



TFM: Email system upgrade

PAC 4 : Project Report

Table of Contents

1. Introduction to CELLS.....	3
2. Background of the project.....	4
3. Project objectives.....	8
3.1 Project scope and exclusions.....	8
3.2 Business case.....	9
4 Constraints and assumptions.....	10
4.1 Technological constraints.....	10
4.2 Business constraints.....	10
4.3 Assumptions.....	10
5. Project plan.....	11
5.1 Timescale.....	12
5.2 Stage plan.....	13
5.3 Project tasks.....	14
5.4 Milestones.....	15
5.5 Desired outcomes.....	16
5.6 Resources.....	17
5.7 Costs.....	18
6. Project Design.....	19
6.1 System Base Installation.....	20
6.2 Email Service Configuration.....	21
6.3 Antispam Servers Upgrade.....	22
6.4 IMAP Proxy Configuration.....	24
6.5 User Migration.....	25
7. Technical Documentation.....	28
8. Project Validation.....	29
9. Final status of the project.....	30
10. Conclusions.....	32
10.1 Review of the business case.....	32
10.2 Review of the project objectives.....	32
10.3 Review of the team performance.....	33
10.4 Lessons report.....	33
10.5 Summary of follow-on action recommendations.....	33
11. References.....	34

1. Introduction to CELLS

CELLS is a public consortium created to build the biggest scientific facility in Spain, the synchrotron light source called ALBA.

The synchrotron light is used to see the properties of any sample material, and it can be used in almost any scientific area, like chemistry, biology, physics, medicine, archeology, nano-technology and a long etcetera.



ALBA has been built in the nearby of Barcelona, between the towns of Cerdanyola del Vallès and Sant Cugat del Vallès. Currently it is in the testing phase of the three particle accelerators that compound the synchrotron, and the construction of the 7 beamlines (the laboratories where the experiments will be made) is about to be finished.

At the moment, CELLS has about 150 employees, but there are also many other private companies that are collaborating with the project. The computing division is the biggest in the company, with 49 people. The rest of the divisions are engineering, accelerators, experiments and administration.

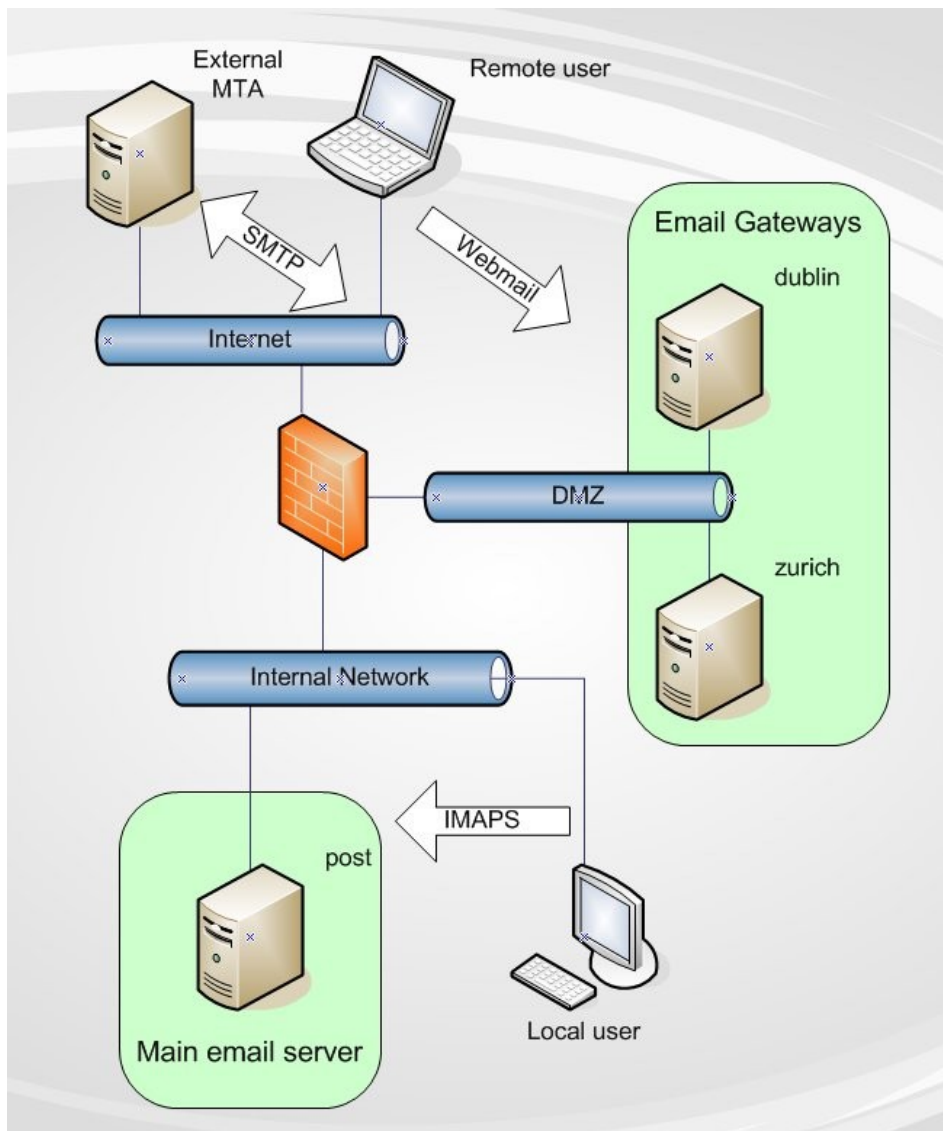
To see more details of the company, visit www.cells.es.

2. Background of the project

Currently, CELLS has an in-house email service with its own email servers. The local email clients (the company employees) can connect to the email server using IMAPS₍₁₎ protocol and send email using SMTPS₍₂₎ as well as SMTP₍₂₎ protocol.

Before this project started, employees could access the email remotely using webmail, but they could not use directly an email client because IMAPS and SMTPS were closed for external connections because of the security policy.

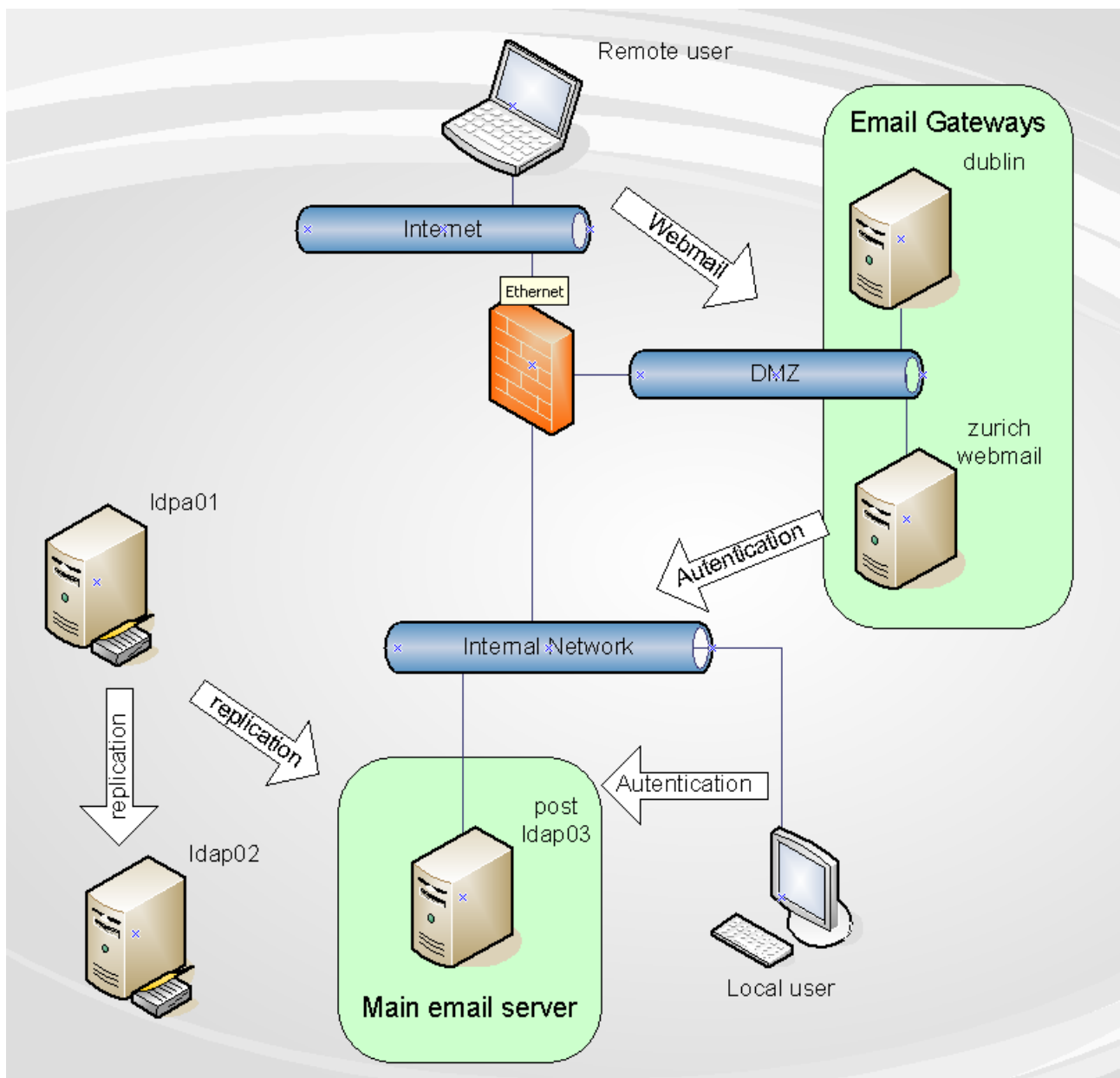
The incoming email to the @cells.es domain was going to two anti-spam₍₃₎ / anti-virus servers called dublin and zurich. The central email repository was hosted in one single machine called post. The webmail service was on a DMZ₍₄₎ server called zurich. The following diagram shows the deployment at the beginning of this project:



The user database is kept in a central LDAP₍₅₎ repository, used for authentication and authorization of many different services. The main LDAP database resides in two dedicated servers called ldap01 and ldap02. Additionally, there was a third replica in the post server (also called ldap03) because of performance reasons.

The authentication of the local email users was done on the replica hosted in the post server. For webmail users, the webmail application redirected the credentials to the post server in order to authenticate the user.

The following diagram shows the LDAP deployment at the beginning of this project:

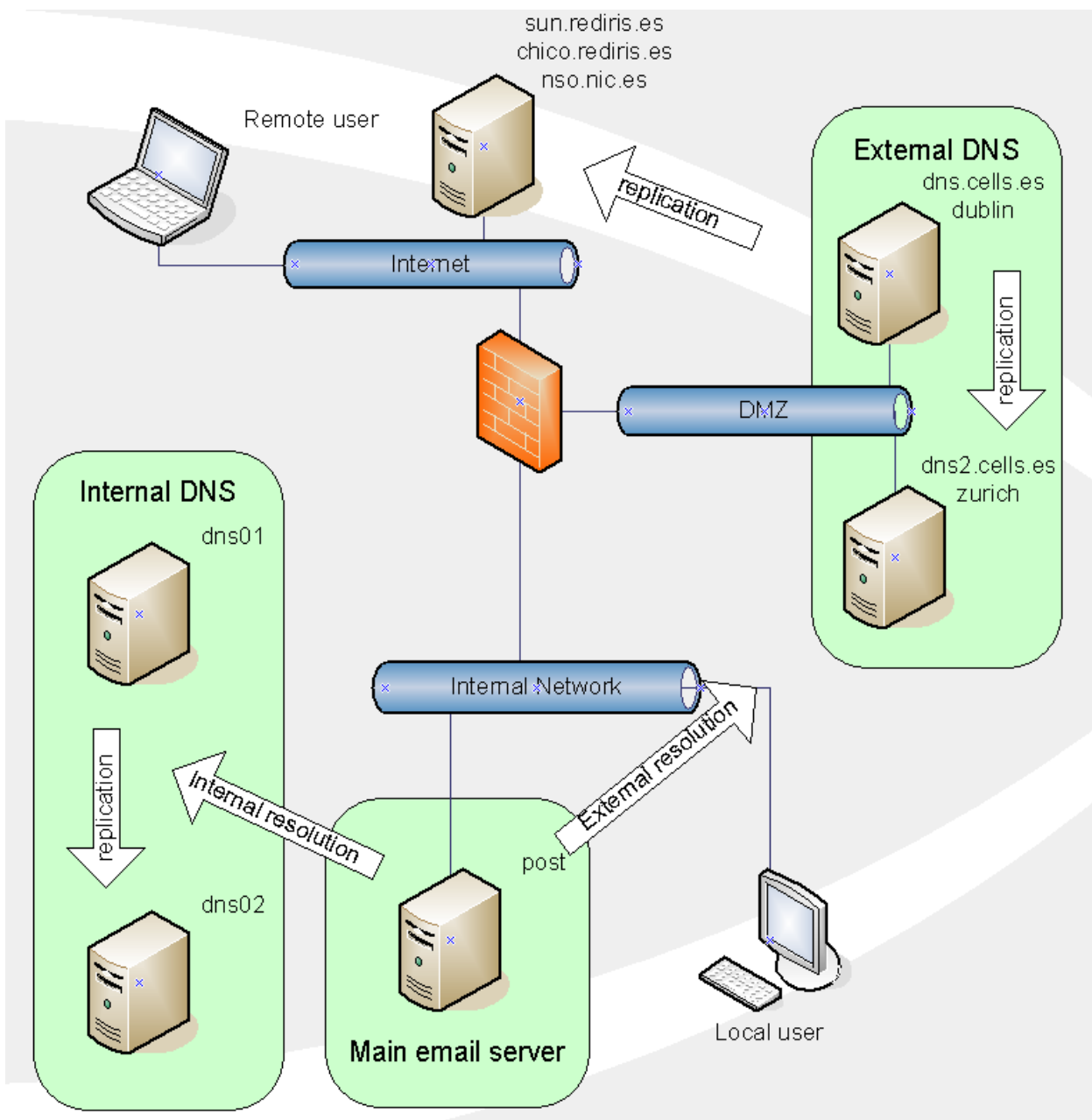


There are also different DNS₍₆₎ servers that provide the cells.es zone from the internal point of view, and other different servers for the resolution of the external cells.es zone. This is necessary because of two main reasons:

- CELLS doesn't want to publish the resolution of internal machines.
- There are names with different resolutions. One example is www.cells.es, that resolves the internal server if you are inside, and a reverse http security proxy₍₇₎ in the DMZ if you are in the Internet.

The internal DNS servers are called dns01 and dns02, while the external DNS servers are dublin (dns.cells.es), zurich (dns2.cells.es), nso.nic.es, chico.rediris.es and sun.rediris.es.

The following diagram shows the current DNS deployment:



The old email deployment had the following drawbacks:

- The main email server, hosting the emails of the @cells.es domain users, was a single point of failure.
- Remote users had the only option of accessing their email using a webmail application. This meant that people which are used to another email client, like Thunderbird or Outlook, were not able to use them outside the company.
- The email software was quite old. It has a quota limitation of 4GBytes per mailbox. This is too small for some cases.

The project objectives have been focused in solving these inconveniences.

3. Project objectives

The main objectives are:

- Provide a more stable infrastructure, avoiding single point of failures as far as possible.
- Enable the possibility of system maintenance without the need of shutting down the email service.
- Ease the user access to their email accounts, providing a more flexible way of connecting to their mailboxes.
- Avoid the current software limitations.
- Increase the hardware resources available for the email service, with more storage space and faster machines.

3.1 Project scope and exclusions

In order to define the aim and limits of this project, we will enumerate the tasks that has been covered by the project, as well as some of the tasks that were not included.

The project has covered the following phases

- Design of the solution, following the constraints defined in this document.
- Installation of a High Availability platform, based in open source operating systems and products.
- Installation and configuration of the new email software.
- Migration of the accounts of the current system to the new system.
- Testing and tuning of the solution based on the performance with real load.

The services involved in the project are:

- Corporate email accounts.
- Mailing lists₍₈₎.
- Remote access to the email.
- Anti-spam and anti-virus.
- DNS changes implied.

It was not included any task beyond the previously defined scope. By instance, it was not included the upgrade of the DNS or the LDAP services, just the necessary configuration changes.

3.2 Business case

In this section I will define the reasons for undertaking the project and explain how the project will enable the achievement of corporate strategies and objectives.

Reasons

The email service is one of the most important services provided by the IT section of the company. This is, with the telephone, the most used internal and external communication channel. The availability of this service is crucial for the company.

Business options

- **Do nothing**
The company could survive some more time with the current email system, but in some moment of time, the system will fail and the business will be seriously affected.
- **Do something**
Affording this project, the organization will ensure the future of the service, and therefore, the future of the communication strategy.

Expected benefits

Achieving the previously defined objectives, the organization will get the following direct benefits:

- ✓ Ensure the availability of the email, making possible the communication 24x7 of the company employees.
- ✓ A more flexible access to the email service will increase the productivity of their users, avoiding the time wasted in resolving complex access issues.
- ✓ Software and hardware limitations affects how users use the email. More resources will imply easier use of the service.

Expected dis-benefits

Some dis-benefits could be expected because of the execution of the project, but not in the outcome. The expected dis-benefits are:

- x Downtime during the migration of the email accounts.
- x Project cost in time and money.

Timescale

The general timescale must fit into the business plan. In order to have the new email service working by next year, and because Christmas holidays are compulsory in CELLS, the basic constraint was having the project finished in the beginning of December. That means we had two months.

4 Constraints and assumptions

At this point we will define the general constraints of the project, from different points of view.

4.1 Technological constraints

- The solution must have been based on open source products.
- The operating system must have been openSuSE because this is the official and supported Linux distribution in the company.
- The new hardware was already bought and it consisted in:
 - 2 x Sun Sunfire X4170 servers
 - 2 x Qlogic QLE2562 HBAs fiber channel cards
 - 1 x Eurostor ES-6600p SATA disk library

4.2 Business constraints

- The project must have been finished by the beginning of December.
- The total amount of expected workforce time was 185 hours.
- The internal quality procedure for the project management must have followed the Prince2₍₉₎ best practices.

4.3 Assumptions

- The company should provide all the reasonable necessary resources, even machinery and human resources, in order to accomplish the objectives of the project.
- The company should not disrupt the project abruptly without previous notice during its execution.

5. Project plan

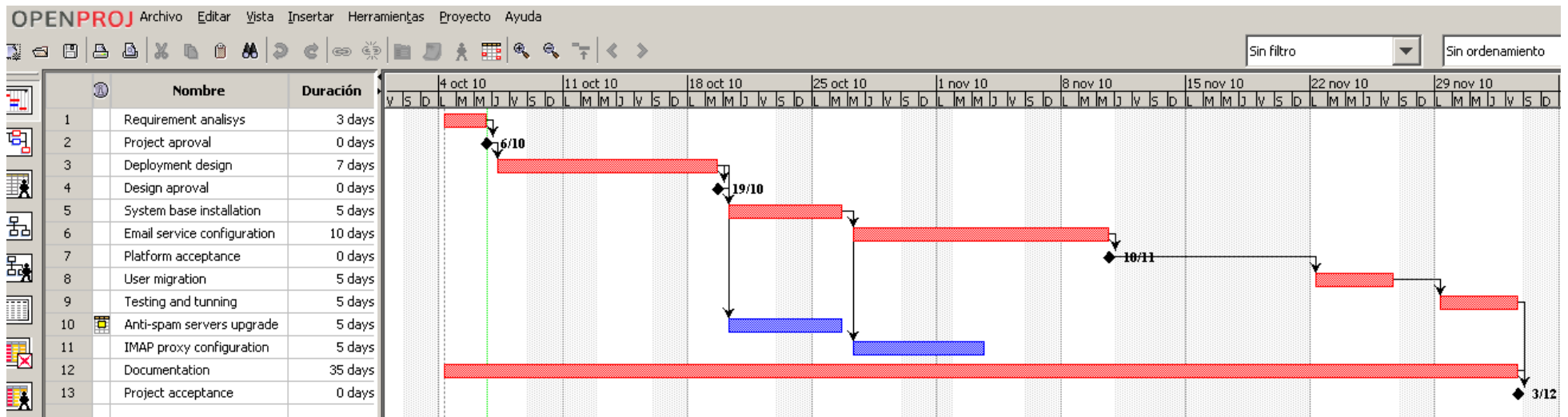
The project has been planned taking into account the different constraints defined in the previous sections, as well as the holiday restrictions and planned absences.

This is the list of days that will not be available for the project:

- 11th and 12th of October : Spanishness day
- 1st November: All saints day
- 15th to 23nd of November: Work absence. Trip to Swiss Light Source.

5.1 Timescale

The following Gantt diagram shows the different tasks that must have been done in order to accomplish the project objectives in a timely fashion. The detailed description of each task is defined in the section "Project tasks".



The tasks marked in red belong to the critical path₍₁₀₎. There are some tasks that have been done in parallel because they didn't need full time dedication.

5.2 Stage plan

There were three main stages defined in the project:

Analysis and Design

This stage consisted in getting the project requirements, describing the current situation and defining the solution to be implemented.

The tasks included are:

- **Requirement analysis**
- **Deployment design**

design acceptance

Implementation

This stage consisted in the installation and configuration of all the new systems, including email servers and gateways.

The tasks included are:

- **System base installation**
- **Email service configuration**
- **Anti-spam servers upgrade**
- **IMAP proxy configuration**

platform acceptance

Production

This stage consisted in the migration of the current platform to the new one and testing all the systems with real load.

The tasks included are:

- **User migration**
- **Testing and tuning**

project acceptance

5.3 Project tasks

In this section I will describe the different tasks done during the project:

Requirement analysis (10 hours)

This task consists in getting the information needed to start the project, plan the timescale, describe the tasks, define the outcome and estimate the cost. The main outcome of this task is the Project Initiation Document.

Deployment design (15 hours)

The detailed design of the solution must be defined taking into account all the technological implications and the service needs. The main outcome of this task is the Design Document.

System base installation (20 hours)

This task consists in the installation of the operating systems in the new machines, the installation of the virtualization software and the configuration of the system for creating a High Availability environment.

Email service configuration (60 hours)

During this task, the email packages were installed and configured to hold the new mailboxes, send and receive email, enable email listing, authenticate using the LDAP server, create the backup process for the emails, monitor the activity of the server and do any other related option decided during the deployment design.

Anti-spam servers upgrade (20 hours)

This task consist in creating and configuring new versions of the current anti-spam servers in order to have most updated version of each module. It is likely to be installed in a virtual machine over a physical machine in the DMZ.

IMAP proxy configuration (20 hours)

This task consists in creating a new secure IMAP proxy in the DMZ, likely in a virtual machine, in order to ease the remote access to the user's mailboxes. This proxy allows only encrypted and authenticated connections to the main email servers.

User migration (10 hours)

This task consists in the migration of the emails from the current email server to the new one. This migration must have been done with the minimal disturbance for the user, so it was possible that it should have been done in different batches.

Testing and tuning (10 hours)

During the process of getting the system working with real load, some problems could appear and should be solved as accurately as possible. Also performance problems could arise. In this case, we should find the optimum configuration in order to have the fastest environment as possible with the hardware we already have.

Documentation (20 hours)

Finally, all the previous tasks has been documented to give as much visibility as possible to the project, as well as for being able to put the email maintenance service in other hands.

5.4 Milestones

In this project we had four basic milestones:

Project approval - 6th of October

After the requirement analysis, the company and the project consultant in the UOC decides the validity of this project for the objectives we want to achieve. After this approval, the deployment design starts.

Design approval - 19th of October

The first stage "Analysis and Design" finishes with the design approval from CELLS and from the UOC. This milestone is the beginning of the implementation stage.

Platform acceptance - 10th of November

The implementation stage finishes when all the email platform is ready for working. The criteria for accepting the platform is based on the tests defined during the deployment design. After the successful completion of these tests, the production stage begins.

Project acceptance - 3rd of December

Finally, the end of the project is accepted when all the users are migrated to the new systems and we can shutdown the current server. That will be the end of the project.

5.5 Desired outcomes

Each task produces a different outcome. In the following table is possible to see the different outcomes for each of the previously defined tasks:

Task	Outcomes
Requirement analysis	<ul style="list-style-type: none">• Project initiation document
Deployment design	<ul style="list-style-type: none">• Design document• Tests for the platform acceptance
System base installation	<ul style="list-style-type: none">• Base system working in HA• Configuration files• Technical documentation
Email service configuration	<ul style="list-style-type: none">• Email system working• Configuration files• Technical documentation
Anti-spam servers upgrade	<ul style="list-style-type: none">• Anti-spam servers working• Configuration files• Technical documentation
IMAP proxy configuration	<ul style="list-style-type: none">• Proxy server working• Configuration files• Technical documentation
User migration	<ul style="list-style-type: none">• Users working in the new system• Technical documentation
Testing and tuning	<ul style="list-style-type: none">• Modified configuration files• Technical documentation
Documentation	<ul style="list-style-type: none">• Summary of the documentation produced in the previous tasks

5.6 Resources

The human resources dedicated to this project was **one person in full time**, with the supervision of project contact in CELLS with a low dedication to the project.

It is worthy to remark that in the Gantt diagram is possible to see that there are some tasks that are planned to be done in parallel. This doesn't mean that there will be more than one person. It means that the dedication for those tasks during that time is only part time.

About hardware resources, it is important to remember that the computers and disk libraries have been already bought. These machines are:

- 2 x Sun Sunfire X4170 servers
- 2 x Qlogic QLE2562 HBAs fiber channel cards
- 1 x Eurostor ES-6600p SATA disk library

5.7 Costs

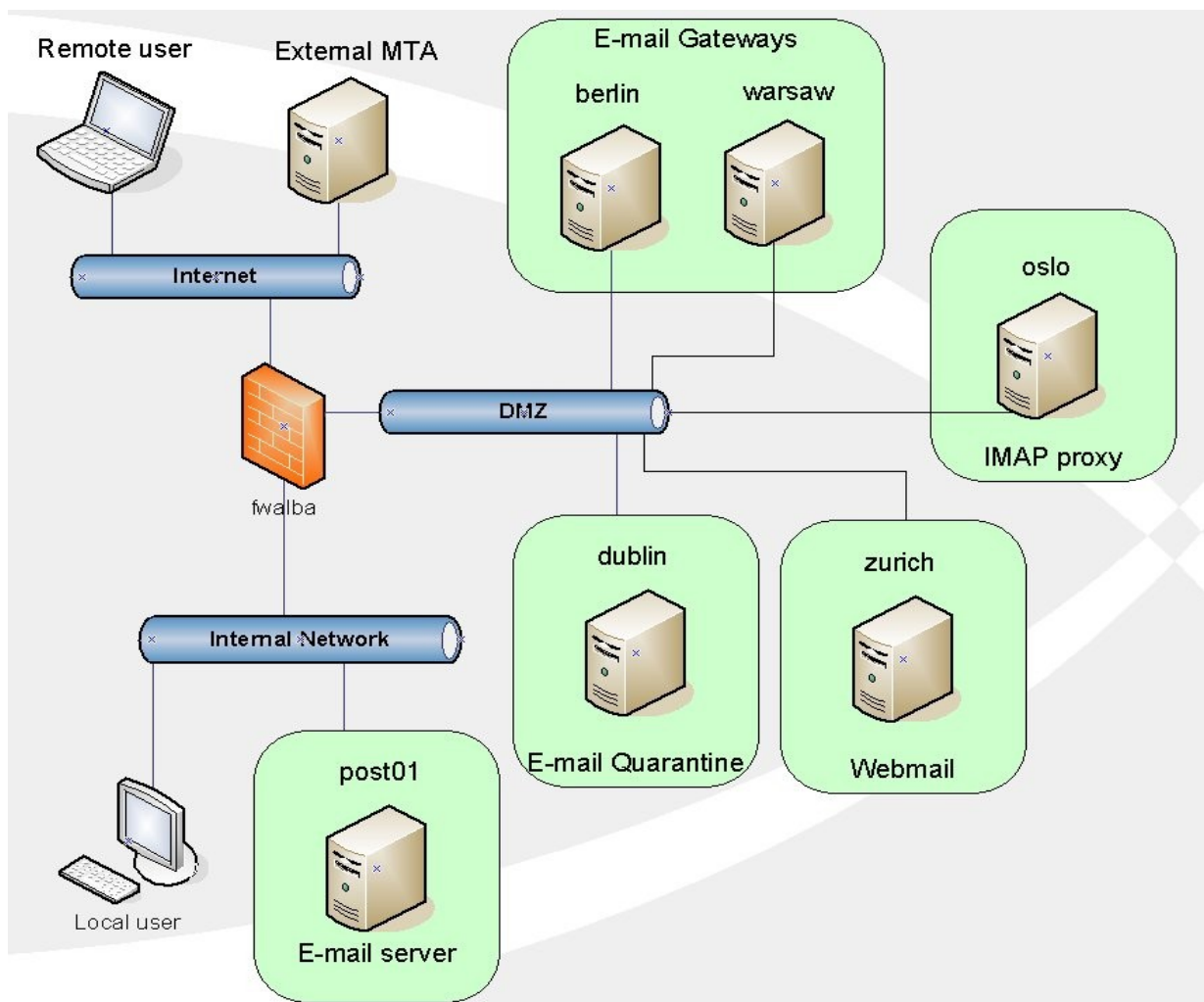
The following table shows the cost of the resources required for doing this project:

Description	Units	Unit cost	Total cost
Human Resources			
Project manager			
- Requirement analysis	10 h	20 €/h	200€
- Deployment design	15 h	20 €/h	300€
- System base installation	20 h	20 €/h	400€
- Email service configuration	60 h	20 €/h	1.200€
- Anti-spam servers upgrade	20 h	20 €/h	400€
- IMAP proxy configuration	20 h	20 €/h	400€
- User migration	10 h	20 €/h	200€
- Testing and tuning	10 h	20 €/h	200€
- Documentation	20 h	20 €/h	400€
Subtotal	185 h	20€/h	3.700€
Project supervisor			
- Project supervision	16 h	25€/h	400€
Subtotal	16 h	25€/h	400€
Total			4.100€
Hardware Resources			
Sun Sunfire X4170 servers	2	4.000€	8.000€
Qlogic QLE2562 HBAs fiber channel cards	2	350€	700€
Eurostor ES-6600p SATA disk library	1	5.000€	5.000€
Software Resources			
All components are Open Source	1	0€	0€
Total			17.800€

6. Project Design

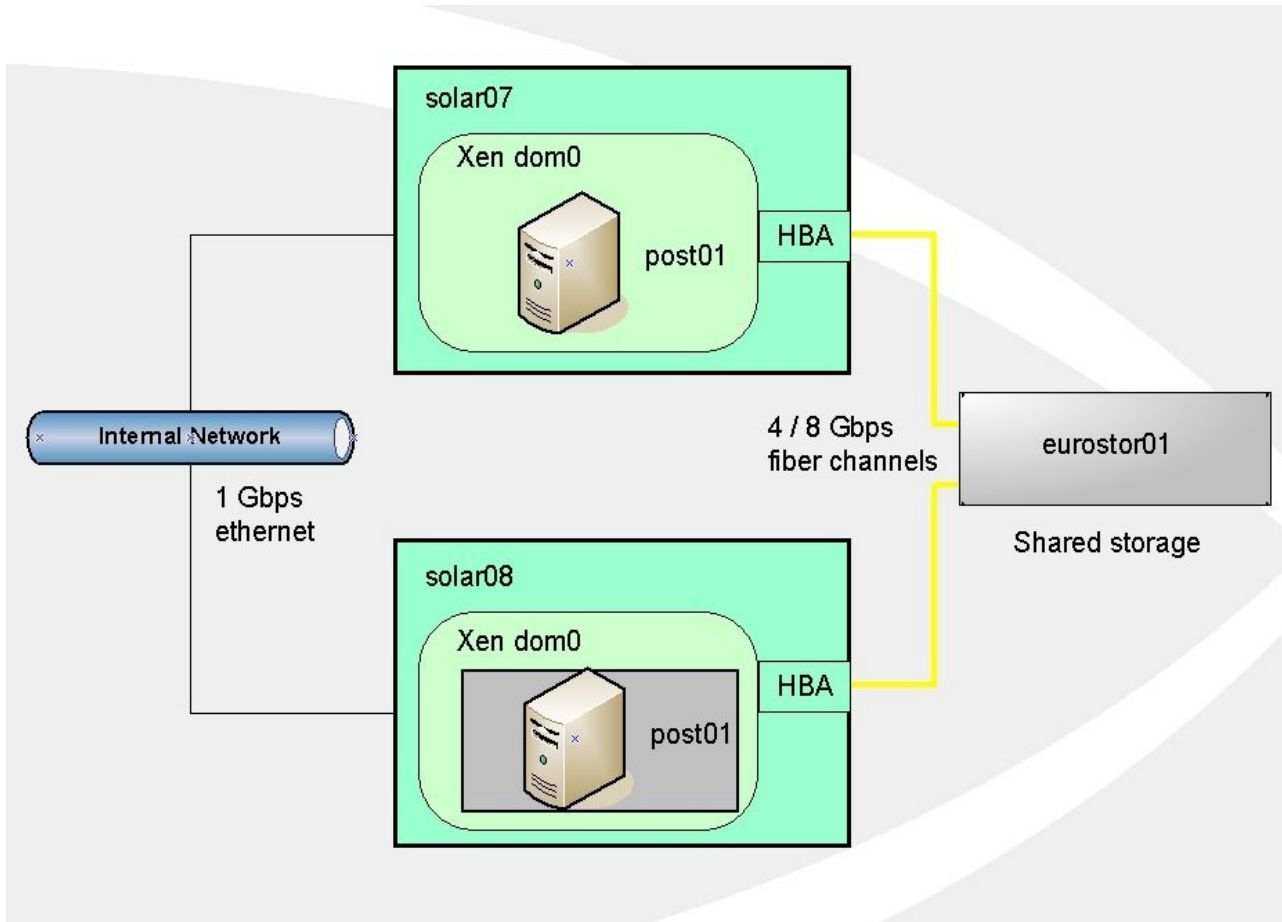
In order to solve all the objectives, taking into account the project constraints, the following decisions have been taken:

1. The current email gateways called dublin and zurich have been replaced by two new servers, called berlin and warsaw respectively.
2. A new imaps proxy has been deployed in the DMZ in order to forward securely the imaps and smtps connections from remote clients to the internal email server. Its name is oslo.
3. The current post server has been replaced by a new one, called post01. This new server is a virtual machine stored in a shared disk library, and is able to be run in two different physical machines, called solar07 and solar08.
4. The email mailbox migration has been done using a script that connects to each original email account and to the new one, copying the emails and folders from the current system to the new one, using IMAP commands.



6.1 System Base Installation

In order to have a high availability platform, two physical servers have been installed with the Xen₍₁₁₎ virtualization software in a cluster configuration. These two servers, called solar07 and solar08, have been connected to a shared storage disk library called eurostor01, using a SAN₍₁₂₎ consisting of two direct fiber optic connections between the HBAs₍₁₃₎ of the servers and the disk library.



The new email server has been installed as a virtual machine on top of the Xen infrastructure. The virtual disks of the virtual machine have been stored on eurostor01, but it is able to run it on solar07 or on solar08.

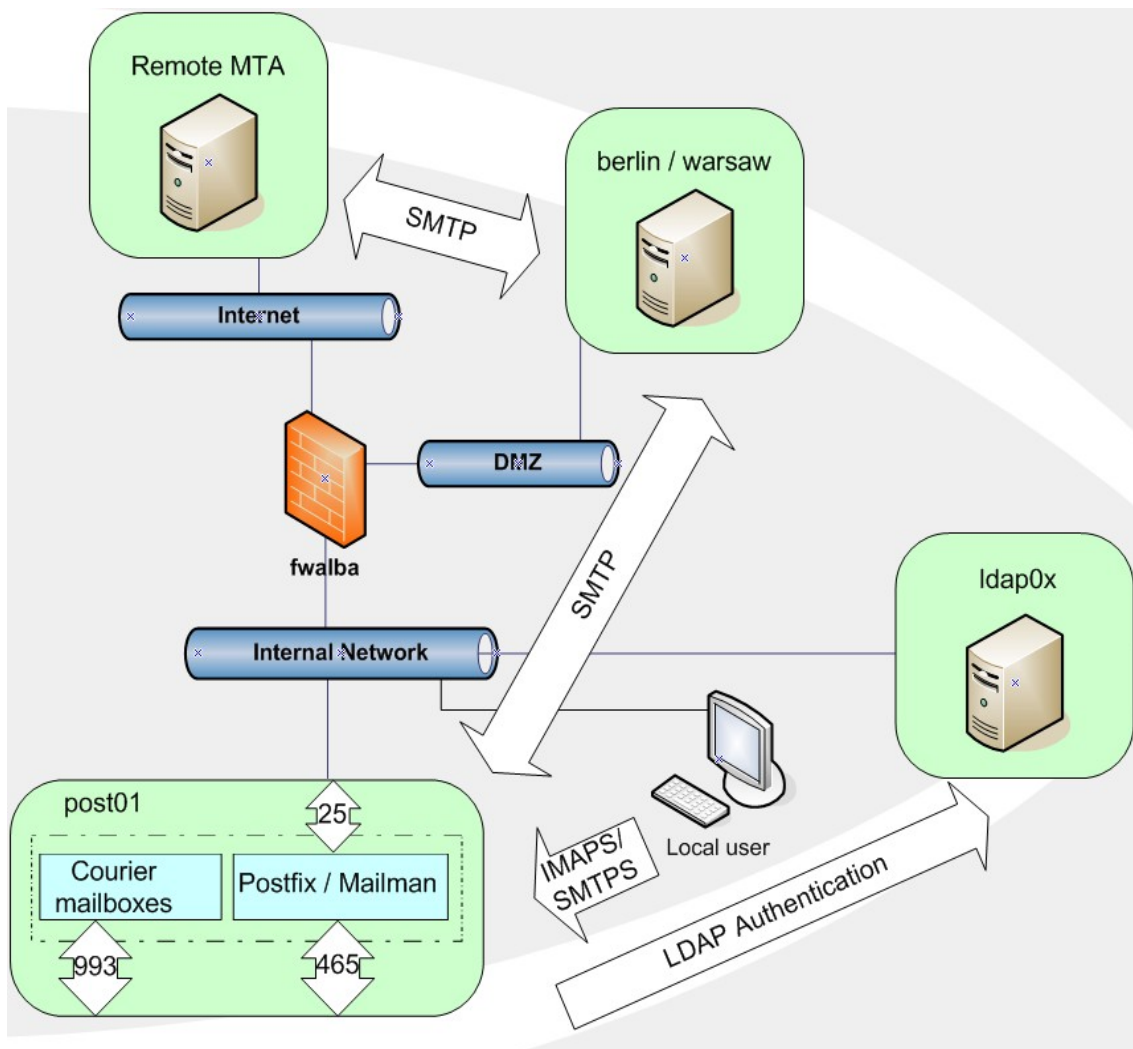
Live Migration₍₁₄₎ of the post01 virtual machine between the two hosts is the key for the HA environment. We are able to “move” the execution of the email server to different physical hardware without interrupting the service. This feature eases the hardware maintenance, allowing us to shutdown/reboot the physical servers without interfering the regular operation of the email server.

6.2 Email Service Configuration

The most important decision related to the new email server is the change of the application to be used as mailbox holder. Up to now, Cyrus⁽¹⁵⁾ software has been used, but the development of project has been going down during the last years in favor of Courier⁽¹⁶⁾.

The MTA⁽¹⁷⁾ is Postfix⁽¹⁸⁾. The authentication goes over the internal Idap servers, while all the communications have been configured to be encrypted.

The mailing lists have been implemented with the same software: Mailman⁽¹⁹⁾. We have installed the last version of the product and we have kept the configuration as similar as the previous one as possible.



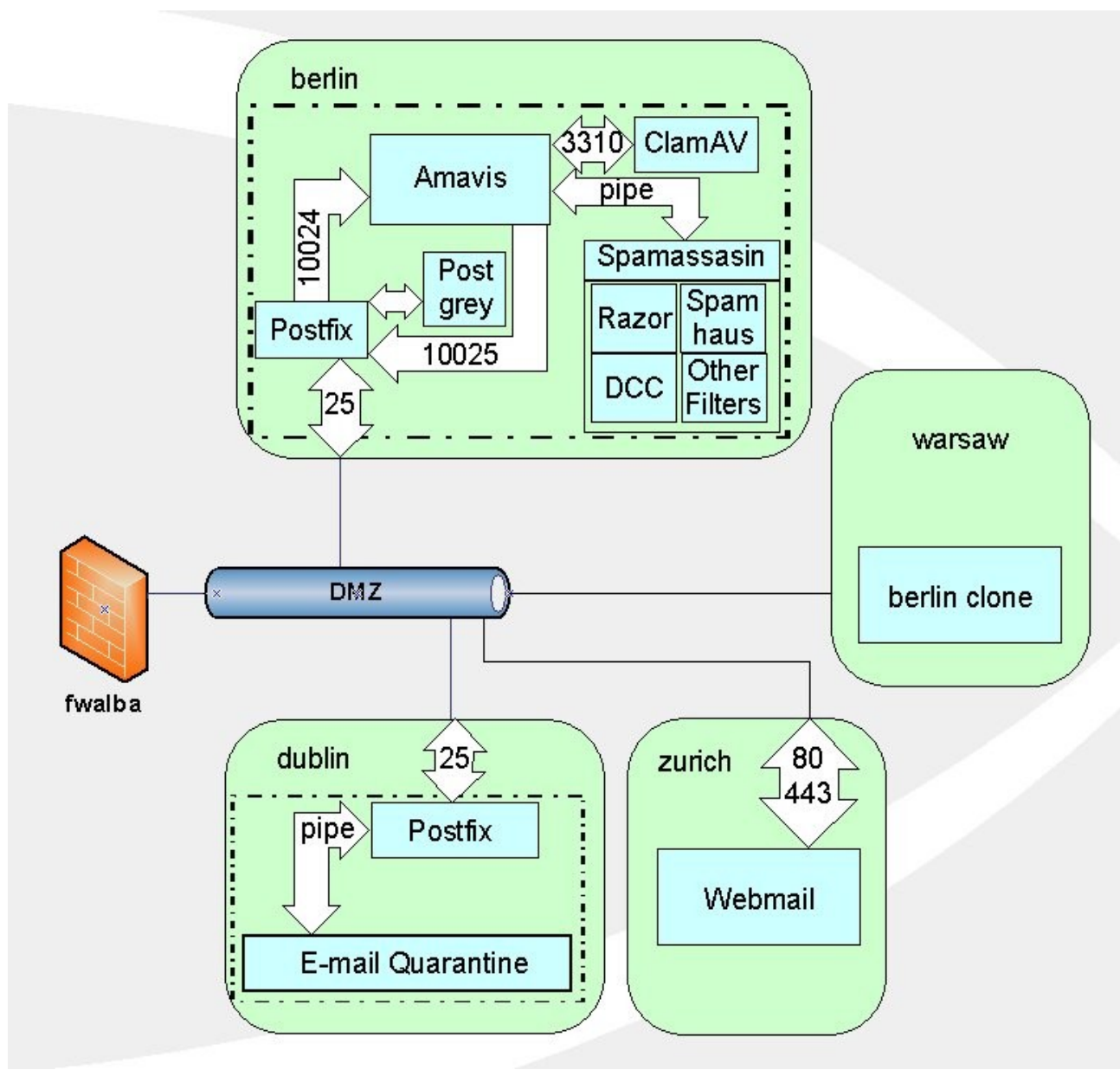
6.3 Antispam Servers Upgrade

The previous anti-spam servers were running on a openSuSE 10.2 distribution. This is an old version that currently doesn't have security patches support. There are also problems with the version of the anti-virus, that is too old to be kept updated, because the current virus pattern is being released in a format that is not compatible with the old version.

The implementation of new e-mail gateways was necessary, and it has been done following these decisions:

- Two new email gateways (berlin and warsaw) has been installed on the DMZ. They are virtual machines on an already installed Xen platform. Berlin and Warsaw are clones, just with different IP addresses and hostnames.
- The services that have been reinstalled are:
 - **Postfix-MTA:** The postfix mail transfer agent is the responsible of receiving and sending the emails to the proper destination. A newest version has been installed.
 - **Postgrey₍₂₀₎:** This is a greylisting software for Postfix. Taking profit of the SMTP protocol, it helps reducing the spam in a very effective way.
 - **Amavis₍₂₁₎:** This is a email content filter, and it is used as a connector between Postfix and other modules like ClamAV and Spamassassin.
 - **ClamAV₍₂₂₎:** This is a powerful open source antivirus. It is used to scan the email attachments for virus protection.
 - **Spamassassin₍₂₃₎:** Email content filter based on pattern rules and other external modules like Razor, Spamhaus or DCC.
 - **Razor₍₂₄₎:** Collaborative database for spam checksum matching.
 - **Spamhaus₍₂₅₎:** Collaborative database for IPs of spam sources.
 - **DCC₍₂₆₎:** Another collaborative database for spam checksum like Razor.
- The services that has been kept in the current servers are:
 - **E-mail Quarantine:** Customized scripts for saving the emails marked as spam, using a MySQL₍₂₇₎ database as a catalog. Every night, an email is sent to each user indicating the spams that has been hold in the quarantine and they can decide if release the email or delete it. They can also add automatically the sender into a whitelist.
 - **Squirrelmail₍₂₈₎ webmail:** This is the HTML external access to the email. This service will be kept in the same server.

At the following picture, it is possible to see the different anti-spam modules and the interfaces (port numbers) they use to communicate among them:



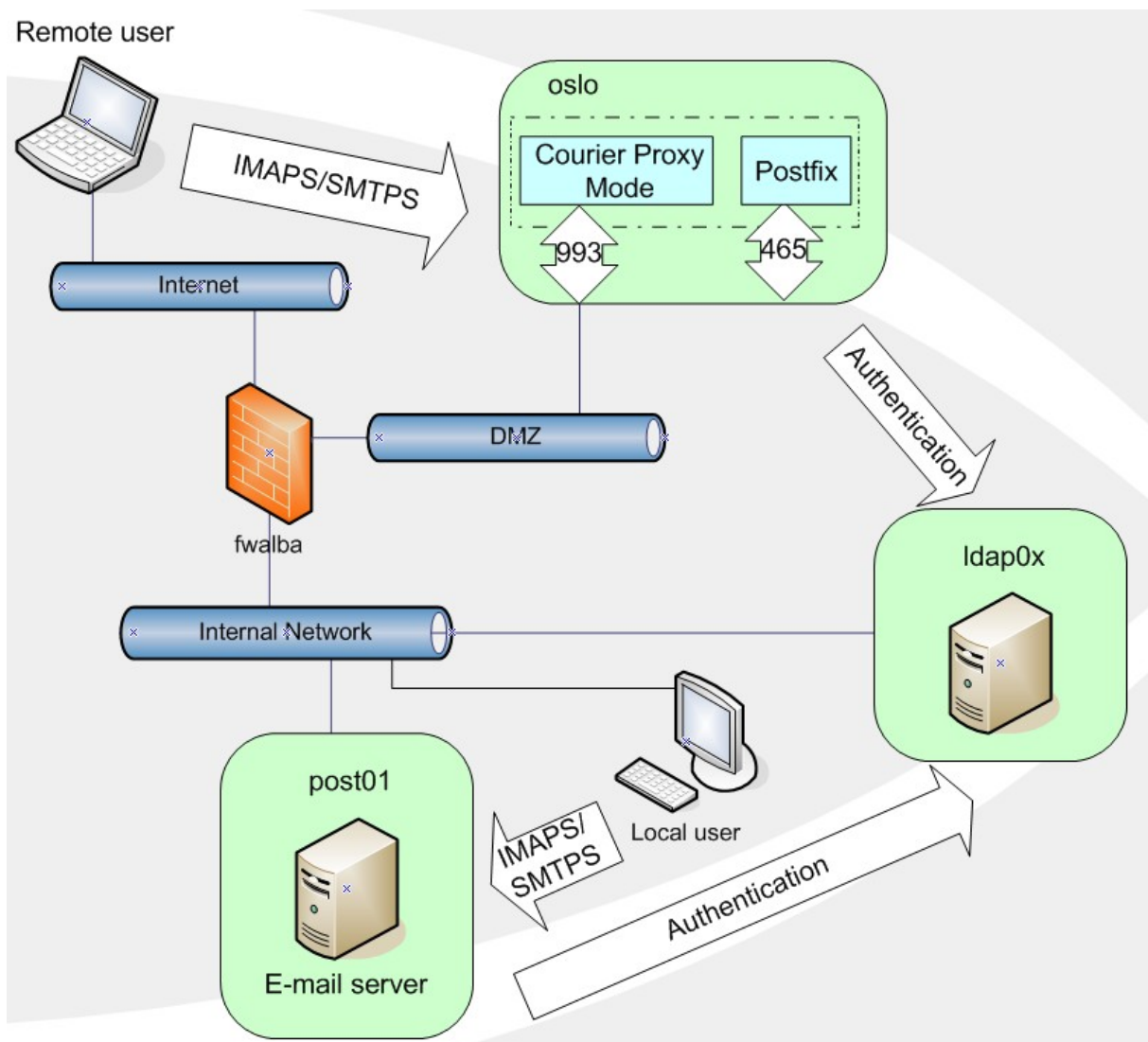
6.4 IMAP Proxy Configuration

Some users require direct access from the Internet, using regular email clients, to their email accounts. Opening directly the email ports of the post01 server is not a secure procedure, because someone could exploit some vulnerability on the email server and gain access to all the email data.

In order to avoid this situation, a new email proxy has been installed on the DMZ in order to get the connections from the Internet, encrypt and validate them against the internal ldap server, and finally forward the data to the internal email server.

The new server has been called oslo, and it uses Courier as the software for proxying the IMAPs connections.

The outgoing email delivery has been configured using Postfix, and the connections are also encrypted and authenticated against the LDAP server, base on openLDAP⁽²⁹⁾.



6.5 User Migration

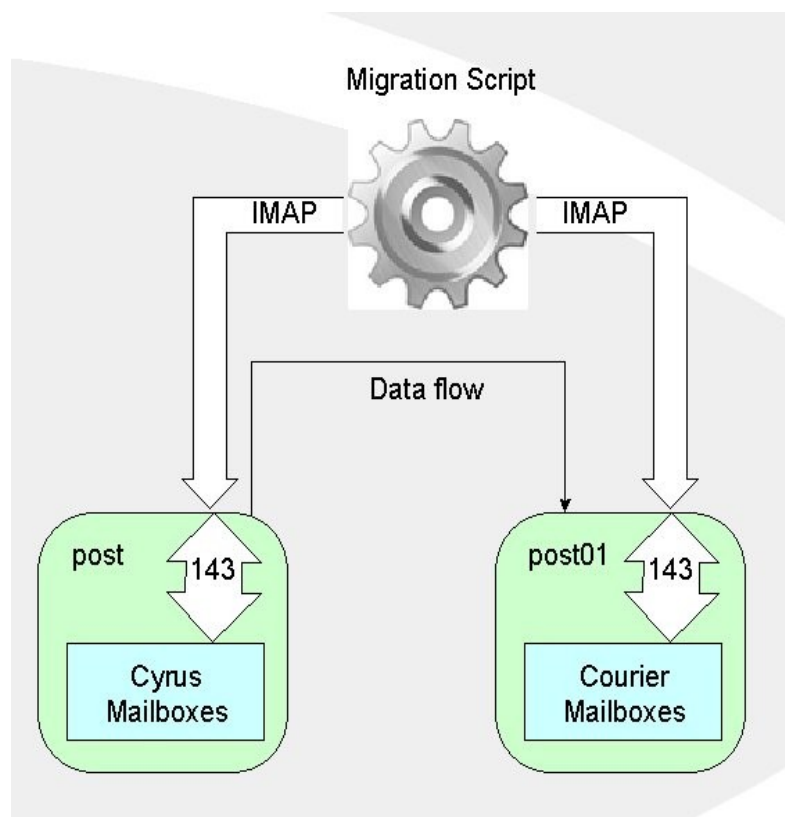
One of the most delicate tasks of this project has been the migration of the email from the current email server to the new one.

The most important thing is to have a way of data migration that produces minimum disturbance to the user. That means:

- Keep the same data on both servers:
 - Keep read/unread flags
 - Keep important/urgent/... flags for each email
 - Keep email received dates
 - Keep folder subscriptions on the client
- Minimize the unavailability time:
 - Be able to do incremental copies/synchronizations between servers
- Do not depend on users actions:
 - The migration must be "workless" for the users

Cyrus and Courier use different mailbox formats and, therefore, it is not possible to directly copying the data between servers.

The best solution is to use a script that will connect both servers using the IMAP protocol, and copy the emails and folders using IMAP commands.

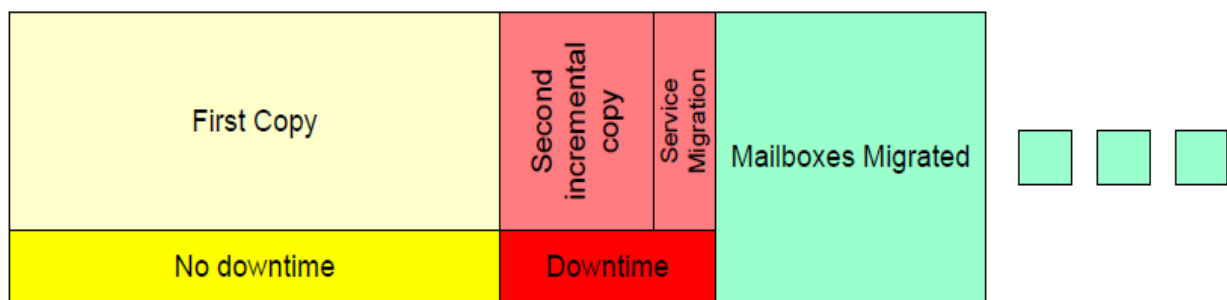


One of the most important tasks, in order to get a successful migration, is to find the correct tool to transfer the data from the source email server to the destination.

After considering different options, even developing an own tool for the email migration, we have decided to use the **imapsync**₍₃₀₎ tool.

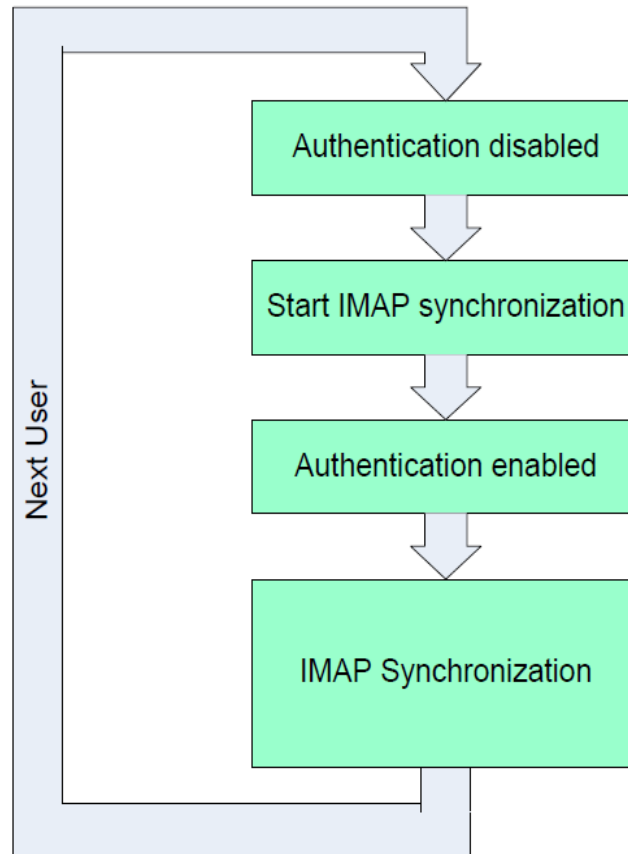
Imapsync is an opensource tool (GPL license until version 1.299) developed by Gilles Lamiral, that executes data synchronization between different IMAP servers. One of the most important features is the “incremental copy”, that will enable an easier and faster migration.

The migration strategy followed this idea: There is a first copy of all the data, that takes longer but does not have service interruption from the user point of view, and a second incremental copy, much faster, where the users do not modify their email accounts, and they are redirected after finishing the copy to the new email server.



There is still another important issue we have to face. The execution of the **imapsync** script requires user authentication for each email account. We cannot provide the user passwords, because we do not have this information, and we cannot bother the users asking for them.

The solution is disabling the user password during the script execution (keeping a temporary one known by us) and restoring the old password after finishing the process.



Because both email servers authenticate against the same ldap server, the password disabling procedure have to be done just once in one place.

7. Technical Documentation

One of the most important outcomes of this project is the big amount of technical documentation generated. This documentation can help understanding the inner details of the project, and it will be the baseline for the future maintenance of the email service at CELLS.

The generated documents are:

- **DesignDocument.v.1.0.pdf** : Description of the project design. This document has been the baseline for the implementation of the project, and the main input for the project acceptance.
- **SystemBaseInstallation.v.1.0.pdf** : Description of the High Availability infrastructure. It includes a step by step description of the installation procedure, as well as the changes needed in the configuration files. It also includes the tests results of the installed parts.
- **EmailServiceConfiguration.v.1.0.pdf** : Description of the main email server installation and configuration. It includes the tests done for checking each part of the system.
- **AntispamServersUpgrade.v.1.0.pdf** : Detailed installation and configuration document. It includes the subsystem design and the tests for each component.
- **IMAPProxyConfiguration.v.1.0.pdf** : Description of the installation and configuration of the server for the remote access to the email using IMAPS and SMTPS. It also include test results.
- **UserMigration.v.1.0.pdf** : Description of the user migration procedure. It includes the commands used for the mailboxes migration, as well as the migration outcome.
- **TestingAndTunning.v.1.0.pdf** : References to the tests done during the project. It also includes the performance tuning actions taken for improving the overall system already on production.

8. Project Validation

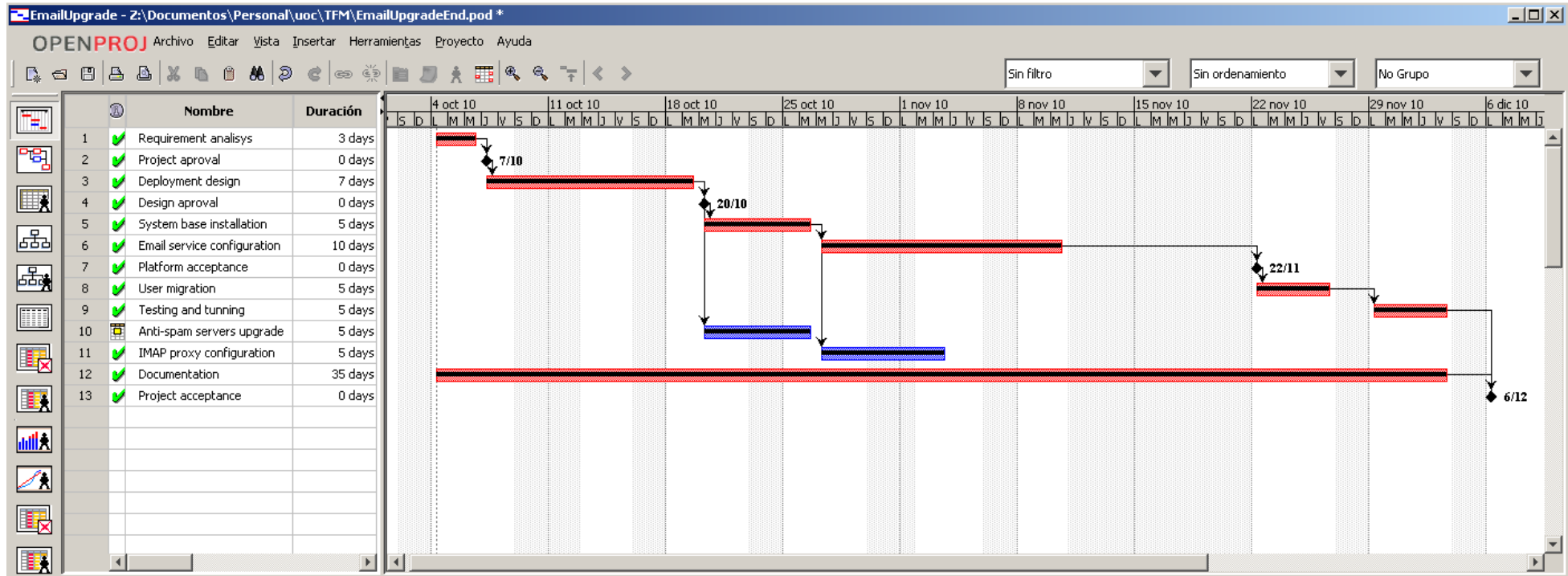
The individual tests of each piece of the platform have been described in the installation documentation.

The following table summarizes where to find the tests done for each element:

Item	Document	Pages	Satisfactory
Basic email functionality			✓
-Send email to Internet	Email Service Configuration Anti-spam servers upgrade IMAP Proxy Configuration	23-25 17-18 23-25	✓
-Send email to a list	Email Service Configuration	31-34	✓
-Receive email from Internet	Email Service Configuration	15-18	✓
-Access mailbox locally	Email Service Configuration	15-18	✓
-Access mailbox remotely	IMAP Proxy Configuration	17-19	✓
Anti-spam/Anti-virus			✓
-EICAR virus test	Anti-spam servers upgrade	28-30	✓
-Greylisting	Anti-spam servers upgrade	21	✓
-Amavis	Anti-spam servers upgrade	25	
-Spamassassin	Anti-spam servers upgrade	38-39	✓
Email migration			✓
-Correct migration	User Migration	08/10/ 11	✓
High Availability			✓
-Live migration of post01	System Base Installation	50-52	✓

9. Final status of the project

The following Gantt diagram shows the current status of the different tasks of the project:



The first stage "Analysis and Design" has been completed with the main milestone "Design Approval", the 20th of October 2010. The second stage "Implementation" has been also completed with the main milestone "Platform Acceptance", the 10th of November 2010. The third stage "Production" has been completed with the main milestone "Project Acceptance", the 21st of December 2010.

The project has been finished with a light delay.

This is a detailed description of the tasks already finished:

- **Requirement analysis:** After a few interviews with the systems section head, Project Initiation Document (PID) has been created with the requirements of the project. The same document was sent the 6th of October to the UOC as PAC1 and accepted by the consultant.
- **Deployment design:** Taking into consideration the restrictions and requirements of the project, different options has been discussed and finally, CELLS and I have agreed in the final design. See the *DesignDocument.v.1.0.pdf* for details.
- **System base installation:** The installation of the servers that will host the email service has been finished, following the implementation described on the design. See the *SystemBaseInstallation.v.1.0.pdf* for details.
- **Anti-spam servers upgrade:** The new email gateways, (berlin and warsaw) has been installed and configured. After the proper tests, the external email has been led to the new servers (modifying the external DNS entries for the MX records in the cells.es domain). See the *AntispamServersUpgrade.v.1.0.pdf* for details.
- **IMAP proxy configuration:** Remote IMAP proxy server (oslo) has been installed and configured. Functional tests have been done successfully. See the *ImapProxyConfiguration.v.1.0.pdf* for details.
- **Email service configuration:** The main virtual machine for the mailboxes email server (post01) has been finished. The main software has been installed and configured. Functional tests have been done successfully. See the *EmailServiceConfiguration.v.1.0.pdf* for details.
- **User migration:** The migration of the mailboxes has been done successfully. Users are accessing the new system without problems. See the *UsersMigration.v.1.0.pdf* for details.
- **Testing and tuning:** Some initial performance problems has been solved. Platform under continuous surveillance. See *TestingAndTuning.v.1.0.pdf* for details.
- **Documentation:** Technical documentation finished for all the tasks of the project.

10. Conclusions

This project has been finished under the supervision of Mario Diaz from CELLS. Up to now, the feedback from the users has been really positive. The feature they have notice the most is the new possibility of remote access using their regular email client. I have received many congratulations for this item.

There were other improvements that are not so visible for the users, like the increase of the service availability with the new infrastructure, or the disappearance of size limitations linked to the old software.

The migration has been also accomplished with the minimum disturbance for the users, scheduling the downtime period out of working time, and making it transparent from the users point of view (no actions needed from their side).

We can say that the project has finished with a big success, and we can be proud of that.

10.1 Review of the business case

At this point, we can review the benefits gained with the finish of this project. It became evident that we have achieved the objectives defined at the beginning of the project, and therefore, we have got the desired outcome:

- ✓ Ensure the availability of the email, making possible the communication 24x7 of the company employees.
- ✓ A more flexible access to the email service has increased the productivity of their users, avoiding the time wasted in resolving complex access issues.
- ✓ Software and hardware limitations affects how users use the email. More resources will imply easier use of the service.

10.2 Review of the project objectives

Is is worthy to check the project objectives and their accomplishment by the end of this project:

- A more stable infrastructure has been provided, avoiding single point of failures as far as possible.
- We have enabled the possibility of system maintenance without the need of shutting down the email service.
- We have made easier the user access to their email accounts, providing a

more flexible way of connecting to their mailboxes.

- The old software limitations has been overcome.
- The hardware resources available have been increased for the email service, with more storage space and faster machines.

We can affirm that all the project objectives have been accomplished.

10.3 Review of the team performance

The estimated workload was 185 working hours. Finally, more than 210 hours have been needed to finish this project, with a deviation of the 13.5% above the original forecast.

This light deviation has been caused by some more work in the data migration than expected. However, the goal of the project has not been affected and the schedule has been fitted inside the company expectations.

10.4 Lessons report

Technically, the acquired knowledge during the execution of this project has been huge, and it is difficult to summarize in only some words. The big amount of technical documentation is the reflection of a hard work that finally has been successful.

From the project leading point of view, the main difficulty was to fit all the needed tasks inside a short time period of only two months. That was the main and most difficult task to deal, resulting finally in some time delay. We can say that migrations workload can be foreseen easily from the technical point of view, but it is a very hard work to do it properly from the human coordination side.

10.5 Summary of follow-on action recommendations

Finally, I would like to recommend CELLS to continue with the process of migrating their services into High Availability platforms and keep the email service in a so excellent way as they have done up to now.

11. References

Web references

- (1) IMAP(s): http://en.wikipedia.org/wiki/Internet_Message_Access_Protocol
- (2) SMTP(s): <http://www.faqs.org/rfcs/rfc821.html>
- (3) SPAM: <http://spam.abuse.net/overview/whatisspam.shtml>
- (4) DMZ: <http://www.webopedia.com/TERM/D/DMZ.html>
- (5) LDAP: <http://en.wikipedia.org/wiki/LDAP>
- (6) DNS: http://en.wikipedia.org/wiki/Domain_Name_System
- (7) Reverse proxy: http://httpd.apache.org/docs/2.2/mod/mod_proxy.html
- (8) Mail listing: <http://www.gnu.org/software/mailman/index.html>
- (9) Prince2 : <http://www.prince2.com/>
- (10) Critical path: http://en.wikipedia.org/wiki/Critical_path_method
- (11) XEN: <http://www.xen.org>
- (12) SAN: http://en.wikipedia.org/wiki/Storage_area_network
- (13) HBA: http://en.wikipedia.org/wiki/Host_Bus_Adapter
- (14) Xen Live Migration: <http://www.linux.com/archive/feed/55773>
- (15) Cyrus: <http://www.cyrusimap.org/>
- (16) Courier: <http://www.courier-mta.org/>
- (17) MTA: http://en.wikipedia.org/wiki/Message_transfer_agent
- (18) Postfix: <http://www.postfix.org/>
- (19) Mailman: <http://www.gnu.org/software/mailman/index.html>
- (20) Postgrey: <http://postgrey.schweikert.ch/>
- (21) Amavis: <http://www.amavis.org/>
- (22) ClamAV: <http://www.clamav.net/>
- (23) SpamAssassin: <http://spamassassin.apache.org/>
- (24) Razor: <http://razor.sourceforge.net/>
- (25) SpamHaus: <http://www.spamhaus.org/>
- (26) DCC: <http://www.rhyolite.com/dcc/>
- (27) MySQL: <http://www.mysql.com/>
- (28) SquirrelMail: <http://squirrelmail.org/>
- (29) openLDAP: <http://www.openldap.org/>
- (30) imapsync: <http://www.linux-france.org/prj/imapsync/>

Bibliography references

- **Postfix: The Definitive Guide** by Kyle D.Dent – O'Reilly Media, Inc.
- **Managing IMAP** by Dianna Mullet and Kevin Mullet – O'Reilly Media, Inc.
- **Programming Internet Email** by David Wood – O'Reilly Media, Inc.
- **Ending Spam** by Jonathan Zdziarski – No Starch Press
- **Slamming Spam: A Guide for System Administrators** by Robert Haskins and Dale Nielsen – Addison-Wesley Professional
- **LDAP System Administration** by Gerald Carter – O'Reilly Media, Inc.
- **Running Linux, Fifth Edition** by Matthias Kalle Dheimer and Matt Welsh – O'Reilly Media, Inc.