

**MALAYSIAN PUBLIC SECTOR  
OPEN SOURCE SOFTWARE (OSS)  
INITIATIVE**

**The Malaysian Government Interoperability  
Framework for Open Source Software  
(MyGIFOSS)**

*MyGIFOSS Updates and Modifications  
13 August 2008*

## Table of Contents

<b>1</b>	<b>INTRODUCTION.....</b>	<b>1</b>
1.1	Definition.....	1
1.2	Objectives.....	2
1.3	Basis Of Recommendations.....	3
1.4	Scope .....	3
1.5	How To Use This Document.....	4
<b>2</b>	<b>OPEN STANDARDS.....</b>	<b>5</b>
2.1	Overview.....	5
2.2	Open Standards and OSS.....	5
2.3	Important Open Standards and their OSS Implementations.....	6
<b>3</b>	<b>OPEN SOURCE SOFTWARE WITHIN DEFINED IMPLEMENTATION AREAS. 9</b>	
3.1	Overview.....	9
3.2	Guidelines/Standards Matrix.....	11
3.3	Operating Systems.....	18
3.3.1	LINUX.....	18
3.3.2	BSD Family of Operating Systems.....	23
3.4	Desktop Applications.....	25
3.4.1	Office Productivity Suite.....	25
3.4.2	Project Management.....	26
3.4.3	Mail Client.....	26
3.4.4	Webmail.....	27
3.4.5	Web Browser.....	28
3.4.6	Multimedia Player.....	29
3.4.7	Desktop Environment.....	30
3.4.8	Graphic Manipulation.....	32
3.5	Server Applications.....	33
3.5.1	Mail Transfer Agent (MTA).....	33
3.5.2	Mail Access Agent.....	34
3.5.3	Groupware.....	35
3.5.4	Calendar Server.....	36
3.5.5	Web Server.....	37
3.5.6	Wikis.....	38
3.5.7	Remote Login Server.....	39
3.5.8	Database Server.....	39
3.5.9	Proxy Server.....	41
3.5.10	Files and Print Server.....	42
3.5.11	Backup Server/Tool.....	43
3.5.12	Domain Name System (DNS) Server.....	44
3.5.13	Network Management.....	45
3.6	Network Security.....	46
3.6.1	Firewall.....	46

3.6.2	Network Intrusion Detection System (NIDS).....	48
3.6.3	Virtual Private Network (VPN).....	48
3.6.4	Anti-virus.....	49
3.6.5	Anti-spam.....	50
<b>3.7</b>	<b>Vertical Applications.....</b>	<b>50</b>
3.7.1	Content Management System (CMS).....	50
3.7.2	Learning Management System (LMS).....	51
3.7.3	Geographic Information System (GIS).....	52
<b>3.8</b>	<b>Products from OSCC.....</b>	<b>53</b>
3.8.1	MySpamGuard.....	53
3.8.2	MyNetWatch.....	53
3.8.3	MyWorkSpace.....	54
3.8.4	MySurfGuard.....	54
<b>4</b>	<b>RECOMMENDATIONS FOR INFORMATION ACCESS.....</b>	<b>55</b>
<b>4.1</b>	<b>Overview.....</b>	<b>55</b>
<b>4.2</b>	<b>Recommended Standards / Specifications.....</b>	<b>56</b>
4.2.1	Hypertext Web Content.....	56
4.2.2	Document.....	56
4.2.3	Spreadsheet.....	57
4.2.4	Presentation.....	58
4.2.5	Graphical Image.....	58
4.2.6	Moving Image And Audio / Visual Content.....	61
4.2.7	Audio / Video Streaming.....	62
4.2.8	Animation.....	63
4.2.9	Mobile Devices Content.....	63
4.2.10	Character Sets And Encoding.....	63
4.2.11	Compression.....	64
4.2.12	Client-Side Scripting .....	65
<b>5</b>	<b>COMPLYING WITH MYGIFOSS.....</b>	<b>66</b>
<b>5.1</b>	<b>What it Means to be Compliant with MyGIFOSS.....</b>	<b>66</b>
<b>5.2</b>	<b>Minimum Requirements.....</b>	<b>66</b>
<b>6</b>	<b>CONCLUSION.....</b>	<b>68</b>
<b>7</b>	<b>REFERENCES.....</b>	<b>69</b>
<b>8</b>	<b>ABBREVIATIONS AND ACRONYMS.....</b>	<b>70</b>

## List of Tables

Table 3.1: Implementation Guideline Matrix.....	18
Table 3.2: Comparison of Popular Linux Distributions.....	20
Table 3.3: Main features of Common and Popular Linux Distributions.....	23
Table 3.4: Main features of Popular BSD-derived Systems.....	25
Table 8.1: Abbreviations & Acronyms.....	71

## **List of Figures**



# 1 INTRODUCTION

The Malaysian Government ICT policy supports and advocates the use of open standards and Open Source Software (OSS). Open standards is seen as a key component in the interoperability framework being drawn up for the ICT initiatives and projects of the Malaysian Government and the usage of open source products that support these open standards are encouraged. This document, the Malaysian Government Interoperability Framework for Open Source Software (MyGIFOSS), is meant to provide detailed recommendations for interoperability in the usage of OSS in the public sector. It contains information on Open Source Software, open standards and technical specifications recommended for adoption in Malaysia. MyGIFOSS is prepared as a supplement to the Malaysian Government Interoperability Framework version 1.0 (MyGIF), August 2003.

The intention of this document is to provide a guide for government agencies in the adoption of, and migration to, OSS within their ICT framework. It focuses on the important ICT open standards and specifications needed and some recommended OSS applications that implement these standards/specifications. Implementation guidelines and strategies while important, are not covered here; these may be found in the MAMPU publication, "Open Source Software (OSS) Implementation Guidelines". In addition, the MAMPU publication "Open Source Software Reference Architecture (OSSRA)", provides guidance on the architecture and design of ICT infrastructure using OSS and in compliance with open standards.

## 1.1 Definition

MyGIFOSS defines the minimum set of standards and technical specifications governing the use of OSS and information access. In addition, it also contains information on open standards and interoperability in key OSS applications.

MyGIFOSS covers the following aspects:

- Examples of OSS within the solution areas of the Malaysian Public Sector OSS Master Plan.
- Recommendations for Information and Services Access, covering standards availability.
- What it means to be compliant with the recommendations of MyGIFOSS.

Instead of creating new standards or specifications, MyGIFOSS adopts internationally recognised and ratified open standards, where available. For the purposes of this document, open standards are defined as standards that are developed and maintained by a process that is open and relatively easy for interested parties to participate in and there should be easy access to the standards. In addition, any patents present in the standards are to be irrevocably available on a royalty-free basis.

These standards should also be developed or recognised and ratified by bodies such as:

- i. International Organization for Standardization (ISO)
- ii. International Telecommunication Union (ITU)
- iii. Institute of Electrical and Electronic Engineers (IEEE)
- iv. The World Wide Web Consortium (W3C)
- v. Internet Engineering Task Force (IETF)
- vi. Organization for the Advancement of Structured Information Standards (OASIS)
- vii. The Free Standards Group (FSG)

However, in cases where no open standards are available, only openly and publicly published de facto standards should be applied.

## **1.2 Objectives**

The objectives of MyGIFOSS are:

- To enable proprietary and open source systems in different Government information systems, both within Government and external to Government, to communicate and inter-operate efficiently and effectively.
- To promote and foster the adoption of open source solutions within the Government, by emphasising the need for openness, transparency and competitiveness for all implementations of information systems.
- To promote and foster the adoption of open standards that enables the exchange of data between applications.

- To promote vendor-neutral and technology-neutral implementations, with the adoption of open standards, for all Government information systems.
- To reduce the total cost of ownership of Government information systems, with the adoption of open standards.

### 1.3 Basis Of Recommendations

The key drivers guiding the recommendations of ICT standards and technical specifications for MyGIFOSS are:

- **Interoperability:**

Standards and specifications recommended must be relevant to recommended use of OSS applications and the use of open standards for information access.

- **Availability of internationally recognised standards:**

The standards, where available, must be recognised and adopted by internationally recognised bodies.

### 1.4 Scope

MyGIFOSS covers the use of OSS and open standards for information access, citing well-known and widely-used OSS applications. In particular, it focuses on the standards and/or specifications that these applications implement for interoperability. The scope of the applications covered are within the six solution areas, as defined within the Malaysian Public Sector OSS Master Plan. The six solution areas are:

- i. Workload Consolidation
- ii. High Performance Computing
- iii. Distributed Enterprise
- iv. Application Solution
- v. Infrastructure Solution

vi. Desktop Solution

MyGIFOSS standards and specifications should be considered for all new system implementations that fall within the solution areas as defined within the OSS Master Plan. For legacy systems that fall within the scope defined, agencies will need to assess if any integration is required between the legacy systems and other systems. If it is determined that integration is required, interfaces will need to be defined to allow such integration to take place. The interfaces should take into consideration the guidelines contained within this document.

## 1.5 How To Use This Document

This document is structured in the following manner:

**Chapter 2:** Discusses open standards in greater detail and lists down some important open standards and their OSS implementations.

**Chapter 3:** Aims to assist in the selection of OSS and contains examples for use within an agency's ICT implementation. A table detailing OSS examples are given, with their associated implementation and solution areas. Agencies are encouraged to refer to the *Preferences and Guidelines* column in the table when considering their implementations. The chapter then goes into greater detail on the software features, capabilities and shortcomings of some of the OSS examples. Several OSS products that have been packaged for deployment by the Open Source Competency Centre (OSCC) of MAMPU are also briefly discussed here.

**Chapter 4:** Gives recommendations on information access governing the use of standards for data access and interchange. This chapter is relevant for agencies considering implementing software, either open source or proprietary, that requires information access and interchange. It provides recommendations to ensure availability of information and interoperability, allowing for different applications, systems and infrastructure to exchange information.

**Chapter 5:** Discusses what is meant by complying with MyGIFOSS and lists down the minimum set of standards/specifications and applications required to be compliant in specific domains.

**Chapter 6:** Sets out the conclusion to this document.

**Chapter 7:** Provides a set of references used throughout the document.

**Chapter 8:** Provides a list of abbreviations and acronyms used within the document.



## 2 OPEN STANDARDS

### 2.1 Overview

Open standards is a very important consideration in the government's ICT policy and one of the key underlying considerations in the recommended software in MyGIFOSS is the adherence to open standards. With open standards it becomes easier and less costly to achieve interoperability among the heterogeneous mix of OSS and proprietary software that is found in the public sector.

As stated earlier in the Introduction, Section 1.1, the term "open standards" in this document is applied to standards that satisfy the following characteristics:

- the standards are developed and maintained by a process that is open;
- it is relatively easy for interested parties to participate in the development of the standards;
- there is easy access to the standards;
- any patents present in the standards are to be made irrevocably available on a royalty-free basis;
- these standards should be developed or recognised and ratified by a body that is associated with developing standards or specifications e.g. ISO, ITU, IEEE, IETF, W3C.

The importance of open standards cannot be over emphasised. By adhering to open standards as far as possible, the public sector can have more flexibility in its choice of ICT technology, vendor and solutions. The ability to mix and match vendors and solutions is crucial in today's complex and heterogeneous ICT environment. Also, as almost all data and information are now exchanged and stored electronically, open standards become critical in the exchange and storage/retrieval process in that it is only by following open standards that the government can be assured of access to that data, both now and in the future when the technology and/or vendor may not be around anymore.

### 2.2 Open Standards and OSS

While OSS and open standards are not the same thing (OSS is software and open standards are specifications) they can share a symbiotic relationship.

Open standards enable OSS to achieve interoperability with proprietary systems more easily since the specifications are openly available for implementation. Open publication and access to the standards ensure that OSS can inter-operate well with proprietary software without having to resort to reverse engineering which may be illegal in many cases. The open access, development and participation characteristics of open standards fit in well with the basic OSS ideals and principles of free software.

Open standards can also help to spread the usage and acceptance of OSS. For example, in the early days of the Internet, the open TCP/IP networking and services protocols were readily available on OSS Linux and \*BSD systems (this refers to the family of operating systems derived from BSD UNIX). In addition, applications supporting open Internet services like mail, news and the web were readily available for OSS systems, both on the client and server side. As a result, OSS operating systems became the platforms of choice for Internet servers and from this many organisations and users became aware of OSS.

On the other hand, OSS can help open standards too. It is natural for an organisation with a pro-OSS policy to specify open standards since the characteristics of open standards are in line with the principles of OSS. Another important way in which OSS can help spread the acceptance of an open standard is that OSS makes it possible to have a free and open implementation of the standard available readily for usage and testing; resulting in wider acceptance if the standard is found to be useful.

## 2.3 Important Open Standards and their OSS Implementations

In this section, some important open standards and their implementations in OSS products are highlighted.

<b>Transmission Control Protocol/ Internet Protocol (TCP/IP)</b>	
Description	<p>The TCP/IP protocol suite provides the infrastructural connection and transport services for a computer network, e.g. the Internet. The main body responsible for the continuous development and maintenance of the TCP/IP standards is the Internet Engineering Task Force (IETF).</p> <p>At the networking layer, IP version 4 (IPv4) is the established and widely used version on the Internet today. IP version 6 (IPv6), the successor to IPv4, that has many new and better features is also now available and its use is encouraged by the IETF and Internet community.</p>
Reference	<a href="http://www.ietf.org/rfc/rfc791.txt">http://www.ietf.org/rfc/rfc791.txt</a> , <a href="http://www.ietf.org/rfc/rfc791.txt">http://www.ietf.org/rfc/rfc791.txt</a>
OSS Implementations	All the UNIX-like OSS operating systems like Linux and *BSD support both IPv4 and IPv6 protocol stacks in their kernels.

<b>Hypertext Transfer Protocol (HTTP)</b>	
Description	This is the primary method by which information (content) is transferred from a web server to a web browser for display over a network. HTTP was developed by the World Wide Web Consortium (W3C) in co-operation with the IETF.
Reference	<a href="http://www.ietf.org/rfc/rfc1945.txt">http://www.ietf.org/rfc/rfc1945.txt</a> , <a href="http://www.ietf.org/rfc/rfc2616.txt">http://www.ietf.org/rfc/rfc2616.txt</a>
OSS Implementations	There are many OSS implementations of servers and/or clients that support HTTP and related protocols. Apache is the most well-known OSS web server while Firefox is the most well-known OSS web browser.

<b>Hypertext Markup Language (HTML)</b>	
Description	HTML specifies the structure and presentation of the content of a web page. The specification is now being maintained by the W3C and a subset of the W3C HTML specification is available as an ISO standard.
Reference	<a href="http://www.w3.org/TR/html401/">http://www.w3.org/TR/html401/</a>
OSS Implementations	There are many OSS products that support the display of HTML pages, notably web browsers. The most well-known OSS browser is Firefox. Seamonkey (formerly known as Mozilla Suite) is another one.

<b>Extended Markup Language (XML)</b>	
Description	<ul style="list-style-type: none"> <li>• A specification from W3C that specifies a meta markup language for the creation of other markup languages.</li> <li>• XML is designed for data transfer and exchange and as a format for document storage and processing.</li> <li>• It has been used as the base for specifying many other data formats and exchange protocols.</li> </ul>
Reference	<a href="http://www.w3.org/TR/REC-xml">http://www.w3.org/TR/REC-xml</a>
OSS Implementations	XML is very well supported by most of the OSS products and development environments. These include web browsers like Firefox, server products like Apache, databases like MySQL, office applications like OpenOffice.org and development tools like PHP, python, perl.

<b>Simple Mail Transfer Protocol (SMTP)</b>	
Description	SMTP forms the backbone of the Internet emailing system. By making use of the email addresses, the transport and routing of email from the sender to the recipient is made possible by SMTP.
Reference	<a href="http://www.ietf.org/rfc/rfc2821.txt">http://www.ietf.org/rfc/rfc2821.txt</a> , <a href="http://www.ietf.org/rfc/rfc2822.txt">http://www.ietf.org/rfc/rfc2822.txt</a>
OSS Implementations	There are many OSS products that support SMTP and its related protocols. The most popular and widely used mail servers include: Sendmail, Postfix and qmail.

<b>OpenDocument Format (ODF)</b>	
Description	The ODF standard specifies file formats for the storage of office documents created by applications such as word processors, spreadsheets, charts and presentations software. It makes use of XML to specify its formats. It started as a standard from OASIS but it has

<b>OpenDocument Format (ODF)</b>	
	since been adopted as an ISO standard (ISO/IEC 26300).
Reference	<a href="http://www.oasis-open.org/specs/index.php#opendocumentv1.0">http://www.oasis-open.org/specs/index.php#opendocumentv1.0</a>
OSS Implementations	Most of OSS office applications support ODF. The most well-known of these is the OpenOffice.org office suite package.

<b>Portable Network Graphics (PNG)</b>	
Description	Portable Network Graphics (PNG) is an extensible file format for the lossless, portable, well-compressed storage of raster images. It is an open graphics file format recommendation from W3C as well as an ISO standard (ISO/IEC 15948).
Reference	<a href="http://www.w3.org/TR/PNG/">http://www.w3.org/TR/PNG/</a>
OSS Implementations	Almost all of the OSS graphics software as well as web browsers support PNG.

## **3 OPEN SOURCE SOFTWARE WITHIN DEFINED IMPLEMENTATION AREAS**

### **3.1 Overview**

This chapter provides a selection of OSS to be used in an agency's ICT implementations. It includes a description of the features, its support of open standards, rationale for inclusion and limitations of the software.

Within the Malaysian Public Sector OSS Master Plan, six solution areas are identified:

- i. Workload Consolidation
- ii. High Performance Computing
- iii. Distributed Enterprise
- iv. Application Solution
- v. Infrastructure Solution
- vi. Desktop Solution

The solution areas consist of individual software implementations, combining to create a complete solution. These individual software implementations are grouped into the headings below, in which OSS examples are given:

- **Operating Systems**
  - Linux
  - BSD Family of Operating Systems (\*BSD)
- **Desktop Applications**
  - Office Productivity Suite
  - Project Management
  - Mail Client
  - Web Browser
  - Multimedia Player
  - Desktop Environment
  - Graphic Manipulation
- **Server Applications**
  - Mail Transfer Agent (MTA)
  - Mail Access Agent
  - Groupware
  - Web Server
  - Wikis
  - Remote Login Server
  - Database Server
  - Proxy Server
  - File & Printer Server
  - Backup Server / Tool
- **Network Security**
  - Firewall
  - Network Intrusion Detection System (NIDS)
  - Virtual Private Network (VPN)
  - Anti-virus
  - Anti-spam
- **Vertical Applications**
  - Content Management System (CMS)
  - Learning Management System (LMS)
  - Enterprise Resource Planning (ERP)
  - Document Management System (DMS)
  - Hospital Information System (HIS)
  - Geographic Information System (GIS)
  - Workflow System

## 3.2 Guidelines/Standards Matrix

**Table 2.1** below lists examples of OSS for use within identified implementation areas. The table is not meant to be exhaustive, but represents a wide range of software released under Open Source licenses. Many of the examples listed here are also recommended for use by the MAMPU publication “Open Source Software Reference Architecture (OSSRA)” as part of its implementation.

The subsections following the table go into greater detail with regard to the OSS examples given, providing information on the software, its support of open standards, its rationale for selection, any limitations and implementation scenario examples.

No	Implementation Areas	Solution Areas Affected	OSS Examples	Preferences and Guidelines
<b>1</b>	<b>Operating Systems</b>			
1.1	Linux	<ul style="list-style-type: none"> <li>•Workload Consolidation</li> <li>•High Performance Computing</li> <li>•Distributed Enterprise</li> <li>•Application Solution</li> <li>•Infrastructure Solution</li> <li>•Desktop Solution</li> </ul>	<ul style="list-style-type: none"> <li>•Red Hat</li> <li>•Fedora</li> <li>•CentOS</li> <li>•Ubuntu</li> <li>•Mandriva</li> <li>•Novell SUSE</li> <li>•Slackware</li> <li>•Debian</li> <li>•Gentoo</li> </ul>	For Linux Distributions, preference should be made for those that comply with the Linux Standard Base (LSB) 2.0, or higher, specifications. These include Red Hat, Ubuntu, Mandriva and Novell SUSE.
1.2	BSD family of operating systems	<ul style="list-style-type: none"> <li>•Workload Consolidation</li> <li>•High Performance Computing</li> <li>•Distributed Enterprise</li> <li>•Application Solution</li> <li>•Infrastructure Solution</li> <li>•Desktop Solution</li> </ul>	<ul style="list-style-type: none"> <li>•FreeBSD</li> <li>•NetBSD</li> <li>•OpenBSD</li> </ul>	There are three popular flavours of operating systems derived from BSD UNIX, with the rest being niche offshoots.
<b>2</b>	<b>Desktop Applications</b>			
2.1	Office Productivity Suite	<ul style="list-style-type: none"> <li>•Desktop Solution</li> </ul>	<ul style="list-style-type: none"> <li>•OpenOffice.org</li> <li>•KOffice</li> <li>•Abiword</li> <li>•GNUmeric</li> </ul>	Data formats based on the OASIS OpenDocument format standard should be used. This is also an ISO standard - ISO/IEC 26300.
2.2	Project Management	<ul style="list-style-type: none"> <li>•Desktop Solution</li> </ul>	<ul style="list-style-type: none"> <li>•OpenProj</li> <li>•dotProject</li> <li>•Open Workbench</li> <li>•Planner</li> </ul>	Software chosen should be based on ability to provide required functions, e.g. GANTT charts, timekeeping, problem ticket tracking.
2.3	Mail Client	<ul style="list-style-type: none"> <li>•Desktop Solution</li> </ul>	<ul style="list-style-type: none"> <li>•Evolution</li> <li>•Kmail</li> <li>•Thunderbird</li> <li>•Seamonkey Mail</li> <li>•Pine</li> </ul>	Adherence to standard mail protocols, e.g. POP3 and IMAP, and other relevant RFCs from IETF are preferred. Address books used should be able to support the LDAP Data Interchange Format (LDIF) and comma-separated value (CSV) format.
2.4	Webmail	<ul style="list-style-type: none"> <li>•Desktop Solution</li> <li>•Infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>•SquirrelMail</li> <li>•Horde IMP</li> </ul>	Those that do not require Javascript preferred as implementations of Javascript are

No	Implementation Areas	Solution Areas Affected	OSS Examples	Preferences and Guidelines
		Solution		notoriously browser-specific.
2.5	Web Browser	•Desktop Solution	•Firefox •Seamonkey •Konqueror •Epiphany	Adherence to W3C standards are preferred.
2.6	Multimedia Player	•Desktop Solution	•MPlayer •Xine •xmms	Ability to play multiple formats is desirable. Should also be able to play open, patent-free media formats, e.g. Ogg Vorbis.
2.7	Desktop Environment	•Desktop Solution	•KDE •GNOME	The examples given here are the two most mature integrated desktop environment available for Linux and *BSD. The use of one environment over the other depends on the user's preference.
2.8	Graphic Manipulation	•Desktop Solution	•GIMP •Inkscape	GIMP is a mature bitmap graphics editor that supports most of the bitmap graphic file formats like GIF, JPG, BMP and PNG. Inkscape is a vector graphics editor that uses SVG, an open XML-based W3C standard, as its native format.
2.9	Control Panel	•Desktop Solution	•Webmin •ISPConfig	This type of software facilitates the management and configuration of Internet services and possibly host system applications and internals such as users, disk quotas, services, configuration files etc.
<b>3</b>	<b>Server Applications</b>			
3.1	Mail Transfer Agent (MTA)	•Infrastructure Solution	•Sendmail •qmail •Postfix •Exim	The Mail Transfer Agents, generally referred to as mail servers, should conform to the relevant RFCs from IETF governing email over the Internet.
3.2	Mail Access Agent	•Infrastructure Solution	•JW IMAP •Courier IMAP •Dovecot	IMAP servers generally implement POP3 servers as well. The main purpose of IMAP/POP3 servers is to allow access to the mail stored in the mail servers.
3.3	Groupware	•Infrastructure Solution •Application Solution	•phpGroupWare •OpenGroupware •Horde Groupware	OSS Groupware vary in features and capabilities. Consider the best fit, and explore the possibility of having to make your own enhancements.

No	Implementation Areas	Solution Areas Affected	OSS Examples	Preferences and Guidelines
			•Zimbra	
3.4	Calendar Server	•Infrastructure Solution •Application Solution	•Zimbra •Darwin Calendar Server	A calendar server provides services that allow multiple users to collaboratively share calendaring information such as schedules and meeting appointments and allow users to send each other invitations as well as manage them. Open standards supported should include iCalendar and CalDAV.
3.5	Web Server	•Infrastructure Solution	•Apache •Lighttpd	Any web server must be able to communicate with web browsers using HTTP protocols from IETF and serve pages that adhere to W3C specifications and guidelines.
3.6	Wikis	•Infrastructure Solution •Application Solution	•PhpWiki •Zwiki •Mediawiki	Wikis are web pages that enable their users to contribute or modify content, using a simplified markup language. It can be a useful collaborative and authoring tool for content creation and maintenance.
3.7	Remote Login Server	•Workload Consolidation •High Performance Computing •Distributed Enterprise •Application Solution •Infrastructure Solution •Desktop Solution	•OpenSSH	The example given here implements documented open standards for asymmetric and symmetric encryption. Any secure remote access software should implement the same.
3.8	Database Server	•Workload Consolidation •High Performance Computing •Distributed Enterprise •Application Solution •Infrastructure Solution	•MySQL •PostgreSQL •Firebird	Relational Databases are often at the core of many complex applications. Depending on the need, the choice of any particular database is largely dependent on the capabilities and requirements for the applications. Databases chosen should support the SQL standard for access.
3.9	Proxy Server	•Infrastructure Solution	•Squid	Proxy servers caches web and ftp traffic. They help to reduce bandwidth requirements. The use of proxy servers are

No	Implementation Areas	Solution Areas Affected	OSS Examples	Preferences and Guidelines
				recommended.
3.1 0	File & Print Server	•Infrastructure Solution	•SAMBA •NFS •Common UNIX Printing System (CUPS)	The Network File System (NFS) and CUPS are standard on all UNIX and UNIX-like operating systems, thus enabling interoperability between these systems. Some non-UNIX proprietary operating systems do not implement NFS or CUPS, but use SMB/CIFS instead. Use of SAMBA is recommended where interoperability with these systems are required.
3.1 1	Backup Server / Tool	•Workload Consolidation •High Performance Computing •Distributed Enterprise •Application Solution •Infrastructure Solution •Desktop Solution	•Amanda •Bacula	Backup software has to have the capability to do incremental backups and network spanning across servers or storage area networks. Further, it must have the ability to handle various operating systems and backup devices, such as disks, tape and optical libraries and multi-changers. Analysis of the level of backups is needed before obtaining any particular software.
3.1 2	Domain Name System (DNS) Server	•Infrastructure Solution	•BIND •djbdns	Servers used should conform to the relevant domain name service RFCs from IETF.
3.1 3	Host-based Intrusion Detection System (HIDS)	•Infrastructure Solution	•OSSEC •SAMHAIN	The HIDS should be capable of working together or integration with other monitoring systems e.g. network IDS, anti-virus scanners, network management software, etc.
3.1 4	Authentication Server	•Infrastructure Solution	•FreeRADIUS	Servers should be able to support the Remote Authentication Dial In User Service (RADIUS) protocol RFCs from IETF.
3.1 5	Directory Server	•Infrastructure Solution	•OpenLDAP •Fedora Directory Server	Directory servers used should conform to the Lightweight Directory Access Protocol (LDAP) RFCs from IETF.
3.1 6	Network Management	•Infrastructure Solution	•Nagios •OpenNMS •MRTG	Network management software should support the Simple Network Management Protocol (SNMP) RFCs from IETF for monitoring network devices.
4	<b>Network Security</b>			

No	Implementation Areas	Solution Areas Affected	OSS Examples	Preferences and Guidelines
4.1	Firewall	•Infrastructure Solution	<ul style="list-style-type: none"> <li>•Linux iptables</li> <li>•FreeBSD IPFilter</li> <li>•IPFW</li> <li>•OpenBSD packetfilter</li> <li>•Monowall</li> <li>•pfSense</li> <li>•Smoothwall</li> </ul>	<p>Firewalls are generally regarded as the first line of defense for Internet security. There are two kinds of firewalls – software and hardware. Software firewalls are implemented within general purpose servers while hardware firewalls are special purpose appliances.</p> <p>The choice of a firewall implementation is often down to “high-level” considerations, like ease of configuration and maintenance since the capabilities are often similar across platforms.</p>
4.2	Network Intrusion Detection System (NIDS)	•Infrastructure Solution	•Snort	<p>Network IDS often acts as a forensic tool for analysing network breaches. It requires active monitoring as well as constant updating of signatures to be effective.</p> <p>When considering a Network IDS, those that are being actively updated with intrusion signatures are recommended.</p>
4.3	Virtual Private Network (VPN)	•Infrastructure Solution	<ul style="list-style-type: none"> <li>•OpenVPN</li> <li>•FreeS/WAN</li> </ul>	<p>VPNs are used as a cheaper alternative to having costly lease-lines to connect distance branch offices and sites. The objective of a VPN is to leverage on the low-cost of having general Internet connections while having the benefits of security and privacy for internal traffic. A VPN implementation must have strong encryption and mechanisms for trust and authentication.</p>
4.4	Anti-virus	<ul style="list-style-type: none"> <li>•Infrastructure Solution</li> <li>•Desktop Solution</li> </ul>	•ClamAV	<p>OSS operating systems and applications are not generally under threat of viruses, worms and trojans. However, they are often used as gateways and servers for proprietary operating systems and applications which are vulnerable. As such, anti-virus scanners for these proprietary software have been created and deployed on OSS systems.</p> <p>Anti-virus software that are actively developed and have the virus signatures constantly</p>

No	Implementation Areas	Solution Areas Affected	OSS Examples	Preferences and Guidelines
				updated are highly recommended.
4.5	Anti-spam	<ul style="list-style-type: none"> <li>•Infrastructure Solution</li> <li>•Desktop Solution</li> </ul>	<ul style="list-style-type: none"> <li>•SpamAssassin</li> <li>•Built-in spam filters within mail clients such as Evolution, Thunderbird and Kmail</li> </ul>	Spam filtering is traditionally executed at the mail server, however, there is now an increasing trend to include spam filtering capabilities on the mail clients themselves. OSS mail clients often have extensive filtering capabilities. When considering a mail client, those with spam filtering capabilities are recommended.
5	<b>Vertical Applications</b>			
5.1	Content Management System (CMS)	•Application Solution	<ul style="list-style-type: none"> <li>•Drupal</li> <li>•Joomla</li> <li>•Mambo</li> <li>•Typo3</li> <li>•OpenCms</li> <li>•PHP-Nuke</li> <li>•Plone</li> </ul>	<p>CMSes are deployed as easy-to-use applications for websites and portals. There are many CMSes on the market today and the user is advised to carefully consider the features and capabilities of each one.</p> <p>CMSes which produce open standards compliant web pages are recommended.</p>
5.2	Learning Management System (LMS)	•Application Solution	<ul style="list-style-type: none"> <li>•Moodle</li> <li>•OLAT</li> </ul>	LMSes should support open eLearning standards like SCORM, IMS CP and QTI.
5.3	Enterprise Resource Planning (ERP)	•Application Solution	<ul style="list-style-type: none"> <li>•Compiere</li> <li>•Adempiere</li> </ul>	<p>Enterprise Resource Planning (ERP) applications are typically large and require a lot of customisation to suit any particular enterprise.</p> <p>It is often difficult to determine which of the ERP subsets that one might need. This is not helped by the fragmentation of ERP itself into, for e.g. Customer Relations Management, Supply Chain Management, Manufacturing Resource Planning, Partner Relations Management and other higher level subsets like business intelligence and KPI dashboards.</p> <p>When considering an ERP system, careful planning and attention to process organisation are needed.</p>
5.4	Document Management	•Application Solution	<ul style="list-style-type: none"> <li>•KnowledgeTree</li> <li>•Alfresco</li> </ul>	Document Management Systems help in organising and archiving

No	Implementation Areas	Solution Areas Affected	OSS Examples	Preferences and Guidelines
	System (DMS)			official documents and other related collateral, such as presentations, drawings and designs. DMSes should make use of available open standards in document and image/graphic formats in their storage of documents and images.
5.5	Hospital Information System (HIS)	•Application Solution	•OpenVISTA •Care2x	Hospitals are complex organisations with multiple levels of operations – usually divided into clinical and non-clinical operations. When choosing an HIS, it is important to have well defined standard operating procedures (SOP) and to evaluate whether the HISes considered have the required flexibility and scalability to implement the SOP. It is also important that the HIS supports established open healthcare standards like HL7, DIACOM, etc.
5.6	Geographic Information System (GIS)	•Application Solution	•GRASS •OSSIM •MapServer •PostGIS	GIS software should support the standards developed by the Open Geospatial Consortium (OGC). The OGC works closely with international standards bodies like ISO, W3C and OASIS in developing standards for geospatial content and services, GIS data processing and exchange. As not all GIS support the rendering of spatial data (maps, images, and vector data) for the web, additional map rendering software may be needed for a web-based GIS application.
5.7	Workflow System	•Application Solution	•Bonita	Software should support XPDL standard as far as possible to facilitate the interchange of business process definitions between different workflow products.

**Table 3.1: Implementation Guideline Matrix**

## 3.3 Operating Systems

### 3.3.1 LINUX

#### Background description:

Linux consists of the Linux kernel (core operating system), originally written by Linus Torvalds, along with utility programs developed by the Free Software Foundation and others. The combination of thousands of OSS and the Linux kernel makes it possible for a functional operating system to be created. Since then, many commercial and community driven projects have been spawned to create new operating systems based on the Linux kernel and associated OSS. The different OSS packages offered, the methodology taken to create them and the philosophy behind the systems created, are now known as Linux distributions. In essence, the three different “uses” of the word Linux can be summarised as:

- i. **Kernel** - the kernel is the central program of any operating system. This is the program that talks directly to the hardware of the computer. Other programs make requests of the kernel to get something done on the computer. For instance, in order to put a character on the computer screen, a program must ask the kernel to put a certain character in a certain place on the display screen. (There are exceptions to this, but in general, all communications to the computer hardware go through the kernel.)
- ii. **Operating System** - the combination of the kernel and the application software used to interact with the kernel.
- iii. **Distribution** - the many different flavours of operating systems created by thousands of other software packaged together with the Linux kernel.

Further information on the Linux kernel, operating system and distributions can be found at the Linux Documentation Project website: <http://www.tldp.org/>

The specific document that answers frequently asked questions on Linux can be found at: <http://tldp.org/FAQ/Linux-FAQ/index.html>

**Table 3.2** below gives a non-exhaustive comparison of some widely used Linux distributions, giving, among other things, their compliance to the Linux Standard Base (LSB) and computer architectures supported.

#### A note on the Linux Standard Base:

From the Linux Standard Base web site (<http://www.linuxbase.org/>):

#### **Mission Statement**

To develop and promote a set of standards that will increase compatibility among Linux distributions and enable software applications to run on any compliant system. In addition, the LSB will help coordinate efforts to recruit software vendors to port and write products for Linux.

What the statement essentially means in the practical sense is that the LSB seeks to remove the uncertainty in choosing a Linux distribution. Distributions that are LSB compliant retain the ability to run any application that is developed following the LSB specifications.

As such, when choosing a Linux distribution for implementation, it is strongly recommended that a LSB compliant distribution is chosen.

<b>Distribution</b>	<b>LSB Certification (certification listed below valid only for some architectures and versions)</b>	<b>Vendor/Community Support</b>	<b>Multi-media support</b>	<b>Package Management</b>	<b>Auto Update</b>	<b>Arch Support</b>
Red Hat Enterprise	1.3, 3.0, 3.1	Vendor	Limited*	rpm	Yes	x86, x86-64, IA64, PPC, S390, S390X
Fedora	No	Community	Limited	rpm	Yes	x86, x86-64
CentOS	No	Community	Limited	rpm	Yes	x86, x86-64, IA64, PPC, S390, S390X
Ubuntu	3.1	Vendor/Community	Yes	rpm	Yes	x86, x86-64, PPC, Sparc
Novell / SUSE Enterprise	1.3, 2.0, 3.0, 3.1	Vendor	Yes	rpm	Yes	x86, x86-64, IA64, PPC, S390, S390X
openSUSE	No	Community	Yes	rpm	Yes	x86, x86-64, PPC
Mandriva	2.0, 3.1	Vendor/Community	Yes	rpm	Yes	x86, x86-64
Slackware	No	Community	Yes	tgz	Yes	x86
Debian	No	Community	Yes	apt-get, dpkg	Yes	Alpha, Arm, HPPA, x86, IA64, m68k, MIPS, PPC, S390, Sparc
Gentoo	No	Community	Yes	emerge	Yes	x86, x86-64, HPPA, PPC, Arm, MIPS, Sparc

\* Limited multimedia support refers to the fact that these Linux distros may not come ready with the necessary support for playing multimedia formats that are proprietary

and/or encumbered by patents e.g. MP3, WMV etc. The users will have to install the necessary supporting multimedia libraries on their own.

**Table 3.2: Comparison of Popular Linux Distributions**

<b>Red Hat / Fedora / CentOS</b>	
Description	<ul style="list-style-type: none"> <li>• Red Hat and Fedora are developed and maintained by Red Hat, Inc.</li> <li>• Red Hat Linux is the commercially supported version by Red Hat Inc.</li> <li>• Fedora Linux is the community version, which is distributed without any commercial support from Red Hat Inc. It has a faster upgrade cycle than Red Hat Linux and it may include software that is less matured.</li> <li>• CentOS Linux is a community project that is derived from sources freely provided to the public by Red Hat Linux. CentOS conforms fully and aims to be 100% binary compatible with Red Hat Linux.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.redhat.com/">http://www.redhat.com/</a>, <a href="http://fedoraproject.org/">http://fedoraproject.org/</a>, <a href="http://www.centos.org/">http://www.centos.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• They are most well-known and the installed base is huge.</li> <li>• They are easy to install.</li> <li>• There is excellent community support.</li> <li>• There is commercial support (for Red Hat).</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• All of the Internet specifications from IETF for commonly used Internet services.</li> <li>• Conforms to a large extent to POSIX (IEC/ISO 9945) and SUS (Single UNIX Specification) specifications for the kernel and system environment.</li> <li>• Red Hat Linux is LSB-certified.</li> <li>• Individual application packages may support specific open standards.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• Poor multimedia support due to Red Hat Inc.'s decision not to include patented software and algorithms, e.g. MP3, Windows Media formats, Apple's Quicktime.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Red Hat Linux distributions are commonly used in server environments. This is due to its large support for commercial based software like Oracle and IBM WebSphere.</li> </ul>

<b>Ubuntu</b>	
Description	<ul style="list-style-type: none"> <li>• It is community developed but sponsored and supported by Canonical Ltd.</li> <li>• It is one of the most popular distributions worldwide, especially for desktops.</li> <li>• It is derived from Debian Linux, but enhanced with many application packages and drivers.</li> <li>• It has a vibrant and very active community of users.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.ubuntu.com/">http://www.ubuntu.com/</a></li> </ul>
Rationale for	<ul style="list-style-type: none"> <li>• It supports multiple architectures, e.g. x86, PowerPC.</li> </ul>

<b>Ubuntu</b>	
selection	<ul style="list-style-type: none"> <li>• It is easy to install.</li> <li>• The desktop edition is very easy to use and supports a wide range of peripheral devices.</li> <li>• Multimedia support is good.</li> <li>• Hardware peripherals driver support is good.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• All of the Internet specifications from IETF for commonly used Internet services.</li> <li>• Conforms to a large extent to POSIX (IEC/ISO 9945) and SUS (Single UNIX Specification) specifications for the kernel and system environment.</li> <li>• It is LSB-certified.</li> <li>• Individual application packages may support specific open standards.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Ubuntu Linux is very suitable for use on the desktop.</li> </ul>

<b>Mandriva</b>	
Description	<ul style="list-style-type: none"> <li>• Formerly known as Mandrake, it was created in 1998 by Gael Duval, with the goal of making Linux easier to use for everyone.</li> <li>• Mandriva is the result of Mandrake acquiring Conectiva of Brazil, another Linux distribution company.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.mandriva.com/">http://www.mandriva.com/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• Mandriva is popular for non-technical desktop users.</li> <li>• There is a lot of community support.</li> <li>• It is user-friendly with graphical configuration utilities.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• All of the Internet specifications from IETF for commonly used Internet services.</li> <li>• Conforms to a large extent to POSIX (IEC/ISO 9945) and SUS (Single UNIX Specification) specifications for the kernel and system environment.</li> <li>• It is LSB-certified.</li> <li>• Individual application packages may support specific open standards.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• It is limited to x86 architectures.</li> </ul>
Implementation Scenario Example	<ul style="list-style-type: none"> <li>• Mandriva Linux Distribution is commonly used on desktop environments. This is mainly due to its robustness, attractive graphics and user friendliness.</li> </ul>

<b>Novell /SUSE Enterprise / openSUSE</b>	
Description	<ul style="list-style-type: none"> <li>• SUSE Linux originated from a German company, SuSE Linux AG but it has since been acquired by Novell Inc.</li> <li>• Novell/SUSE Enterprise is the commercially available and supported distribution by Novell Inc.</li> </ul>

<b>Novell /SUSE Enterprise / openSUSE</b>	
	<ul style="list-style-type: none"> <li>• openSUSE is a community distribution sponsored by Novell Inc. It provides the base for SUSE Enterprise.</li> <li>• It is very popular in Europe.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.novell.com/linux/">http://www.novell.com/linux/</a>, <a href="http://www.opensuse.org/">http://www.opensuse.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• SuSE is widely implemented in European governments and corporations.</li> <li>• Multiple architectures, e.g. x86, PowerPC, IBM Mainframes are supported.</li> <li>• Easy to install.</li> <li>• There is a special desktop edition for Novell Linux.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• All of the Internet specifications from IETF for commonly used Internet services.</li> <li>• Conforms to a large extent to POSIX (IEC/ISO 9945) and SUS (Single UNIX Specification) specifications for the kernel and system environment.</li> <li>• Novell/SUSE Enterprise is LSB-certified.</li> <li>• Individual application packages may support specific open standards.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• SUSE Linux distributions are mostly used because of its comprehensive system and network administration tools. It has excellent commercial support on various platforms.</li> </ul>

<b>Slackware</b>	
Description	<ul style="list-style-type: none"> <li>• One of the earliest Linux distributions, started by Patrick Volkerding in 1993.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.slackware.com/">http://www.slackware.com/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• Slackware is favoured by many system administrators for servers, due to its minimalist design.</li> <li>• It is one of the older Linux distributions, proving its stability.</li> <li>• It does not suffer from the package dependency issues of RPM-based distributions.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• All of the Internet specifications from IETF for commonly used Internet services.</li> <li>• Conforms to a large extent to POSIX (IEC/ISO 9945) and SUS (Single UNIX Specification) specifications for the kernel and system environment.</li> <li>• Individual application packages may support specific open standards.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• Minimalist design and simple installation tools means that there is a steeper learning curve.</li> <li>• Its support options not as comprehensive as Red Hat, Novell SuSE or Mandriva.</li> <li>• It supports only x86 hardware.</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>• Slackware is mainly used on servers which require minimal user</li> </ul>

Slackware	
scenario example	interaction. It is often the distribution of choice for edge servers, i.e. firewalls, intrusion detection systems etc.

**Table 3.3: Main features of Common and Popular Linux Distributions**

### 3.3.2 BSD Family of Operating Systems

#### Background description:

BSD stands for “Berkeley Software Distribution”, the UNIX derivative distributed by the University of California, Berkeley beginning from the 1970s. It is also used collectively to describe the modern descendants of the original distribution. The BSD family of operating systems provides a number of complete operating system packages, the three most popular being FreeBSD, NetBSD and OpenBSD.

FreeBSD	
Description	<ul style="list-style-type: none"> <li>• An advanced OS derived from BSD UNIX, the version of UNIX developed at the University of California, Berkeley.</li> <li>• It is managed by the FreeBSD Foundation.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.freebsd.org/">http://www.freebsd.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• FreeBSD is robust and stable.</li> <li>• It is ideal for Internet and intranet servers.</li> <li>• It has features of high performance and ease of use by end users.</li> <li>• It is optimized for x86 platform.</li> <li>• it has a lot of Linux applications ported.</li> <li>• It has the ability to run Linux binaries.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• All of the Internet specifications from IETF for commonly used Internet services.</li> <li>• Conforms to a large extent to POSIX (IEC/ISO 9945) and SUS (Single UNIX Specification) specifications for the kernel and system environment.</li> <li>• Individual application packages may support specific open standards.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• FreeBSD may be used as an alternative to Linux.</li> <li>• It is commonly used where the users are more comfortable with native UNIX features.</li> </ul>

NetBSD	
Description	<ul style="list-style-type: none"> <li>• NetBSD is a free, secure, and highly portable UNIX-like operating system available for <a href="#">many platforms</a>. It is derived from BSD UNIX, the version of UNIX developed at the University of California, Berkeley.</li> <li>• It is managed by the NetBSD Foundation.</li> </ul>

<b>NetBSD</b>	
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.netbsd.org">http://www.netbsd.org</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• NetBSD has a wide range of support for many platforms. NetBSD is designed to take advantage of the latest high-end hardware available in Alpha, PowerPC, and PC systems, while still retaining support for older architectures.</li> <li>• The entire kernel and the core of the user-land utilities are shipped under a BSD license. This allows companies to develop products based on NetBSD without the requirement to make the changes public.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• All of the Internet specifications from IETF for commonly used Internet services.</li> <li>• Conforms to a large extent to POSIX (IEC/ISO 9945) and SUS (Single UNIX Specification) specifications for the kernel and system environment.</li> <li>• Individual application packages may support specific open standards.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• NetBSD may be used as an alternative to Linux.</li> <li>• It is commonly used where the users are more comfortable with native UNIX features.</li> <li>• NetBSD has a wide range of support for various platforms and this makes it suitable for the research and development environment.</li> </ul>

<b>OpenBSD</b>	
Description	<ul style="list-style-type: none"> <li>• OpenBSD is a free, multi-platform BSD-based UNIX-like operating system. It emphasises portability, correctness, and integrated cryptography.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.openbsd.org/">http://www.openbsd.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is shipped with many security features, applications and tools, including cryptography, making it suitable for developing cryptography applications.</li> <li>• It includes integrated cryptography applications for software and hardware.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• All of the Internet specifications from IETF for commonly used Internet services.</li> <li>• Conforms to a large extent to POSIX (IEC/ISO 9945) and SUS (Single UNIX Specification) specifications for the kernel and system environment.</li> <li>• Individual application packages may support specific open standards.</li> <li>• Cryptographic transforms supported include DES, 3DES, Blowfish and Cast.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• OpenBSD may be used as an alternative to Linux.</li> <li>• It is often used as firewalls, since its default install is considered to be secure.</li> <li>• It is exported with cryptography, making it suitable for developing cryptography applications.</li> </ul>

**Table 3.4: Main features of Popular BSD-derived Systems**

## 3.4 Desktop Applications

### 3.4.1 Office Productivity Suite

**Background description:**

An Office Suite is a group of applications, consisting of a word processor, spreadsheet, presentation slides creator and optionally a simple database that are used as productivity tools.

<b>OpenOffice.org</b>	
Description	<ul style="list-style-type: none"> <li>• OpenOffice.org originated from a proprietary office suite, StarOffice from StarDivision GMBH. After acquiring this company in 1999, Sun Microsystems open sourced StarOffice, and the open source version is named OpenOffice.org.</li> <li>• StarOffice is still available, it uses the same code base as OpenOffice.org.</li> <li>• Differences between the two can be found at:  <a href="http://www.openoffice.org/FAQs/mostfags.html#6">http://www.openoffice.org/FAQs/mostfags.html#6</a></li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.openoffice.org/">http://www.openoffice.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• OpenOffice.org has a similar user interface with popular proprietary office suites, such as Microsoft Office.</li> <li>• It has features comparable to Microsoft Office.</li> <li>• It can read, edit and write Microsoft Office file formats.</li> <li>• It supports the OASIS OpenDocument format (ISO/IEC 26300) by default.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• OASIS and ISO/IEC 26300 OpenDocument format (ODF).</li> <li>• Export of documents in PDF format, a de facto standard.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• Reading and writing to Microsoft Office file formats by using OpenOffice.org may not be reproduced perfectly.</li> <li>• OpenOffice.org may have limited fonts and graphical images on platforms other than MS-Windows.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• OpenOffice.org can be installed on Linux, Solaris, FreeBSD, MS-Windows and Mac OS X operating systems.</li> <li>• It allows co-existence with Microsoft Office Suite when it is being installed on MS-Windows.</li> <li>• In an office environment, it can be used for all desktop computers.</li> </ul>

### 3.4.2 Project Management

#### Background description:

Project Management software aims to assist the management of projects by providing tools to plan and monitor time lines, milestones, resources and budget, among others.

OpenProj	
Description	<ul style="list-style-type: none"> <li>• OpenProj is a complete desktop replacement for Microsoft Project.</li> <li>• Amongst other features, it supports Gantt Charts, Network Diagrams (PERT Charts), WBS and RBS charts and Earned Value costing.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://openproj.org/">http://openproj.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is the closest alternative tool to Microsoft Project.</li> <li>• It opens existing Microsoft Project files.</li> <li>• It runs on Linux, Unix, Mac and MS-Windows.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• Lack of good documentation.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• OpenProj can be installed on the desktop for project management purposes.</li> </ul>

### 3.4.3 Mail Client

#### Background description:

Mail clients are formally referred to as Mail User Agents (MUA). Their purpose is for retrieving, reading, composing and replying/sending emails.

Evolution	
Description	<ul style="list-style-type: none"> <li>• Evolution is developed by Ximian to provide a unified email client, similar to Microsoft Outlook</li> <li>• Ximian has been acquired by Novell Inc.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.ximian.org/">http://www.ximian.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is the closest alternative tool to Microsoft Outlook.</li> <li>• It comes with a Personal Information Manager (PIM) feature.</li> <li>• It supports GNU Privacy Guard.</li> <li>• It supports Microsoft Exchange server with the Ximian connector.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF mail message formats e.g. RFC 2822, RFC 2045-9 (MIME)</li> <li>• IETF mail access protocols: RFC 1939 (POP3), RFC 3501 (IMAP), RFC 2821 (SMTP)</li> <li>• IETF mail encryption: RFC 4880 (OpenPGP)</li> <li>• IETF LDAP Data Interchange Format (LDIF): RFC 2849.</li> </ul>

<b>Evolution</b>	
	<ul style="list-style-type: none"> <li>Public key encryption and signing of e-mail using S/MIME, a de facto standard</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>Evolution can be installed on Linux or *BSD systems.</li> <li>In an office environment, it can be used on all desktop computers running Linux or a UNIX-like operating system.</li> </ul>

### 3.4.4 Webmail

#### Background description:

Webmail or web-based email refers to a service that enables email to be accessed via a web browser. The main advantage of webmail over traditional mail clients is that the email can be accessed and managed from any computer that has an Internet connection and web browser.

<b>SquirrelMail</b>	
Description	<ul style="list-style-type: none"> <li>A standards-based webmail package written in the PHP scripting language.</li> <li>It includes built-in pure PHP support for the IMAP and SMTP protocols, and all pages are rendered in pure HTML.</li> </ul>
Reference	<ul style="list-style-type: none"> <li><a href="http://www.squirrelmail.org/">http://www.squirrelmail.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>Output from SquirrelMail is compatible with most modern web browsers as they conform to standard HTML and Javascript is not used.</li> <li>Extensible as it uses a plugin architecture to accommodate additional features around the core application. Available plugins include mail filters, spell checkers, calendar.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>W3C HTML 4.0</li> <li>IETF RFC 3501 (IMAP), RFC 2821 (ESMTP), RFC 2822, RFC 2045-9 (MIME), RFC 2849 (LDIF).</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>SquirrelMail can be installed on a departmental Linux web and mail server connected to the Internet and users can access their email from any computer or even from the outside (subject to departmental policy) by using their web browsers.</li> <li>The default configuration of SquirrelMail is to store the messages in files rather than use a database but on sites with many users it may be desirable to use a database instead. While it is possible to make use of a database back end some additional configuration setup is needed to accomplish this.</li> </ul>

### 3.4.5 Web Browser

#### Background description:

A program to surf the Internet.

<b>Mozilla Firefox</b>	
Description	<ul style="list-style-type: none"> <li>• Mozilla Firefox is a web browser that originated from Netscape Navigator, which was open sourced by the Netscape corporation.</li> <li>• The Navigator code was considered too complicated and a complete rewrite was made, resulting in Mozilla.</li> <li>• Mozilla is the base for several other derived web browsers, e.g. Firefox, Netscape, Galeon.</li> <li>• Mozilla comes with email client, chat tools, HTML composer and news reader. This Mozilla suite is now known as Seamonkey.</li> <li>• Firefox is the browser only.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.mozilla.org/">http://www.mozilla.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• Firefox is the most popular OSS browser.</li> <li>• It complies largely with most of the major web standards/specifications.</li> <li>• It has extra functionalities which include high privacy and security encryption, pop-ups and junk mail stopper, and tabbed browsing.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• Most of the major web standards e.g. HTML, XML, XHTML, CSS, ECMAScript (JavaScript), DOM, MathML, DTD, XSLT, XPath</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• Inability to access some Internet Explorer specific websites, especially those containing ActiveX.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Firefox can be installed on Linux, FreeBSD or MS-Windows operating systems.</li> <li>• It also allows co-existence with Internet Explorer as well as other commercial browsers when it is being installed on MS-Windows.</li> <li>• In an office environment, it can be used for all desktop computers.</li> </ul>

<b>Konqueror</b>	
Description	<ul style="list-style-type: none"> <li>• Konqueror was developed by the KDE group to be their default file and web browser.</li> <li>• It uses its own rendering engine, KHTML, but can also use Mozilla's Gecko to render web pages.</li> <li>• The rendering engine is constantly improved and is now used by Apple Computers Inc. for their Safari browsers.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.kde.org/">http://www.kde.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• Konqueror integrates local and external browsing.</li> <li>• Its rendering engine is under constant enhancements.</li> <li>• It has the ability to change browser identification, depending on website visited. Therefore, Konqueror has the ability to present itself as Internet Explorer, Mozilla or any other browser.</li> <li>• It has several other innovations, such as integrated translation tools, tabbed browsing etc.</li> </ul>

<b>Konqueror</b>	
Limitations	<ul style="list-style-type: none"> <li>• Konqueror may not correctly render Internet Explorer specific pages.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Konqueror can be installed on Linux or FreeBSD.</li> <li>• In an office environment, it can be used on desktop computers that uses a UNIX-like operating system.</li> </ul>

### 3.4.6 Multimedia Player

#### Background description:

A media player for video and/or audio.

<b>MPlayer</b>	
Description	<ul style="list-style-type: none"> <li>• MPlayer is developed to be a player that can play any type of known audio and video formats using pre-existing codecs.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.mplayerhq.hu/">http://www.mplayerhq.hu/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• For i386 architecture-based machines, MPlayer can utilise codecs used by MS-Windows-based media players.</li> <li>• MPlayer's default supported formats are MPEG, AVI, VCD and DVD.</li> <li>• It has extra supported formats (codecs required) for Apple Quicktime Movie (MOV), RealPlayer (RM), Microsoft Windows Media (WMV), Adobe Flash Video (FLV) and others.</li> <li>• The companion program, MEncoder, enables the encoding of an input audio/video stream or file and its transformation into several different output formats.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• Many of the video and audio file specifications in popular use and supported by MPlayer are either proprietary ones or international standards (e.g. ISO standards) encumbered by patents requiring royalty payments.</li> <li>• Mplayer also supports the patent-free Ogg-Vorbis audio and Ogg-Theora video specifications.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• MPlayer can be installed on major operating systems, including Linux and other UNIX-like systems, MS-Windows and Mac OS X.</li> <li>• With the right decoder files installed, it can view almost any file formats including MOV, RM and WMV.</li> </ul>

<b>xine</b>	
Description	<ul style="list-style-type: none"> <li>• xine is a multimedia player.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://xinehq.de/">http://xinehq.de/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It has a user-friendly interface.</li> <li>• It supports a wide range of audio and video formats.</li> </ul>
Open	<ul style="list-style-type: none"> <li>• Many of the audio and video formats supported by xine are either</li> </ul>

<b>xine</b>	
standards/specific ations supported	proprietary ones or international standards (e.g. ISO standards) encumbered by patents requiring royalty payments. <ul style="list-style-type: none"> <li>• xine also supports the patent-free Ogg-Vorbis audio and Ogg-Theora video specifications.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• It cannot play certain video formats, which do not have Linux or FreeBSD codecs.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• xine can be installed on any OSS UNIX-like operating system.</li> </ul>

<b>xmms</b>	
Description	<ul style="list-style-type: none"> <li>• xmms is an audio player, that has a similar interface to WinAmp.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.xmms.org/">http://www.xmms.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It supports MP3, Ogg Vorbis, WAV and audio CD formats.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• To support MP3, xmms requires an MP3-plugin. Since the MP3 standard is encumbered by patents that are not royalty-free, some Linux distributions do not include it.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• xmms can be installed on any OSS UNIX-like operating system.</li> <li>• It can play many different audio file formats including WAV, MP3 and Ogg Vorbis.</li> </ul>

### 3.4.7 Desktop Environment

#### Background description:

A desktop environment is a graphical user interface (GUI) system which sits on top of Linux, \*BSD or other UNIX-like operating systems. For these operating systems, the GUI is not tightly coupled with the kernel, as in the MS-Windows environment. As such, there are several desktop environments that can be used.

<b>KDE</b>	
Description	<ul style="list-style-type: none"> <li>• KDE or K Desktop Environment is an open source project initiated by Matthias Ettrich in 1996.</li> <li>• It was created to provide a uniform, consistent and user-friendly desktop environment for UNIX and UNIX-like operating systems.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.kde.org/">http://www.kde.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• KDE has a “click, drag and drop” capability.</li> <li>• The KDE desktop includes applications for personal and office productivity e.g. media player, personal information manager, instant messenger, file manager, image viewer, text editor, office suite, web browser.</li> <li>• Its administration is easy with its bundled programs.</li> </ul>

<b>KDE</b>	
	<ul style="list-style-type: none"> <li>• It supports other OSS environment software.</li> </ul>
Open standards/specifications supported	<p>The KDE project works closely with the freedesktop.org project to bring about interoperability for free/open source software desktop environments for the X Window System. These specifications include:</p> <ul style="list-style-type: none"> <li>• Window manager</li> <li>• Drag and drop</li> <li>• Menu</li> <li>• Clipboard</li> <li>• Desktop entry</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• KDE can be installed as the desktop environment of choice for OSS UNIX-like operating systems.</li> </ul>

<b>GNOME</b>	
Description	<ul style="list-style-type: none"> <li>• After the KDE project was started, some Free Software advocates raised the issue of licensing. Even though KDE was licensed under the GPL, its core library, QT (<a href="http://www.trolltech.com/">http://www.trolltech.com/</a>) was not. Furthermore, the OSS license for QT at that time was considered incompatible with the GPL.</li> <li>• A parallel desktop environment, developed with GTK+, a GPLed library, was initiated.</li> <li>• The project is called GNOME, short for the GNU Network Object Model Environment.</li> <li>• It was also created to provide a uniform, consistent and user-friendly desktop environment for UNIX and UNIX-like operating systems.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.gnome.org/">http://www.gnome.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It has a “Click, drag and drop” capability.</li> <li>• The GNOME desktop includes applications for personal and office productivity e.g. media player, personal information manager, instant messaging, file manager, image viewer, text editor, office suite, web browser.</li> <li>• Its administration is easy with its bundled programs.</li> <li>• It supports other OSS environment software.</li> </ul>
Open standards/specifications supported	<p>The GNOME project works closely with the freedesktop.org project to bring about interoperability for free/open source software desktop environments for the X Window System. These specifications include:</p> <ul style="list-style-type: none"> <li>• Window manager</li> <li>• Drag and drop</li> <li>• Menu</li> <li>• Clipboard</li> <li>• Desktop entry</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>• GNOME can be installed as the desktop environment of choice for</li> </ul>

<b>GNOME</b>	
scenario example	OSS UNIX-like operating systems.

### 3.4.8 Graphic Manipulation

#### Background description:

Software that can be used to perform various types of graphical manipulation.

<b>GIMP</b>	
Description	<ul style="list-style-type: none"> <li>• GIMP is a very mature OSS bitmap graphic manipulation tool</li> <li>• Works on many operating systems, including Linux, *BSD, MS-Windows and Mac OS X.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.gimp.org">http://www.gimp.org</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It supports most of the graphic files format in use, both open as well as proprietary ones.</li> </ul>
Open standards/specifications supported	Graphics format that are supported by GIMP include: <ul style="list-style-type: none"> <li>• GIF, JPG, PNG, TIFF, bitmap</li> <li>• Postscript, PDF</li> <li>• Proprietary applications like Autodesk flic animations, Paintshop Pro images</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• It is used for creating graphical images and editing graphics.</li> <li>• It can be used as a replacement for proprietary image manipulation software.</li> </ul>

<b>Inkscape</b>	
Description	<ul style="list-style-type: none"> <li>• Inkscape is a vector graphics editor, similar to Adobe Illustrator, that makes use of Scalable Vector Graphics (SVG), an open XML-based W3C standard, as its native format.</li> <li>• Works on many operating systems, including Linux, *BSD, MS-Windows and Mac OS X.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.inkscape.org/">http://www.inkscape.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It supports a large portion of the basic vector graphics editing capabilities.</li> <li>• It makes use of SVG, an open XML-based W3C standard.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• It natively supports opening or importing SVG, SVGZ (gzipped SVG), PDF, and AI (Adobe Illustrator) formats as well as most raster formats (JPG, PNG, GIF, etc.).</li> <li>• It can save as SVG, SVGZ, PDF, Postscript/EPS/EPsi, Adobe Illustrator (*.ai), LaTeX (*.tex), POVray (*.pov), HPGL, and other formats.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• Inkscape does not have all the features of the leading vector graphics editors.</li> <li>• It currently does not support SVG animation.</li> </ul>

<b>Inkscape</b>	
Implementation scenario example	<ul style="list-style-type: none"> <li>• It is used for creating and editing vector graphics images.</li> </ul>

## 3.5 Server Applications

### 3.5.1 Mail Transfer Agent (MTA)

#### Background description:

Email servers are formally referred to as Mail Transfer Agents (MTA). Their purpose is to receive and distribute email to the correct destination. An email server can also serve as a relay, i.e. it forwards email between locations when direct routing is not possible.

<b>Sendmail</b>	
Description	<ul style="list-style-type: none"> <li>• Sendmail is written by Eric Allman while a researcher at the University of California at Berkeley.</li> <li>• It is the most popular UNIX-based MTA.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.sendmail.org">http://www.sendmail.org</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is included in most OSS operating systems.</li> <li>• It has the ability to disable open relaying.</li> <li>• It has spam filtering capabilities.</li> </ul>
Open standards/specifications supported	IETF RFCs pertaining to email and SMTP including: <ul style="list-style-type: none"> <li>• RFCs 2821, 2822, 2554, 2045, 1869, 1891-4, 1985, 2034, 2476</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Sendmail can be used to replace Microsoft Exchange server for mail transport.</li> <li>• However, there are some migration issues that might effect Microsoft Exchange groupware functionality.</li> </ul>

<b>qmail</b>	
Description	<ul style="list-style-type: none"> <li>• qmail is written by Dan Bernstein while a researcher at the University of Illinois, Chicago.</li> <li>• It is a popular MTA.</li> <li>• The source code to qmail has been released to the public domain by its author, making it Free Software but modifications are not encouraged.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.qmail.org">http://www.qmail.org</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is included in most OSS operating systems.</li> <li>• It has good mailing list management capabilities.</li> </ul>

<b>qmail</b>	
	<ul style="list-style-type: none"> <li>• It claims to be more secure than Sendmail.</li> <li>• It is very efficient and fast.</li> </ul>
Open standards/specifications supported	IETF RFCs pertaining to email and SMTP.
Implementation scenario example	<ul style="list-style-type: none"> <li>• qmail can be used as an alternative to Sendmail.</li> </ul>

<b>Postfix</b>	
Description	<ul style="list-style-type: none"> <li>• Postfix is written by Wietse Zwietsje Venema while working at IBM's Thomas J. Watson Research Center, USA.</li> <li>• It is another alternative UNIX-based MTA</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.postfix.org">http://www.postfix.org</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is included in most OSS operating systems.</li> <li>• It has the ability to disable open relaying.</li> <li>• It has spam filtering capabilities.</li> <li>• It has a similar configuration scheme to the Apache web server.</li> </ul>
Open standards/specifications supported	IETF RFCs pertaining to email and SMTP.
Implementation scenario example	<ul style="list-style-type: none"> <li>• Postfix can also replace Microsoft Exchange server for mail transport.</li> <li>• However, there are some migration issues that might affect Microsoft Exchange groupware functionality.</li> </ul>

### 3.5.2 Mail Access Agent

#### Background description:

Mail Access Servers are software that implement protocols that allow mail clients to retrieve email from a mail server. The most used protocols are Post Office Protocol version 3 (POP3) and Internet Message Access Protocol (IMAP). IMAP is the more advanced protocol. It supports online and disconnected/offline access. POP3 only supports offline access.

<b>UW IMAP</b>	
Description	<ul style="list-style-type: none"> <li>• UW IMAP is developed by University of Washington to implement the IMAP protocol.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.washington.edu/imap/">http://www.washington.edu/imap/</a></li> </ul>
Rationale for	<ul style="list-style-type: none"> <li>• UW IMAP has a full featured IMAP server.</li> </ul>

<b>UW IMAP</b>	
selection	<ul style="list-style-type: none"> <li>• It also supports POP3.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF RFC 1939 (POP3), RFC 3501 (IMAP)</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• IMAP is mainly used as a mechanism for retrieving electronic mail from the servers.</li> <li>• It is most suitable for use by users accessing emails from multiple clients and machines.</li> </ul>

<b>Dovecot</b>	
Description	<ul style="list-style-type: none"> <li>• Dovecot is an OSS IMAP and POP3 server for Linux and UNIX-like systems, written with security primarily in mind.</li> <li>• It is suitable for both small and large installations.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.dovecot.org/">http://www.dovecot.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• Dovecot has a full featured IMAP server and it also supports POP3.</li> <li>• It is the default IMAP and/or POP3 server for many Linux distributions.</li> <li>• It is fast, simple to set up and uses very little memory.</li> <li>• It is secure.</li> <li>• It is easily extensible via plug-ins.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF RFC 1939 (POP3), RFC 3501 (IMAP)</li> <li>• IETF RFC 4346 (SSL/TLS)</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Dovecot is mainly used as a mechanism for retrieving electronic mail from the servers.</li> <li>• It is most suitable for use by users accessing emails from multiple clients and machines.</li> </ul>

### 3.5.3 Groupware

#### Background description:

Software that enables a group of users to collaborate on a project by means of sharing resources.

<b>Horde Groupware</b>	
Description	<ul style="list-style-type: none"> <li>• This is a browser based collaboration suite developed under the Horde Project Framework.</li> <li>• Users can manage and share calendars, contacts, tasks and notes with the standards compliant components from the Horde Project.</li> </ul>

<b>Horde Groupware</b>	
	<ul style="list-style-type: none"> <li>Horde Groupware consists of the separately available applications Kronolith, Turba, Nag and Mnemo under the Horde Project.</li> </ul>
Reference	<ul style="list-style-type: none"> <li><a href="http://www.horde.org/groupware">http://www.horde.org/groupware</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>It is written in PHP under the Horde Project Framework.</li> <li>It supports the import and export of groupware data from other applications as well as the synchronisation of data with PDAs, mobile phones and groupware clients.</li> <li>It has an integrated user management, group support and permissions system.</li> <li>It can be extended with any of the Horde applications or modules.</li> <li>It is platform independent, works on any web server with PHP support, including Linux, *BSD, MS-Windows, Solaris, Mac OS X.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>Horde Groupware can be deployed in an organisation or enterprise for the users to share resources such as calendars, tasks, notes, contacts., etc.</li> </ul>

<b>phpGroupWare</b>	
Description	<ul style="list-style-type: none"> <li>phpGroupWare is a web based messaging, collaboration and enterprise management suite. written in PHP.</li> </ul>
Reference	<ul style="list-style-type: none"> <li><a href="http://www.phpgroupware.org">http://www.phpgroupware.org</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>phpGroupWare provides an API for developing additional applications.</li> <li>It has tight security controls via Access Control List (ACL).</li> <li>It has multi-language support.</li> <li>It has over 50 web-based applications including a Calendar, Addressbook, an advanced Projects manager, Todo List, Email, and File manager.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>phpGroupWare is not designed to handle groups for electronic commerce transactions.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>phpGroupWare requires a database server to manage its data.</li> <li>It also requires a web server to be installed with PHP support in it.</li> <li>In most cases, phpGroupWare can be implemented to handle community, office or departmental groups.</li> </ul>

### 3.5.4 Calendar Server

#### Background description:

Server software that enables multiple users to collaboratively share calendaring information such as schedules, shared resources, events or appointments and the management of invitations using appropriate calendar clients.

<b>Zimbra</b>	
Description	<ul style="list-style-type: none"> <li>• The Zimbra calendar server is part of the Zimbra Collaboration Suite (ZCS) groupware product.</li> <li>• It provides services that allow multiple users to collaboratively share calendaring information.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.zimbra.com/products/zimbra_calendar.html">http://www.zimbra.com/products/zimbra_calendar.html</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It supports the calendaring open standards iCalendar and CalDAV.</li> <li>• Apart from its own client, it can be used with other clients like the proprietary Microsoft Outlook and Apple iCal as well as open source ones such as Novell Evolution, Mozilla Thunderbird (with Lightning) and Mozilla Sunbird.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF RFC 1939 (POP3), RFC 3501 (IMAP)</li> <li>• IETF RFC 2445 (iCalendar)</li> <li>• IETF RFC 4791 (CalDAV)</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Users in an organisation can share calendar information by connecting to the server using either the Zimbra web client or other third party clients such as Evolution, Sunbird, Thunderbird (with Lightning), MS-Outlook or Apple iCal.</li> </ul>

### 3.5.5 Web Server

#### Background description:

An application to host website content. Some web servers can be integrated with other middle-tier applications or tools to provide web-based applications.

<b>Apache</b>	
Description	<ul style="list-style-type: none"> <li>• Apache is a robust, commercial-grade, featureful web server.</li> <li>• Apache started when Brian Behlendorf started collecting patches to be applied to the last version of NCSA in 1995. Hence the name Apache came from "A patchy server" (this is an apocryphal anecdote).</li> <li>• The Apache Software Foundation was formed in June of 1999 to maintain the Apache project.</li> <li>• It runs on a variety of platforms including Linux, *BSD, Mac OS X, Solaris, Novell Netware and MS-Windows.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://httpd.apache.org/">http://httpd.apache.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is the most widely used web server on the Internet.</li> <li>• It supports development tools such as PHP, CGI (Perl, C++), etc.</li> <li>• It is modularly designed, modules can be added to have extra functionality.</li> </ul>
Open standards/specifications supported	IETF HTTP specifications including: <ul style="list-style-type: none"> <li>• RFC 1945 (HTTP/1.0), RFC 2616 (HTTP/1.1)</li> <li>• RFC 4346 (SSL/TLS)</li> </ul>

<b>Apache</b>	
	<ul style="list-style-type: none"> <li>• RFC 2396 (URI)</li> <li>• RFC 2617 (Basic access authentication)</li> </ul> W3C HTML specifications including: <ul style="list-style-type: none"> <li>• HTML 3.2, 4.01</li> <li>• XHTML 1.0, 1.1</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Apache is a very robust web server.</li> <li>• It has various extensions that can support many different languages.</li> <li>• To support web applications developed using Microsoft ASP or .NET technologies, Mono is needed.</li> </ul>

<b>Lighttpd</b>	
Description	<ul style="list-style-type: none"> <li>• Lighttpd has a very low memory footprint compared to other web servers and it is fast, standards-compliant and very flexible.</li> <li>• It runs on Linux, Mac OS X and other Unix-like operating systems as well as MS-Windows (under Cygwin).</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.lighttpd.net/">http://www.lighttpd.net/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is designed and optimised for high performance environments.</li> <li>• It has a small memory footprint and it can manage the cpu-load effectively.</li> <li>• It supports development tools such as PHP, perl, python. Ruby etc.</li> <li>• It is modularly designed, modules can be written and added to complement the basic functionalities.</li> </ul>
Open standards/specifications supported	IETF HTTP specifications including: <ul style="list-style-type: none"> <li>• RFC 1945 (HTTP/1.0), RFC 2616 (HTTP/1.1)</li> <li>• RFC 4346 (SSL/TLS)</li> <li>• RFC 2396 (URI)</li> <li>• RFC 2617 (Basic access authentication)</li> </ul> W3C HTML specifications including: <ul style="list-style-type: none"> <li>• HTML 3.2, 4.01</li> <li>• XHTML 1.0, 1.1</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• WebDAV support is limited.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• A typical scenario is to use lighttpd as an off-load server to push out static content and leave another server to handle the complex work.</li> </ul>

### 3.5.6 Wikis

#### Background description:

Wikis are web pages that enable their users to contribute or modify content, using a simplified markup language. It can be a useful collaborative and authoring tool for content creation and maintenance.

<b>MediaWiki</b>	
Description	<ul style="list-style-type: none"> <li>• Originally written for the use of Wikipedia, it is also now used by several other projects of the non-profit Wikimedia Foundation.</li> <li>• It is written in the PHP scripting language, and can be used with either MySQL or PostgreSQL database.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.mediawiki.org/">http://www.mediawiki.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is powerful and scalable being able to run on a large server farm.</li> <li>• It has a feature-rich wiki implementation.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Mediawiki can be used as a tool for content creation, collaboration and sharing in a large organisation.</li> </ul>

### 3.5.7 Remote Login Server

#### Background description:

Remote login is a method to access other computers. This is usually done for convenience of administration and maintenance. An unencrypted login can compromise the security of the remote computer. Therefore, use of secure methods are recommended.

<b>OpenSSH</b>	
Description	<ul style="list-style-type: none"> <li>• OpenSSH is an OSS implementation of the the ssh protocol. The ssh protocol is a secure alternative to telnet, rlogin and ftp. OpenSSH was originally written for OpenBSD.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.openssh.org/">http://www.openssh.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• OpenSSH's transactions are encrypted.</li> <li>• It is the default remote login used by all Linux distributions and BSD flavours.</li> <li>• It comes with extra tools such as scp for remote copy and sftp for implementing file transfer protocol (ftp) securely.</li> <li>• It supports other open source environment software.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF RFC 4250-4 (SSH)</li> <li>• Supports 3DES, Blowfish, AES and arcfour encryption algorithms.</li> <li>• Kerberos and AFS Ticket Passing</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• OpenSSH is arguably the most secure way to access a remote machine.</li> <li>• It supports most operating systems, and has a variety of clients for different kinds of operating systems.</li> <li>• It allows secure login and file transfer from one host to another.</li> </ul>

### 3.5.8 Database Server

#### Background description:

A database is an organised collection of data, and a database engine as applied to software is a system for the organisation and collection of data. Databases form an important component within an organisation, ranging from ERP, CRM, to web-based applications and portals.

<b>MySQL</b>	
Description	<ul style="list-style-type: none"> <li>MySQL is an open source relational database. It is developed by MySQL AB, a company from Finland which has been acquired by Sun Microsystems Inc.</li> <li>MySQL comes with two licenses, a GPL version and a commercial one.</li> <li>For applications that require support and the ability to make modifications to the source code without releasing the changes, the commercial license can be used.</li> </ul>
Reference	<ul style="list-style-type: none"> <li><a href="http://www.mysql.org/">http://www.mysql.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>MySQL is lightweight and less resource hungry.</li> <li>It is the most popular database for PHP-based applications.</li> <li>It works with many other development tools.</li> <li>Third-party tools are available to provide a graphical user interface for administration.</li> <li>It can be installed on MS-Windows as well as Linux/*BSD operating systems.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>ISO/IEC 9075 (ANSI/ISO SQL)</li> <li>ODBC levels 0-3.51.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>MySQL can be used as a replacement for proprietary databases in just about any scenario.</li> <li>In large-scale implementations, hardware requirements should be given due consideration.</li> <li>In the case of migrating from other databases to MySQL, a few migration issues might cause some problems, especially where non-ANSI SQL calls are frequently used.</li> </ul>

<b>PostgreSQL</b>	
Description	<ul style="list-style-type: none"> <li>PostgreSQL is a free RDBMS, originally started in 1985 by Micheal Stonebreaker at University of California, Berkeley.</li> <li>It was originally initiated as a more modern and contemporary version of another database called Ingres.</li> <li>It is released under a flexible BSD-style license.</li> </ul>
Reference	<ul style="list-style-type: none"> <li><a href="http://www.postgresql.org/">http://www.postgresql.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>PostgreSQL is a full featured DBMS database.</li> <li>It is able to handle large volumes of data.</li> </ul>

<b>PostgreSQL</b>	
	<ul style="list-style-type: none"> <li>• It works with many development tools.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• ISO/IEC 9075 (ANSI/ISO SQL)</li> <li>• ODBC</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• PostgreSQL can be used as a replacement for proprietary databases in just about any scenario.</li> <li>• In large-scale implementations, hardware requirements should be given due consideration.</li> <li>• In the case of migrating from other databases to PostgreSQL, a few migration issues might cause some problems, especially where non-ANSI SQL calls are frequently used.</li> </ul>

### 3.5.9 Proxy Server

#### Background description:

Proxy servers act as a form of protection for client machines accessing untrusted web and ftp servers. It achieves this by acting as the intermediary between a client requesting information and the server providing the information, in the process masking the client's identity.

As an added benefit, a proxy server can also act as a cache server, storing the information requested by a client, such that when it, or other clients, request the same information, the proxy then serves the information from its own cache without having to access the remote server. This saves on bandwidth.

<b>Squid</b>	
Description	<ul style="list-style-type: none"> <li>• Squid is a full-featured open source proxy and cache server designed to run on UNIX-like systems .</li> <li>• It can also be installed on MS-Windows.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.squid-cache.org/">http://www.squid-cache.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It supports proxying and caching of URIs (e.g. HTTP, FTP)</li> <li>• It supports proxying for SSL cache hierarchies ICP, HTCP, CARP, Cache Digests.</li> <li>• It supports transparent caching and HTTP server acceleration.</li> <li>• It supports extensive access controls.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Squid is a proxy server to cache heavily accessed files on the network.</li> <li>• Its works well with other applications like the Apache web server to cache web pages.</li> <li>• A web server runs together with a Squid server to minimize the load on the web server while data is being accessed from the hard disk. This will provide better performance on the hosted web pages and</li> </ul>

<b>Squid</b>	
	also lengthen the life of the hard disk.

### 3.5.10 Files and Print Server

#### Background description:

File and print servers allow the sharing of resources within a networked environment. A file server consolidates data storage into a centrally managed storage system, allowing easier maintenance, backup and upgrading. A print server allows multiple clients to share printers. Further, print servers can additionally have the capability to allow and restrict access to printers, and keep an audit of printer usage.

<b>SAMBA</b>	
Description	<ul style="list-style-type: none"> <li>• SAMBA is a file and print server for MS-Windows clients using Microsoft's Server Message Block (SMB) or Common Internet File system (CIFS) protocols.</li> <li>• It provides a link at the filesystem level between MS-Windows and UNIX-like machines. With SAMBA, files and printers can be shared on these two different operating systems.</li> <li>• It is being actively developed by a global team.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.samba.org/">http://www.samba.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• SAMBA is the most widely used software to enable printer and file sharing between UNIX and MS-Windows environments.</li> <li>• It can act as a PDC (Primary Domain Controller) for MS-Windows machines.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• It supports the Microsoft proprietary SMB and CIFS protocols.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• SAMBA allows MS-Windows and UNIX-like machines to coexist and share files.</li> <li>• It can be implemented to replace MS-Windows Domain Controllers for file and printer sharing, and authentication.</li> </ul>

<b>NFS</b>	
Description	<ul style="list-style-type: none"> <li>• NFS is a networked file system making the filesystem on a remote system accessible on the local system. From a user's perspective, an NFS-mounted filesystem is indistinguishable from a filesystem on a directly-attached disk drive.</li> <li>• It is also considered to be the UNIX equivalent of the Server Message Block (SMB) protocol.</li> <li>• The original version was developed by Olaf Kirch and Alan Cox.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://nfs.sourceforge.net/nfs-howto/">http://nfs.sourceforge.net/nfs-howto/</a></li> </ul>

<b>NFS</b>	
Rationale for selection	<ul style="list-style-type: none"> <li>• Fast, seamless sharing of files over the network. Similar in features to SAMBA.</li> <li>• The advantage of NFS today is that it is mature, standard, well understood, and supported robustly across a variety of platforms.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF RFC 1094, RFC 1813 and RFC 3530</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• NFS allows different operating systems to share files.</li> <li>• It can be implemented together with SAMBA to provide filesystem access to users of the network.</li> </ul>

<b>CUPS</b>	
Description	<ul style="list-style-type: none"> <li>• The Common Unix Printing System (CUPS) is a modularised computer printing system for UNIX-like operating systems that allows a computer to act as a powerful print server.</li> <li>• A computer running CUPS is a host that can accept print jobs from client computers, process them, and send them to the appropriate printer.</li> <li>• Originally created by Easy Software Products , it is available on all Linux and BSD type operating systems</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.cups.org/articles.php">http://www.cups.org/articles.php</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• CUPS is a widely used printing system</li> <li>• CUPS provides both the System V and Berkeley printing commands so the traditional methods of printing files can be used for CUPS.</li> <li>• The CUPS server itself runs a web server administration interface, so configuration is a relatively simple task.</li> <li>• The primary advantage of CUPS is that it is a standard and modularised printing system that can process numerous data formats on the print server.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF RFC 2910-1, RFC 2567-9 (Internet Printing Protocol)</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• CUPS can be used in a heterogeneous computing environment.</li> </ul>

### 3.5.11 Backup Server/Tool

#### Background description:

Any organisation requires a backup policy to ensure that critical data and applications are protected from system and infrastructure failure. The use of a backup server allows automated execution of this backup policy.

It is recommended that the backup software has a native client or agent for the operating system of the host where the data files to be backed up are located.

<b>Amanda</b>	
Description	<ul style="list-style-type: none"> <li>• Amanda, the Advanced Maryland Automatic Network Disk Archiver, is a backup system that allows the system administrator to set up a single master backup server to back up multiple hosts to a single large capacity tape drive.</li> <li>• It was originally written by James da Silva while at the University of Maryland's Computer Science Department.</li> <li>• Today, Amanda is completely maintained by a volunteer group, including a user community that provides most of the support.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.amanda.org/">http://www.amanda.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is able to backup multiple servers on a network.</li> <li>• It can use SAMBA to backup MS-Windows servers.</li> <li>• It supports various backup devices, from hard disks to multi-tape libraries.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• It does not have a native MS-Windows agent to facilitate backup from MS-Windows machines.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Amanda backup server can be used to backup files of data centers.</li> <li>• It was initially designed for UNIX and UNIX-like systems; the ability to backup MS-Windows machines is reliant on the use of SAMBA.</li> </ul>

<b>Bacula</b>	
Description	<ul style="list-style-type: none"> <li>• Bacula is a set of computer programs that permits the management of backups, recovery, and verification of computer data across a network of computers of different kinds.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.bacula.org/">http://www.bacula.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It is able to backup multiple servers on a network.</li> <li>• It has an agent (client) for MS-Windows and so can backup MS-Windows servers.</li> <li>• It handles multi-volume backups.</li> <li>• There is a full comprehensive SQL standard database of all files backed up. This permits on-line viewing of files saved on any particular volume.</li> <li>• It supports various backup devices, from hard disks to multi-tape libraries.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• While Bacula can generally restore any backup made from a client to any other client, if the architecture is significantly different (i.e. 32 bit architecture to 64 bit or Win32 to Unix), some restrictions may apply.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Bacula backup server can be used to backup files of data centers.</li> </ul>

### 3.5.12 Domain Name System (DNS) Server

#### Background description:

A DNS server is used to look up and translate domain names to IP addresses. This infrastructural service is crucial for the operation of large IP-based networks and services like the Internet.

<b>BIND</b>	
Description	<ul style="list-style-type: none"> <li>• BIND (Berkeley Internet Name Domain) provides an openly redistributable reference implementation of the major components of the Domain Name System. This includes a DNS server (named), a DNS resolver library and tools for verifying the proper operation of the DNS server.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.isc.org/sw/bind/">http://www.isc.org/sw/bind/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• BIND provides a robust and highly configurable DNS server (named).</li> <li>• It can scale very well, being able to handle DNS queries for small networks as well as serving as a root DNS server for the Internet.</li> <li>• It is included in all UNIX-like OSS operating systems.</li> </ul>
Open standards/specifications supported	IETF RFCs pertaining to DNS including: <ul style="list-style-type: none"> <li>• RFC 1032-5</li> <li>• RFC 4033-5 (DNSSEC)</li> <li>• RFC 2845 (TSIG)</li> <li>• RFC 3596 (DNS extensions for IPv6)</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• As distributed, BIND can only store and retrieve zone data in text files. Patches must be applied if the use of database or other forms of storage and retrieval are required for large networks.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• BIND (named) can be deployed as a DNS server for an organisation on the Internet.</li> </ul>

### 3.5.13 Network Management

#### Background description:

Network management and monitoring software enables the monitoring of network devices so that alerts can be sent when a specified event occurs e.g. a device going offline. Besides monitoring the status of network devices, host and service monitoring software is also available to monitor the inventory, configuration, performance and services running on host systems.

<b>Nagios</b>	
Description	<ul style="list-style-type: none"> <li>• It is a host and service monitor designed to run on Linux and other UNIX-like systems.</li> <li>• It can monitor SNMP-enabled devices as well as services and resources on host computers.</li> </ul>

<b>Nagios</b>	
	<ul style="list-style-type: none"> <li>The monitoring daemon runs intermittent checks on the specified hosts and services using external plugins which return status information to Nagios.</li> </ul>
Reference	<ul style="list-style-type: none"> <li><a href="http://www.nagios.org/">http://www.nagios.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>It can monitor network services (SMTP, POP3, HTTP, NNTP, PING, etc.) and host resources (processor load, disk and memory usage, running processes, log files, etc.) as well as environmental factors such as temperature.</li> <li>It has a simple plugin design to enable users to easily develop their own host and service checks.</li> <li>It has a web interface for viewing current network status, notification and problem history, log files, etc.</li> <li>It can monitor non-UNIX hosts like MS-Windows and Novell Netware systems.</li> <li>It has plugins that enable it to support SNMP and monitor SNMP-enabled devices like switches, routers and hosts.</li> </ul>
Open standards/specifications supported	IETF RFCs for network services including SMTP, POP3, HTTP, NNTP, PING. IETF RFCs for SNMP including: <ul style="list-style-type: none"> <li>SNMPv2 - RFCs 1902-8</li> <li>SNMPv3 - RFCs 2271-5</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>Nagios is not meant to be a full-blown SNMP management application.</li> <li>The monitor daemon runs only on Linux and UNIX-like platforms.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>Nagios can be utilised to monitor the hosts and network devices running in a departmental or enterprise network.</li> </ul>

## 3.6 Network Security

### 3.6.1 Firewall

#### Background description:

A firewall is a program or collection of programs that resides at a network gateway server or external access point that protects the resources of an internal private network from other networks.

<b>iptables</b>	
Description	<ul style="list-style-type: none"> <li>iptables is a firewall included in the Linux kernel version 2.4. and above.</li> <li>iptables is maintained by netfilter.org.</li> </ul>
Reference	<ul style="list-style-type: none"> <li><a href="http://www.netfilter.org/">http://www.netfilter.org/</a></li> </ul>

<b>iptables</b>	
Rationale for selection	<ul style="list-style-type: none"> <li>• iptables is able to perform stateful packet filtering, network address translation, packet mangling and port forwarding.</li> <li>• It is able to add functionality by adding extensions.</li> <li>• It allows the creation of meta-rules to reduce the complexity of configuration.</li> <li>• It also has the ability to act as a bandwidth manager.</li> <li>• iptables is one of the most robust, and modern firewalls available today.</li> <li>• GUI frontends to manage iptables are available.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF RFCs related to IPv4</li> <li>• IETF RFCs related to IPv6</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• In most cases it is implemented on network gateways.</li> <li>• It can also be implemented at various nodes in a network infrastructure to control flow of data across the network.</li> </ul>

<b>IPFilter</b>	
Description	<ul style="list-style-type: none"> <li>• IPFilter (commonly referred to as ipf) is a software package that can be used to provide stateful packet filtering and network address translation services.</li> <li>• IPFilter comes as a part of FreeBSD, NetBSD, Solaris 10 and OpenSolaris. It can also run on Linux with kernels 2.4 and above.</li> <li>• Author and maintainer is Darren Reed.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://coombs.anu.edu.au/~avalon/">http://coombs.anu.edu.au/~avalon/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• Ability to distinguish between various interfaces.</li> <li>• Ability to provide packet header details to a user program for authentication</li> <li>• It supports temporary storage of pre-authenticated rules for passing packets through</li> <li>• IPFilter is one of the most robust, and modern firewalls available today.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF RFCs related to IPv4</li> <li>• IETF RFCs related to IPv6</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• In most cases it is implemented on the network perimeter.</li> <li>• It can also be implemented at various nodes in a network infrastructure to control flow of data across the network.</li> </ul>

<b>IPFW (IPFIREWALL)</b>	
Description	<ul style="list-style-type: none"> <li>• IPFW is a FreeBSD packet filter and traffic accounting facility.</li> <li>• IPFW is included in the basic FreeBSD install as a separate run time loadable module.</li> </ul>

<b>IPFW (IPFIREWALL)</b>	
	<ul style="list-style-type: none"> <li>• IPFW is authored and maintained by FreeBSD volunteer staff members.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.freebsd-howto.com/HOWTO/lpfw-HOWTO">http://www.freebsd-howto.com/HOWTO/lpfw-HOWTO</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• IPFW is targeted at the professional user or the advanced technical computer hobbyist who has advanced packet selection requirements</li> <li>• It can also be used as a tunnel shaper.</li> <li>• IPFW is similar to IPFilter but has advanced capabilities.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF RFCs related to IPv4</li> <li>• IETF RFCs related to IPv6</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• It can be implemented at various nodes in a network infrastructure to control flow of data across the network.</li> </ul>

### 3.6.2 Network Intrusion Detection System (NIDS)

#### Background description:

Network IDSes often act as a forensic tool for analysing network breaches. This is achieved by intercepting traffic entering and leaving the network, and analysing the packet headers and payloads. It requires active monitoring as well as constant updating of signatures to be effective.

<b>Snort</b>	
Description	<ul style="list-style-type: none"> <li>• Snort is a open source network intrusion detection system, capable of performing real-time traffic analysis and packet logging on IP networks.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.snort.org/">http://www.snort.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• Snort has 3 distinct modes; sniffer, packet logger and intrusion detection.</li> <li>• It uses ACID ( Analysis Console for Intrusion Databases) as a GUI reporting tool.</li> <li>• It has third-party GUI interfaces as well.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• IETF RFCs related to IPv4</li> <li>• IETF RFCs related to IPv6</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• The easiest way to implement Snort is by installing it at the gateways within a network.</li> <li>• It can also be installed behind the firewall as a second-level detector of network breaches.</li> </ul>

### 3.6.3 Virtual Private Network (VPN)

#### Background description:

VPNs serve to reduce the cost of having secure internal network communications across geographically dispersed locations. Instead of having expensive dedicated leased-lines, an organisation can construct secure “tunnels” across the Internet, using strong encryption.

OpenVPN	
Description	<ul style="list-style-type: none"> <li>• OpenVPN is a newer generation VPN in that it is based on SSL as the underlying security mechanism.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://openvpn.net/">http://openvpn.net/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• OpenVPN works on many different operating systems, including Linux, *BSD, Mac OS X and MS-Windows.</li> <li>• It supports dynamic IP addresses and NAT.</li> <li>• It fully supports OpenSSL PKI.</li> <li>• It uses an industrial-strength security model designed to protect against both passive and active attacks.</li> <li>• It has been rigorously designed and tested to operate robustly on unreliable networks.</li> </ul>
Open standards/specifications supported	OpenVPN makes use of OpenSSL to provide encryption of both the data and control channel and as such supports IETF RFC 4346 (SSL/TLS).
Implementation scenario example	<ul style="list-style-type: none"> <li>• OpenVPN can be implemented in bridging or routing mode. Both modes have advantages and disadvantages.</li> <li>• A discussion on the two modes can be found at <a href="http://openvpn.net/faq.html#bridge1">http://openvpn.net/faq.html#bridge1</a></li> <li>• It is often installed between static remote machines.</li> <li>• It can also be installed to accommodate users who are often traveling, but yet need to be connected to their internal network.</li> </ul>

### 3.6.4 Anti-virus

#### Background description:

Anti-virus software is designed to protect users from malicious programs such as viruses, trojans and worms.

ClamAV	
Description	<ul style="list-style-type: none"> <li>• ClamAV is an anti-virus toolkit for UNIX-like and MS-Windows operating systems designed especially for e-mail scanning on mail gateways.</li> <li>• It provides a flexible and scalable multi-threaded daemon, a command line scanner, and an advanced tool for automatic database updating via the Internet and the virus signature database</li> </ul>

<b>ClamAV</b>	
	is kept up to date.
Reference	<ul style="list-style-type: none"> <li>• <a href="http://clamav.net/">http://clamav.net/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• ClamAV supports all popular operating systems such as Linux, *BSD, MS-Windows, AIX, Solaris &amp; Mac OS X.</li> <li>• It supports on-access scanning (Linux and FreeBSD only).</li> <li>• It detects viruses, worms, and trojans, including Microsoft Office and MacOffice macro viruses.</li> <li>• It scans within archives and compressed files.</li> <li>• It has auto update of the virus database.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• ClamAV does not disinfect infected files.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• ClamAV is mostly used together with a mail transport agent (MTA) or any mail scanner to act as a mail gateway.</li> <li>• It can also be used as an anti-virus scanner on the desktop.</li> </ul>

### 3.6.5 Anti-spam

#### Background description:

Anti-spam software is designed to detect and eliminate spam emails.

<b>SpamAssassin</b>	
Description	<ul style="list-style-type: none"> <li>• SpamAssassin is a mail filter which attempts to identify spam using a variety of mechanisms including text analysis, Bayesian filtering, DNS blocklists, and collaborative filtering databases.</li> <li>• These tests are applied to email headers and content to classify email using advanced statistical methods.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://spamassassin.apache.org/">http://spamassassin.apache.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• SpamAssassin is widely used in all aspects of email management.</li> <li>• It has a modular architecture that allows other technologies to be quickly wielded against spam and is designed for easy integration into virtually any email system.</li> <li>• Its practical multi-technique approach, modularity, and extensibility continue to give it an advantage over other anti-spam systems.</li> <li>• It is ready for use in both email clients and servers, on many different operating systems, filtering incoming as well as outgoing email.</li> <li>• It has been shown to produce around 0.9% false negatives (spam that was missed) and around 0.1% false positives (incorrectly marked as spam).</li> <li>• SpamAssassin typically differentiates successfully between spam and non-spam with an accuracy of between 95% and 100%.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• SpamAssassin is mostly used together with mail transport agents (MTA) or any mail scanner to act as a mail gateway.</li> </ul>

## 3.7 Vertical Applications

### 3.7.1 Content Management System (CMS)

**Background description:**

A content management system (CMS) for websites is a web application designed to make it easier for authorised users to publish and manage the content of a website.

<b>Drupal</b>	
Description	<ul style="list-style-type: none"> <li>• It is an open source content management system written in PHP.</li> <li>• It can run on any platform that supports either Apache or IIS web servers and PHP.</li> <li>• It requires MySQL or PostgreSQL as a backend database to store its contents and settings.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://drupal.org/">http://drupal.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• A wide variety of content on a website can be easily organised, managed and published using Drupal.</li> <li>• It runs on a wide variety of OSS platforms including Linux and FreeBSD,</li> <li>• It has very useful built-in functionalities and many other add-on modules to extend the functionalities are freely available.</li> <li>• It can be used for a small organisation as well as for large corporations.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Drupal can be used to manage the content of the website of an organisation.</li> </ul>

### 3.7.2 Learning Management System (LMS)

**Background description:**

A learning management system (LMS) enables the management and delivery of online content to learners. Many LMS are web-based thereby facilitating access to content and administration through the Internet.

<b>Moodle</b>	
Description	<ul style="list-style-type: none"> <li>• Moodle is an open source learning management system written in PHP.</li> <li>• It is used for producing Internet-based courses and web sites</li> <li>• Moodle can be installed on any computer that can run PHP, and can support a SQL-type database. Platforms that have successfully used it include Linux, FreeBSD, MS-Windows and Mac OS X.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://moodle.org/">http://moodle.org/</a></li> </ul>

<b>Moodle</b>	
Rationale for selection	<ul style="list-style-type: none"> <li>• It is a very widely used LMS.</li> <li>• It is highly extensible, being modular in design and can be readily extended by creating plug-ins for specific new functionalities.</li> <li>• It runs on a wide variety of OSS platforms including Linux and FreeBSD,</li> <li>• It can be utilised as a learning and training platform for a small organisation as well as for large corporations.</li> <li>• It supports many open standards/specifications for interoperability with other LMS.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• LDAP for authentication and enrollment.</li> <li>• SCORM / IMS Content Packaging standards.</li> <li>• IMS QTI 2 format for export of quiz questions.</li> <li>• RSS newsfeeds.</li> <li>• XML for import/export.</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• Moodle can be used to implement a system for continuous online learning, training and assessment in an organisation, big or small.</li> </ul>

### 3.7.3 Geographic Information System (GIS)

#### Background description:

A geographic information system (GIS) is a system for creating, storing, analysing and managing geospatial data and associated attributes. As a GIS may not have good or advanced features for rendering spatial data (maps, images, and vector data), a map rendering software may be required to complement it.

<b>GRASS GIS</b>	
Description	<ul style="list-style-type: none"> <li>• The Geographic Resources Analysis Support System (GRASS) is a GIS used for geospatial data management and analysis, image processing, graphics/maps production, spatial modeling, and visualisation.</li> <li>• It is an official project of the Open Source Geospatial Foundation.</li> <li>• it can be used on multiple platforms, including Linux, *BSD and other UNIX-like OS, Mac OS X and MS-Windows.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://grass.osgeo.org/">http://grass.osgeo.org/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• GRASS is very widely used around the world; it is found in academic and commercial settings as well as in many governmental agencies and environmental consulting companies.</li> <li>• It can serve as a Desktop GIS and as the backbone of a complete GIS infrastructure.</li> <li>• It possesses many interfaces to other programs in related domains like geostatistics, databases and mapserver.</li> <li>• It can import/export a wide range of 2D/3D raster and topological</li> </ul>

<b>GRASS GIS</b>	
	vector data formats and can link to many databases. <ul style="list-style-type: none"> <li>• It provides a sophisticated GIS library which can be used for the user's own development.</li> <li>• It can generate HTML image maps for area vector data.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• OGC Simple Features</li> <li>• Standard raster and vector formats</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• GRASS can be used to manage and publish geographical information as part of a broader Land Information System.</li> <li>• It can be used as the backbone of a complete GIS infrastructure.</li> </ul>

<b>MapServer</b>	
Description	<ul style="list-style-type: none"> <li>• MapServer provides a development environment for building spatially-enabled Internet applications. It excels in rendering spatial data (maps, images, and vector data) for the web.</li> <li>• It is an official project of the Open Source Geospatial Foundation.</li> <li>• it can be used on multiple platforms, including Linux, *BSD and other UNIX-like OS, Mac OS X and MS-Windows.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://mapserver.gis.umn.edu/">http://mapserver.gis.umn.edu/</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>• It allows the creation of "geographic image maps", that is, maps that can direct users to content.</li> <li>• It supports advanced cartographic output.</li> <li>• It supports popular scripting and development environments such as, PHP, Python, Perl, Ruby, Java, and C#.</li> <li>• It supports many raster and vector formats.</li> </ul>
Open standards/specifications supported	<ul style="list-style-type: none"> <li>• OGC Web Map Service (WMS) and Web Feature Service (WFS)</li> <li>• Standard raster and vector formats</li> </ul>
Implementation scenario example	<ul style="list-style-type: none"> <li>• MapServer can be used to create maps and other spatially-enabled web applications.</li> <li>• It can be used in conjunction with a GIS to browse GIS data and create "geographic image maps".</li> </ul>

## **3.8 Products from OSCC**

The Open Source Competency Centre (OSCC) of MAMPU has packaged several OSS products for use by the public sector. These products currently cover the areas of spam and malware protection, group collaboration, and network monitoring/management. Most of these products are created by putting together several popular and established OSS applications in an easy to install and use package to enable the easy deployment and maintenance of OSS applications in a practical and useful manner.

### **3.8.1 MySpamGuard**

Website: <http://myspamguard.oscc.org.my/>

As the name suggests, this is a spam and malware detection application. MySpamGuard consists of the OSS applications: SpamAssassin (for spam detection), MailScanner (for general email scanning and filtering), MailWatch (for reporting and statistics), ClamAV (for anti-virus scanning), Postfix (mail server) and Webmin (for web-based administration).

### **3.8.2 MyNetWatch**

Website: <http://mynetwatch.oscc.org.my/>

This is a suite of OSS products for monitoring services and resources running on host computers and the status of network devices. It makes use mainly of Nagios for its functionalities and RRDTool for producing graphs and charts of the data collected over time. Nmap is used for port checking and Webmin is used for web-based administration. Data is collected and stored in MySQL databases.

### **3.8.3 MyWorkSpace**

Website: <http://myworkspace.oscc.org.my/>

This group collaboration application makes use of the components from the OSS Horde Project. Using a browser, users can read, send and organise email messages and manage and share calendars, contacts, tasks and notes.

### **3.8.4 MySurfGuard**

Website: <http://mysurfguard.oscc.org.my/>

The MySurfGuard suite of software provides web content filtering and caching as well as anti-virus scanning features. It comprises the OSS applications Squid (for web caching proxy), DansGuardian (for web content filtering proxy) and Webmin (for administration and reporting).

## 4 RECOMMENDATIONS FOR INFORMATION ACCESS

### 4.1 Overview

Information Access within MyGIFOSS covers components and technical specifications that are not specified in, or have not been considered under, MyGIF v1.0. MyGIFOSS takes precedence over MyGIF for OSS implementations.

In line with the stated objective of MyGIF to utilise Extensible Markup Language (XML) to facilitate the exchange of data between applications, MyGIFOSS emphasises the adoption of XML-based formats wherever possible for data and information storage and exchange.

Information Access covers components and technical specifications required to enable users to access public sector information and services electronically via a range of delivery channels (e.g. World Wide Web) and devices (e.g. personal computers, mobile phones, PDAs). Interoperability components covered in the Information Access area include:

- Hypertext Web Content;
- Document;
- Spreadsheet;
- Presentation;
- Graphical Image;
- Moving Image and Audio / Visual Content;
- Audio / Video Streaming;
- Animation;
- Mobile Devices Content;
- Character Sets and Encoding;
- Compression; and

- Client-Side Scripting.

It should be noted that standards can, and do, evolve. In addition, standards are also created and deprecated continuously. Therefore, the standards defined here are non-exhaustive, and will be constantly updated.

## **4.2 Recommended Standards / Specifications**

### **4.2.1 Hypertext Web Content**

Hypertext Web Content standards are required to specify the development and formatting of hypertext documents for presentation on browsers via a range of delivery channels including Internet and intranet.

Recommended standards and specifications are as defined in MyGIF.

### **4.2.2 Document**

Standards on Documents are required to define the format and file types of documents for interchange between agencies and departments as well as third parties.

Recommended standards/specifications:

- OASIS Open Document Format for Office Applications v1.0
- ISO/IEC 26300:2006 - Open Document Format for Office Applications (OpenDocument) v1.0

Other recommended standards and specifications for documents are as specified in MyGIF, with the exception of the Microsoft Office Word Document (.doc) format. This is because the format is not fully portable to other platforms and word processing software.

Microsoft has submitted, through ECMA, its XML-based office document format, Office Open XML (OOXML), to be approved by the ISO/IEC Joint Technical committee (JTC) 1 through its fast track process as an ISO standard (ISO/IEC 29500). As OOXML has not yet been approved by ISO in its current state and there remain some confusion and uncertainty regarding the extent that open source applications can legally implement and support OOXM MyGIFOSS does not recommend the usage of OOXML at this juncture.

<b>OpenDocument Text Format (ODT)</b>	
Description	<ul style="list-style-type: none"> <li>The OpenDocument Text Format is part of the OpenDocument for Office Applications standard, specifically aimed at word processing.</li> </ul>
Reference	<ul style="list-style-type: none"> <li><a href="http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=office">http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=office</a></li> </ul>
Rationale for selection	<ul style="list-style-type: none"> <li>The standard defines an XML schema which is well documented and published.</li> <li>It is friendly to transformations using XSLT or similar XML-based tools.</li> <li>This has been approved as an ISO international standard by the ISO/IEC JTC 1 committee.</li> <li>It has the ability to open and write to Microsoft Word binary (.doc) format.</li> </ul>

### 4.2.3 Spreadsheet

Standards on Spreadsheet are required to define the format and file types of spreadsheets for interchange between agencies and departments as well as third parties.

Recommended standards / specifications:

- OASIS Open Document Format for Office Applications v1.0
- ISO/IEC 26300:2006 - Open Document Format for Office Applications (OpenDocument) v1.0

Other standards and specifications for spreadsheets are as specified in MyGIF, with the exception of the Microsoft Office Excel Spreadsheet (.xls) format. This is because the format is not fully portable to other platforms and spreadsheet software.

<b>OpenDocument Spreadsheet Format (ODS)</b>	
Description	<ul style="list-style-type: none"> <li>The OpenDocument Spreadsheet Format is part of the OpenDocument for Office Applications standard, specifically aimed at spreadsheet.</li> </ul>
Reference	<ul style="list-style-type: none"> <li><a href="http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=office">http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=office</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>The standard defines an XML schema which is well documented and published.</li> <li>It is friendly to transformations using XSLT or similar XML-based tools.</li> <li>This has been approved as an ISO international standard by the ISO/IEC JTC 1 committee.</li> <li>It has the capability to read and write other file formats including Microsoft Excel binary (.xls) format.</li> </ul>

#### 4.2.4 Presentation

Standards on presentation are required to define the format and file types of presentation for interchange between agencies and departments as well as third parties.

Recommended standard / specifications:

- OASIS Open Document Format for Office Applications v1.0
- ISO/IEC 26300:2006 - Open Document Format for Office Applications (OpenDocument) v1.0

Other standards and specifications for presentations are as specified in MyGIF, with the exception of the Microsoft Office Powerpoint (.ppt) format. This is because the format is not fully portable to other platforms and presentation software.

<b>OpenDocument Presentation format (ODP)</b>	
Description	<ul style="list-style-type: none"><li>• The OpenDocument Presentation Format is part of the OpenDocument for Office Applications standard, specifically aimed at word processing.</li></ul>
Reference	<ul style="list-style-type: none"><li>• <a href="http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=office">http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=office</a></li></ul>
Rationale for Selection	<ul style="list-style-type: none"><li>• The standard defines an XML schema which is well documented and published.</li><li>• It is friendly to transformations using XSLT or similar XML-based tools.</li><li>• This has been approved as an ISO international standard by the ISO/IEC JTC 1 committee.</li><li>• It has the ability to read and write to Microsoft Powerpoint binary (.ppt) format.</li></ul>

#### 4.2.5 Graphical Image

Standards on graphical images are required to define the format and files types of graphics and still images for interchange between agencies and departments as well as third parties.

Recommended standards and specifications are as contained within MyGIF with the following additional information and format additions:

- Joint Photographic Experts Group (JPEG)
- Graphic Interchange Format (GIF)

- Tag Image File Format (TIFF)
- Portable Network Graphics (PNG)
- Xpixmap (XPM)
- Scalable Vector Graphics (SVG)

<b>Joint Photographic Experts Group (JPEG)</b>	
Description	<ul style="list-style-type: none"> <li>• This is a standardised image compression mechanism from the Joint Photographic Experts Group (JPEG).</li> <li>• The JPEG compression is an ISO graphic image file format standard (ISO/IEC 10918).</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.jpeg.org/">http://www.jpeg.org/</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>• JPEG standard is widely supported by browsers and the majority of image processing, graphics designing, photo processing and scanner accessory software.</li> <li>• It is a mature standard – originally ratified in 1994 and is natively supported by Firefox, Seamonkey and Konqueror.</li> <li>• It is able to save images with millions of colors.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• There are potential patent issues especially with some of its optional features namely arithmetic coding and hierarchical storage.</li> </ul>

<b>Graphic Interchange Format (GIF)</b>	
Description	<ul style="list-style-type: none"> <li>• Graphic Interchange Format (GIF) is one of the most common formats for graphics images on the Web.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.w3.org/Graphics/GIF/spec-gif89a.txt">http://www.w3.org/Graphics/GIF/spec-gif89a.txt</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>• Graphic Interchange Format is a de facto standard widely supported by browsers and the majority of image processing, graphics design, photo processing and scanner accessory software.</li> <li>• It is natively supported by Firefox, Seamonkey and Konqueror.</li> <li>• It can be animated.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• GIF only provides 256 color patterns.</li> <li>• Usage of GIF has diminished since the creation of alternatives to it like PNG.</li> </ul>

<b>Tag Image File Format (TIFF)</b>	
Description	<ul style="list-style-type: none"> <li>• Tag Image File Format (TIFF) was developed by Aldus and Microsoft Corp, and the specification was owned by Aldus, which in turn merged with Adobe Systems, Inc. Consequently, Adobe Systems now holds the copyright for the TIFF specification.</li> <li>• TIFF is a common format for exchanging raster graphics (bitmap) images between application programs.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://partners.adobe.com/public/developer/tiff/">http://partners.adobe.com/public/developer/tiff/</a></li> </ul>

<b>Tag Image File Format (TIFF)</b>	
Rationale for Selection	<ul style="list-style-type: none"> <li>• TIFF is a de facto standard graphics format for high colour depth (32-bit) graphics.</li> <li>• The TIFF specification is publicly published by Adobe and it can be implemented without restriction by anyone.</li> <li>• It is widely supported by browsers through freely available plug-ins and the majority of image processing, graphics design, photo processing and scanner accessory software.</li> </ul>

<b>Portable Network Graphics (PNG)</b>	
Description	<ul style="list-style-type: none"> <li>• Portable Network Graphics (PNG) is an extensible file format for the lossless, portable, well-compressed storage of raster images.</li> <li>• It is an open graphics file format recommendation from W3C as well as an ISO standard (ISO/IEC 15948).</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.w3.org/TR/PNG/">http://www.w3.org/TR/PNG/</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>• It is supported by all major graphics software and web browsers.</li> <li>• For the Web, PNG has three main advantages: alpha channels (variable transparency), gamma correction (cross-platform control of image brightness), and two-dimensional interlacing (a method of sieve display).</li> <li>• For image editing, either professional or otherwise, PNG provides a useful format for the storage of intermediate stages of editing.</li> </ul>

<b>Xpixmap (XPM)</b>	
Description	<ul style="list-style-type: none"> <li>• Xpixmap (XPM) is a de facto standard for creating icon pixmaps for use on the X Window System.</li> <li>• It consists of an ASCII image format and a C library.</li> <li>• The format defines how to store color images (X Pixmap) in a portable and powerful way.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://koala.ilog.fr/lehors/xpm.html">http://koala.ilog.fr/lehors/xpm.html</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>• It is a de facto standard that has been used widely by both commercial and non-commercial developers.</li> <li>• This is the format of choice when simplicity is required.</li> </ul>

<b>Scalable Vector Graphics (SVG)</b>	
Description	<ul style="list-style-type: none"> <li>• SVG is an XML specification and file format for describing two-dimensional vector graphics, both static and animated.</li> <li>• It allows the creation of graphics that can be rendered optimally on all sizes of device.</li> <li>• It is an open standard created by the W3C's SVG Working Group.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.w3.org/TR/SVG11/">http://www.w3.org/TR/SVG11/</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>• It is a royalty-free vendor-neutral open standard developed under the W3C Process</li> <li>• It builds upon many other successful standards such as XML, JPEG and</li> </ul>

<b>Scalable Vector Graphics (SVG)</b>	
	<p>PNG for image formats, DOM for scripting and interactivity, SMIL for animation and CSS for styling.</p> <ul style="list-style-type: none"> <li>• It is interoperable. The W3C has released a test suite and implementation results to ensure conformance.</li> <li>• It is widely applicable in many industries e.g. mobile, print, embedded systems, web applications, design and interchange, GIS and mapping.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• The use of SVG on the web is not widespread. This is due to the long-time use of pure raster formats and other competing formats like Adobe Flash or Java applets.</li> <li>• Browser support for SVG is still not very good.</li> </ul>

#### 4.2.6 Moving Image And Audio / Visual Content

Standards on Moving Image and Audio/Visual contents are required to define the compressed format and file types of audio/visual content such as movies, for interchange between agencies and departments as well as third parties.

In addition to the MPEG-1 standard recommended in MyGIF, the newer MPEG-2 and MPEG-4 standards can also be considered. Most of the audio and video standards and specifications are encumbered by patents with some form of royalty payment. One notable exception is the Ogg project. The audio and video formats associated with this like Ogg Vorbis and Ogg Theora are patent-free.

<b>MPEG-2</b>	
Description	<ul style="list-style-type: none"> <li>• The MPEG standards are an evolving set of standards for video and audio compression and for multimedia delivery developed by the Moving Picture Experts Group (MPEG). These MPEG specifications have been adopted as ISO standards.</li> <li>• MPEG-2 specifies a video codec for interlaced and non-interlaced video signals. MPEG-2 outperforms MPEG-1 at higher bit-rates (over 3 Mbits/s).</li> <li>• MPEG-2 is widely used for video broadcasting, film making and DVD discs.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• MPEG-2 is defined by ISO/IEC 13818.</li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>• MPEG-2 has a very large installed base and market acceptance.</li> <li>• It is an open, international standard.</li> <li>• OSS players for MPEG-2 are available.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• MPEG-2 contains numerous software patents and hence patent infringement issues can arise for implementations on OSS products/platforms.</li> </ul>

<b>MPEG-4</b>	
Description	<ul style="list-style-type: none"> <li>• The MPEG standards are an evolving set of standards for video and audio compression and for multimedia delivery developed by the Moving Picture Experts Group (MPEG). These MPEG specifications</li> </ul>

	<ul style="list-style-type: none"> <li>have been adopted as ISO standards.</li> <li>MPEG-4 can compress video more efficiently than MPEG-1 and MPEG-2.</li> <li>The video coding standard for MPEG-4 is the same as the ITU-T H.264 standard.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>MPEG-4 is defined by ISO/IEC 14496.</li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>MPEG-4 is flexible, allowing it to accommodate applications in a wide variety of environments.</li> <li>It is gaining adoption in a wide variety of applications and digital broadcasting and TV systems.</li> <li>It is an open, international standard.</li> <li>OSS players for MPEG-4 are available.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>MPEG-4 contains numerous software patents and hence patent infringement issues can arise for implementations on OSS products/platforms.</li> </ul>

<b>Ogg</b>	
Description	The Ogg family of audio and video formats is developed by the non-profit Xiph.Org Foundation. These include: <ul style="list-style-type: none"> <li>Vorbis, a lossy audio compression format</li> <li>FLAC a lossless audio compression format</li> <li>Theora a lossy video format</li> </ul>
Reference	<ul style="list-style-type: none"> <li><a href="http://www.xiph.org/">http://www.xiph.org/</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>The audio Vorbis format is comparable in quality and file size with MP3.</li> <li>The Ogg formats are not encumbered by patents.</li> <li>Good support by open source media players.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>Commercial players that support these audio or video specifications are limited.</li> </ul>

#### 4.2.7 Audio / Video Streaming

Audio/Video Streaming Standards on Audio/Video Streaming are required to define the formats and file types streaming audio/video content such as web casts and web seminars, for interchange between agencies and departments as well as third parties.

Recommended standards / specifications:

- Helix DNA
- VideoLAN

<b>Helix DNA</b>	
Description	<ul style="list-style-type: none"> <li>Helix DNA is an open multi-format digital media platform, intended to accelerate the development and deployment of digital media</li> </ul>

	<p>applications of any media, on any device, over any network, on any operating system and created in any development environment.</p> <ul style="list-style-type: none"> <li>• Helix originated from Real Networks' Real Audio/Video streaming server and player. It was made open source by Real Networks in 2003.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://helixcommunity.org/">http://helixcommunity.org/</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>• The Helix DNA system supports multiple media formats, including Real Media, Windows Media and Quicktime.</li> <li>• The Helix Server and Player are cross-platform with clients across all major operating systems.</li> </ul>

<b>VideoLAN</b>	
Description	<ul style="list-style-type: none"> <li>• VideoLan is a cross-platform media server and player.</li> <li>• It started as a student project at the French École Centrale Paris, then released under the GPL.</li> <li>• The VideoLan server can stream MPEG-1, MPEG-2 and MPEG-4 files, DVDs, digital satellite channels, digital terrestrial television channels and live videos on the network using unicast or multicast.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.videolan.org/">http://www.videolan.org/</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>• It supports a wide range of audio/video formats and codecs.</li> <li>• Available on multiple operating systems.</li> </ul>

#### **4.2.8 Animation**

Animation standards are required to define the applications and formats to be used for the interchange of animated content between agencies and departments as well as third parties.

Due to the lack of mature OSS animation formats, standards and specifications as defined within MyGIF can be used. Users are however advised to use publishing software that provide players that are available on OSS platforms, e.g. Adobe Flash.

#### **4.2.9 Mobile Devices Content**

Mobile Devices Content Standard on Mobile Device Content is required to define the format of content for presentation on mobile devices such as mobile phone and PDAs.

Recommended standards and specifications are as defined in MyGIF.

## 4.2.10 Character Sets And Encoding

Character Sets and Encoding standards define the character sets to be used for content to be interchanged in English or Malay, as well as how those characters are to be encoded.

Recommended standards and specifications are as defined in MyGIF.

## 4.2.11 Compression

Compression is required to define the applications and format to be used for compressing files for interchange in between related parties.

Recommended standards / specifications:

- Zip
- GNU Zip
- Bzip

<b>Zip</b>	
Description	<ul style="list-style-type: none"> <li>• The Zip file compression specification allows one or more files to be compressed and placed together in a single file.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.pkware.com/products/enterprise/white_papers/appnote.htm">http://www.pkware.com/products/enterprise/white_papers/appnote.htm</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>• It is a global, matured and widely adopted de facto standard. It was introduced in 1989.</li> <li>• It is supported on a range of operating systems including Linux, *BSD, UNIX and MS-Windows. Extractors are freely available.</li> </ul>

<b>GNU Zip (Gzip)</b>	
Description	<ul style="list-style-type: none"> <li>• Gzip is a compression utility.</li> <li>• It has been adopted by the GNU project and is popular on the Internet.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>• <a href="http://www.ietf.org/rfc/rfc1952.txt">http://www.ietf.org/rfc/rfc1952.txt</a></li> </ul>
Rationale for Selection	<ul style="list-style-type: none"> <li>• Gzip is a commonly utilised file compression format on UNIX-like systems.</li> <li>• It is supported on a range of operating systems including MS-DOS, UNIX and MacOS. It can be extracted on MS-Windows operating systems using the freely available WinZip utility.</li> <li>• It is an IETF standard - RFC 1952.</li> </ul>

<b>bzip2</b>	
Description	<ul style="list-style-type: none"><li>• bzip2 is another file compression utility.</li></ul>
Reference	<ul style="list-style-type: none"><li>• <a href="http://bzip.org/">http://bzip.org/</a></li></ul>
Rationale for Selection	<ul style="list-style-type: none"><li>• The bzip2 utility is capable of greater compression ratios than gzip.</li><li>• A bzip2 file can be 10-20% smaller than a gzip version of the same file.</li><li>• The use of this format of compression is compatible with a wide range of operating system such as Linux, MS-Windows and UNIX.</li></ul>

#### **4.2.12 Client-Side Scripting**

Client-side scripts are programs written and attached or embedded in HTML documents in a manner independent of the scripting language. The scripts add interactivity and program logic to browser-based content, for instance, providing runtime validation of form field contents by responding to a user's mouse action with the execution of a program to validate user input. It reduces server load by transferring some of the processing of the program to be handled locally at the client.

Standards on client-side scripting are required to ensure consistency in the script implementation in different browsers, in particular, the dominant browsers such as Firefox, Seamonkey, Konqueror, Microsoft IE.

Recommended standards and specifications are as defined in MyGIF.

## 5 COMPLYING WITH MYGIFOSS

### 5.1 What it Means to be Compliant with MyGIFOSS

MyGIFOSS supplements the recommendations stated in MyGIF with respect to the implementation of OSS for the public sector. It recommends appropriate open standards as well as OSS products/solutions for ICT usage. It is important that the OSS implementation and roll-out for the government bodies and agencies comply with MyGIFOSS as much as possible so as to enable a high degree of quality and interoperability in the ICT services provided by the government.

At its highest level, for an organisation to be compliant with MyGIFOSS will mean that OSS is used on a daily basis for most of the ICT work carried out, both at the server and desktop. It will also imply that the ICT technical staff is comfortable with the installation, configuration, administration and support of the main OSS products in use. The software used should follow the recommended ones given in this document.

At its most basic level, compliance with MyGIFOSS will mean that OSS is used for some of the ICT work carried out; this can be at the server or desktop level. Again, the software used should follow the recommended ones given in this document.

### 5.2 Minimum Requirements

Within a particular area or domain, the minimum set of standards that an organisation has to follow and the services/applications that it should offer using OSS in order to be considered compliant with MyGIFOSS are listed below.

<b>Operating Environment</b>	
Operating system	Linux, *BSD operating systems
Networking	TCP/IP standards
User interface	Desktop - GUI desktop environment Server - command line interface or GUI desktop environment
File and printer sharing	NFS and/or SMB/CIFS file and printer sharing specifications. CUPS printing system for access to local as well as networked printers.

<b>Internet Services</b>	
Websites and web content	Web pages and content created should conform with W3C standards so as to be compatible with as many web browsers as possible. Browser-specific specifications and extensions are to be avoided.

<b>Internet Services</b>	
Web server	Web servers used should be compliant with HTTP and related standards from IETF.
Web browser	Browsers should be compliant with HTML and related standards from W3C.
Email	Email servers should support SMTP and related standards from IETF. Email clients should be able to send and receive email using either the POP3 or IMAP4 protocols from IETF. Address books used should be able to support the import/export of data in LDIF or comma-separated value (CSV) format.
Calendaring	Calendaring clients and servers used should support the iCalendar data format and the CalDAV scheduling information access protocol.

## **6 CONCLUSION**

The Malaysian Government Interoperability Framework for OSS is constructed to be a “live” document, providing ICT managers within the public sector examples, guidelines and recommendations for the adoption of OSS within their organisations. The constantly changing nature of technology and implementation methodologies mean that this document cannot possibly be exhaustive nor definitive.

However, it does serve as a useful reference in fulfilling the objectives of this document, which is primarily to ensure the interoperability and co-existence of new and legacy systems.

Throughout this document, the importance of open standards have been repeatedly emphasised, simply because the adherence to these standards, does more than any other measures that can be taken to ensure interoperability.

## 7 REFERENCES

- i. Standards, Policies and Guidelines – Malaysian Government Interoperability Framework (MyGIF) v1.0, Malaysian Administrative Modernisation and Management Planning Unit, August 2003:

<http://www.mampu.gov.my/mampu/pdf/ISPlan/ispdoc/Interoperability%20Framework.pdf>

- ii. Open Source Software (OSS) Implementation Guidelines:

[http://www.oscc.org.my/component/option,com\\_docman/task,doc\\_download/gid,49/Itemid,86/](http://www.oscc.org.my/component/option,com_docman/task,doc_download/gid,49/Itemid,86/)

- iii. Open Source Software Reference Architecture:

[http://www.oscc.org.my/component/option,com\\_docman/task,doc\\_download/gid,86/Itemid,29/](http://www.oscc.org.my/component/option,com_docman/task,doc_download/gid,86/Itemid,29/)

- iv. The United Kingdom e-Government Interoperability Framework v6.0, The Cabinet Office, e-Government Unit, Technology Policy Team, Interoperability Policy Advisor, April 2004:

<http://www.govtalk.gov.uk/schemasstandards/egif.asp>

- iv. Free/Open Source Software - Open Standards:

[http://en.wikibooks.org/wiki/FOSS\\_Open\\_Standards](http://en.wikibooks.org/wiki/FOSS_Open_Standards)

## 8 ABBREVIATIONS AND ACRONYMS

The abbreviations and acronyms throughout this document are similar to the ones detailed in MyGIF, with some additions as given below:

<b>Abbreviation / Acronym</b>	<b>Expansion</b>
<b>Multimedia</b>	
codec	Short for encoder/decoder, this term is used to describe the process to encode or decode digital data (usually video, images or audio) from one form to another. For example, digital images are <i>encoded</i> into the JPEG format for storage and <i>decoded</i> from the format for display onto the screen. Encoding involves compressing the data and decoding, decompressing.
Ogg Vorbis	It is an audio compression format that is patent free and open source. It was started after litigation possibilities were raised in using the popular MP3 format which had patents held by the Fraunhofer Institute. Ogg is the container format and Vorbis is the compression scheme
Ogg Theora	It is a video compression format that is patent free and open source. Ogg is the container format and Theora is the compression scheme.
MP3	MPEG-1 Audio Layer-3
<b>Linux</b>	
RPM	RPM Package Manager (formerly known as Redhat Package Manager) is a package management system, primarily for Linux which installs, updates, uninstalls, verifies and queries software. It is used by many Linux distributions for this very purpose.
DPKG	DPKG is the base of the Debian Package Management System which is similar to RPM. In fact, RPM was originally based on DPKG, though simplified.
APT	Advanced Packaging Tool - a high-level package management system which manages the retrieval, configuration and installation of software packages. It is used mainly for DPKG-based packages but has been expanded to handle RPM-based ones as well.
TGZ	File extension which means that a collection of files within a software package have been inserted into a Tar archive and compressed with gzip - the TGZ files are commonly referred to as gzipped tarballs. It is also the package management system used in some Linux distributions. As a package management system, though, it is not as advanced as others.
emerge	A package management system used by primarily by the Gentoo Linux distribution. It works similarly like APT, in that it obtains the source code for a package and then configures and installs it.
tar	An archive program. Tar stands for "tape archive".
<b>Standards Bodies</b>	
ANSI	American National Standards Institute

<b>Abbreviation / Acronym</b>	<b>Expansion</b>
ECMA	European Computer Manufacturers Association
IEEE	Institute of Electrical and Electronics Engineers
IEC	International Electro-Technical Commission
IETF	Internet Engineering Task Force
ISO	International Standards Organization
ITU	International Telecommunication Union
OASIS	Organization for the Advancement of Structured Information Standards
OGC	Open Geospatial Consortium
W3C	World Wide Web Consortium

**Table 8.1: Abbreviations & Acronyms**