

Open Source Software Solution for Small and Medium Enterprises

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Abstract—Information Technology is an enabler that brings flexibility to the business processes. Major factors to the successful adoption of Information Technology for Small and Medium Enterprises (SMEs) are the IT benefits and organizational culture, the selection and implementation of IT, and technical support. The paper discusses the selection and implementation of Open Source Software (OSS) and the technical support options, knowing which gives the SMEs better visibility at the IT adoption process. The paper also presents the implementation of selected OSS projects that can fulfill the common IT requirements of an SME, like Web server: to host and serve the web applications, Mail server: to facilitate the email messaging functionality within and outside of the SME, File server: to provide a space where the employees of an SME can store their files, and Backup server to copy the files, applications and/or databases of an SME and restore them in case of data loss.

Keywords—SME, Open Source Software, Information Technology, IT selection, IT implementation, IT Support.

I. INTRODUCTION

SMEs play a vital role in the economic development of a country, particularly in developing countries. The legal partition of SME varies based on the country it operates in and is usually defined in the scale of annual revenue and /or the number of employees. Most businesses worldwide are small and medium enterprises, which helps the job market and improves the economy. 90% of businesses are small and medium enterprises with 50% employment across the world. In the emerging economies, small and medium enterprises provided up to 40% of national income. The statics are even higher while considering informal enterprises. World Bank evaluations show that 600 million work opportunities must be created by 2030, to employ the rising workforce. That is why the development of small and medium enterprises are important for governments around the world [1]. However, limited access to finance and competition are the main obstacles to SME's growth in the emerging markets and developing countries. SMEs are less likely to get bank loans to compare large enterprises, instead, they depend on internal funds, or cash from friends and family, to launch and initially run their enterprises [2].

For most enterprises, Information Technology is not a core business but a helper, knowing the limited access to finance makes it less likely that SMEs will invest in Information Technology. Competition is identified to be another key factor for SMEs' survival, customers' expectations change for the price, quality, and innovative products and services[3]. Keeping up with these expectations require the adoption of an agile and effective IT solution. With all these constraints in mind, The paper explores the information technology adoption process with

Open Source software, the fact that everyone can freely access, use, change and share Open Source software (in modified or unmodified form) helps SMEs to remain competitive and save on Information Technology expenditure.

The paper has five sections: section two discusses, the Related Work, section three presents, SME's Network Architecture, section four presents, Implementation, and Results, and the paper will be concluded in section five.

II. RELATED WORK

Information Technology adoption is the phase at which a decision is made about adopting specific hardware and/or software technology. It is an investment to improve the quality of products and services to expand businesses, and more importantly, to meet and/or exceed the customer's expectation, which is a requirement that small and medium enterprises must meet in the current competitive market[4]. Considering Open Source Software in the IT adoption process, the paper studies its characteristics to find out how it can help SMEs from a technology perspective to sustain and grow in the market.

A. Security and Reliability

Small and medium enterprises have a substantial need for information technology. The rapid growth of information technology and networking has increased threats and attacks, and most enterprises are vulnerable to protect their products and systems against these attacks. Large enterprises work with small and medium enterprises by outsourcing services to them, and the demand for the services of small and medium enterprises is increasing. Large enterprises require that small and medium

enterprises must have an equal security system. IT Security proficiency and financial budgets are the constraints where small and medium enterprises do not want to invest in the protection system[5].

The scientific research community identifies the widespread adoption of Open Source Software as a potential factor for security and reliability[6]. Because large Open Source software projects can have millions of users testing the source code, there is a great chance that more bugs are found and fixed. This is an advantage that SMEs can get by running Open Source software.

B. Cost

Enterprises willing to decrease the licensing fees of proprietary software, while also avoiding the penalties and legal liabilities associated with their illegal use, can consider open source software a credible alternative[7]. Many organizations by implementing open source software have realized significant cost savings in technology expenditure. Open Source software is open to the public, anyone can download the source code, and lots of this software is developed and maintained collaboratively by unpaid volunteers to employees at the largest technology companies. Now the question arises, what are the motivations for the effort in Open Source software? The motivational factors in the form of extrinsic and intrinsic rewards are the reasons individuals take part in Open Source projects, extrinsic rewards e.g. better job or career development are the main factors, intrinsic rewards e.g. enjoyment or how creative a person feels when working to create solutions, are the most pervasive and strongest factors of the effort in the Open Source projects[8].

C. Main Business Models of Open Source Software

The motivations behind an individual's effort to open source projects have been discussed, now SMEs must understand how Companies make money whose core business is the development of Open Source software. Open Source software is licensed free of charge, So how is it monetized, when the product is given away for free? The answer lies in selling support services, SaaS/subscriptions, and commercial versions of the software.

- 1) *Service Model*: anyone can download the software for free, but if businesses want technical support and training, they must buy a subscription, e.g. Red Hat Enterprise Linux.
- 2) *Open Core Model*: the basic features are open source and free of charge, but add-ons and other useful elements are proprietary, e.g. the database program MongoDB and integration platform MuleSoft.
- 3) *Dual Licensing Model*: one product/project that gets licensed with an Open Source License especially GPL-Style license and a commercial closed source license, e.g. MySQL.

4) *SAAS or Subscriptions Model*: Not charging for the software but for the tooling and platform to consume the software as a service, often via subscription.

There are a lot of different models for how people make money in Open Source, and one model is that they do not.

D. Technical Support

Whether an Open Source software is being tested or has been put to production, it has the same global community of developers and users available for asking questions and advice. With just time investment anyone can get free technical support through different channels like forums, wikis, email lists, live chat, and detailed documentation. Now the question arises, why would information providers voluntarily help information seekers for free? The effort invested by help providers is extrinsically and intrinsically rewarding to them. The public posting of both questions and answers created a site that potential information providers wanted to visit and study to gain valuable information. Besides, the public posting of answers with the names of providers attached created the possibility of gaining reputation and related benefits through helping[9]. In case SME does not have in-house IT skills to provide technical support, there are other support options available:

- 1) *Pay the project foundation*: Buy a support package for a product or take a subscription that has support included for your specific product.
- 2) *Support from third-party*: Take the support of a software developer with the necessary skills or a company that provides support for Open Source projects.
- 3) *Support contract*: Sign a contract with a third-party support provider, they usually have options like on phone support, email support, guaranteed response times, and choice of business hours.
- 4) *Support from the system integrator or IT consultants*: If system integrator or IT consultants are responsible for the part of your infrastructure running Open Source software ask them for support.

III. SME NETWORK ARCHITECTURE

Every small and medium enterprise willing to integrate information technology to the business processes has some common technology needs and as well as some business-specific applications. The network architecture presented in figure 1 represents the common IT resources, applications, and requirements of an SME, like Web server, Mail server, Backup Server, and File server, to support the collaborative work environment and customer database & request handling using Open Source software.

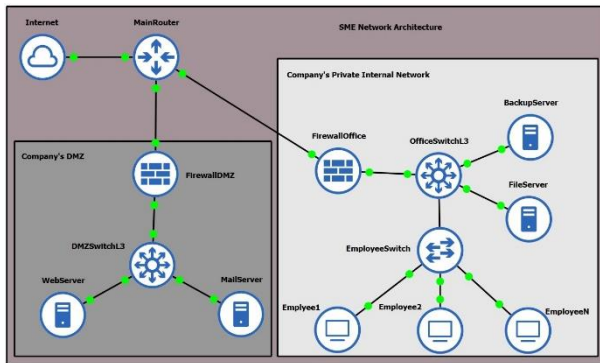


Figure 1 - Network Architecture

DMZ enhances the security of the enterprise's network; it divides the network into a private and publicly accessible network using a firewall. One network that contains the Web server and the Mail server and can be accessed by the people from the internet so that the SME can stay in business. The second network is the company's private network where the Backup and File servers, along with the workstations are kept secure.

IV. IMPLEMENTATION AND RESULTS

Once the infrastructure design has been completed, it is required to set up the physical and/or virtual servers with the server operating system. Two Open Source operating systems are selected to run the servers.

- **GNU/Linux operating system:** An Open Source operating system based on the Linux kernel, and supporting system software and libraries, many of which are created by the GNU Project. The Web server and Mail server are running on Ubuntu 18.04, a GNU/Linux distribution.
- **FreeBSD Operating System:** A free and Open Source operating system, it releases the source code under a permissive BSD license. FreeBSD maintains a complete system, i.e. the project provides a kernel, drivers, utilities, and detailed documentation, the Backup server, and the File server are running based on the FreeBSD operating system.

A. Web Server Implementation: For this task, the well-known Apache HTTP Server is used, it is an Open Source and free web server. Apache webserver has a global community of developers that contributes to the project under the supervision of the Apache Software Foundation. They distribute this webserver under the Apache License 2.0. As of April 2020, it has a 24.73% market share of all sites according to Netcraft's survey.

```

ubuntu@ubuntu:~$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
  Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor preset: enabled)
  Drop-In: /lib/systemd/system/apache2.service.d
           └─apache2-systemd.conf
  Active: active (running) since Mon 2020-04-13 10:24:07 UTC; 9min ago
  Main PID: 1390 (apache2)
  Tasks: 55 (limit: 4632)
  CGroup: /system.slice/apache2.service
          └─1390 /usr/sbin/apache2 -k start
             1391 /usr/sbin/apache2 -k start
             1392 /usr/sbin/apache2 -k start

Apr 13 10:24:06 ubuntu systemd[1]: Starting The Apache HTTP Server...
Apr 13 10:24:07 ubuntu systemd[1]: Started The Apache HTTP Server.
ubuntu@ubuntu:~$

```

Figure 2 - Apache2 HTTP server is running

The website was successfully hosted and lunched using the configured Web server.

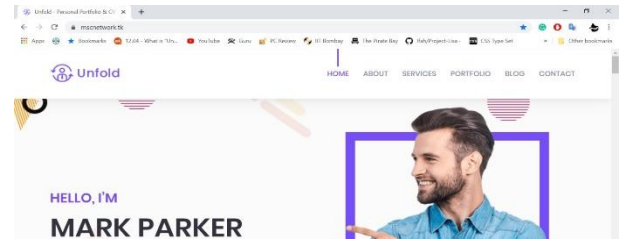


Figure 3 - Website hosted by Apache2 HTTP server

Using HTTP all the information is sent in clear text when the information is exchanged between a client and a web server, it is transferred over the public internet and it is vulnerable. This is a serious issue if personal data like name, address, mobile number, passwords, or bank information are entered into the web application. To overcome this issue, HTTPS was developed which stands for Secure Hypertext Transfer Protocol, this protocol encrypts the data exchanged between a client and a web server. The services of Let's Encrypt, a free, automated, and open certificate authority are used to achieve the same.

B. Mail Server Implementation

Internet email system comprises protocols working together to achieve this functionality, Mail Transfer Agent program authenticates and directs the transfer of electronic mails and their attachments from one node to another with the use of simple mail transfer protocol (SMTP). The project uses the Postfix server which is an Open Source and free mail transfer agent (MTA). Postfix has the IBM Free Public License.

```

ubuntu@ubuntu:~$ sudo systemctl status postfix
● postfix.service - Postfix Mail Transport Agent
  Loaded: loaded (/lib/systemd/system/postfix.service; enabled; vendor preset: enabled)
  Active: active (exited) since Mon 2020-04-13 10:24:08 UTC; 12min ago
  Main PID: 1619 (code=exited, status=0/SUCCESS)
  Tasks: 0 (limit: 4632)
  CGroup: /system.slice/postfix.service

Apr 13 10:24:08 ubuntu systemd[1]: Starting Postfix Mail Transport Agent...
Apr 13 10:24:08 ubuntu systemd[1]: Started Postfix Mail Transport Agent.
ubuntu@ubuntu:~$

```

Figure 4 - Postfix server is running

To fetch the electronic mails from the mail server, a mail delivery agent or message delivery agent (MDA) software is required. Dovecot, which is an Open Source server works with the Internet Message Access Protocol (IMAP) and Post Office Protocol 3 (POP3), available under MIT, and LGPLv2 free software licenses are used.

```

ubuntu@ubuntu:~$ sudo systemctl status dovecot.service
● dovecot.service - Dovecot IMAP/POP3 email server
  Loaded: loaded (/lib/systemd/system/dovecot.service; enabled; vendor preset: enabled)
  Active: active (running) since Mon 2020-04-13 10:24:06 UTC; 10min ago
  Docs: man:dovecot(1)
         http://wiki2.dovecot.org/
  Main PID: 1031 (dovecot)
  Tasks: 4 (limit: 4632)
  CGroup: /system.slice/dovecot.service
          └─1031 /usr/sbin/dovecot -F
             1207 dovecot/anvil
             1208 dovecot/log
             1235 dovecot/config

Apr 13 10:24:06 ubuntu systemd[1]: Started Dovecot IMAP/POP3 email server.

```

Figure 5 - Dovecot server is running

Now that sending and retrieving email servers are running, an interface is needed where users can interact to read or write email messages for which an email client is needed. Mozilla Thunderbird is an Open Source and free email client or Mail User Agent (MUA) which can work with POP3 and IMAP protocols, created by the Mozilla Foundation.

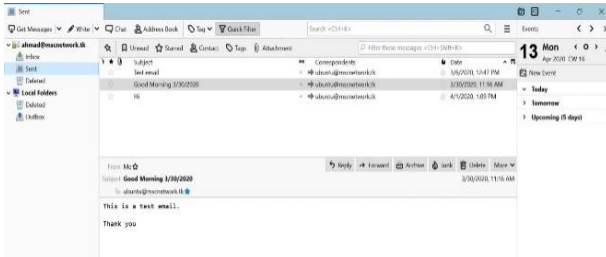


Figure 6 - Email Sent

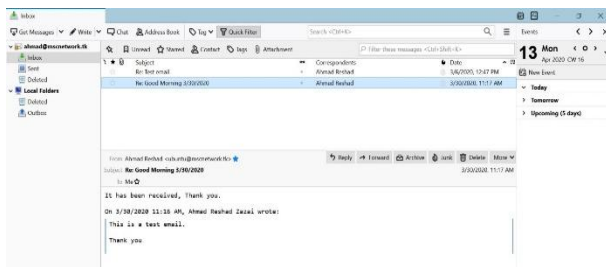


Figure 7 - Email Received

C. Backup Server Implementation

Enterprises store a huge amount of data vital for a business to operate and helps to better understand customers. It is necessary to copy the essential data so if any unexpected changes happen for example the devices fail, cyber-attack, or accidentally files are altered or deleted by administrators we have to recover the original data as soon as possible. FreeNAS is an operating system that is Open Source and free and is based on the FreeBSD and OpenZFS file system. This operating system uses the BSD License.

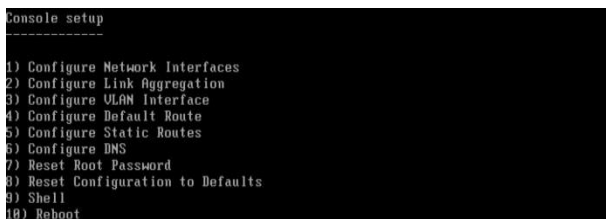


Figure 8 - FreeNAS based on the FreeBSD OS

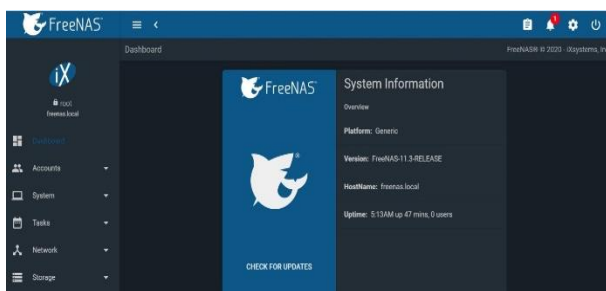


Figure 9 - The web user interface of FreeNAS

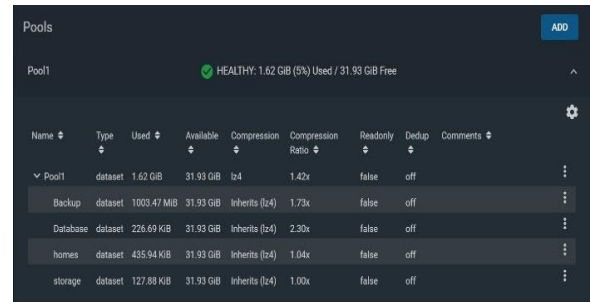


Figure 10 - The pool of storage

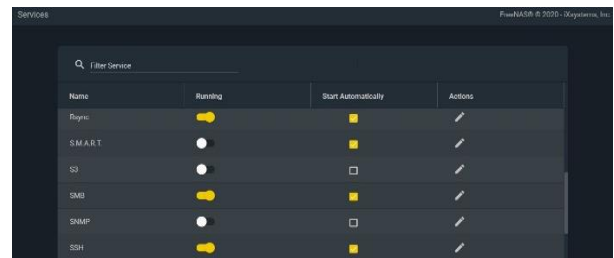


Figure 11 – Services

- 1) *Rsync* service is running to synchronize the source and destination data.
- 2) *SMB* service is running for file sharing among the workstations running in an enterprise.
- 3) *SSH* service is running to remotely access the web server, this is used by Rsync service to PULL and PUSH data.

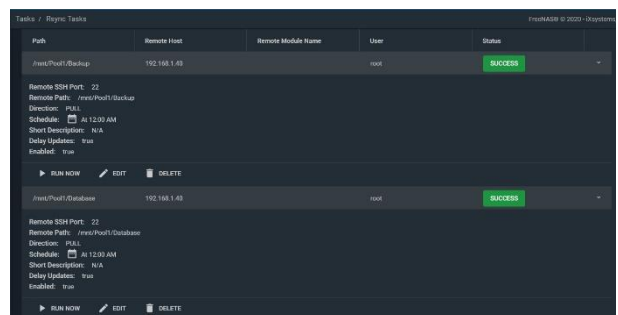


Figure 12 - Rsync Tasks

Rsync tasks are scheduled to pull website contents and database files from the Web server at regular intervals and in case of data loss, tasks will be configured to push back data to the web server over SSH connection.

Task 4 - File Server Implementation

A file server provides storage where workstations or clients can store their files, it is mostly used in schools and SMEs, Server Message Block (SMB) communication protocol is set up to provide shared access to data and resources. The protocol checks users for their permission and only authenticated and authorized users can access the files. The SMB shares can be browsed and mounted by major operating systems.

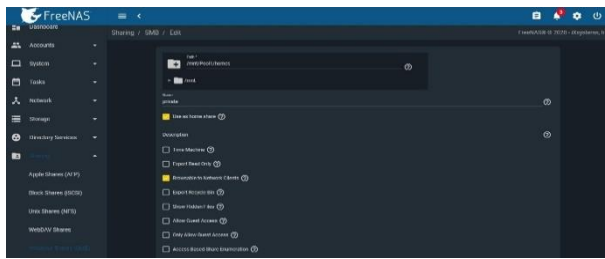


Figure 13 - SMB Shares

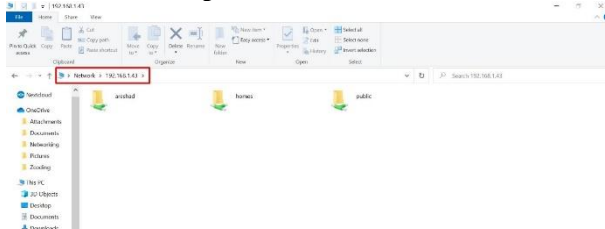


Figure 14 - SMB share accessed in windows Client OS

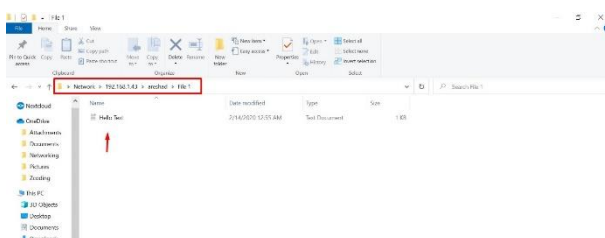


Figure 15 - Create, Modify and Delete Files

V. CONCLUSION

Most businesses worldwide are small and medium enterprises that help to create more jobs and grow the economy. These enterprises struggle to access finance and to survive. The adoption of information technology with the use of Opens Source software is one factor to help them survive, sustain, and grow in the competitive market. Open Source software can provide reliable solutions with various technical support options at much-reduced costs. Open Source software is not inherently more reliable than closed source (proprietary) software, analytical arguments in the approval of either software are not decisive. But as in the scientific research community, the free exchange of software supports innovations and improves the community. The momentum from the combined effort of developers across the globe will give quality software that fulfills and exceed the security, reliability, and customer expectations metrics of their proprietary counterparts at a much-reduced cost. In the implementation section, Open Source software has fulfilled a set of common information technology needs of a small and medium enterprise. We completed these tasks with the use of software products that have free licenses, and anyone can download and use them for their purposes. We deployed the tasks in an on-premises data center. As future work to compare the infrastructure costs, the tasks to be executed using public cloud solutions.

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Authors Profile

Mr. Ahmad Reshad pursued Bachelor of Computer Applications from Bangalore University, Bangalore, India, 2016. He has Postgraduate Diploma in E-business and Computer-Aided Management from Mount Carmel College, Bangalore, India 2016, and pursued Master of Network Technologies and Management from Amity University Haryana, Haryana, India, 2020.



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