essentially the same every time. The first option is to install using the Synaptic package manager which provides a nice interface to Ubuntu's package management system:

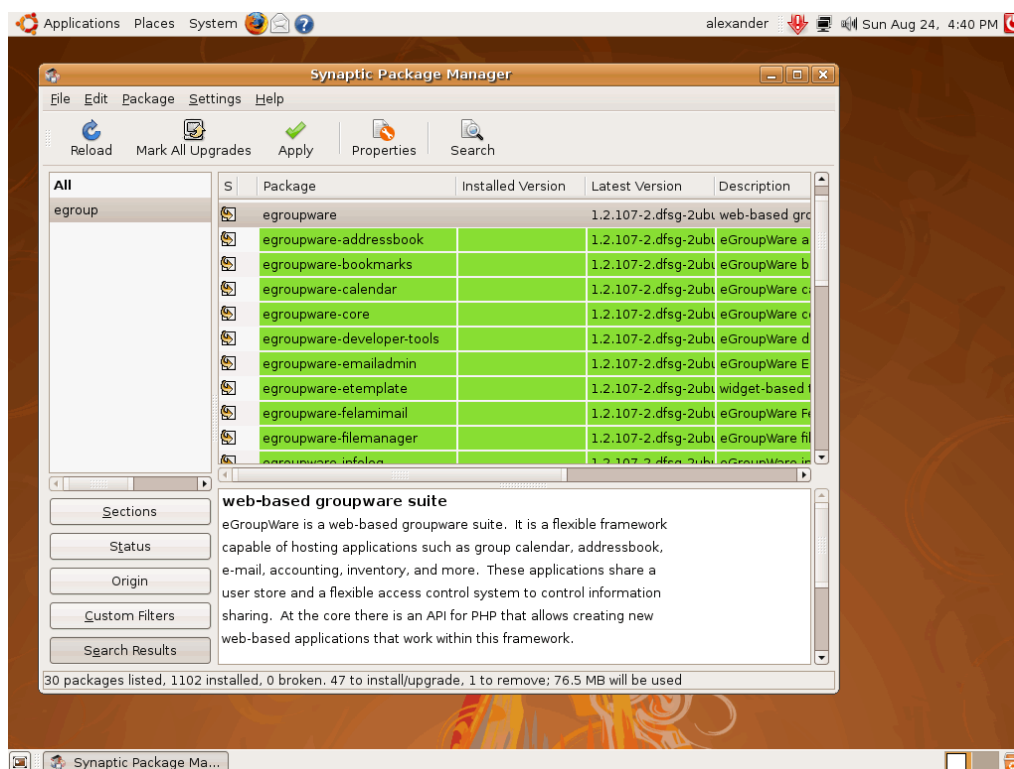


Figure 45: After clicking on „egroupware“ Synaptic automatically highlights and selects the relevant modules

Alternatively, eGroupWare (and software in general) can be installed using a terminal. This option is preferable when working from a remote location (via SSH¹³⁵) since bandwidth requirements are lower and a GUI¹³⁶ (e.g., by using VNC⁶³ or FreeNX¹³⁷) is not necessary.

```
alexander@ubuntu:~$ sudo apt-get install egroupware
Reading package lists... Done
```

¹³⁵ Secure shell – http://en.wikipedia.org/wiki/Secure_Shell

¹³⁶ GUI – <http://en.wikipedia.org/wiki/GUI>

¹³⁷ FreeNX – <http://en.wikipedia.org/wiki/Freenx>

```
Building dependency tree
```

```
Reading state information... Done
```

```
The following extra packages will be installed:
```

```
apache2 apache2-mpm-prefork apache2-utils apache2.2-common
egroupware-addressbook egroupware-bookmarks egroupware-calendar
egroupware-core egroupware-developer-tools egroupware-emailadmin
egroupware-etemplate egroupware-felamimail egroupware-filemanager
egroupware-infolog egroupware-manual egroupware-mydms egroupware-news-
admin
egroupware-phpbrain egroupware-phpsysinfo egroupware-polls
egroupware-projectmanager egroupware-registration egroupware-resources
egroupware-sambaadmin egroupware-sitemgr egroupware-timesheet
egroupware-wiki egroupware-workflow libapache2-mod-php5 libapr1 li-
baprutil1
libc-client2007 libgd2-xpm libpq5 libt1-5 mlock php-fpdf php-log php-
pear
php5 php5-cli php5-common php5-gd php5-ldap php5-pgsql
```

```
Suggested packages:
```

```
apache2-doc egroupware-ldap php5-auth-pam php4-auth-pam php5-mcrypt
php4-mcrypt php5-mhash php4-mhash uw-mailutils libgd-tools ttf2pt1 php-
db
php5-sqlite php-mdb2 php5-dev php4-dev
```

```
Recommended packages:
```

```
php4-mcal postgresql-client mysql-client php4-xslt
```

```
The following packages will be REMOVED:
```

```
libgd2-noxpm
```

```
The following NEW packages will be installed:
```

```
apache2 apache2-mpm-prefork apache2-utils apache2.2-common egroupware
egroupware-addressbook egroupware-bookmarks egroupware-calendar
egroupware-core egroupware-developer-tools egroupware-emailadmin
egroupware-etemplate egroupware-felamimail egroupware-filemanager
egroupware-infolog egroupware-manual egroupware-mydms egroupware-news-
admin
egroupware-phpbrain egroupware-phpsysinfo egroupware-polls
```

```
egroupware-projectmanager egroupware-registration egroupware-resources
egroupware-sambaadmin egroupware-sitemgr egroupware-timesheet
egroupware-wiki egroupware-workflow libapache2-mod-php5 libapr1 li-
baprutil1
libc-client2007 libgd2-xpm libpq5 libt1-5 mlock php-fpdf php-log php-
pear
php5 php5-cli php5-common php5-gd php5-imap php5-ldap php5-pgsql
0 upgraded, 47 newly installed, 1 to remove and 248 not upgraded.
Need to get 18.9MB of archives.
After this operation, 76.5MB of additional disk space will be used.
Do you want to continue [Y/n]?
```

Figure 46: Text-based installation of eGroupWare using the apt-get package management system

Both ways of installing are easy and do not require any advanced computer skills. Downloading and installing eGroupWare using either of the two ways takes about 5 minutes assuming a broadband Internet connection. Setting the application up – meaning configuring MySQL and user accounts – takes another 10 minutes.

The installation time of OSS in this scenario will in general be less than when using MS software because every MS Windows workstation needs additional software such as anti-malware and anti-virus programs to be actually usable in a production environment.

6.1.4 Results

The initial setup will be finished faster than in an MS Windows environment and require less administrative attention. But a company in this industry will have to work with MS Excel spreadsheets at some point. Although OpenOffice.org Calc offers very good compatibility with MS Excel there are still functions available in MS Excel that are not implemented in OpenOffice.org Calc and vice versa. Still, in this case a Linux setup is easier than a MS Windows setup since all applications such as email clients, and office productivity software are already installed. It is also cheaper since there are no licensing costs for productivity software and anti-virus or anti-malware programs.

6.2 Large enterprise case

The second case is a large enterprise (or, alternatively, a department in an even bigger organization) with around 250 users. The company does not outsource any IT services but instead runs all its servers at its office location and has considerable IT staff. Employees do not use any special software but standard email and office applications on their computers. While this scenario might seem over-simplified it is actually quite common. Consider large consulting companies where employees spend their whole day in applications such as MS Outlook, MS Excel and MS PowerPoint. A growing number of new software programs are being implemented as web services allowing for the assumption that if employees in our scenario use special software it's a web service and therefore does not require any software on the client (except, of course, a browser, which is part of the standard Ubuntu installation). The best examples are probably the web-based groupware solutions reviewed in this thesis. Due to the size of the organization not only a good document management solution is needed but also a calendaring software to schedule meetings and appointments with other employees and clients. Some employees have never met each other but still need to collaborate on projects – IM software is required as is the need to occasionally collaborate remotely on documents. Employees also need access to the company's data via the internet depending on their assignment. An organization of this size needs a directory service¹³⁸ to administer users and allow them to login on computers other than their own within the organization. If necessary, users can work in close vicinity of each other simply by using adjacent computers. MS' implementation of a directory service is called Active Directory¹³⁹ and was introduced with Windows 2000. A good open-source implementation of a directory service is the Fedora Directory Server¹⁴⁰ actively developed by Red Hat¹⁴¹. Hardware for workstations and laptops is standardized to allow for an image-based installation of Ubuntu. Phones are standardized on Symbian (see Section 5.5) with Java installed for the Funambol client (e.g., currently most Nokia phones fulfill these requirements). Synchronization is done using the Funambol server software. The following chart gives an overview of the company's structure:

¹³⁸ Directory service – http://en.wikipedia.org/wiki/Directory_server

¹³⁹ Active Directory – <http://www.microsoft.com/windowsserver2003/technologies/directory/activedirectory/default.msp>

¹⁴⁰ Fedora Directory Server – <http://directory.fedoraproject.org/>

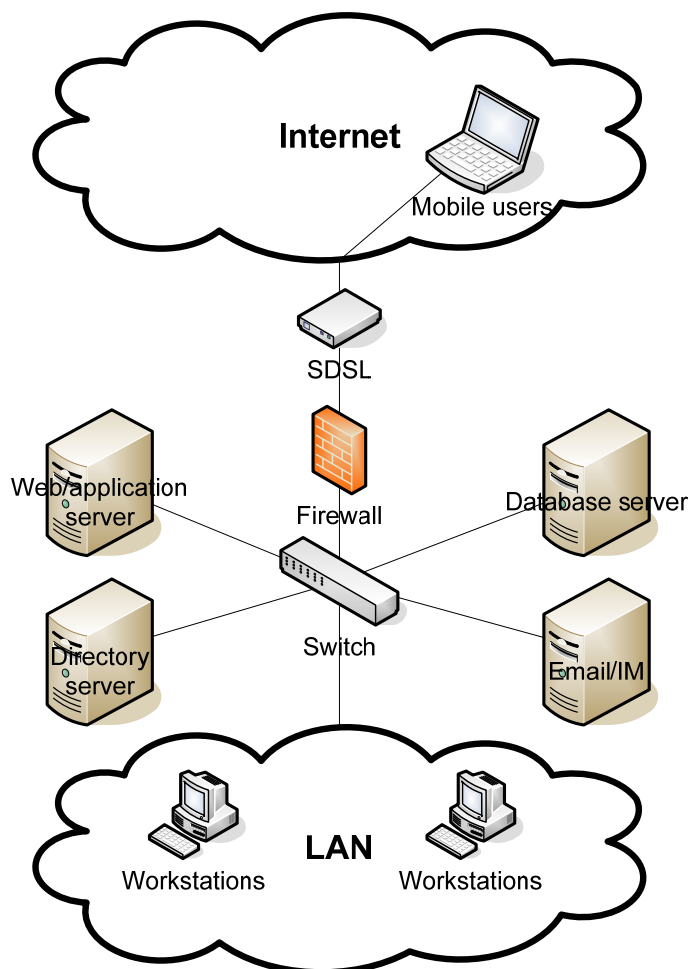


Figure 47: Organizational chart for the large enterprise case

The following software is being used:

- Ubuntu Linux on the server, the workstations and laptop computers.
- On workstations and laptop computers Ubuntu is a standard setup with applications such as Novell Evolution and OpenOffice.org preinstalled.
 - IM application Pidgin is also installed by default.
 - VNC software (see Section 3.4.8) for working together remotely on documents is also installed by default.
- There are three servers for different tasks:
 - An application server running Apache, Simple Groupware (see Section 3.5.4), and Funambol for synchronizing with mobile clients

- A server running FDS, Postfix¹⁴², Courier-IMAP⁷⁸ and Jabber¹⁴³ for IM
- A database server running MySQL

6.2.1 Costs

The company has in-house IT staff due to the complexity of the implemented solution, the number of users and the resulting number of support calls. Setup costs will be higher than for a comparable MS solution, also because of the higher complexity. After the setup, a large deployment like in this case generates a steady stream of problems and resulting support requests but probably no more than when using MS software, especially when considering the threat from viruses or malware. An assumption has to be that the software solution is properly implemented and will run as expected and that the major origin of costs will be user-related problems.

6.2.2 Software maintenance

Like in the Small business-case every software is maintained by a company or organization. The only exception is Postfix which is not important since as a SMTP service it can be replaced rather easily should the need arise. It still is a good choice because of its broad user base, its good documentation and regular security updates. FDS is a rebranded version of the Red Hat Directory Server¹⁴⁴ with full functionality maintained by the Fedora Project.¹⁴⁵ The synchronization server Funambol is actively developed by a growing organization with the same name supported by companies such as, Nokia, Motorola, Red Hat. For a more detailed overview of Funambol see Section 4.2.5.

6.2.3 Installation

Ubuntu Linux for desktops will be installed on all workstations, laptops, and servers. Although Ubuntu's hardware detection generally works with most devices such as webcams or scanners there are no guarantees that a recently purchased webcam will simply work. To

¹⁴² The Postfix Homepage – <http://www.postfix.org/>

¹⁴³ Jabber Software Foundation – http://www.jabber.org/web/Main_Page

¹⁴⁴ Red Hat Directory Server – http://www.redhat.com/directory_server/

¹⁴⁵ Fedora Project – <http://fedoraproject.org/>

alleviate this problem the organization has standardized on one model, the Logitech QuickCam Pro 9000¹⁴⁶ with integrated microphone which is known to work in Ubuntu.

6.2.3.1 Laptops and workstations

Installation on the laptops and workstations is done using a customized and according to the organizations' corporate identity rebranded version of Ubuntu created with Reconstructor.¹⁴⁷ The software allows the customization (e.g., change Boot and Splash screens as well as the theme, and add or remove software packages and sources for software packages) and then the creation of an ISO¹⁴⁸ image with the result starting with only the software and a standard Ubuntu CD.

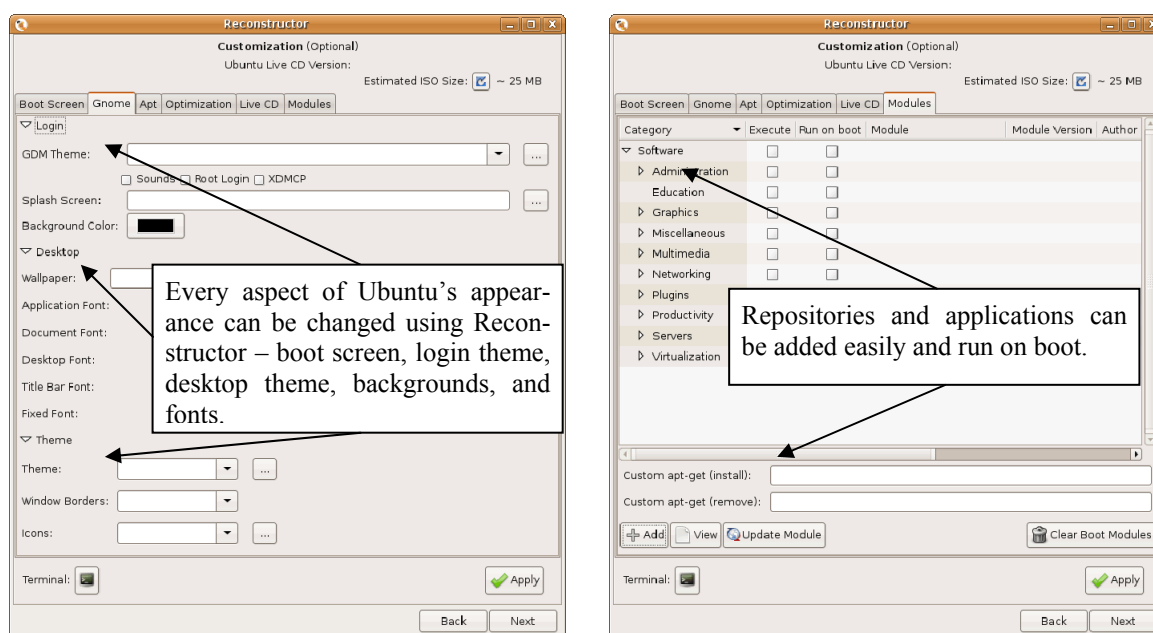


Figure 48: Branding the customized Ubuntu CD

Figure 49: Installing additional applications

When the branded, new Ubuntu CD is created it has to be installed on one of the clients to check if everything works properly. Then, using [Desh08], client packages for FDS are added and additional configuration is done. As soon as the servers are set up (see Section 6.2.3.2) everything will be tested. If the setup works correctly the How-to [Gram08] outlines the steps to create an image of the production-ready Ubuntu client and distribute it to

¹⁴⁶ Logitech QuickCam Pro 9000 –

http://www.logitech.com/index.cfm/webcam_communications/webcams/devices/3056&cl=us,en

¹⁴⁷ Reconstructor – http://reconstructor.aperantis.com/index.php?option=com_frontpage&Itemid=1

¹⁴⁸ ISO – <http://www.ecma-international.org/publications/standards/Ecma-119.htm>

other clients. This procedure requires a server to store and distribute the image – however no special software is required, a running SSH service and an account with the service is sufficient. To set up new clients computers need to be booted with the standard Ubuntu CD and with a single ssh-command the image can be fetched from the server and stored on the client.

6.2.3.2 Servers

Postfix, Courier-IMAP and Jabber for IM are all available via Ubuntu's package repositories. Since FDS is actively developed by Red Hat for their line of Linux products there is no package available for Ubuntu. It is possible however, to download the package in RPM¹⁴⁹ format and convert it to a Deb¹⁵⁰ package format. [Chin08] offers an easy way of converting the package and then installing FDS on Ubuntu. FDS depends on Java to run, the installation of a JVM and other dependencies is also covered in [Chin08]. The whole process takes about 45 minutes and can be immediately tested with the already set up client. For IM, a Jabber server is installed on the same machine as the email server. [Sett08] describes this simple process – essentially one command to install the software and then few minutes of configuration. Similarly easy is the installation process for the Apache web server, MySQL, Postfix, and Courier-IMAP. It is important to install the php5-gd¹⁵¹ package (available via Ubuntu's package repository) when installing Apache since it's one of Simple Groupware's dependency packages. Except for php5-gd, SG works with Ubuntu's standard setup for Apache, MySQL, Postfix, and Courier-IMAP. The two most important steps when installing SG is the integration with FDS and the Funambol server. SG offers this functionality without any additional modules, changes to the source code or modifications of FDS or Funambol configuration files. The only requirement for SG and Funambol is that they are running on the same computer (FDS can run on a separate computer since it is accessed using LDAP). FDS is installed already, Funambol can be downloaded from the project's website as an executable installer. The software requires Java which is already installed for FDS. The SG website offers two very short manuals [Bley08], [Thom08] on how to install and integrate Funambol and FDS with SG. One drawback with this setup is the fact that Funambol and SG do not use the same user database. Users have to be manu-

¹⁴⁹ Red Hat Package Manager – <http://www.rpm.org/>

¹⁵⁰ deb (file format) – [http://en.wikipedia.org/wiki/Deb_\(file_format\)](http://en.wikipedia.org/wiki/Deb_(file_format))

ally created for each of the two applications (using the same user name, passwords may be different) but this step can be automated using a script. Integration with FDS is also very brief and easy using [Thom08], not taking up more than 5-10 minutes. After all servers have been set up and user accounts have been created, initially all user accounts have to be copied from the server running FDS to the computer running Postfix and Courier-IMAP (see Figure 47). This process is straight-forward and described in [Vive07]. Later, when adding, removing, or editing users this can be done separately on each server or a script could be used.

6.2.4 Results

The resulting set up offers a high level of flexibility for users, allowing them to roam between computers and collaborate in different ways. The level of complexity is well hidden from the user and not distracting from work (except maybe when using VNC, see Section 3.4.8). A few comparisons to a MS based solution can be made: The process of creating and deploying images over a network is easier when using MS Windows (specifically, the free Microsoft Deployment Toolkit¹⁵²) since there are GUI-based tools for every step, making updating to a new OS version or joining a domain much easier. User management is greatly simplified compared to this OSS solution since every aspect of user management is controlled via AD for the whole organization – no copying of users to other machines or manually updating user entries in more than one place. There are fewer applications to install and maintain when it comes to patching or updating, e.g., MES replaces all of the functionality of Postfix, Courier-IMAP, and Funambol. These facts together suggest that the OSS solution will probably generate higher costs in the long term, assuming equal influencing factors such as employee turnover or number of support incidents. However, the number of support incidents could be higher on an MS installation because of the elevated threat from viruses and malware.

¹⁵¹ GD Graphics Library for dynamically manipulating images – http://www.libgd.org/Main_Page

¹⁵² Microsoft Desktop Deployment – <http://technet.microsoft.com/en-us/desktopdeployment/default.aspx>

7 Conclusion

Replacing MS software with OSS is possible in most scenarios but often only with significantly higher effort and, therefore, costs. MS' solution requires less effort because their various software programs are very well integrated and cover a wide range of applications. This integration offers many benefits: having one source for all software needs and updates greatly reduces the complexity of a setup. Similar ways of doing things in every software makes looking for configuration options or errors easier and quicker. Even if, e.g., the integration of FDS and SG doesn't require much more effort there still more steps to take during set up which consume valuable time and which leave room for errors. MS also offers very detailed configuration options in some programs where OSS just has not reached a similar high level of complexity. An example would be Active Directory and its numerous configuration possibilities for an organization's branch offices and the integration with MES and MOSS to allow single sign-on. The conclusion can be made that an MS solution is better suited for large-scale deployments where directory services and remote collaboration become very important. In small organizations with lower requirements such as the small business case in Section 6.1 OSS can gain an edge over MS because of no licensing costs and often lower support costs. It is often easier to have students maintain a small OSS setup since they can gain knowledge on the platform without spending any money.

When considering costs there is no general rule as to which solution is cheaper, MS or OSS. No single factor weighs in enough to give a clear decision. Organizations implementing an OSS solution have to calculate accurately if the reduced cost in licensing (and maybe support contracts) offsets the almost always higher initial outlay. Of course, choosing one software over another is not always financially motivated. Some organizations deliberately choose OSS for other reasons, such as trying not to be bound to MS' upgrade policies or to avoid vendor lock-in. Others, such as some public authorities in various places around the world want to, or even have to, use open standards for greater interoperability or security. The possibility of looking at the source code, or at least knowing that the source code is accessible and being looked at by countless individuals all across the globe, makes OSS very attractive from a security standpoint.

A clear movement has formed over the past years showing that major corporations have started to endorse OSS as a viable alternative to MS software. Some corporations have

made significant capital investments in OSS, becoming important contributors to the code-base. IBM contributes (among others) to the Apache web server, OpenOffice.org, the Eclipse¹⁵³ project and even to SUSE Linux Enterprise which is distributed by Novell. This engagement of companies like IBM makes it easier for organizations to invest in and use OSS, creating confidence and trust by making clear that Linux and other prominent OSS is here to stay.

¹⁵³ Eclipse.org – <http://www.eclipse.org/>

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