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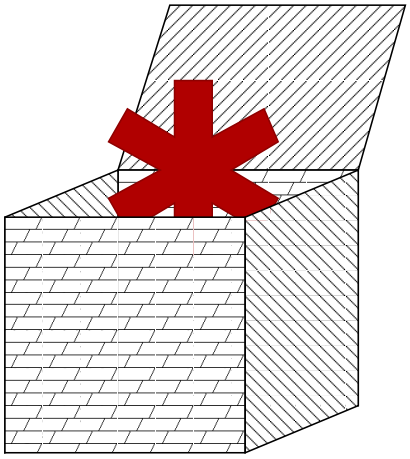
Note

Evaluation of VoIP Linux Distributions Based on Asterisk



Note no DART/02/10
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Abstract

There is a variety of VoIP Linux distributions available, all based on the popular Asterisk software. Hence, the decision what distribution to choose is not straightforward. In this document, three popular distributions are evaluated with regard to a number of criteria, such as ease of installation, user interface, and security. Based on the evaluation, the deployment of trixbox and particularly Elastix can be recommended.

Keywords	Evaluation, Asterisk, IP-PBX, VoIP, Linux distribution, Elastix, PiaF, trixbox
Target group	Project stakeholders
Availability	Open
Project	EUX2010Sec
Project number	320376
Research field	Information Security
Number of pages	22

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1 Introduction

In this document, three Linux distributions tailored for VoIP[1] are evaluated. All distributions have in common that they use Asterisk as the IP-PBX[2] [17]. They are as follows.

- Elastix
- PiaF
- trixbox

It is noted that the latest releases of Asterisk available as of today are *1.4.30-rc3* and *1.6.2.6-rc2* [17]. As a consequence, each distribution is offered in different versions. The installations carried out for this report are based on version *1.6*, which is the Standard Release type according to [18], as the life span for the Long-Term Support type is approaching its end (2010-04-01 for full maintaintance).

For the sake of completeness, a few other distributions are briefly introduced in see Section 6 on page 19.

2 Installations

In order to test the claims in the documentation of each distribution, each systems is installed, and vital system parameters are checked. All distributions are installed as virtual machines in the VMware hypervisor. The installation is carried out either by copying the appropriate image of the VM[3], or by building the VM from scratch.

In case of the latter, the VMware configuration comprises the following parameters.

- Typical configuration
- Linux, Other Linux *2.6.x* kernel
- Bridged networking
- 5 GB disk

1. Voice over Internet Protocol
2. Internet Protocol Private Branch Exchange
3. virtual machine

The disk space given is sufficient for the storage requirements of any subsequent installation, as can be seen in the tables with the system parameters.

A VM is installed by using the appropriate installation image, which has to be downloaded from the distribution resources in advance, as representative for the CDROM[4] drive. Then the VM can be started, and the installation procedure begins.

2.1 Security

As mentioned before, all distributions evaluated here are based on Asterisk. Other than that, the distributions contain roughly the same components (freePBX, etc.), such that the security considerations presented below apply to all of them.

Every system component of a distribution, such as instant messaging, fax, mail, groupware, etc., has its own security issues and therefore contributes to the overall system vulnerability. Thus, reducing the number of components, for instance in case they are not needed, simultaneously increases the system's vulnerability. Software modules and scripts should be updated continuously and in particular directly after the initial installation process to get the latest released revision. It is also noted that all components are pre-installed with their default credentials (combination of username and password) which should be changed for security reasons immediately after installation. During the installation, the system was configured according to DHCP[5], and this should be changed to a fixed IP[6] address.

A series of very useful suggestions on how to secure Elastix is given in [Yardley]. These are the following.

- Disable all services that are not needed
- Secure ssh
- Properly set up the firewall
- Set up the system and network monitoring
- Secure the web interface

Additional suggestions are found in [21] and include the following.

- Do not accept SIP[7] authentication requests from all IP addresses

4. read-only memory compact disk
5. dynamic host configuration protocol
6. Internet protocol
7. Session Initiation Protocol

- Do not leak information upon bad authentication requests
- Use strong passwords for SIP entities
- Reduce inbound connections to known hosts only
- Allow a maximum of two calls at a time per SIP entity
- Make SIP usernames different from the corresponding extensions
- Do not use unauthenticated calls in the default context

Another valuable source is the blog of one of the lead developers of PiaF [20]. The most important actions to secure an Asterisk box are reproduced as follows.

- Inspect and analyze the system log on a regular basis, e.g., to detect unusual customer behavior and safeguard against random password attacks
- Periodically change passwords
- Enable a proper SW[8]-based firewall to safeguard against threads from the intranet
- Activate only the ports absolutely essential to run the PBX[9]
- Activate only the modules essential to run the PBX
- Enable a proper HW[10]-based firewall to safeguard against threads from the internet
- Provide only minimum access by means of IP address restrictions for both Asterisk and other packages
- Redirect all default ports (except for SIP and IAX[11]) on a regular basis, and for particular time periods
- Use secure passwords, e.g., not identical to the extension number
- Regularly change passwords
- Have special password protection for web access of system-critical directories

8. software
9. private branch exchange
10. hardware
11. Inter-Asterisk eXchange (protocol)

- Use VPN[12] for system control
- Update your knowledge by means of news channels and discussion forums
- Restrict international calling possibilities to a minimum
- Do not mix POTS[13] lines with regular VoIP lines

3 Elastix

Elastix [1] is a software bundle for a unified communications appliance solution with an extensive feature list [2]. It was created and is maintained by PaloSanto Solutions, a company whose business model is to provide support for FOSS[14].

Besides a beta version, there is a latest stable (conventional) version, and there is an image of a VMware installation.

The system parameters are the following.

Source model FOSS

OS[15] GNU[16]/Linux (CentOS 5.3)

Latest Asterisk release 1.6

License GNU GPL[17]

Important components Asterisk, Flash Operator Panel, freePBX, CDR[18] reporting and maintenance system, others

Except for the references mentioned in the following, in particular [3] is of valuable help covering basically all aspects of Elastix (1.x). Another useful resource is [4] which provides tutorials and a supporting community.

3.1 VMware installation

The normal installation procedure from the Installation section [5] is followed, bearing the label *Elastix-1.1Vmware*.

12. virtual private network
13. plain old telephone service
14. free and open source software
16. GNU is not Unix
17. General Public License
18. Call Detail Records

After the download of the 557 MB large (gzipped) image from the downloads section [6], the image is unpacked to 4.3 GB. The image can then be opened as a VM in VMware by choosing the appropriate *.vmx* file.

The VM starts without any issues.

Testing Elastix' web interface by directing the browser to the appropriate address gives an error, however, due to a self-signed certificate (server's name "x.x.x.x" does not match the certificate's name "localhost.localdomain"). The web interface, as shown in Figure 1, can be accessed by accepting the exception. Alternatively, a proper certificate can be deployed.

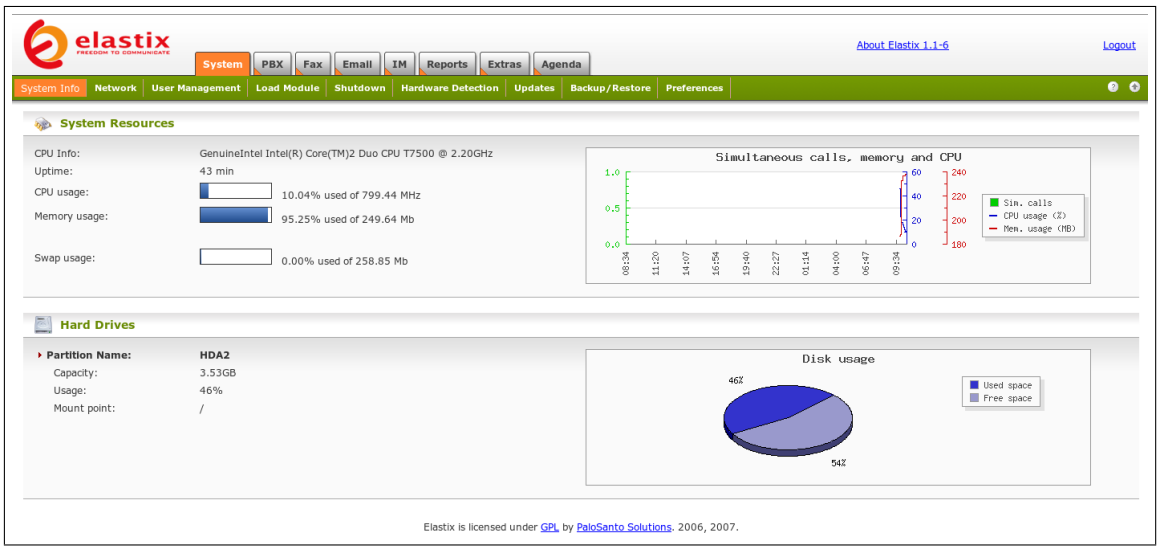

Figure 1. Screenshot of the dashboard of Elastix as a VM

The system parameters are the following.

Kernel 2.6.18-53.1.19.el5

Used disk space 3.8 GB

Stability Unknown (It is not possible to measure the stability of all involved components without proper configuration and execution over a longer period of time.)

The entire installation process takes less than 10 min. However, the system still has to be configured with for instance dial plans, etc. before it can be used.

3.2 Plain installation

The normal installation procedure documented in the Installation section [5] is followed. Also helpful are the installation manual and the Elastix documentation

[7], both found on the download page [6].

The installation process succeeds without any issues. Basically, all suggested default values can be kept. Accessing the web interface, as detailed in Section 3.1 on page 10, the same certificate exception has to be made. The dashboard as depicted in Figure 2 looks roughly identical to Figure 1 on the preceding page.

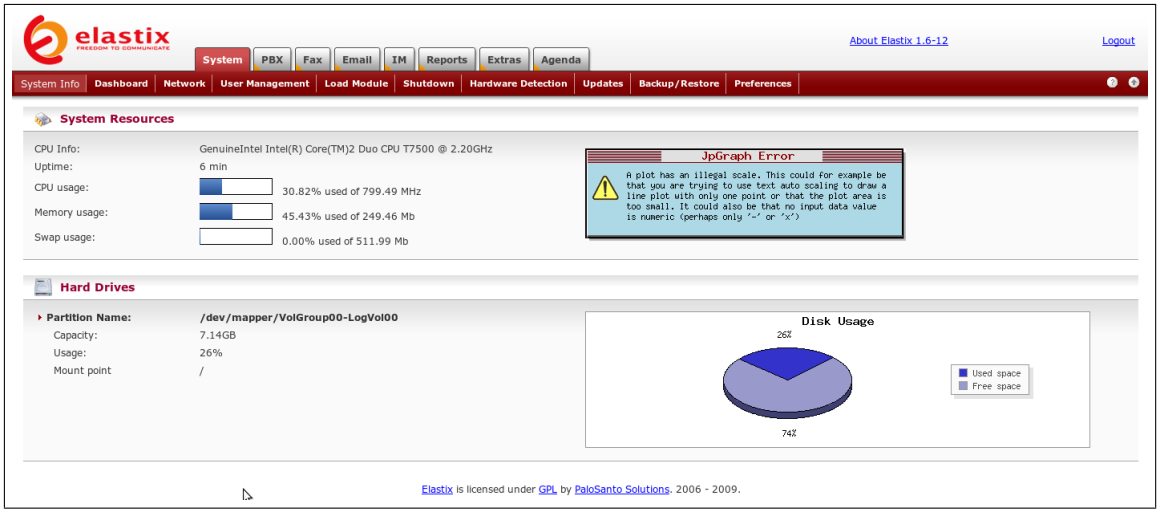

Figure 2. Screenshot of the Elastix dashboard

The system parameters are the following.

Kernel 2.6.18-164.el5

Used disk space 2 GB

Stability Unknown (See corresponding explanation above.)

The entire installation process lasts approximately 30 min. As before, the system has still to be configured before it can be used.

One advantage of the plain installation vs. the virtual-machine installation is that particular packages, such as printing, legacy web server, etc., can be excluded during the installation.

3.3 Security

Concerning security, the considerations made in Section 2.1 on page 8 apply.

It is further noted that Elastix is the evaluation's only distribution which provides *HTTPS*[19] for the web interface.

19. secure HTTP

3.4 Other

The site elastix.org is rather confusing, and it is not easy to find the anticipated information.

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4 PBX in a Flash (PiaF)

PiaF [8] is the product of development of Asterisk's core and the freePBX package. The name refers to getting everything up and running in basically no time. The distribution is actively maintained by a small number of core developers and a community.

The latest version available is *1.5B*.

The system parameters are the following.

Source model FOSS

OS CentOS 5.x

Latest Asterisk release 1.4

License GPL

Important components Asterisk, freePBX, Flash Operator Panel, CDR reporting and maintenance system, others

Concerning other guidelines, in particular [9] is a valuable source covering most aspects of getting started with PiaF, although it is not a complete manual, and although this resource addresses PiaF 1.2. The book is similar to the one mentioned in Section 3 on page 10.

4.1 VMware installation

PiaF is available for installation as a VM. However, in contrast to the Elastix installation Section 3.1 on page 10, the file to download as a VMware module given on [10] turns out to contain a VM which has to be built through a network installation. This leads basically to the same system as described in Section 4.2, so it is referred to this section for installation details. Moreover, the VMware installation seems to have issues where the installation process stops, therefore it is recommended to do the installation from scratch.

It should also be mentioned that the developers recommend not to use a VM for a production system due to performance reasons [11].

4.2 Plain installation

The distribution is installed as a VM for testing purposes. The VMware configuration compounds the parameters given in Section 2 on page 7. The image downloaded is labeled *PBX in a Flash (32-bit, CentOS 5.4 beta)*.

The installation process continues with a network install and succeeds without any issues, i.e., all suggested default values can be kept. The entire process turns out to be a bit lengthy, though.

The web interface can then be tested by directing the browser to the host's IP address. Of course, this testing is only of rudimentary nature, as all services still have to be configured before they can be used.

Figure 3. Screenshot of the PiaF's portal page

The system parameters are the following.

Kernel 2.6.18.164.6.1.el5

Used disk space 1.9 GB

Stability Unknown (See corresponding explanation above.)

The entire installation process lasts approximately 30 min.

4.3 Security

Concerning security, the same considerations as made for other distributions apply Section 2.1 on page 8.

It should, however, be mentioned that PiaF's web interface can be accessed by plain *HTTP*[20] instead of *HTTPS*, which has security implications.

20. Hyper-Text Transfer Protocol

4.4 Other

PiaF claims its installation to be particularly easy and excellently documented. It is, however, the author's experience that the installation is not easier than for instance Elastix' installation. The installation is further said to be minimal, and it is recommended to install add-ons on demand. Compared to the plain Elastix installation, the distributions are measured to be of approximately the same size, though.

References

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5 trixbox

trixbox [12] is the distribution formerly known as Asterisk@Home. trixbox is maintained by a small core of developers and a community.

Beside the community edition called trixbox CE [12], which is referred to in the following, there is also a commercial edition named trixbox Pro and an appliance server [13] offered by a company named Fonality. There are two stable version of trixbox CE as of today, version 2.8.0.3 based on Asterisk 1.6, and version 2.6.2.3, which is based on Asterisk 1.4.

The system parameters are the following.

Source model FOSS

OS GNU Linux (CentOS 5.4)

Latest Asterisk release 1.6

License GPL (2.0)

Important components Asterisk, freePBX, Flash Operator Panel, CDR reporting and maintenance system, others

The trixbox development team claims trixbox to have the highest download numbers of any Asterisk-based PBX as of August 2009, while the author's own evaluation [14] shows that Elastix is the most popular software currently, with 7700 downloads per week compared to trixbox' 5300 downloads. The team further claims that each release of trixbox undergoes an extensive QA[21] testing procedure to assure a certain quality in terms of stability and security. Unfortunately, it was not possible to confirm this claim.

Except the references mentioned, [15] is of valuable help covering aspects like installation and configuration of trixbox.

5.1 Installation

The installation refers to trixbox CE 2.8.0.3. The *trixbox-2.8.0.3.iso* image at 659 MB is downloaded and installed as a VM as described above Section 2 on page 7.

The installation process is straight forward, meaning that most default values can simply be confirmed. After choosing Admin mode on the splash screen and then typing the proper credentials, the web interface is reached. The dashboard as depicted in Figure 4 on the following page and shows an elegant user interface.

The system parameters of the installation are the following.

Kernel 2.6.18-128.1.10.el5

Used disk space 1.56 GB

Stability Unknown (See corresponding explanation above.)

The entire installation process lasts approximately 15 min.

5.2 Security

Concerning security, the same considerations as made for other distributions based on Asterisk apply Section 2.1 on page 8.

It is further noted that trixbox's web interface is accessed by plain *HTTP* instead of *HTTPS*, which has certain security implications.

21. quality assurance

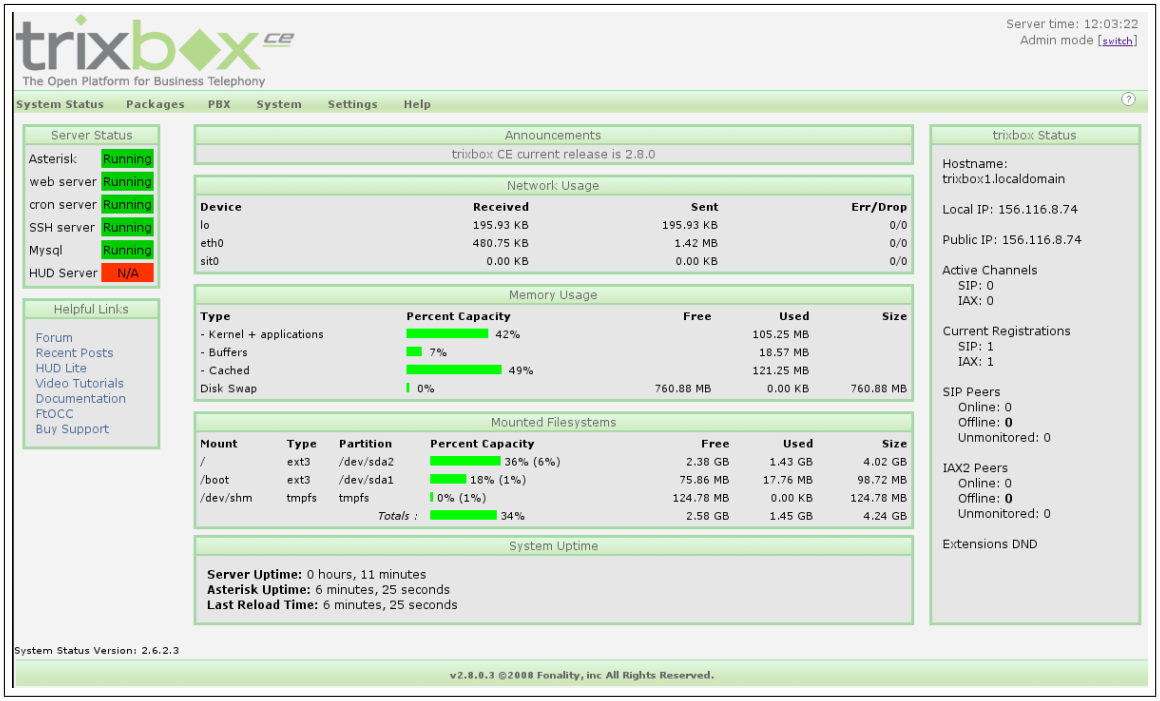

Figure 4. Screenshot of the trixbox dashboard

Another known issue is that, according a discussion in the community (e.g., [16]) in 2007, trixbox not only sends important system data to Fonality, but it contains in fact a remotely controlled mechanism for modification of the installation with root access privileges. This is a serious security thread, as there is no overview of what kind of data is sent to Fonality. Besides, a remote system control like the one described is outside the control of the system administrator and is not desirable at all for obvious reasons.

5.3 Other

The user interface of trixbox shows interoperability issues under Opera 10.1 but works fine with Firefox 2.

The development team recommends to set up trixbox on a dedicated machine due to performance issues.

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6 Other distributions

There is a number of other distributions available which are based on Asterisk, besides those mentioned previously. A selection of these are briefly presented in the following.

6.1 AsteriskNOW

AsteriskNOW [19] is a distribution by Digium Inc. It is available with version 1.5.0 and includes the popular freePBX package. Its developers claim that the install would last less than 15 minutes.

6.2 Druid

Druid [Druid Development Team] is a unified-communications distribution made available by a company named Voiceroute. It can be downloaded in the current version 2.0. The distribution's developers claim that the user interface is particularly easy to use.

6.3 LinuxMCE

LinuxMCE [LinuxMCE Development Team] is a distribution primarily targeting home automation, but it also includes an Asterisk-based IP-PBX. The distribution is maintained by the open-source community. The development team claims that

Asterisk is pre-configured such that phones can simply be plugged in without a separate configuration.

7 Summary and conclusion

Three PBX distributions have been evaluated with regard to features included, popularity, ease of installation, size of installation, installation time, usability and interoperability of the user interface, and potential security weaknesses. Under a literature survey, special attention has been given to suggestions concerning how to combat attacks and avoid system breaches. The most important data about each distribution have been presented along with useful resources with further information. Moreover, each distribution has been installed in an effort to look for potential issues, and the user interface has been evaluated with a brief smoke test.

The overview is completed by a rough presentation of three similar distributions, which are not part of the detailed evaluation.

Even though the distributions contain roughly the same components (freePBX, etc.), their ranking varies depending on what criteria have been given the most weight. With other words, there is no clear winner. And, as they share the same modules, the security matters apply to all distributions to the same extent. The type of components available is further not critical since any desired components can be added to the system after finished installation through the user interface.

PiaF appears to be the worst choice of the three distributions tested, mainly due to the lengthy installation process and a user interface with a big improvement potential. However, this statement is strongly influenced by the author's personal preferences. Elastix and in particular trixbox have a very modern and elegant user interface. Additionally, the small footprint of trixbox's installation makes it an attractive candidate.

The drawback with trixbox's solution is that the web interface is reached through plain *HTTP* (out of the box), whereas Elastix uses *HTTP*, a clear advantage. Also, as long as the discussion around trixbox's "phone home" behavior is not settled, this distribution should be avoided for the time being.

Given the high popularity of Elastix, this SourceForge project is assured a lot of activity in the nearby future, be it in terms of development or in form of an active community. To maintain control with all installed modules (and the footprint), though, an Elastix box should be built as a fresh install, not a prefabricated virtual machine.

8 Glossary

CDROM read-only memory compact disk

CDR Call Detail Records

CE community edition

DHCP dynamic host configuration protocol

FOSS free and open source software

GNU GNU is not Unix

GPL General Public License

HTTPS secure HTTP

HTTP Hyper-Text Transfer Protocol

HW hardware

IAX Inter-Asterisk eXchange (protocol)

IP-PBX Internet Protocol Private Branch Exchange

IP Internet protocol

OS operation system

PBX private branch exchange

POTS plain old telephone service

QA quality assurance

SIP Session Initiation Protocol

SW software

VM virtual machine

VPN virtual private network

VoIP Voice over Internet Protocol

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